UN environment programme

Think Eat Save

Tracking Progress to Halve Global Food Waste

Food Waste Index Report 2024

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List of abbreviations and acronyms

CGCSA	Consumer Goods Council of South Africa
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FLI	Food Loss Index
GDP	Gross domestic product
JICA	Japan International Cooperation Agency
J-PRISM II	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management in Pacific Island Countries Phase II
MSW	Municipal solid waste
NDC	Nationally Determined Contribution
POS	Point of sale
PPP	Public-private partnership
SAGO	Saudi Grains Organisation
SDG	Sustainable Development Goal
SDG 12.3	Sustainable Development Goal 12, target 12.3
UNEP	United Nations Environment Programme
UN-Habitat	United Nations Human Settlements Programme
UNSD	United Nations Statistics Division
U.S. EPA	United States Environmental Protection Agency
WaCT	Waste Wise Cities Tool
WRAP	Waste and Resources Action Programme

Definitions

"Food waste" is defined as food and the associated inedible parts removed from the human food supply chain.

"Removed from the human food supply chain" means one of the following end destinations: co/anaerobic digestion; compost / aerobic digestion; land application; controlled combustion; sewer; litter/discards/refuse; or landfill.

"Food" is defined as any substance – whether processed, semi-processed or raw – that is intended for human consumption. "Food" includes drink, and any substance that has been used in the manufacture, preparation or treatment of food. Therefore, food waste includes both:

"edible parts": i.e. the parts of food that were intended for human consumption, and

"inedible parts": components associated with a food that are not intended to be consumed by humans. Examples of inedible parts associated with food could include bones, rinds and pits/stones.

"Food loss" is defined as all the crop and livestock human-edible commodity quantities that, directly or indirectly, completely exit the post-harvest/slaughter production/supply chain by being discarded, incinerated or otherwise, and do not reenter in any other utilization (such as animal feed, industrial use, etc.), up to, and excluding, the retail level. Losses that occur during storage, transport and processing, also of imported quantities, are therefore all included. Losses include the commodity as a whole with its non-edible parts decrease in edible mass at the production, post-harvest and processing stages of the food chain (Food and Agriculture Organization of the United Nations 2022).

The *Food Waste Index* tracks the global and national generation of food and inedible parts wasted at the retail and consumer (household and food service) levels. UNEP is its custodian. In contrast to the Food Loss Index, the Food Waste Index measures total fresh mass of food waste (rather than specific commodities).

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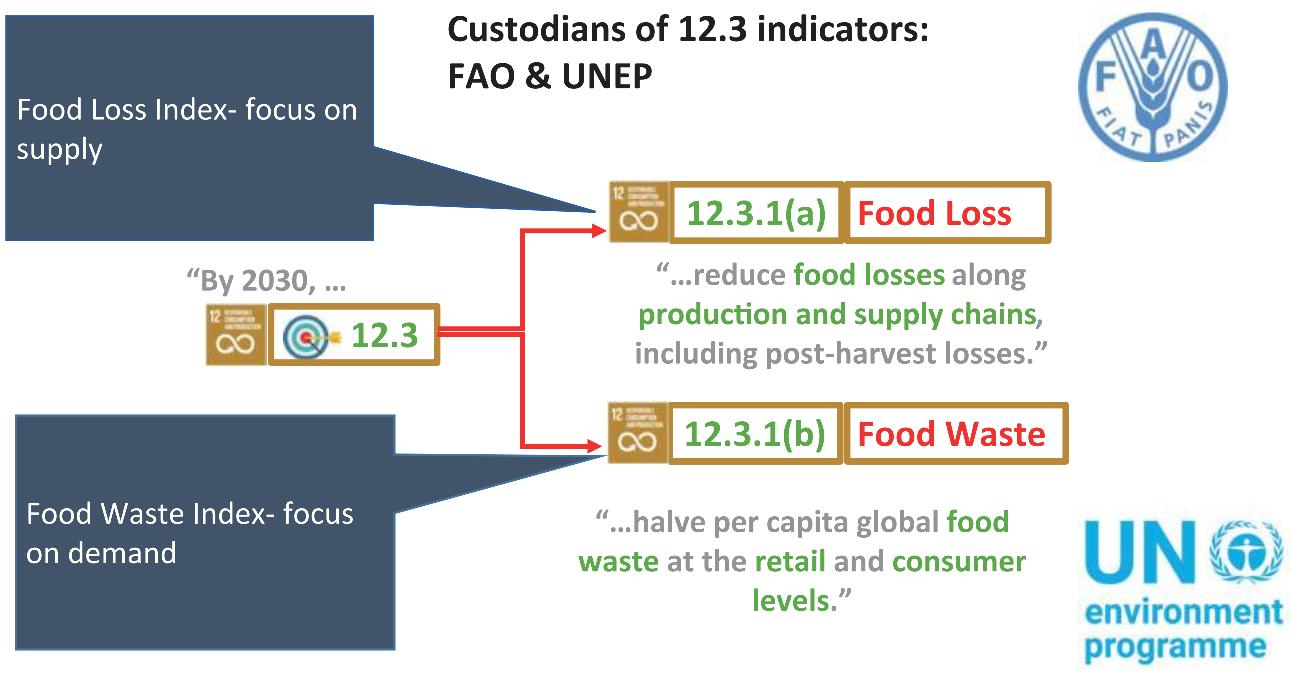
Executive summary

Food waste is a market failure that results in the throwing away of more than US$1 trillion worth of food every year. It is also an environmental failure: food waste generates an estimated 8–10 per cent of global greenhouse gas emissions (including from both loss and waste), and it takes up the equivalent of nearly 30 per cent of the world's agricultural land. The conversion of natural ecosystems for agriculture has been the leading cause of habitat loss. Just as urgently, food waste is failing people: even as food is being thrown away at scale, up to 783 million people are affected by hunger each year, and 150 million children under the age of five suffer stunted growth and development due to a chronic lack of essential nutrients in their diets.

Sustainable Development Goal 12, target 12.3 (herein, SDG 12.3) captures a commitment to halve per capita global food waste at the retail and consumer levels and to reduce food loss across supply chains by 2030. As custodian of the Food Waste Index, the United Nations Environment Programme (UNEP) tracks global food waste occurring at the retail, food service and household levels; meanwhile, the Food and Agriculture Organization of the United Nations (FAO) is custodian of the Food Loss Index, which tracks food loss occurring along the post-harvest supply chain up to and excluding the retail level (Figure 1). SDG 12.3 has a key role to play in the delivery of other Sustainable Development Goals, including those around Zero Hunger (SDG 2), Sustainable Cities (SDG 11) and Climate Action (SDG 13). The connection between food waste and biodiversity loss, moreover, is now recognized in the Kunming-Montreal Global Biodiversity Framework, which specifically calls out halving global food waste by 2030 in target 16.

Figure 1: Tracking progress on SDG 12.3: Food Loss Index and Food Waste Index



A substantial increase in data availability and coverage was observed in the household sector, with 194 datapoints across 93 countries (Table 2). This represents a near doubling in the number of countries with some type of estimate (up from 52 countries in the *Food Waste Index Report 2021*), with particularly notable growth in the coverage of low- and middle-income countries. An estimated 85 per cent of the global population resides in a country where there is at least some data on household food waste. This improvement in coverage strengthens confidence in the food waste estimates.

There is increased confidence in the conclusion from the Food Waste Index Report 2021 that household per capita food waste generation is broadly similar across country income groups.

Table 2: Total data coverage by sector, and change from Food Waste Index Report 2021

INCLUDED IN 2024 REPORT (CHANGE FROM 2021 REPORT)	HOUSEHOLD	FOOD SERVICE	RETAIL	TOTAL
Number of datapoints	194 (+103)	49 (+17)	45 (+16)	288 (+136)
Number of countries	93 (+41)	41 (+18)	45 (+22)	102 (+48)

Despite a near doubling of data coverage, there has been increased convergence in the average per capita household food waste, with the average observed household food waste in high income, upper-middle income and lower-middle income countries varying by just 7 kilograms per capita per year (Table 3).[5]

Food waste is an urban issue. With more than half of the global population now living in urban areas, the role of local governments in tackling food waste is expected to only increase in the coming years.

Table 3: Average food waste in kilograms per capita per year, by World Bank income grouping

INCOME GROUP	HOUSEHOLD	FOOD SERVICE	RETAIL
High income countries	81	21	13
Upper-middle income countries	88	*Insufficient data*	
Lower-middle income countries	86	*Insufficient data*	
Lower income countries	*Insufficient data*	*Insufficient data*	

Local government engagement in addressing the food waste issue should be scaled up and prioritized. National governments working closely with cities will ensure that policies are put in place and efforts are sustained to get food out of landfills and into circular and productive use.

Most new food waste estimates are at the city or other subnational levels. Countries with disaggregated data for urban and rural areas are relatively rare, but typically show lower levels of food waste in rural areas. This may be because rural areas have greater circularity in their food systems (including feeding scraps to animals and composting), and special attention is needed to help circularity thrive in the city.

5 *The household food waste global average is lower than any of the income group averages presented in Table 1 because the income-group averages are a simple mean of estimates from countries with datapoints. In other words, it does not account for population size of different countries. The total amount wasted, and the global averages, however, do account for population size.*

Table 4: Number of national and subnational datapoints included in the Food Waste Index Report 2024

INCLUDED IN 2024 REPORT (CHANGE FROM 2021 REPORT)	HOUSEHOLD	FOOD SERVICE	RETAIL
Number of national datapoints	49 (+11)	40 (+16)	40 (+13)
Number of municipal and subnational datapoints	145 (+92)	9 (+1)	5 (+3)

(change from Food Waste Index Report 2021)

Countries in the G20 should leverage their economic and political influence to take significant action on food waste. This starts with accurate measurement and reporting through the Food Waste Index.

Among the G20, only Australia, Japan, the United Kingdom, the United States and the European Union have food waste estimates suitable for tracking progress to 2030, while in Brazil activities to develop a robust baseline are under way. Most G20 countries do not have data suitable for tracking progress. As a community of the world's largest economies, the G20 has significant potential to demonstrate successful pathways to SDG 12.3 delivery – as Japan and the United Kingdom are doing – and to lead by example, connecting the fight against hunger and the triple planetary crisis of climate change, pollution and biodiversity loss. The G20 also has considerable influence on consumer behaviour: by promoting awareness and education on food waste, the G20 can encourage sustainable consumption across the globe.

How is "food" defined? Why are inedible parts included? How much could have been eaten?

For the purposes of the Food Waste Index, "food waste" is defined as food and the associated inedible parts removed from the human food supply chain in the following three sectors: retail, food service and households. As a result, the estimates include both "edible" and "inedible" parts of food. There are three key reasons why "inedible" parts are worthy of attention:

1. The distinction between what is "edible" or "inedible" is often not clear-cut. Many animal parts or fruit and vegetable skins may be removed in some cultures, or for some uses, while being commonly eaten in others. Chicken feet, for example, are commonly consumed in some parts of the world but not in others. Even within a particular culture, the "edibility" may depend on the degree of processing, and perceptions of edibility due to personal preference can vary within one family. For example, orange peel can "become" edible through processing into marmalade.
2. The "upcycling" of food allows re-integration of "inedible" parts back into the human supply chain. These could either be for direct human consumption, such as integrating brewers' spent grains into bakery products and high-protein snacks, or by diverting "inedible" food surplus to animal feed where it is safe to do so. A circular food system involves useful applications of all parts, and through circular approaches, parts normally considered "inedible" can help improve food security.
3. From a practical perspective, the recommended methods to measure food waste (see chapter 2) are first applied to *all* food waste, from which edible parts could subsequently be disaggregated. It is challenging to accurately measure edible food waste without also measuring inedible parts. SDG Indicator 12.3.1(b) allows the separate reporting of inedible parts where they have been measured.

Even if all of the food wasted in households globally contained just 25 per cent edible parts – a very conservative estimate, lower than any of the observed rates of edibility from countries where it has been measured – then the equivalent of 1 billion meals of edible food is being wasted every single day in households worldwide. This is likely a minimum estimate, and the real amount could be much higher.

Data on the edible fraction of food waste across different countries, and on the causes of food waste in homes worldwide, remains very limited. Very few countries have accurate data that include the share of waste that is "edible." Among those that do, the share that is "edible" varies between 31 per cent and 77 per cent. Even if food waste is assumed to be at the bottom of this range globally, the quantities of edible food that are wasted are staggering.

This further reinforces the crucial role that food waste reduction has to play in improving food security worldwide. **This conservative estimate of the amount of edible food waste amounts to the equivalent of 1.3 meals per person impacted by hunger, per day.**

What about the retail and food service sectors?

Data for the retail and food service sectors remains insufficient, particularly in low- and middle-income countries. These represent substantial data gaps that should be addressed for a more complete understanding of global food waste. These unknown quantities could be substantial.

There has been little change in the availability and coverage of data on food waste in the retail and food service sectors, with an ongoing lack of accurate nationwide data outside of high-income countries. This is a major data gap that is driven in part by the difficulty in accurately measuring multiple subsectors (both the food service and retail sectors contain multiple qualitatively different settings) and by the challenges in scaling estimates by appropriate national factors (such as the amount of food served in a particular subsector).

As more countries start to measure their food waste in the retail and food service sectors, and as their measurements cover more subsectors than currently, food waste estimates are expected to increase due to broader coverage. It is critical to address this data gap through increased measurement, and reducing food waste in these settings can help businesses reduce costs in their operation and waste disposal.

Measuring and reporting Sustainable Development Goal target 12.3

What are the two SDG 12.3 indicators?

SDG 12.3 covers food and inedible parts that exit the supply chain and thus are lost or wasted. This is tracked through two indicators:

- Indicator 12.3.1(a), the Food Loss Index, measures losses for key commodities in a country across the supply chain, up to but not including retail. The FAO is its custodian.
- Indicator 12.3.1(b), the Food Waste Index, measures food and inedible parts wasted at the retail and consumer levels (food service and households). The United Nations Environment Programme (UNEP) is its custodian. In contrast to the Food Loss Index, the Food Waste Index measures total food waste (rather than loss or waste associated with specific commodities).

The Food Waste Index also allows countries to measure and report on food loss and waste generated in manufacturing processes, which would not be captured under key commodity losses by the Food Loss Index. The results presented in the Food Loss Index and in the Food Waste Index cannot be directly compared or summed due to different reference points. The Food Loss Index covers *production*, which includes (human) food, seed and feed for livestock. The Food Waste Index covers food available for human consumption, which may take place after a degree of processing or conversion of feed into animal products.

How do countries measure and report on food waste?

To report on SDG 12.3 indicator 12.3.1(b), the Food Waste Index, countries will fill out a separate table of the UNSD-UNEP Questionnaire on Environment Statistics (waste section) shared with Member States (environment ministries) by UNEP and the United Nations Statistics Division (UNSD).

To complete measurement in line with Food Waste Index requirements, Member States are invited to:

- Define a scope – i.e. select the sector(s) they are able to report on
- Select suitable methods to measure food waste (net fresh mass)
- Conduct studies using the chosen method(s)
- Scale measurement from representative studies into national estimates
- Report food waste for the Food Waste Index
- Repeat studies regularly (at least every four years) using a consistent methodology.

Table 5 illustrates suitable methods for food waste measurement by sector.

Table 5: Appropriate methods of measurement for different sectors

<table>
<tr><th>SECTOR</th><th colspan="6">METHODS OF MEASUREMENT</th></tr>
<tr><td>Manufacturing (if included)</td><td rowspan="4">Direct measurement (for food-only waste streams)</td><td rowspan="4">Waste composition analysis</td><td rowspan="4">Volumetric assessment</td><td rowspan="2">Mass balance</td><td></td><td></td></tr>
<tr><td>Retail</td><td rowspan="2">Counting/ scanning</td><td></td></tr>
<tr><td>Food service</td><td></td><td rowspan="2">Diaries (for material going down sewer, home composted or non-waste destinations)</td></tr>
<tr><td>Household</td><td></td><td></td></tr>
</table>

Use the Food Waste Index guidance provided in this report to measure food waste consistently. Report baselines and progress towards halving food waste at regular intervals through the UNSD-UNEP Questionnaire on Environment Statistics (waste section).

This report expands on the guidance for measurement as outlined in the *Food Waste Index Report 2021.* In particular, it expands on:

- How to prioritize which subsectors to study in the retail and food service sectors;
- How to determine the sample size and sampling unit; and
- How to scale measurements conducted at a sampling unit into national estimates.

These are explained in detail in chapter 3.

Reducing food waste through a collaborative approach

The *Food Waste Index Report 2024* introduces a "Solutions Focus" chapter that spotlights approaches that can deliver food waste reductions at scale. The first solution in this series explores public-private partnerships (PPPs). As food waste is an issue throughout the entire supply chain, PPPs bring stakeholders together to collaborate and deliver a shared goal, thus overcoming some of the challenges of a fragmented food system. PPPs connect businesses with government and policy makers in a pre-competitive space, allowing best practice to be shared while driving innovation for long-term, holistic change.

Food waste PPPs require signatories to measure and report their food waste for monitoring purposes, which provides important data that can be used to demonstrate the business case to invest in food waste reduction. PPPs are typically designed at the country level, but in very large countries they can be subregional (for example, the Pacific Coast Food Waste Commitment). Sector-specific industry agreements at the regional level also can play a role, such as the International Food Waste Coalition focusing on food waste in the hospitality sector.

PPPs have a proven track record of delivering food waste reductions. The Courtauld Commitment in the United Kingdom was initiated in 2005, and the current phase, Courtauld Commitment 2030, aims to deliver farm-to-fork reductions in food waste, greenhouse gas emissions and water stress through collaborative action across the entire UK food chain. Actions have resulted in a 27 per cent reduction in household food waste per capita and a 23 per cent reduction in total food waste per capita between 2007 and 2018 (Devine et al. 2023). Cost-benefit analysis of the Courtauld Commitment 2015–2018, including government spending and operational costs, suggests that there is a 7:1 benefit-to-cost ratio (see chapter 4).

What does a public-private partnership look like?

The framework for a food waste PPP uses a "Target, Measure, Act" approach, with four complementary parts:

1. **Strategy and commitment**: The aims and objectives of the PPP are laid out, including a collectively agreed target and a delivery roadmap to ensure that targets can be achieved.
2. **Collaborative activity**: Members should collaborate through action-orientated working groups, projects, campaigns and reporting.
3. **Outputs**: Outputs should support the delivery of targets; this includes guidance to support wide adoption of the PPP, industry recommendations and pilot activity to test approaches in a local context.
4. **Impact**: The impact of these actions are captured on an annual basis to inform progress towards targets.

Food and drink organizations are at the heart of a PPP, and the public sector and third parties also play a pivotal role. The roles and responsibilities of the different stakeholders are discussed in section 4.2.

What are the steps to developing a public-private partnership?

There are five key steps for developing a PPP, taken from a model developed by REFRESH (2021):

1. **Initiation and set-up:** Conduct an exploratory study to assess the readiness and willingness of stakeholders to develop a PPP, and design an implementation plan.
2. **Ambitions, goals and targets:** Set a target for businesses, including interim targets. These should be in line with the 50 per cent reduction of SDG target 12.3.
3. **Governance and funding**: Establish a Steering Committee or independent Secretariat to oversee day-to-day management of the agreement.
4. **Establishing actions**: Establish a roadmap or delivery plan, targeting priority areas or "hotspots" of waste. Businesses adopt their own action plans, focusing on their own operations, engaging customers/consumers and their supply chain.
5. **Measurement and evaluation**: The Secretariat captures, anonymizes and aggregates data from businesses to assess progress towards the targets, and publicly reports on this progress.

Develop structures for multi-stakeholder collaboration on food loss and waste reduction, targeting hotspots and working together around shared interim goals.

By following this five-step process, stakeholders in a PPP are able to define the most appropriate and viable solutions for their business, sector and country context. In some cases, these may be operational changes to improve food forecasting; in other situations, the focus may be on facilitating redistribution to those in need.

The complex challenge of food loss and waste requires a systemic approach. Effective collaboration through a PPP is one potential solution to reducing food loss and waste, alleviating food insecurity and delivering environmental benefits. To take a collective approach is to recognize that no one actor can solve the problem alone, and that collaboration can create a movement that is more than the sum of its parts.

Conclusions

Reducing food waste is an opportunity to reduce costs and to tackle some of the biggest environmental and social issues of our time: fighting climate change and addressing food insecurity. This report shows that global food waste datapoints have doubled since 2021 – yet few countries have robust baselines suitable for tracking progress to 2030. Across the globe, governments, cities, food businesses, researchers and non-governmental organizations of all sizes have a role to play in joint efforts to change practices and behaviours; target hotspots; innovate; and deliver SDG 12.3.

Countries that have been tackling this issue for many years are invited to step up efforts to share their experiences and resources with countries that are just getting started. Halving food waste is a job that is too large for any one stakeholder. However, it can be achieved through concerted, collaborative effort to commit to the SDG 12.3 *target*, accurately measure food waste, and most importantly act to achieve food waste reduction.

01 Introduction

Food waste is a hugely important global issue. Estimates suggest that well over US$1 trillion worth of food is wasted each year (World Bank 2020). This represents more than one-third of all the food that is produced globally, using over a quarter (28 per cent) of the world's agricultural area (Food and Agriculture Organization of the United Nations [FAO] 2013). This waste has devastating effects on both the planet and people. In 2022, an estimated 29.6 per cent of the global population was moderately or severely food insecure, and up to 783 million people were affected by hunger, around 122 million more than in 2019 (FAO 2023a). Reducing food waste can increase food availability for those who need it. Food waste also is responsible for an estimated 8–10 per cent of greenhouse gas emissions (FAO 2013). As environmental impacts accrue across the life cycle of food products, food waste at the consumer level presents the highest burden.

In 2021, the United Nations Environment Programme (UNEP) published the initial *Food Waste Index Report*, shedding new light on the magnitude of food waste and on the prevalence of household food waste on all continents, irrespective of country income levels.

1.1 The Food Waste Index and Sustainable Development Goal target 12.3

Sustainable Development Goal 12, target 12.3 (hereafter "SDG 12.3") is a commitment to halve per capita global food waste at the retail and consumer levels and to reduce food losses along production and supply chains, including post-harvest losses. The focus is on both food and its inedible parts that exit the supply chain and thus are lost or wasted. This is further split into two indicators:

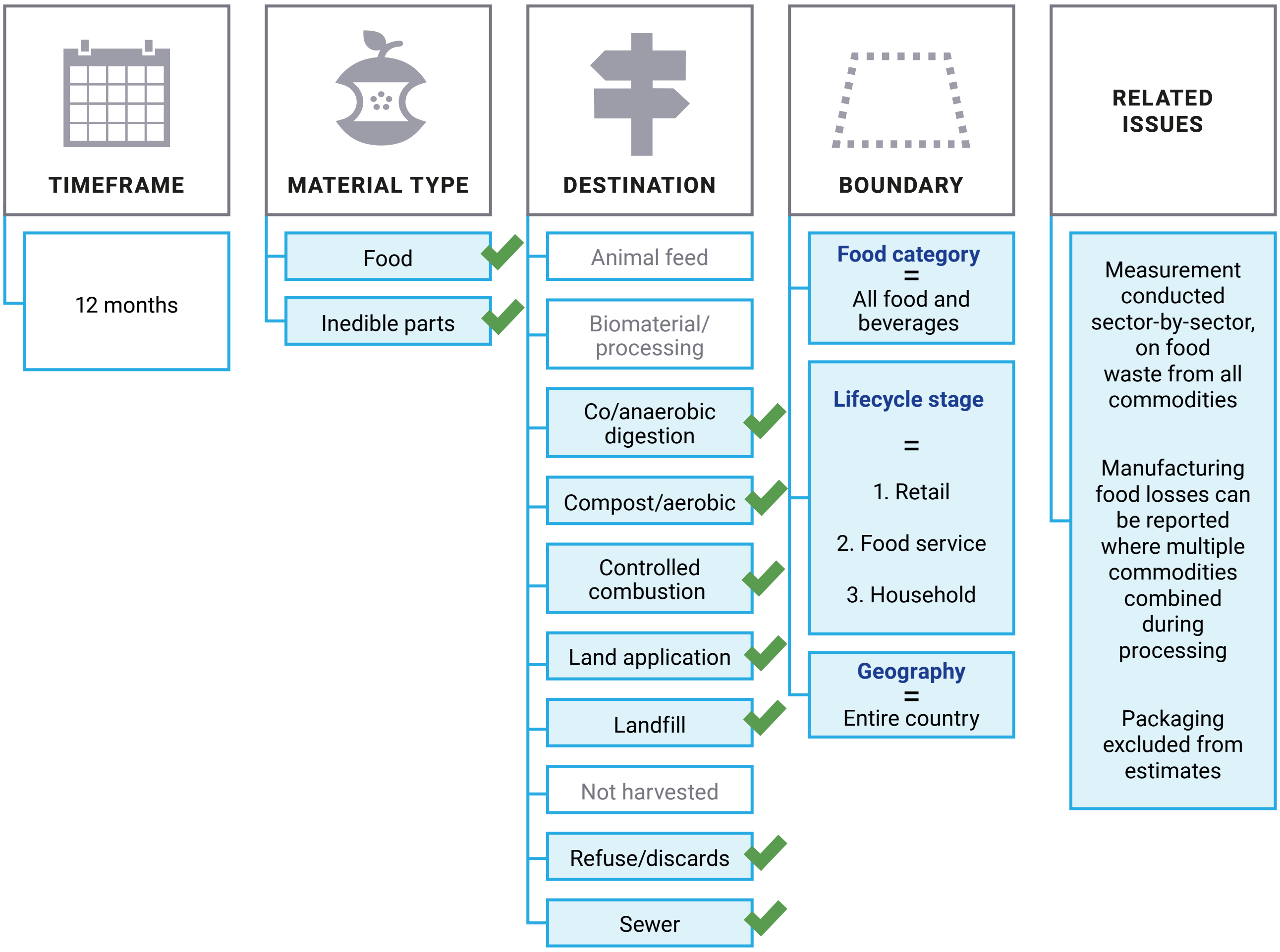
- Indicator 12.3.1(a), the Food Loss Index, measures losses for key commodities in a country across the supply chain, up to and not including retail. The FAO is its custodian. This indicator is not discussed in detail in the present report, except to describe its boundary with the Food Waste Index.
- Indicator 12.3.1(b), the Food Waste Index, measures food and inedible parts wasted at the retail and consumer levels (household and food service). UNEP is its custodian. In contrast to the Food Loss Index, the Food Waste Index measures total food waste (rather than specific commodities).

For this reason, the three sectors covered by the Food Waste Index are: food retail, food service and households.

The Food Waste Index also allows countries to report on food loss in manufacturing that is not captured by the Food Loss Index (for example, where more than one commodity is combined to produce complex food products). This is an optional supplementary reporting area, a "Level 3" methodology (see later discussion). Wholesale food remains under the Food Loss Index and therefore should not be reported under the Food Waste Index.

The scope of the Food Waste Index is Illustrated in Figure 3: Scope of the Food Waste Index (Levels 2 and 3) adapted from the Food Loss and Waste Accounting and Reporting Standard. Animal food and feed and bioprocessed materials are not classified as food waste, as these materials are deemed not to have been removed from the human food supply chain.[6] Definitions of the destinations of food waste are provided in section 3.4.

Figure 3: Scope of the Food Waste Index (Levels 2 and 3) adapted from the Food Loss and Waste Accounting and Reporting Standard



Source: Hanson et al. 2016.

6 *Note that animal food (for pets) is included alongside feed (for livestock), although animal food is not technically kept in the human food supply chain. Neither is considered waste so should not be reported in the Food Waste Index, and the figures in this report exclude this wherever possible. This is an additional clarification from the Food Waste Index Report 2021 and is discussed in section .*

The Food Waste Index has a three-level methodology, increasing in the accuracy and usefulness of data, but also increasing in the resources required to undertake these levels:

- **Level 1 uses modelling to estimate food waste** and is relevant for Member States that have not yet undertaken their own measurement. Level 1 involves extrapolating data from other countries to estimate food waste in each sector for a given country. The estimates for these countries are approximate: they are sufficient to provide insight into the scale of the problem and to make a case for action, but inadequate to track changes in food waste over time. They are intended as a short-term support while governments develop capacity for national measurement (consistent with Level 2). UNEP has calculated Level 1 estimates on behalf of countries, and they are presented in chapter 2 of this report.
- **Level 2 is the recommended approach for countries** and involves measurement of food waste. The nature of the measurement will vary according to sector and circumstance. It will be either undertaken by national governments or derived from other nationwide studies undertaken in line with the framework described in this report. Level 2 generates primary data on actual food waste generation and fulfils the requirement for tracking food waste at a national level, in line with SDG 12.3.
- **Level 3 provides additional information to inform policy and other interventions** designed to reduce food waste generation. This includes: the disaggregation of data by destination, edible/inedible parts; reporting of manufacturing food loss not covered by the Food Loss Index (e.g. where more than one commodity is combined to produce complex food products), and additional destinations such as sewers or home composting.

Measurement and reporting by countries are required at Levels 2 or 3, with data submitted to the United Nations Statistics Division (UNSD). Chapter 3 provides considerable additional guidance into how countries should approach measurement in a manner consistent with SDG 12.3.

1.2 How the Food Waste Index is calculated

For each sector within a country, the level of food waste is expressed as an index relative to the level of food waste in the baseline year. A value of:

- 100 would indicate the same level of food waste in that sector as the baseline year; and
- 50 would indicate that food waste in that sector had halved since the baseline year, consistent with the target of SDG 12.3.

The indices for each sector are not combined into a single Food Waste Index. This allows the granular data for individual sectors to be more easily communicated. It also alleviates issues if a country is unable to report on all sectors in a single reporting cycle.

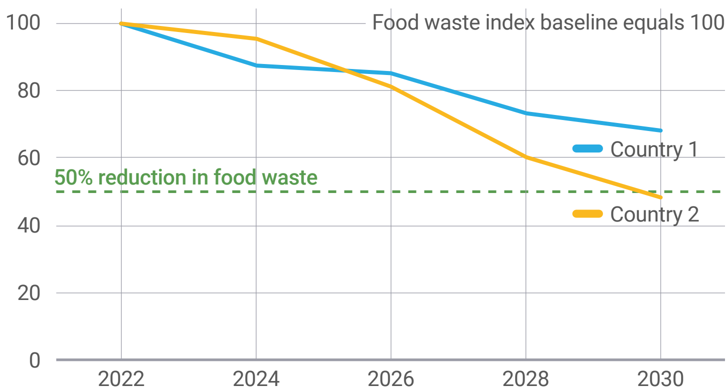
The first indices for countries with suitable data will be published in the next Food Waste Index Report, once those countries have reported the data to the United Nations. The Level 1 estimates presented in the present report are not suitable for tracking changes over time

Example: Food Waste Indices for two hypothetical countries

Figure 4 provides a worked example of the household Food Waste Index for two hypothetical countries. In both cases, the baseline year is 2022. Country 1 has 87 kilograms per capita of household food waste in 2022; because this is the first year of measurement, this is defined as 100 in the Food Waste Index. By 2030, this has reduced to 60 kilograms per capita: a value of 69 in the Food Waste Index. This represents a reduction of 31 per cent: good progress, but insufficient to meet the 50 per cent reduction for SDG 12.3(b), represented by the blue dotted line.

Country 2 has a baseline value of 84 kilograms per capita per year, which is defined as 100 in the Food Waste Index for this country. By 2030, this country has achieved SDG 12.3(b) for this sector, with food waste at less than half the baseline level (41 kilograms per capita per year). Therefore, the final Food Waste Index value for Country 2 is a value less than 50.

Figure 4: Food Waste Indices for two hypothetical countries



1.3 Structure of the report

This report serves three primary functions, spread across the three main chapters.

- Chapter 2 provides a summary of known data on food waste in the retail, food service and household sectors worldwide. As in the Food Waste Index Report 2021, this data is used to extrapolate data from other countries to estimate food waste in each sector for a given country. These "Level 1" estimates are approximate but are sufficient to provide insight into the scale of the problem and to make a case for action. By combining these estimates for each country, new estimates of the amount of food waste globally in the retail, food service and household sectors can be formed.
- In chapter 3, the report outlines guidance for how countries should measure and report food waste for SDG indicator 12.3.1(b). This is greatly expanded on from the Food Waste Index Report 2021. The guidance explains the data reporting template from the United Nations Statistics Division (UNSD) and UNEP and outlines considerations for how measurement can be made accurate and achievable in varying national and cultural circumstances.
- In chapter 4, the report shifts from measuring food waste, to how to reduce it. The first of a new "Solutions Focus" series looks at public-private partnerships for food waste reduction: what they are, how they work and guidance for their adoption. Subsequent Food Waste Index report publications will turn a spotlight to different areas for food waste action.

Throughout the report, short boxes explore other relevant topics to food loss and waste, such as the impact of COVID-19 restrictions on household food waste (*Box 6*), integrating food loss and waste targets into Nationally Determined Contributions (*Box 11*), and the integration of justice, equity, diversity and inclusion in food waste reduction activities (*Box 17*).


CSG

02 Index Level 1: Existing data and modelling

2.1 Level 1 estimates of food waste: what and why?

Although data remains limited, there have been growing efforts to quantify food waste both nationally and within cities in recent years. This section builds on the dataset of the *Food Waste Index Report 2021*, adding new and newly identified food waste data around the world. It assesses the availability of food waste estimates in the three following sectors:

- Retail
- Food service
- Household

A **Level 1** (modelled) estimate for each sector has been calculated for all Member States of the United Nations.[7] These Level 1 estimates are derived from:

- *Existing datapoints* from studies carried out in a Member State (where applicable), or
- *Extrapolations* based on the estimates observed in other countries, where no estimate is available from a given Member State.

Most Level 1 estimates are not sufficiently accurate to track changes over time and to report progress on SDG 12.3. They are indicative estimates, which provide a sense of scale of the issue. They support a country's case for action to tackle food waste and prioritization of different sectors, while the government works towards more accurate measurement (consistent with Level 2 or Level 3).

This section contains:

- An overview of the methodology used (section), with full detail given in the Appendix.
- The coverage of food waste data globally (section), with information on the sector and on the income level of a country and region. Information is also provided on the level of confidence in datapoints obtained.
- A deep-dive into data coverage for each UNEP regional group (section 2.4): Africa, Latin America and the Caribbean, Asia and the Pacific, West Asia, North America and Europe.
- Global estimates of food waste in the three assessed sectors (section 2.5).

Estimates of individual countries, whether these are datapoints from existing studies or extrapolations from other countries' data, are reported in Annex 3 (Table of household estimates) and in the Appendix.

7 *Estimates are calculated for every country or area appearing in the United Nations Statistics Division (UNSD) M49 standard. All territories with both an M49 code and a UN estimate of population are included. In total, estimates for 233 countries or areas are estimated. An additional 16 countries or areas (total 249) are included in the M49 standard but without population estimates on* ***https://data.un.org*** *so had no estimates calculated.*

2.2 Summary of the methodology

The methodology for the calculation of Level 1 estimates in the Food Waste Index Report 2024 follows the five steps taken in the Food Waste Index Report 2021 (Figure 5).

Figure 5: Summary of Level 1 modelling methodology

Additional resources: Based on the above methodology, a database of food waste estimates was created and is available for download as supplementary information to this report. This is not an exhaustive list of the studies that were considered, and, in the cases of high confidence estimates, only the latest data is included.

A separate resource is provided in the Appendix that covers studies that may be of use to food waste practitioners within a country, but that cannot be used to infer national food waste at this point in time. These are particularly relevant in the food service and retail sectors, where studies may have been conducted within a particular subsector. This is discussed further in the Appendix.

A summary of the methodology is given below. Full details of the methodology are provided in the Appendix.

Search and collate existing data: An online literature review was performed to collect recent estimates of food waste across the world. Online databases, both academic and non-academic, were used to search for possibly relevant published estimates of food waste (net fresh mass) at a sectoral level (household, food service, retail). These searches focused on evidence published since the Food Waste Index Report 2021 but also contained searches of earlier dates to capture any evidence not identified in the previous study. Studies carried out both at the national level and at the subnational level were included. Estimates of food waste were extracted from relevant studies.

In addition, data was gathered from two reporting exercises: the European Union's first data report on food waste across the EU-27 and the UNEP pilot data gathering for SDG 12.3. The European Union data is discussed in section 2.4.

Filter data: Only studies that involved direct measurement of food waste or using data from other studies that involved direct measurement were considered. This is in line with the aim to track levels of food waste over time, which requires reasonably accurate data while avoiding methodologies with substantial biases. As a result, studies that formed estimates based on proxy data or waste factors not derived from direct measurement were not included. Due to known issues related to the underreporting of total mass in food waste diary studies, they were also excluded from the analysis. Removing diaries is a change from the Food Waste Index Report 2021, given increasing data availability, to encourage countries to use more robust methods.

Adjust some data: Some datapoints were adjusted to make them comparable with the majority of studies. For example, studies that presented only the edible share of food waste were adjusted by estimating the inedible share using data from other studies that included this disaggregation.

Extrapolate for countries without data: All estimates were normalized to give the amount of food waste per capita per year. The adjusted, normalized (per capita) estimates were used for the calculation of regional, country income group and global averages. The adjusted, normalized per capita estimates were also used to extrapolate estimates for countries with no relevant study using data from nearby countries and those of a similar income level. If neither were available, global data was used. This process is described in more detail in the Appendix.

For the purposes of national and global estimates, these per capita food waste estimates were scaled by 2022 UN population data by country, forming Level 1 estimates of food waste in 2022. Therefore, per capita datapoints from a range of years are normalized into total food waste estimates for a single year.

Assign confidence rating: Each Level 1 estimate was assigned a confidence rating. This rating indicates the degree to which the estimate is suitable for tracking national food waste over time:

- High confidence indicates that the estimate is highly likely to be suitable for tracking.
- Medium confidence estimates have the possibility for identifying larger trends in food waste but may miss smaller changes, or may be applicable only to a subnational population, such as a particular city. The distinction between high and medium confidence is based on methodological details, such as geographic coverage, sample size and whether the figure required adjustment.
- Low and very low confidence estimates are based on extrapolation from other countries, with the confidence level determined by the number of countries in the income group and region that inform the extrapolation.

It cannot be stressed enough that the confidence rating is not a judgement on the quality of the study undertaken. It is an assessment – based on the reviewers' understanding of the study – of how robust the estimate of food waste is for tracking food waste at a national level in the given country.

2.3 Results: data coverage

Summary of datapoints

This section describes the extent and coverage of studies containing relevant estimates of food waste. Information is presented by sector, by the income group[8] of the country and by region.

A total of 288 datapoints[9] were used in this analysis. This represents nearly double the number of datapoints included in the Food Waste Index Report 2021 (152 datapoints). This growth is driven primarily by new information on the household sector, where more than two-thirds of the additional datapoints were identified. The increase in datapoints is reflected by an increase in geographical coverage, with the number of countries with estimates in at least one sector nearly doubling from the Food Waste Index Report 2021 (Table 6).

Table 6: Total data coverage by sector (and change from the Food Waste Index Report 2021)

INCLUDED IN 2024 REPORT (change from 2021 report)	HOUSEHOLD	FOOD SERVICE	RETAIL	TOTAL
Number of datapoints	194 (+103)	49 (+17)	45 (+16)	288 (+136)
Number of countries	93 (+41)	41 (+18)	45 (+22)	102 (+48)

In the retail and food service sectors, the increase in datapoints has been driven in large part by the publication of food waste data across the EU-27, which was reported to the European Commission and published by Eurostat. As a result, retail and food service estimates are still concentrated in high-income countries, with few nationwide estimates available in other income groupings.

By contrast, in the household sector, the growth has primarily been in subnational studies (Table 7). A substantial share (29 per cent, n=42) of subnational studies came from studies by UN-Habitat and the "Waste Wise Cities tool" and guidance, which is based on the monitoring methodology for SDG indicator 11.6.1 and can generate relevant household food waste information for the Food Waste Index at the same time.

Another large part of the new household data emerged from the identification of academic analyses that have been published in the literature, both since the Food Waste Index Report 2021 and before it (but not previously identified). Notably, the greater coverage of household estimates does not reflect the generation of nationally representative baselines by governments or national agencies. Most (76 per cent) of the newly identified household studies are not sufficiently robust for tracking at the national level due to their limited geographic scope. New nationwide studies were identified in 11 UN Member States; however, more work is needed to generate robust, nationally representative data in most countries.

*8 "Income group" refers to **World Bank classification**, for the 2024 fiscal year. There are four categories: Low-income countries, defined as those with Gross National Income (GNI) per capita of US$1,135 or less; lower-middle income countries, with a GNI per capita between $1,136 and $4,465; upper-middle income countries, with a GNI per capita between $4,466 and $13,845; and high-income countries, with a GNI per capita of $13,846 or more.*

9 "Datapoint" refers to an individual estimate in a study included in the calculation. Some countries have multiple datapoints due to having multiple studies from different time periods or different subnational areas.

Table 7: Number of datapoints, by scope of study (and change from the Food Waste Index Report 2021)

INCLUDED IN 2024 REPORT (change from 2021 report)	HOUSEHOLD	FOOD SERVICE	RETAIL	TOTAL
Number of national datapoints	49 (+11)	40 (+16)	40 (+13)	129 (+40)
Number of municipal and subnational datapoints	145 (+92)	9 (+1)	5 (+3)	159 (+96)

A full list of the datapoints can be found in Annex 2 (Table of datapoints). This describes the countries in which the studies were conducted, methodological details and the confidence level assigned to each datapoint.

Summary of countries with data

This section focuses on the number of countries with measured datapoints. In countries with more than one datapoint for the same sector, where there is no obvious reason to prefer one to another (such as methodological robustness or geographic coverage), the average of multiple datapoints is taken.

Table 8 presents the number of estimates for all sectors based on countries' World Bank income groupings. As in the Food Waste Index Report 2021, in all sectors the majority of datapoints are from high income countries. The growth in countries with datapoints in 2024 is driven in large part by the European Commission's data reporting exercise, which covered all EU-27 countries, some of which did not have estimates in the Food Waste Index Report 2021. The high income category is also the largest income grouping, so it would be expected that more countries have data there.

There has been notable growth in the number of countries with household estimates across all income groupings, particularly the lower-middle income and low income groupings, where the number of countries represented has more than doubled, although starting from a low base. In the case of low-income countries, the number of countries with data remains very low and is unlikely to be representative. As a result of a lack of confidence, these figures are not presented separately in the results.

Table 8: Number of countries with data, by World Bank income classification (and change from the Food Waste Index Report 2021)

WORLD BANK INCOME GROUP	TOTAL NUMBER OF COUNTRIES IN GROUP	HOUSEHOLD	FOOD SERVICE	RETAIL
High income countries	81	42 (+14)	32 (+14)	35 (+15)
Upper-middle income countries	53	21 (+9)	8 (+5)	8 (+6)
Lower-middle income countries	54	23 (+13)	1 (-1)*	2 (+1)
Lower income countries	26	6 (+4)	0 (0)	0 (0)
Not covered by World Bank groups	35	1 (+1)	0 (0)	0 (0)

**One food service datapoint was removed due to being particularly old and insufficiently representative.*

The same data is presented according to regional distribution in Table 9.[10] There remain uneven distributions of data between regions, but this shows – for the household sector at least – substantial growth of identified datapoints in multiple regions. Notably, some regions with very small numbers of datapoints – or none at all – in the Food Waste Index Report 2021 now have many more countries represented. In particular, Northern Africa, Melanesia and Micronesia all now have identifiable estimates, which are beneficial for improving the regional extrapolations. The addition of some datapoints from small island states improves the understanding of household food waste in different food environments. Only Central Asia and Polynesia remain as subregions without any estimates.

Section 2.4 provides a descriptive summary of the data in each region.

Table 9: Number of countries with data, by region (and change from the Food Waste Index Report 2021)

REGION	HOUSEHOLD	FOOD SERVICE	RETAIL
Northern Africa	3 (+3)	0 (0)	0 (0)
Sub-Saharan Africa	14 (+6)	1 (0)	2 (+1)
Latin America and the Caribbean	10 (+6)	1 (+1)	3 (+3)
Northern America	2 (0)	2 (+1)	2 (+1)
Central Asia	0 (0)	0 (0)	0 (0)
Eastern Asia	5 (+3)	2 (0)	2 (+1)
South-eastern Asia	8 (+5)	1 (0)	1 (0)
Southern Asia	7 (+3)	1 (0)	0 (0)
Western Asia	9 (+3)	3 (+2)	3 (+1)
Eastern Europe	6 (+3)	6 (+6)	6 (+5)
Northern Europe	9 (+2)	9 (+2)	9 (+4)
Southern Europe	8 (+3)	7 (+5)	8 (+5)
Western Europe	7 (+1)	7 (+1)	7 (+1)
Australia and New Zealand	2 (0)	1 (0)	2 (0)
Melanesia	2 (+2)	0 (0)	0 (0)
Micronesia	1 (+1)	0 (0)	0 (0)
Polynesia	0 (0)	0 (0)	0 (0)
Total	**93 (+41)**	**41 (+18)**	**45 (+22)**

The regional distribution remains very uneven in the non-household sectors, with many lacking usable data. This is not to suggest that no work is being undertaken in these sectors and countries; in many cases, measurements have taken place for some subsectors (such as hotels or restaurants) but are lacking the disaggregation or scaling required to form a nationally representative estimate. This is discussed further in Box 1.

As a result of these differences in the availability of data, many uncertainties remain about food waste generation in these sectors. This is particularly the case in low income countries and for the food service and retail sectors in all middle-income and low-income countries.

10 For the purposes of this report, the regional disaggregation used was the subregions as per UNSD classification.

Box 1: Why so few retail and food service estimates?

While the number of estimates for household food waste have increased, there is a notable absence of usable estimates for the retail and food service sectors, particularly in middle- and low-income countries. However, this does not mean that there is no data. Often, some data is available, but it may require additional work to form a sector-specific national estimate. There are two key sources of existing data that countries may be able to use to help them form national estimates, described here and in more depth in the Appendix:

1. Measurements in particular subsectors that need scaling:

The retail and food service sectors are made up of a variety of subsectors, representing different establishment types. In the retail sector, for example, in any given country there may be supermarkets and hypermarkets, smaller convenience stores or traditional retailers, outdoor or occasional farmers' markets and specialist retail such as butchers, bakers or greengrocers. While in some countries, the large majority of sales will go through supermarket channels, in other countries there may be a more balanced diversity of establishments, with some forms being common in urban areas or particular regions. The same can be said for food service: there are restaurants, canteens and catering in a variety of establishments including offices, schools and hospitals; event catering such as conferences or weddings; street markets and mobile food vendors; and food provision for care home residents or prisoners, among others.

It is common for research studies to be conducted at a single establishment type or subsector: academics may study restaurants or schools, but they are unlikely to have the resources to do both at the same time. In such cases, the results from these subsector studies may offer normalized estimates at the level of one or more sampling units. If appropriately scaled (see section 3.2), these studies may contribute to national estimates. However, studying one subsector alone cannot form a national estimate for the entire sector, and additional research may be required in other relevant subsectors to generate a more complete picture.

A non-exhaustive list of research papers identified during the research for the Food Waste Index 2024 which focuses on particular subsectors, can be found in the Appendix. This resource may be of use to researchers and government officials in those countries to prioritize where additional research is required.

2. Waste composition of "commercial" waste:

It is common for studies of municipal solid waste to be conducted by collecting waste from the source. In such studies, waste often has been collected from specific establishments. This is sometimes called "commercial" or "industrial, commercial and institutional" waste. However, these results may be presented at an aggregated level, such as the total waste arisings for all commercial enterprises, or an average waste composition across all businesses. As a result, specific estimates for the retail and food service sectors cannot be derived from these headline results.

The raw data underlying existing reports could be rearranged to support reporting on SDG 12.3. For example: if waste generation and composition was recorded at the level of specific businesses, it may be possible to split the businesses between "retail," "food service" and "other" categories and to aggregate the data differently. Revisiting and repurposing existing data could therefore be a cost-effective way for countries with no current estimates for food service and retail to form estimates. This includes studies in Jamaica (Inter-American Development Bank [IDB] et al. 2022), Mexico (Aguilar, Moreno and Moreno Pérez 2017), Ethiopia (Japan International Cooperation Agency [JICA] 2022) and the Solomon Islands (Environment Unit n.d.). This data may also be able to inform the development of accurate sample sizes (see section 3.2).

While the proportion of countries with some food waste estimates is relatively low, the estimates found are generally concentrated in more populous countries. In households, for example, coverage by country is less than 50 per cent, but the population of countries with at least some household data covers 85 per cent of the global population (Table 10). Even if smaller countries with more limited resources are not able to directly measure their own food waste, the understanding of global food waste will benefit from direct measurement and reporting in the world's largest countries. The G20 countries, as the largest economies and representing around two-thirds of the global population, have a particular role to play in advancing food waste measurement and action (Box 3).

Table 10: Share of population in countries with some identified data on food waste, by region

	HOUSEHOLD	FOOD SERVICE	RETAIL
Northern Africa	**50%**	0%	0%
Sub-Saharan Africa	**66%**	**5%**	**6%**
Latin America and the Caribbean	**75%**	**19%**	**59%**
Northern America	**100%**	**100%**	**100%**
Central Asia	0%	0%	0%
Eastern Asia	**98%**	**95%**	**95%**
South-eastern Asia	**92%**	**5%**	**5%**
Southern Asia	**94%**	0%	0%
Western Asia	**43%**	**19%**	**16%**
Eastern Europe	**75%**	**75%**	**75%**
Northern Europe	**100%**	**100%**	**100%**
Southern Europe	**94%**	**55%**	**94%**
Western Europe	**100%**	**100%**	**100%**
Australia and New Zealand	**100%**	**83%**	**100%**
Melanesia	**8%**	0%	0%
Micronesia	**21%**	0%	0%
Polynesia	0%	0%	0%
Total	**85%**	**36%**	**40%**

When interpreting Table 10, it should be noted that, for a country to be considered to have an estimate, there merely needs to be one study meeting the requirements for inclusion (see section 2.2). In many cases, a large country has a single, geographically focused study (e.g. focusing on a city) that has been included but that may not provide an estimate sufficiently accurate for the country to allow tracking of food waste over time. Even in countries with reported medium confidence estimates, additional work is needed to form nationally representative measurements that are sufficiently robust for tracking.

High confidence estimates

The above discussion does not differentiate between high confidence and medium confidence estimates. These are classifications given to the datapoints based on their likelihood of being suitable for tracking national levels of food waste. They are not commentary on the quality of the research undertaken.

- High confidence estimates are likely to be suitable for tracking national levels of food waste. They are developed using a robust methodology, covering a substantial part of the country and with no adjustment of the data required to align with the current study's purposes.
- Medium confidence estimates are measured using methodologies that may be suitable for detecting larger changes in food waste, but are not geographically representative. They include datapoints from cities used to represent a country, or datapoints requiring adjustment to align with the current study's purposes.

As discussed in this report, most of the newly added data was driven by subnational estimates. Only four countries that did not previously have estimates in the Food Waste Index Report 2021 have had newly identified data considered to be sufficiently robust for high confidence classification. These are summarized in Table 11, with descriptions of the studies provided in Annex 2 (Table of datapoints).

Table 11: Newly added countries with "high confidence" estimates

COUNTRY	SECTOR	SOURCE
Argentina	Retail	(We Team, Consumer Goods Forum and GS1 Argentina 2021)
Bhutan	Household	(Bhutan National Statistics Bureau 2021)
Qatar	Household	(UNEP Regional Office for West Asia 2022)
Jamaica	Household	(IDB et al. 2022)

In addition to this, in Europe, data reported to the European Commission and published through Eurostat are available for the first time across all sectors. The guidelines provided for measurement methods are consistent with the Food Waste Index, although there are some differences in sectoral scope as the "retail" and "processing and manufacturing" sectors include some data that would instead be reported to the Food Loss Index (such as wholesale).

However, because 2022 was the first year in which the EU data was released, not all countries may have adequately followed this guidance, and methodological information for each datapoint was not available at the time of writing. As a result, data from Eurostat has not been assigned a confidence rating at this point. EU-27 countries reporting in line with European Commission requirements should be able to use this data for reporting on SDG 12.3 as well, in some cases with minor adjustments.

Tables with the datapoints included for each sector can be found in Annex 2 (Table of datapoints).

Key narratives around data availability

Building on the Food Waste Index Report 2021, some further key narratives can be drawn around the global availability of data:

- **There is a substantial and growing body of evidence about the extent of household food waste worldwide.** Most of the world's population lives in a country in which there is at least some empirical evidence about the extent of household food waste. Some of the data gaps observed in the Food Waste Index Report 2021 have been at least partly filled through recently conducted studies. As discussed later (see section 2.5), when analysed this extensive data further reinforces the conclusions drawn in the Food Waste Index Report 2021 around the broad consistency worldwide in the quantities of household food waste per capita.
- However, this wide data availability for the household sector is subject to the caveat that **most of the available data is not from nationally representative baseline studies. Despite the wealth of household studies, few are suitable for tracking progress to SDG 12.3 on a national basis.** The majority of the data comes from small instances of subnational studies in urban areas, particularly in low- and middle-income countries. These are very valuable insights, but substantial variation is observed within studies in the same country, including between urban and rural populations (see section 2.5). A comprehensive understanding of household food waste in a country – and how it varies within that country – relies on more consistent, large-scale baseline studies being undertaken. The methodology for doing so is discussed in chapter 3.
- A third key narrative from this data overview is **the ongoing challenge to generate nationally representative estimates of food waste in the retail and food service sectors.** For low- and middle-income countries, there are still very few estimates reported that give insight into waste in these sectors. As discussed in ***Box 1***, this is not necessarily due to a lack of research in these countries, but rather points to the need for additional work to pick apart existing data and to scale it to form robust national estimates. The methodological guidance provided in chapter 3 expands on how countries should measure retail and food service food waste in an accurate and cost-effective manner. Sharing learnings from EU-27 countries that have been required to undertake measurement and produce estimates for these sectors would be valuable to help improve the process for other countries.

2.4 Results: regional breakdowns

This section provides a breakdown of identified data across different world regions. These are grouped according to the regional classification of UNEP.

Latin America and the Caribbean

In Latin America and the Caribbean, a total of 23 datapoints were included, measuring food waste in 11 countries. Of these datapoints, 19 were household estimates (Table 12), 1 was from food service and 3 were from retail. Other than the household estimate for Jamaica and the retail estimate for Argentina, all datapoints are classified as medium confidence.

The Dominican Republic and Jamaica are the only Caribbean countries included in the sample. The household study in Jamaica took food waste samples of 250 kilograms each from four waste disposal sites from trucks collecting waste from households, one in each watershed in Jamaica, over three seasons (IDB et al. 2022). The results present weighted averages for Jamaica as a whole: the representative samples and adjustment mean that this method would be suitable for tracking food waste over time.[11]

One household estimate for the Dominican Republic (García 2018) is the highest household estimate in the region, at 207 kilograms per capita per year. This study sampled 87 households from three socioeconomic groups in Salcedo Municipality over seven days. A second household estimate for the Dominican Republic (UN-Habitat 2021a) includes a similar sample size but produces a much lower estimate of 113 kilograms per capita per year. There is no clear methodological reason for the differences in estimates, except for regional differences from studies in two different cities. The substantial variation observed in different studies and locations (see in particular Belize, the Dominican Republic and Ecuador in Table 12) reinforces the need for nationally representative studies.

A number of the studies identified in Latin America and the Caribbean came through the work of students in published theses or dissertations, such as in Peru (Cutipa 2016; La Rosa Caballero 2022) and Ecuador (Auquilla 2015; Castro 2023). Although constrained to small geographic areas, these studies show the importance of universities in furthering information-gathering, whether for national or municipal-level decision-making. More systematic searches of university publications may identify further, similar work.

The household estimates observed across the region (Table 12 and Figure 6) are highly divergent. It is currently unclear whether these reflect real differences between countries and regions within countries, as many of the studies had small samples or were confined to particular small locations. More representative nationwide baseline studies will help improve confidence in the data in the region (see chapter 3 for guidance on conducting measurement).

There were four non-household estimates identified, two of which were from Mexico (Garduño *et al.* 2023). In the Mexico study, questionnaire surveys were distributed to actors across the food chain, including 52 in the food service businesses and 50 to wholesale and retail businesses. Surveys asked for perceptions of wastage rates by specific products (for example, the percentage of bread wasted) and these were then used to assign waste generation rates that were scaled by representative business data. Authors highlight that the analysis is limited by being built on the perceptions of the stakeholders. The high figures (64 kilograms per capita for food service, 45 kilograms per capita for retail) may be a result of very high tourism in the study region of Baja California Sur.

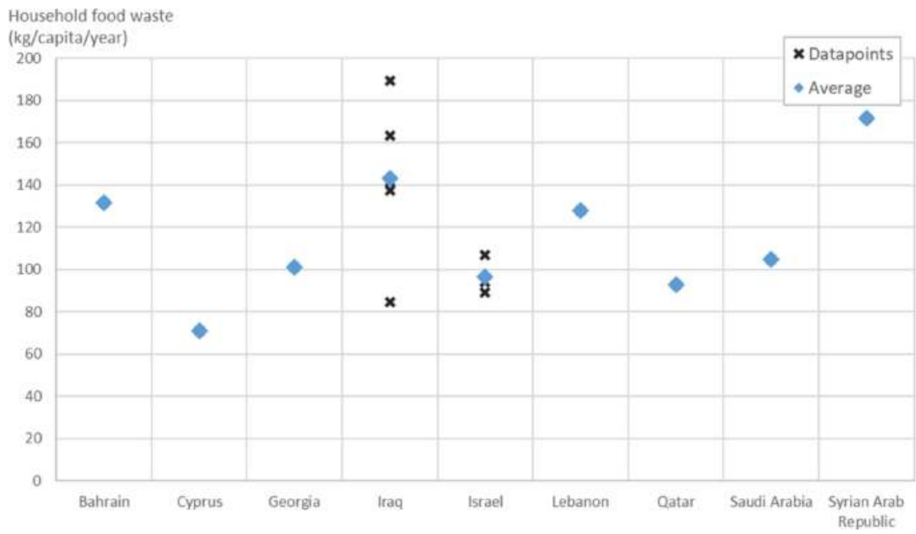
The Argentina study (We Team, Consumer Goods Forum and GS1 Argentina 2021)el segmento de autoservicios y supermercados tuvo, sobre el total de ventas, un 4,76% promedio de merma operativa equivalente a unas 123.434 toneladas (año 2019 collected data on sales and wastage of 16 food categories from supermarkets representing 41 per cent of the total market share. The data was projected over the remaining market share to estimate the entire sector nationwide. Although additional data on other retail avenues would be welcome, the supermarket estimate is sufficiently robust to be judged as suitable for tracking.

11 *Waste sampled from collection rounds does have risks of contamination by small businesses, which should be mitigated where possible (see section 3.2 for more on household food waste measurement methods). In this particular example, waste collection trucks collected only from households and were followed by people on bikes documenting the number of households and, where possible, the number of residents in households, increasing the accuracy of what was captured.*

Table 12: **Household food waste datapoints in Latin America and the Caribbean**

COUNTRY	SOURCE	STUDY AREA	FOOD WASTE ESTIMATE (kg/capita/year)
Belize	(IDB 2011)	San Ignacio / Santa Elena	95
	(IDB 2011)	Caye Caulker	45
	(IDB 2011)	San Pedro	36
	(IDB 2011)	Belize City	34
Brazil	(Gilbert and Ricci 2023)	Rio de Janeiro	94
Colombia	(JICA 2013a)	Bogota	70
Dominican Republic	(García 2018)	Salcedo Municipality	207
	(UN-Habitat 2021a)	Santo Domingo	113
Ecuador	(Auquilla 2015)	Zaracay, Santo Domingo	158
	(Castro 2023)	Balsapamba, San Miguel	34
Jamaica	(IDB *et al.* 2022)	0	86
Mexico	(Kneller *et al.* 2019)	0	94
	(Ojeda-Benítez, Vega and Marquez-Montenegro 2008)	Mexicali	126
	(Aguilar, Moreno and Moreno Pérez 2017)	Berriozábal, Chiapas	71
	(Aguilar Virgin *et al.* 2010)	Ensenada, Baja California	129
Panama	(JICA 2003)	Panama City	101
Peru	(La Rosa Caballero 2022)	Punta Hermosa, Lima	91
	(Cutipa 2016)	Macusani	84
Venezuela	(Sánchez *et al.* 2014)	Chacao, Miranda State	93

Figure 6: **Distribution of household datapoints in the Latin America and the Caribbean region**



Note: Where multiple datapoints exist, the mean (average) is taken, and where only one datapoint exists, this is treated as the "average."

Box 2: Country profile: Brazil

In 2023, Brazil began developing a household food waste baseline, together with ISWA, ABRELPE, Comlurb, and UNEP, to understand the amounts and types of food discarded by households. This baseline, including data from three different areas of the country, will support SDG 12.3 reporting and inform the development of Brazil's National Organic Waste Strategy. The first results, from the city of Rio de Janeiro, have been delivered.

Rio de Janeiro is the second most populous city in Brazil, with over 13 million people in the metropolitan area. According to data published by the City of Rio de Janeiro, the city produces around 4,800 tonnes of household food waste on a daily basis, which is collected and disposed of by the municipal urban cleaning company, Comlurb (Prefeitura da Cidade do Rio de Janeiro 2021). City data suggests that half (51 per cent) of household solid waste is classified as organic (food or garden waste), and less than 2 per cent of this waste is currently recycled (mainly cardboard, cans and plastics). Comlurb collects around 2,000 tonnes of food waste annually from municipal schools and large generators such as supermarkets and restaurants. The social enterprise Ciclo Orgânico (Organic Cycle) collects food waste from households for compost, although the service is targeted towards families in high-income areas.

Rio de Janeiro is developing a food strategy, responding in part to COVID-19's impact on the food system, that will support the creation of a specific food waste measurement strategy, with an initial focus on households. This planning and research presents a framework and opportunity to build expertise that will help Brazil track food waste in the future.

The 2023 study conducted in Rio de Janeiro involved 102 households, with 86 actively participating, in all five areas of the municipality (Figure 7). These households were selected and categorized based on income, dwelling type, residential area and number of residents. Each household sorted its waste into three categories: food waste (fruit and vegetables, meat, dairy and bakery products), packaging materials and residual waste. To minimize bias, participants, aware of the waste study, were not informed that the focus was on food specifically. Waste was collected over eight days, with the first day's waste excluded.

THE STUDY FOUND THE FOLLOWING:

Food waste was **62% by mass** of total household waste, significantly more than the fractions for packaging and residual waste fractions.

No correlation was found between income group and per capita food waste generation.

Median per capita food waste generation was **77 kg/capita/year**

FOOD WASTE CATEGORIES (% BY MASS) WERE:

- Fruit and vegetables: **62%**
- Meat: **11%**
- Dairy: **11%**
- Bakery: **16%**

EDIBLE AND INEDIBLE FRACTIONS WERE:

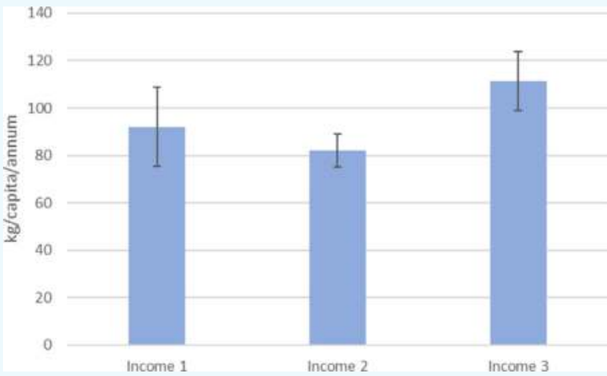
- Edible **39%**
- Inedible **61%**

Inedible fruit and vegetables were the largest fraction, at **81%** of all fruit and vegetable waste generated or **73%** of all inedible food waste.

Three income groups were sampled across the municipality (Figure 8):

- Income Group 1: up to R$5,000
- Income Group 2: between R$5,000 and R$10.000, and
- Income Group 3: above R$10,000.

Figure 8: Annual household food waste per capita in high-, medium- and low-income groups in Rio de Janeiro



Food waste accounted for 62 per cent of the total waste collected, which is 11 per cent higher than the city's estimates for organic waste (Prefeitura da Cidade do Rio de Janeiro 2021). This variance may stem from differences in classification, methodologies and sample sizes.*

On average, the median amount of food waste is 212 grams per person per day or 77 kilograms per person per year, close to the global average of 81 kilograms in this report. Household food waste per capita and household income level did not appear to be correlated.

Based on the study's findings, food waste minimization campaigns for family meal practices, a separate food waste collection scheme, and exploring home composting options for fruit and vegetable waste may be relevant for Rio de Janeiro's Food Strategy. Food waste collection schemes should target densely populated areas or residences with multiple occupants, and an initial focus on fruit and vegetable waste may offer the most potential.

Behaviour change campaigns could prioritize greengrocers for information dissemination, which can be reinforced at communal collection sites to increase exposure multiple times a week. Waste reduction campaigns for family meal preparation should involve all family members, including children, and provide guidance on portion sizes and leftover management to further enhance waste minimization efforts.

** Comlurb carries out annual household waste analyses using aggregated samples and by sorting food waste into a single category, not four separate subcategories as was the case in this research.*

Box 3: G20 countries

As a community of the world's largest economies, the G20 has an important role to play in demonstrating leadership in food waste measurement and reduction. Representing around two-thirds of the global population, the G20 countries delivering SDG 12.3 in their countries will be pivotal to global success. The current coverage of data is mixed, as illustrated in Table 13.

Table 13: Data coverage in G20 countries

	HOUSEHOLD	FOOD SERVICE	RETAIL
Argentina	No identified data	No identified data	High confidence datapoint
Australia	High confidence datapoint	High confidence datapoint	High confidence datapoint
Brazil	1 medium confidence datapoint	No identified data	1 medium confidence datapoint
Canada	High confidence datapoint	1 medium confidence datapoint	1 medium confidence datapoint
China	3 medium confidence datapoints	6 medium confidence datapoints	1 medium confidence datapoint
France	Eurostat-reported data*	Eurostat-reported data*	Eurostat-reported data*
Germany	Eurostat-reported data*	Eurostat-reported data*	Eurostat-reported data*
India	7 medium confidence datapoints	No identified data	No identified data
Indonesia	10 medium confidence datapoints	No identified data	No identified data
Italy	Eurostat-reported data*	No identified data	Eurostat-reported data*
Japan	High confidence datapoint	High confidence datapoint	High confidence datapoint
Mexico	4 medium confidence datapoints	1 medium confidence datapoint	1 medium confidence datapoint
Republic of Korea	1 medium confidence datapoint	No identified data	No identified data
Russian Federation	1 medium confidence datapoint	1 medium confidence datapoint	1 medium confidence datapoint
Saudi Arabia	High confidence datapoint	No identified data	High confidence datapoint
South Africa	6 medium confidence datapoints	No identified data	No identified data
Türkiye	No identified data	No identified data	No identified data
United Kingdom	High confidence datapoint	High confidence datapoint	High confidence datapoint
United States of America	High confidence datapoint	High confidence datapoint	High confidence datapoint
European Union	Has instituted common measurement and reporting, see "Europe" section for a summary of data.		
African Union	No common measurement and reporting, see "Africa" section for a summary of data.		

** Data reported on Eurostat has not been assigned a confidence rating due to missing metadata.*

Six G20 countries (Australia, Canada, Japan, Saudi Arabia, the United Kingdom, the United States) have datapoints for household food waste that have been classified as *high confidence,* suitable for tracking purposes. These estimates come from a range of government bodies and authoritative independent organizations:

- Canada's estimate is from Environment and Climate Change Canada (2019), involving a synthesis of 56 different waste compositional analyses.
- The United States' estimate is from the U.S. Environmental Protection Agency [EPA] (2023), which combines waste generation factors from other studies with relevant scaling statistics.
- Japan's estimate is from the Ministry of the Environment (UNEP 2023), derived from annual surveys of each municipality's waste compositional data.
- Australia's estimate comes from a 2021 study by The Food and Agribusiness Growth Centre (Bontinck, Grant and Lifecycles 2021), which uses data from state audits as part of a mass balance model of the whole supply chain.
- Saudi Arabia's estimate is from the Saudi Grains Organisation (SAGO) waste composition analysis (2019).
- The United Kingdom's estimate is from WRAP, conducted through a mixture of local authority food waste collections and waste compositional analysis data (Devine et al. 2023).

A further four G20 members (France, Germany, Italy and all other EU-27 countries) have datapoints from Eurostat, for which a confidence rating cannot currently be given. Although European Commission measurement requirements are broadly consistent with UNEP (SDG indicator 12.3.1(b)), the methodologies used for specific datapoints were not yet published at the time of writing, so cannot be verified (see "Europe" section for more detail). The sectoral scope of EU-reported data may also differ with the inclusion of wholesale in the retail category, so the retail results may be overstated.

In most countries with some *high confidence* data, there is data for every sector. This is likely due to at least one organization having clear responsibility for food waste quantification, whether a ministry, national agency or independent organization. By contrast, the countries with multiple medium confidence data have estimates largely based on ad hoc studies published by researchers in academic journals.

China, Mexico, the Russian Federation and South Africa all have nationwide household studies, but these are classified as *medium confidence* for different reasons. The Mexican study is discussed in the "Latin America and the Caribbean" section.

The nationwide Chinese study (Xue *et al.* 2021) combines two approaches, including scaling up estimates from studies conducted in rural and urban areas based on national populations, but it only looks at edible waste and so has been adjusted for comparability. Across China, estimates range from 28 kilograms per capita per year at the lowest to 150 kilograms per capita per year at the highest, based on 196 samples of household food waste in urban municipal solid waste (Zhang et al. 2020).

The nationwide Russian study (Tiarcenter 2019) cites what is assumed to be a waste composition analysis, but the original source data and information on the calculations used could not be identified.

The South African national study (Chakona and Shackleton 2017)"plainCitation":"(Chakona and Shackleton 2017 combines a literature review of waste compositional analyses across three cities (Cape Town, Johannesburg and Rustenburg) and scales this nationally, according to different income groups. This study gave an estimate of 27 kilograms per capita per year, while other studies in specific areas of South Africa varied from 8 to 134 kilograms per capita per year. Given this large variation, this was not considered an estimate in which we could have *high confidence*.

India, Indonesia and the Republic of Korea have subnational estimates only, while Argentina and Türkiye have no estimates for household food waste (although Argentina has a nationwide estimate for retail food waste). In countries with multiple *medium confidence* estimates for household food waste, substantial variance is observed. This variance, especially in China and South Africa, but also in India, Indonesia, and Mexico, demonstrates the need for representative national food waste studies in these countries.

G20 countries have a significant opportunity to take initiative in the measurement, reporting and reducing of food waste.

Firstly, G20 countries can take a leading role in international cooperation and policy development to deliver SDG 12.3. By taking action on food waste, they can lead the way in developing international agreements and standards for reducing food waste and improving food sustainability. They have the means and capacity to lead by example in addressing global challenges. Tackling food waste sends a powerful message about responsible consumption and production, setting a precedent for other countries to follow.

Secondly, G20 countries have a substantial influence on global consumer trends. By promoting awareness and education about food waste at home, they can encourage sustainable consumption patterns that resonate globally. G20 countries thus have the economic and political influence, as well as the responsibility, to take significant action on food waste. By doing so, they can have a substantial positive impact on the environment, economy, and global food security while setting an example for the rest of the world to follow.

West Asia

In West Asia, 21 datapoints were found in 9 countries (Table 14 and Figure 9). Of these datapoints, 15 were household estimates, 3 were retail and 3 were food service estimates. Only the estimates for Saudi Arabia and Qatar are classified as *high confidence*, suitable for tracking.

In addition to the nationwide estimates for household food waste in Israel, Saudi Arabia and Bahrain that were already identified in the *Food Waste Index Report 2021*, further nationwide studies in Cyprus and Qatar were identified. In the Qatar study (see Appendix to this report), food waste estimates were taken from 437 households across ten zones of Qatar in two eight-day phases including Ramadan. The differing Ramadan and non-Ramadan estimates were scaled to a year-wide estimate based on the number of holidays or religious occasions per year and the number of regular days. Waste rates were scaled by different housing types to reflect the variety of household types. Given the methodology, sample days and approach to scaling in the study, this study was classified as high confidence.

Estimates for Cyprus are from Eurostat, meaning that a confidence rating cannot currently be given to the data. Although European Commission requirements are consistent with the Food Waste Index, the methodologies used have not been verified (see "Europe" section for more detail). Data for Cyprus has been flagged by Eurostat as being "estimated," but it is unclear in what way. The Eurostat metadata mentions that information came from 68 households, but no further information was given.

Leket Israel and BDO publish yearly nationwide studies of food waste in Israel. Only the latest, covering 2021, was included in the Food Waste Index data model. The food waste estimates in these reports (Leket Israel 2019; Leket Israel 2020; Leket Israel 2021; Leket Israel 2022) come from three sources: a "bottom-up" value chain model, using weighted data from the Central Bureau of Statistics in the relevant year; a national survey of the composition of household garbage conducted by the Ministry of Environmental Protection for 2012/13; and research on household garbage in Israel – therefore not always a new direct measurement of food waste. These are therefore classified as medium confidence. These studies also provide food waste estimates for the food service and retail estimates but are classified as medium confidence for the same reason as the household estimates.

Although there is no nationwide study of household food waste in Iraq, there are five subnational studies, with food waste estimates ranging from 85 to 190 kilograms per capita per year. This includes one study (Aziz *et al.* 2011)proper waste management systems that consider both the quantity and composition of domestic solid waste are strongly required to address the increasing amount of solid waste. Unfortunately, these essential data are not easily available. The present study sought to gather data on the quantity and composition of domestic solid waste collected from different quarters in Erbil, and the feasibility of recycling these wastes. The solid waste generation rate (GR that was not included in the Food Waste Index Report 2021 and that provides the highest estimate of household food waste in West Asia (190 kilograms per capita per year). For this study, researchers collected waste from 72 households, with the number of days' waste collected varying between households. The total number of sample days in this study is low (around 130), and although "food" is explicitly identified, there is no category for other organics, so it is possible the estimate includes some non-food organic waste.

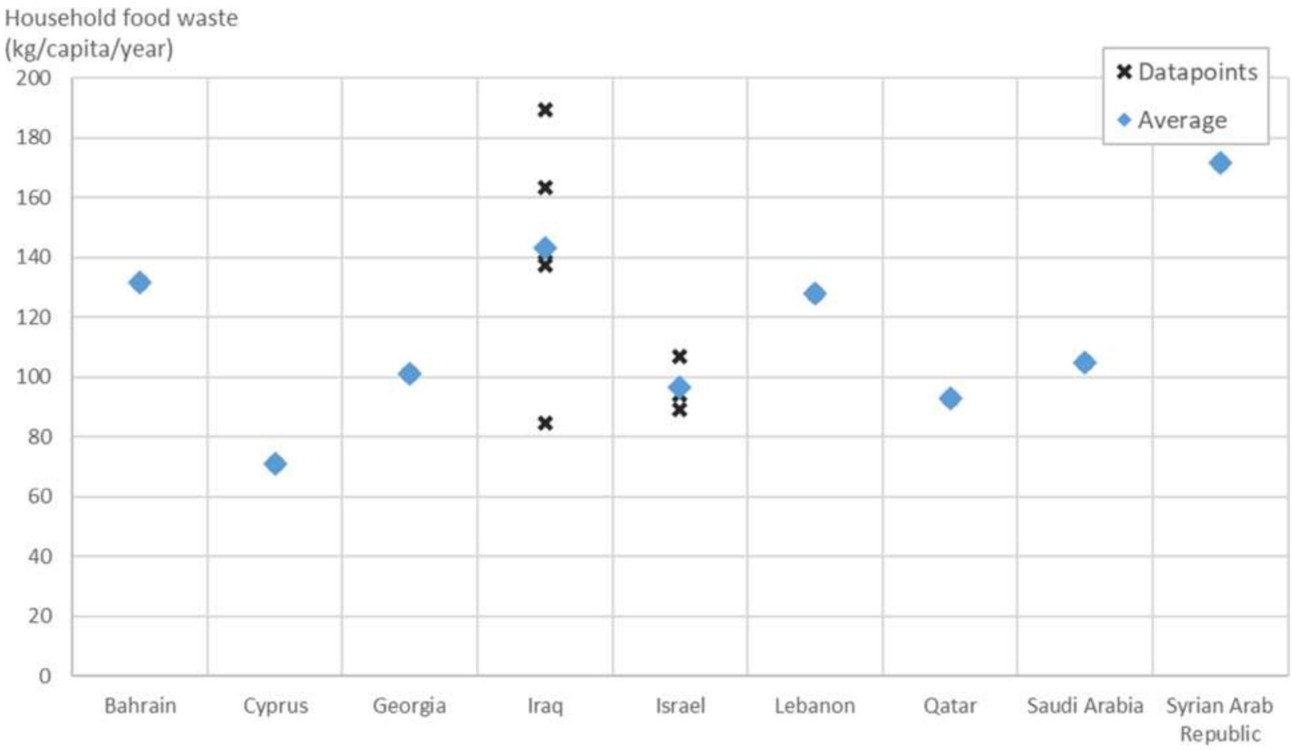
The only non-household estimates identified, aside from those already mentioned from Cyprus (Eurostat 2023) and Israel (Leket Israel 2019; Leket Israel 2020; Leket Israel 2021; Leket Israel 2022), were a food service estimate from Iraq (Filimonau *et al.* 2023) and a retail estimate from Saudi Arabia (SAGO 2019). Saudi Arabia's baseline study (SAGO 2019), conducted by Saudi Grains Organisation, included extensive direct measurement, with more than 7,000 samples across 13 regions. However, wholesale was not disaggregated from retail. This makes it unclear how many samples were specifically from retail and means that wholesale has been included in the retail food waste figure.

The Iraq study (Filimonau *et al.* 2023) sampled 18 restaurants over four consecutive days in 2021, and then scaled this to an Iraq-wide estimate based on the total number of food service operators. This study has several limitations: the small sample size, measuring only in restaurants rather than other food service subsectors, the fact that data was collected during COVID-19 restrictions and may not be representative of normal conditions, and the fact that only edible food waste was included, requiring further adjustment for inedible food waste.

Table 14: Household food waste datapoints in the West Asia region

COUNTRY	SOURCE	STUDY AREA	FOOD WASTE ESTIMATE (kg/capita/year)
Bahrain	(Alayam 2018)	Nationwide	132
Cyprus	(Eurostat 2023)	Nationwide	71
Georgia	(Denafas *et al.* 2014)	Kutaisi	101
Iraq	(Al-Rawi and Al-Tayyar 2013)	Mosul	85
	(Al-Mas'udi and Al-Haydari 2015)	Karbala	142
	(Sulaymon, Ibraheem and Graimed 2010)	Al-Kut City	138
	(Yasir and Abudi 2009)	Nassiriya	163
	(Aziz *et al.* 2011)	Erbil	190
Israel	(Elimelech, Ayalon and Ert 2018)	Haifa	94
	(Elimelech, Ert and Ayalon 2019)	Haifa Municipality (Neve Sha'anan, Ramat Remez, and Yizraelia)	89
	(Leket Israel 2022)	Nationwide	107
Lebanon	(UN-Habitat unpublished)	Tyre	128
Qatar	(UNEP Regional Office for West Asia 2022)	Nationwide	93
Saudi Arabia	(SAGO 2019)	Nationwide	105
Syrian Arab Republic	(Noufal *et al.* 2020)	Homs	172

Figure 9: Distribution of household datapoints in the West Asia region.



Note: Where multiple datapoints exist, the mean (average) is taken, and where only one datapoint exists, this is treated as the "average."

Africa

For the Africa region, there are 52 datapoints from 17 countries (Table 15 and Figure 10). The Africa region is split into two subregions, Northern Africa and Sub-Saharan Africa. For Northern Africa, data was identified from three countries with a total of eight datapoints, six of which come from across six different regions in Egypt.

A lack of data for Northern Africa was highlighted in the *Food Waste Index Report 2021*, a situation that has been improved upon. However, all datapoints identified are medium confidence due to being studies of smaller municipal areas and not representative national studies.

For Sub-Saharan Africa, 44 datapoints were identified from 14 countries, 41 of which are household estimates. Seven household food waste estimates were identified in Kenya and five in South Africa. As in the *Food Waste Index Report 2021*, the only household estimate in the Africa region to be judged as high confidence is for Ghana, where over 1,000 households across ten districts had their waste categorized for five weeks (Miezah et al. 2015).

A wide range of estimates exist for household food waste in the Africa region, with seven of the estimates for household food waste in the region being among the highest identified globally (top 10 per cent of datapoints). The UN-Habitat Waste Wise Cities Tool (WaCT) survey in Iramba District, Tanzania (UN-Habitat 2023a) is the highest reported household food waste figure in the dataset at 245 kilograms per capita per year. This datapoint comes from a UN-Habitat study; the WaCT guidance suggests a sample size of 90 households collecting waste for one week. Other studies conducted in Tanzania observed considerably lower waste rates (Table 15). The Iramba District has many households engaged in agriculture, leading them to generate significant post-harvest waste from crops in their municipal waste due to a lack of other recovery activities (UN-Habitat personal communication). A comprehensive, nationally representative study would be needed to understand average generation across the country.

Three of the highest estimates are from a single study in Egypt: Abdallah *et al.* (2020) with the aim of finding the waste generation rates and composition in correlation with key socioeconomic features such as household income, family size, and electricity consumption. The per capita waste generation rates were found to range between 0.63 and 0.82 kg/day, and the waste was composed mostly of food (41–70% collected waste from four different regions, Gharbiya, Asyout, Kafr El-Sheikh, and Qena, which are geographically distributed. The study collected all generated waste from 300 households in the urban centre of each region over the course of eight consecutive days, discarding the first day. Composition analysis was then conducted on around one-quarter of the samples collected from each region. The authors do not provide an explanation as to why the food waste estimates are so high.

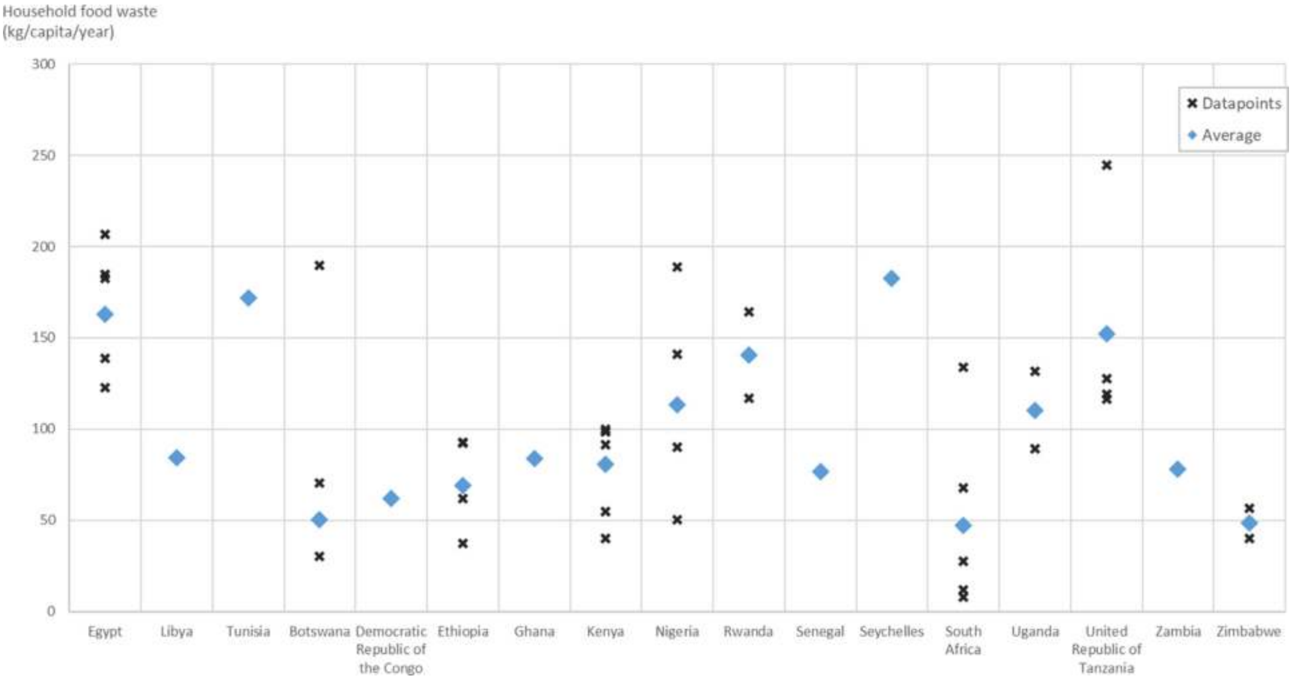
It remains unclear whether these high levels of waste reflect *edible* food being disposed of, or greater generation of inedible parts due to cooking from scratch. More research is needed that disaggregates food waste to better understand the situation in different countries. The higher rates of food waste could also reflect the climate, with a relationship being observed between average temperature and household food waste in a country (see section 2.5).

Two studies were identified exploring non-household food waste; one evaluating household and retail food waste in Zimbabwe (JICA 2013b) and another that looks at retail, food service and household food waste in Kenya (JICA 2010). Both were conducted by the Japan International Cooperation Agency. The latter study was included in the *Food Waste Index Report 2021* auditing waste from 90 food service and retail institutions in Nairobi, whereas the former evaluates retail food waste in Chitungwiza, Zimbabwe. The study collected samples from nine establishments across three different retail types (corner shops, supermarkets, markets) each day for five days to calculate waste generation rates. Composition analysis was then conducted from one sample per establishment type each day for five days.

Table 15: Household food waste datapoints in Africa

COUNTRY	SOURCE	STUDY AREA	FOOD WASTE ESTIMATE (kg/capita/year)
Egypt	(Abdallah et al. 2020)	Gharbiya	182
	(Abdallah et al. 2020)	Asyout	122
	(Abdallah et al. 2020)	Kafr El-Sheikh	185
	(Abdallah et al. 2020)	Qena	207
	(UN-Habitat 2022a)	Alexandria	142
	(UN-Habitat unpublished)	Dakahlia	139
Libya	(Moftah et al. 2016)	Tripoli City	84
Tunisia	(UN-Habitat 2021b)	Sousse	172
Botswana	(Letshwenyo and Kgetseyamore 2020)	Extension 7 Suburb, Palapye	71
	(Dikole and Letshwenyo 2020)	Palapye	30
Democratic Republic of the Congo	(UN-Habitat 2021c)	Bukavu	62
Ethiopia	(Assefa 2017)	Laga Tafo Laga Dadi town, Oromia	92
	(Balilo et al. 2023)	Shone Town	37
	(JICA 2022)	Addis Ababa	93
	(UN-Habitat 2021d)	Addis Ababa	62
	(UN-Habitat 2021e)	Bahir Dar	62
Ghana	(Miezah et al. 2015)	Nationwide	84
Kenya	(JICA 2010)	Nairobi	100
	(Takeuchi 2019)	Nairobi	99
	(UN-Habitat 2023b)	Homa Bay	40
	(UN-Habitat 2020a)	Kiambu County	99
	(UN-Habitat 2020b)	Mombasa County	80
	(UN-Habitat 2019a)	Nairobi City County	91
	(UN-Habitat 2022c)	Taita Taveta County	55
Nigeria	(Orhorhoro, Ebunilo and Sadjere 2017)	Sapele	189
	(Saidu, Musa and Akanbi 2022)	Bida town, Niger State	90
	(Emeka et al. 2021)	Port Harcourt	141
	(Yakubu, Woodard and Aboagye-Nimo 2023)	Jos	50
	(Emeka et al. 2021)	Port Harcourt	141
	(UN-Habitat 2021f)	Lagos	69
Rwanda	(Mucyo 2013)	Kigali	164
	(UN-Habitat 2023c)	Musanze	117
Senegal	(UN-Habitat 2022b)	Dakar	77
Seychelles	(UN-Habitat 2019b)	Victoria	183
South Africa	(Nahman et al. 2012)	Nationwide	27
	(Oelofse, Muswema and Ramukhwatho 2018)	Johannesburg	12
	(Oelofse, Muswema and Ramukhwatho 2018)	Ekurhuleni	8
	(Ramukhwatho 2016)	Tshwane Metropolitan Municipality	134
	(Tsheleza et al. 2022)	Mthatha city	34
	(Nell, Schenck and De Waal 2022)	Stellenbosch Local Municipality	68
Uganda	(UNEP and Uganda Cleaner Production Centre 2021)	Kampala	89
	(UN-Habitat unpublished)	Kampala	131
United Republic of Tanzania	(Oberlin 2013)	Kinondoni Municipality, Dar es Salaam	119
	(Kihila, Wernsted and Kaseva 2021)	Dar es Salaam City	117
	(UN-Habitat 2021g)	Dar es Salaam	128
	(UN-Habitat 2023a)	Iramba District	245
Zambia	(Edema, Sichamba and Ntengwe 2012)	Ndola	78
Zimbabwe	(JICA 2013b)	Chitungwiza	57
	(UN-Habitat 2021h)	Harare	40

Figure 10: Distribution of household datapoints in the Africa region



Note: Where multiple datapoints exist, the mean (average) is taken, and where only one datapoint exists, this is treated as the "average."

Box 4: Country profile: Kenya

There are seven datapoints providing estimates for household food waste in Kenya, ranging from 40 kilograms per capita per year to 100 kilograms per capita per year (Figure 11). All of the estimates identified are from subnational studies, categorized as *medium confidence.* Five of the datapoints are from UN-Habitat surveys of the Waste Wise Cities Tool (WaCT) developed by UN-Habitat, a step-by-step guide to assess a city's municipal solid waste management performance through monitoring of SDG indicator 11.6.1. The WaCT guidance suggests a sample size of 90 households (ten households from three survey areas, with three income groups each). There are WaCT estimates for five cities: Homa Bay (UN-Habitat 2023b), Taita Taveta (Voi) (UN-Habitat 2022), Kiambu (UN-Habitat 2020a), Mombasa (UN-Habitat 2020b) and Nairobi (UN-Habitat 2019). In addition, there are two further regional estimates in Nairobi that were included in the Food Waste Index Report 2021 (JICA 2010; Takeuchi 2019).

Figure 11: Summary of household food waste datapoints in Kenya

Although a large number of datapoints are available for Kenya, there is less available evidence in rural areas. Future research should focus on providing a nationwide estimate either via a nationally representative sample or through weighting results to more accurately represent variations within the country.

Asia and the Pacific

In Asia and the Pacific, 96 datapoints were identified, 79 of which provide estimates for household food waste, along with 12 food service and 5 retail datapoints. These datapoints span 25 different countries in the Asia and the Pacific region (Table 16 and Figure 12).

The region is made up of seven subregions: Central Asia, Southern Asia, East Asia, Southeast Asia, Australia and New Zealand, Micronesia, and Melanesia and Polynesia. An estimate of household food waste has been identified from each region, with the exception of Central Asia and Polynesia. In addition to the four nationwide studies identified for the *Food Waste Index Report 2021* in China, New Zealand, Japan, and Malaysia, a further five nationwide estimates have been identified. There are now high confidence estimates for four countries over three subregions: Japan (Eastern Asia) and Bhutan (Southern Asia), along with an estimate for both New Zealand and Australia.

Southern Asia has the greatest number of household food waste datapoints with 31 estimates over seven countries, equating to an estimate for all countries in the subregion except Iran and Nepal. A large range of estimates exist for Southern Asia, ranging from 19 kilograms per capita per year to 212 kilograms per capita per year.

At the lower end is the national estimate for Bhutan (Bhutan National Statistics Bureau 2021); for this national study, households received bags to store all waste generated over seven days, and the waste was then collected, sorted and weighed. In total, 1,584 households were sampled across seven administrative districts. The authors state that in rural areas "there are no waste collecting facilities [...] they use food waste as either animal food or dumped in vegetables directly" (which is assumed to mean composted or applied to land), which could explain the low result.

Several of the results in the Southern Asia subregion are among the highest 10 per cent identified across the whole dataset. These include estimates for Pakistan (Kamran, Chaudhry and Batool 2015) at 212 kilograms per capita per year, Maldives (Moosa 2021) with two estimates of 209 and 206 kilograms per capita per year across 2018 and 2019, and Afghanistan (Ghaforzai, Ullah and Asir 2021) with an estimate of 186 kilograms per capita per year. In some cases, there are possible reasons suggested for high results: Kamran, Chaudhry and Batool (2015) in Pakistan conducted research in Lahore where 84 samples were collected over one week from communal containers. The use of communal containers has a risk for contamination by small businesses or passersby, which could lead to higher waste estimates than if measured directly at homes.

The authors of the Afghan study (Ghaforzai, Ullah and Asir 2021) also provide an explanation as to why the results may be above average, noting that "the higher proportion of food waste was mainly attributed to the occurrence of huge quantities of cores of locally grown seasonal honey melons and watermelons that were consumed in higher amounts during the survey period due to their cheaper availability." Sampling households across the year to capture seasonal variability in consumption and minimizing biases in collection methods are important for generating accurate national estimates (see chapter 3).

In the Eastern Asia subregion, in addition to the estimates for China and Japan identified in the *Food Waste Index Report 2021*, estimates have been identified for the Republic of Korea (Adelodun, Kim and Choi 2021) and Mongolia (The Asia Foundation 2019; Guerber and Gursed 2021). For Adelodun, Kim and Choi (2021), an estimate of 95 kilograms per capita per year was reached by collecting food waste for two weeks from 84 households in the Republic of Korea across four seasons, resulting in 336 household samples.

There are two estimates for household food waste in Mongolia. An estimate of 29 kilograms per capita per year was derived from collecting waste from 131 households over one week in the summer and 130 households for a week in the winter (The Asia Foundation 2019). Following training, participants segregated their waste into different bags that were collected daily for further segregation. The research was conducted in Ulaanbaatar, an urban region in Mongolia.

The second estimate for Mongolia is from research conducted in a rural area, Khishig-Undur, which found a much lower estimate at 6 kilograms per capita per year (Guerber and Gursed 2021). The study adopted a similar methodology to the Ulaanbaatar study, with waste collected and self-sorted for collection and further segregation and analysis over two weeks, one in the summer and one in the winter. The main difference between the two studies is the sample size, with the Ulaanbaatar study collecting data from 130 households and the Khishig-Undur study collecting data from 35 households in the winter and 36 in the summer. Notably, the population size of the two areas is vastly different, as the selected 35 households in Khishig-Undur equated to around 10 per cent of households (Guerber and Gursed 2021).

In the South-eastern Asia subregion, estimates for a further five countries have been identified: Cambodia, Lao People's Democratic Republic, the Philippines, Singapore and Thailand. All household datapoints are documented in Table 16.

With regard to food waste estimates from the food service sector, 12 datapoints from five countries have been identified in the Asia Pacific region. These estimates range from 9 kilograms per capita per year in Malaysia (Jereme *et al.* 2013) to 58 kilograms per capita per year in Australia (Bontinck, Grant and Lifecycles 2021). In addition, there are food waste estimates from retail in five countries: Malaysia, China, Japan, New Zealand and Australia.

Pacific Islands in Micronesia, Melanesia and Polynesia were highlighted as a data gap in the *Food Waste Index Report 2021*. This has been partly addressed by identified datapoints in Vanuatu (J-PRISM II 2018), the Solomon Islands (Environment Unit n.d.) and the Federated States of Micronesia (J-PRISM II 2017). Consistent waste compositional analyses have been conducted across numerous Pacific Island countries under the PacWastePlus programme.[12] At present, these reports include only the share of organic, rather than food, waste, but if raw data at a more granular level is available from these assessments, they would likely be appropriate for SDG 12.3 reporting.

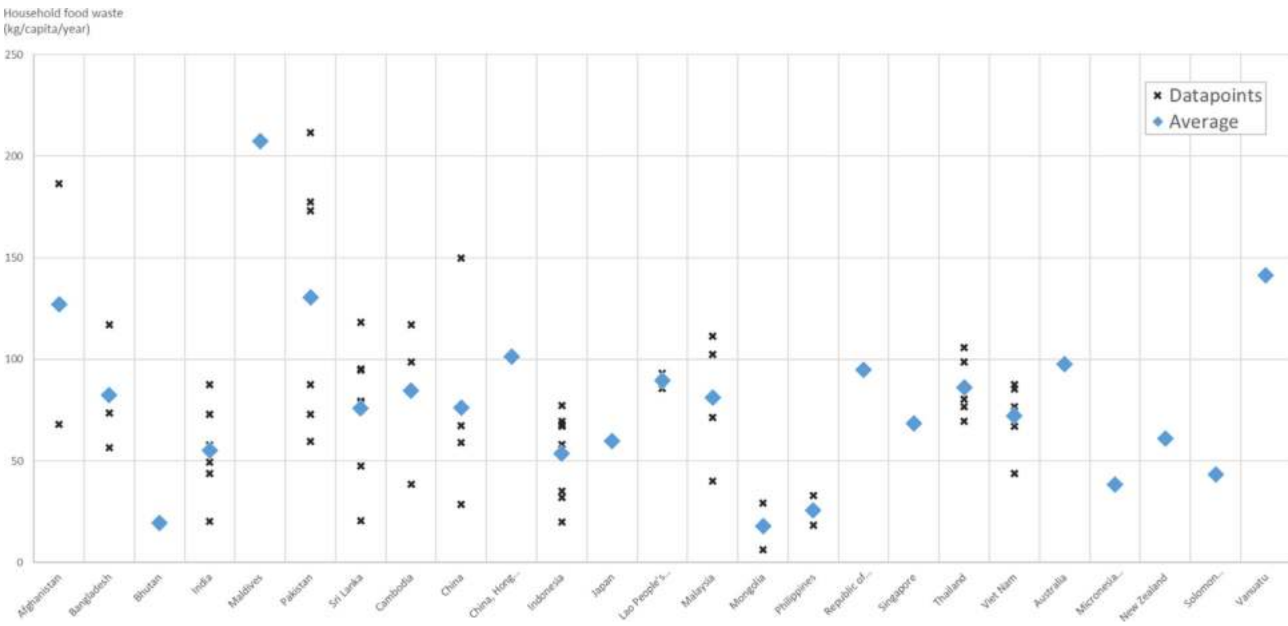
12 https://pacwasteplus.org

Table 16: Household food waste datapoints in the Asia Pacific region

COUNTRY	SOURCE	STUDY AREA	FOOD WASTE ESTIMATE (kg/capita/year)
Afghanistan	(Ullah et al. 2022)	Kabul City	68
	(Ghaforzai, Ullah and Asir 2021)	Kabul City	186
Australia	(Bontinck, Grant and Lifecycles 2021)	Nationwide	98
Bangladesh	(Salam et al. 2012)	Chittagong	74
	(Sujauddin, Huda and Hoque 2008)	Chittagong	57
	(UN-Habitat 2021i)	Khulna	117
Bhutan	(Bhutan National Statistics Bureau 2021)	Nationwide	19
Cambodia	(Parizeau, Maclaren and Chanth 2006)	Siem Reap	38
	(UN-Habitat unpublished)	Kep	99
	(UN-Habitat unpublished)	Sihanoukville	117
China	(Gu et al. 2015)	Suzhou	67
	(Zhang et al. 2020)	Nationwide	150
	(Xue et al. 2021)	Nationwide	29
	(Qu et al. 2009)	Beijing	59
China, Hong Kong Special Administrative Region	(Lo and Woon 2016)	Hong Kong	101
India	(Grover and Singh 2014)	Dehradun	73
	(Ramakrishna 2016)	Rajam, Andhra Pradesh	58
	(Suthar and Singh 2015)	Dehradun	20
	(Khan, Kumar and Samadder 2016)	Dhanbad	49
	(Rawat and Daverey 2018)	Rishikesh, Uttarakhand	54
	(UN-Habitat unpublished)	Mangalore	88
	(UN-Habitat unpublished)	Thiruvananthapuram	44
Indonesia	(Dhokhikah, Trihadiningrum and Sunaryo 2015)	Surabaya	77
	(Warmadewanthi and Kurniawati 2018)	Sukomanunggal Subdistrict	67
	(Higgins and Harris 2022)	Cianjur	53
	(Higgins and Harris 2022)	Cirebon	68
	(Higgins and Harris 2022)	Pekalongan	35
	(Higgins and Harris 2022)	Purbalingga	58
	(Higgins and Harris 2022)	Blueleng	20
	(Higgins and Harris 2022)	Karangasem	32
	(UN-Habitat unpublished)	Bogor	55
	(UN-Habitat unpublished)	Depok	69
Japan	(UNEP 2023)	Nationwide	60
Lao People's Democratic Republic	(JICA 2015a)	Vientiane	86
	(JICA 2015a)	Luang Prabang	93
Malaysia	(Jereme et al. 2013)	Nationwide	112
	(Watanabe 2012)	Bandar Baru Bangi	71
	(Kulleh and Manaf 2023)	Sungai Asap, Belaga, Sarawak	81
	(Alias et al. 2014)	Sabah	40
	(UN-Habitat 2021j)	Seremban	102
Maldives	(Moosa 2021)	Nationwide	206
	(Moosa 2021)	Nationwide	209
Micronesia (Federated States of)	(J-PRISM II 2017)	Pohnpei	38
Mongolia	(Guerber and Gursed 2021)	Khishig-Undur	6
	(The Asia Foundation 2019)	Ulaanbaatar	29
New Zealand	(Sunshine Yates Consulting 2018)	Nationwide	61

Pakistan	(JICA 2015b)	Gujranwala	88
	(JICA 2015b)	Gujranwala	60
	(Jadoon, Batool and Chaudhry 2014)	Gulberg Town, Lahore	177
	(Kamran, Chaudhry and Batool 2015)	Shalimar Town, Islamabad	212
	(Ali et al. 2023)	Peshawar	173
	(UN-Habitat 2021k)	Karachi	73
Philippines	(UN-Habitat unpublished)	Cagayan de Oro	26
	(UN-Habitat unpublished)	Legazpi	33
	(UN-Habitat unpublished)	Ormoc	18
Republic of Korea	(Adelodun, Kim and Choi 2021)	Daegu	95
Singapore	(Singapore National Environment Agency 2017)	Nationwide	68
Solomon Islands	(Environment Unit n.d.)	Tulagi Town	43
Sri Lanka	(JICA 2016)	Nationwide	118
	(JICA 2016)	Nuwara Eliya	95
	(JICA 2016)	Kataragama	95
	(JICA 2016)	Thamankaduwa	79
	(JICA 2016)	Katunayake	78
	(JICA 2016)	Moratuwa	75
	(JICA 2016)	Kesbewa	75
	(JICA 2016)	Dehiwala Mt Lavinia	75
	(JICA 2016)	Kurunegala	47
	(JICA 2016)	Trincomalee	21
Thailand	(UN-Habitat 2021l)	Chonburi	106
	(UN-Habitat unpublished)	Hatyai	69
	(UN-Habitat unpublished)	Samui	99
	(UN-Habitat unpublished)	Songkhla	80
	(UN-Habitat unpublished)	Surat Thani	77
Vanuatu	(J-PRISM II 2018)	Port Vila	141
Viet Nam	(Thanh, Matsui and Fujiwara 2010)	Mekong Delta	85
	(Zakarya et al. 2022)	Da Nang	67
	(UN-Habitat 2021m)	Hội An	77
	(UN-Habitat 2021n)	Tam Kỳ	44
	(UN-Habitat unpublished)	Hue	88

Figure 12: Distribution of household datapoints in the Asia Pacific region



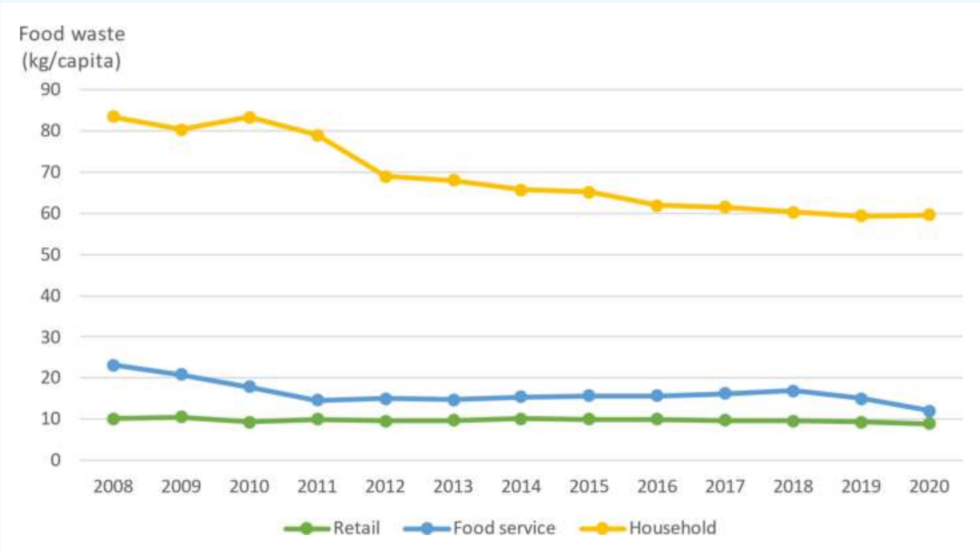
Note: Where multiple datapoints exist, the mean (average) is taken and where only one datapoint exists, this is treated as the "average.

Box 5: Country profile: Japan

In Japan, consistent reporting of food waste has allowed for the development of time-series data from 2008 onwards. For households, the Ministry for Environment conducts annual surveys to collect waste generation and recycling data via municipalities that have conducted waste compositional analyses. Some municipalities conduct additional research on the amount of edible parts of food waste, which since 2012 have been used to form the national estimate of edible food waste. Food-related businesses that generate more than 100 tonnes of food waste per year, including retailers and food service, are mandated to report this waste to the government in accordance with the Food Recycling Law, data from which is used to inform estimates for smaller businesses.

As a result of this consistent approach, Japan has a rich insight into how food waste has changed over time. This data was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection. It gives evidence of the impact of Japan's food waste reduction activities: from 2008 to 2019 (discounting 2020 data due to possible impacts of the COVID-19 pandemic), Japanese food waste was reduced by 28 per cent on a per capita basis, going down as much as 35 per cent in food service and 29 per cent in households (Figure 13). Including 2020 data, total food waste reduced by 31 per cent from 2008 (UNEP 2023).

Figure 13: Food waste per capita in Japan over time



Source: UNEP 2023.

Europe

European Union Data

In 2023, for the first time, the European Commission published via Eurostat the results of food waste monitoring across the European Union (EU). EU Member States are required to measure the amount of food waste arising for all stages of the supply chain, using methodologies set out in Annex III of Commission-delegated decision (EU) 2019/1597 (European Commission 2019). This is the largest region-wide collation of food waste data available worldwide to date.

The definition of food waste used and the methodologies required by Commission-delegated decision (EU) 2019/1597 (see Annex III) are consistent with those outlined in the Food Waste Index. However, there are some differences in sector definitions, as with "processing and manufacturing" and "retail and other distribution of food" containing sectors that would be disaggregated between the Food Loss Index and Food Waste Index. As a result, Eurostat-reported data should be broadly applicable for use in SDG 12.3 reporting, although the current retail estimates may be higher where wholesale has been included.

At the time of this writing, Eurostat has verified and published numerical values reported by EU Member States but has not completed verification on the applied methodologies. Therefore, while there is overall consistency between what is required by Eurostat (under "env_wasfw") and UNEP (SDG indicator 12.3.1(b)) for most sectors, the authors have not been able to validate each individual datapoint. It is possible that some EU Member States reporting for the first time have not submitted full and accurate data. Eurostat stated that overall, "data are of good quality."[13]

In some cases, the data is known to have inaccuracies in scope or method. This includes where countries have used estimates or indicated that their definitions differ for some sectors, "due to limitations in sample size, exclusion of small subsectors or of small companies or activities, incompleteness of sector surveys, suboptimal estimation of coefficients for the fresh mass calculation, misinterpretation of definitions by data reporters, difficulties in attributing the waste measurement in between two or more sectors." At this point it is unclear, for each specific datapoint flagged as an "estimate," which particular limitation applies.

The metadata included explanations provided by EU Member States for some specific datapoints, which explain where a different methodology or definition has been used. In Italy, for example, the "Restaurants and food services" data only includes waste from canteens, and not restaurants and other food services due to lack of available information. Because of this very limited sectoral coverage, this is expected to be a significant understatement and has been removed from inclusion in the Food Waste Index. However, it is likely that similar inconsistencies in scope exist in other countries' data, but this has not yet been fully verified by Eurostat, and not all figures marked as "estimates" have explanatory notes like Italy's.

As a result of this lack of information, confidence ratings cannot be given to specific Eurostat-reported datapoints at this point. However, the general alignment between the European methodology and data reporting and SDG indicator 12.3.1(b) means that countries in Europe will be equipped to report for SDG 12.3. This data still represents the most authoritative source of information for Europe. All previously included studies for European Union countries in the *Food Waste Index Report 2021* have been replaced by the Eurostat data.

Non-European Union data

A small number of datapoints were identified in European countries neither in the EU nor reporting data to Eurostat. Some of these datapoints (Bogdanović *et al.* 2019; Tiarcenter 2019; WRAP 2020a) were included in the *Food Waste Index Report 2021*. Additional datapoints have been added for food service in the Russian Federation (Filimonau and Ermolaev 2021) and for all sectors in Switzerland (Beretta and Hellweg 2019). Additionally, two studies in Belgrade, Serbia were added that studied household food waste and retail and food service waste, respectively. These sampled 100 households, 6 hotels, 15 restaurants and food services, 2 schools and 6 retail stores across four municipalities in Belgrade (Vujić *et al.* 2021; Vujić *et al.* 2022). Full descriptions of all datapoints can be found in Annex: 2 (Table of Datapoints).

Data summary

Unlike most regions, in which data availability has been driven by subnational studies at the household level, across Europe many estimates are conducted using nationally representative samples or datasets. In some cases, this is by scaling evidence from restaurants gathered in a smaller territory by nationally appropriate statistics for the whole country, as in the Russian Federation (Filimonau and Ermolaev 2021). In other cases, data from national waste data gathering for households and businesses is used, as in the United Kingdom (Devine *et al.* 2023). The requirement for Member State reporting in the European Union has clearly provided an impetus for nationwide reporting across Europe, meaning that this is the region with the greatest coverage across all subsectors. Only Romania did not report data to Eurostat (Eurostat 2023).

Substantial variation is observed across all sectors in Europe (Figure 14). At this point, given that the specific methodologies for each Eurostat-reported datapoint are not clearly known, it is hard to say whether this reflects real variation or differences in methodologies and scopes, particularly in the retail and food service sectors. However, the data does reinforce the importance of household food waste as being particularly large and worthy of focus. While in most countries retail waste was far lower in quantity than household food waste, retailers have a key role in helping their customers reduce waste (see chapter 4).

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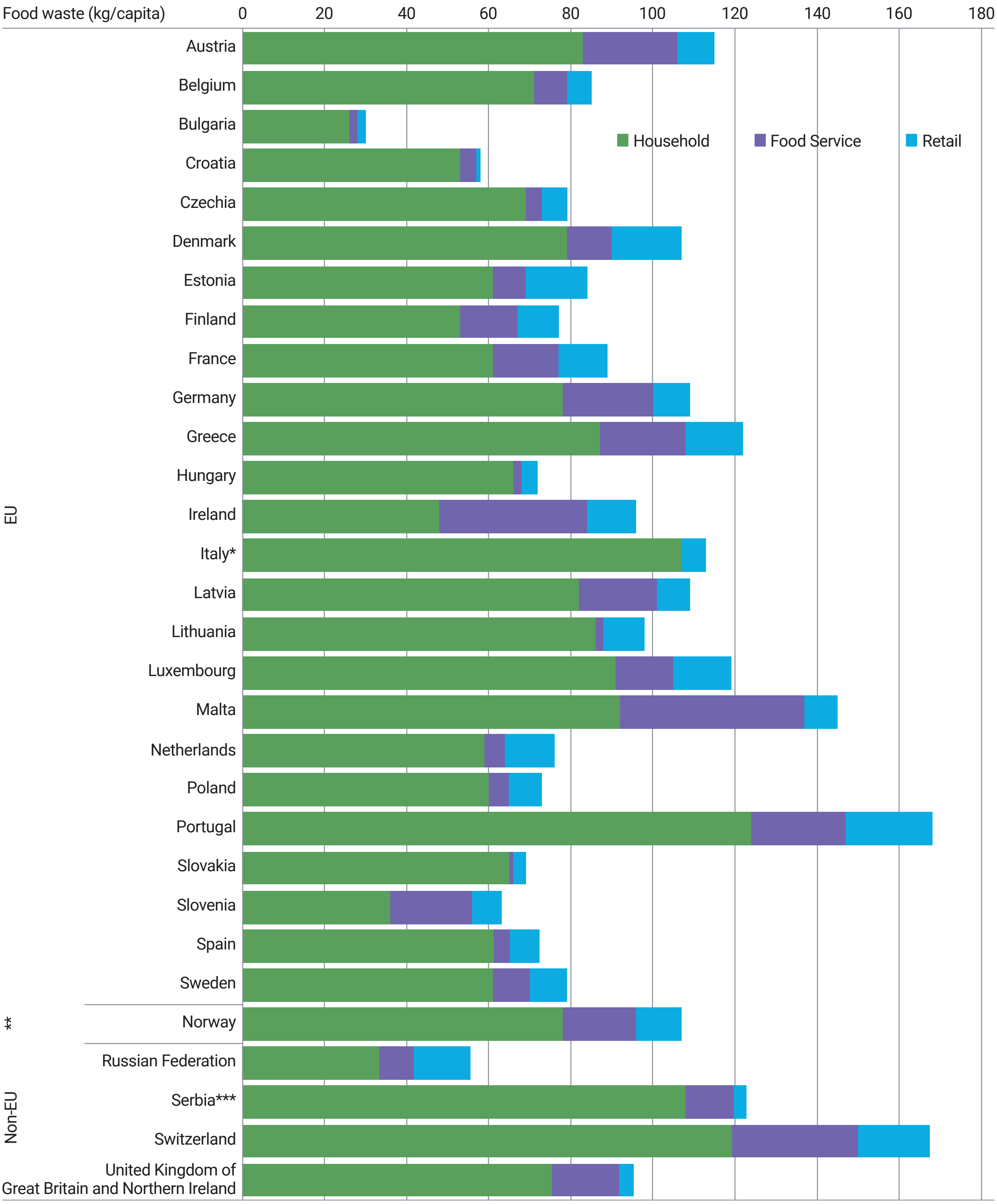
13 *Eurostat code "Env_wasfw" - Food waste and food waste prevention by NACE Rev. 2 activity - tonnes of fresh mass* https://ec.europa.eu/eurostat/cache/metadata/en/env_wasfw_esms.htm

Figure 14: Food waste estimates across Europe



**Italy did provide a food service estimate to Eurostat, but this was removed from this dataset due to the known limitations in scope, as it was representative of only a small part of the food service sector.*

***Norway is not in the European Union but reported food waste data to Eurostat.*

**** Serbia's food service estimate is the average of two different estimates.*

Full detail of every datapoint can be found in Annex 2 (Table of datapoints).

North America

Some data is available on a national basis for all three sectors in both the United States and Canada. In the United States, this is published by the Environmental Protection Agency (EPA) in its *Wasted Food Report* for 2019 (U.S. EPA 2023). This report provides a clear example of the scaling process described in section 3.2: the U.S. estimate is based on a collection of empirically observed studies within different subsectors, normalized and scaled by subsector-appropriate factors such as the number of households, number of employees or revenue. However, as highlighted in the uncertainties of the EPA publication, some subsectors rely on a small number of studies, and in some cases these generation factors may be out of date due to changing policies.

In Canada, household data comes from an aggregation study of 56 waste compositional analyses conducted across the country. Food service and retail data comes from a whole-food-chain mass balance study based on survey responses from the Canadian food chain, which reported collecting data on their own waste. Without further verification of the waste factors reported by businesses, and whether they gathered that in a consistent and accurate manner, there remains uncertainty about the results, which the authors state are based on "conservative" loss rates (Gooch *et al.* 2019).

Table 17: Summary of datapoints in North America

COUNTRY	SECTOR	FOOD WASTE ESTIMATE (KG/CAPITA/YEAR)
Canada	Household	79
	Food service	80
	Retail	30
United States of America	Household	73
	Food service	74
	Retail	12

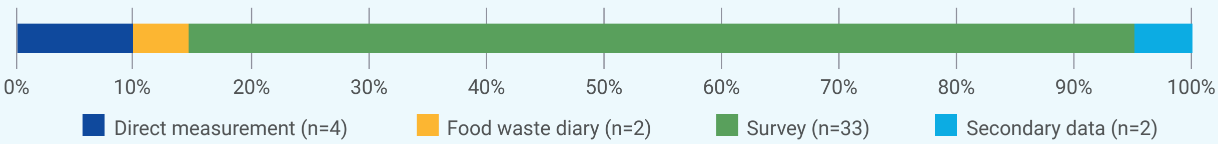
Box 6: Household food waste and COVID-19

Throughout the COVID-19 pandemic, particularly during 2020-2021, there were considerable disruptions to normal food practices in many regions. This included, but was not limited to, closure of food service businesses, requirements or advice for citizens to stay at home, or additional health measures such as reduced capacity in shops. Did this experience impact the amounts and types of food wasted, particularly in the home?

Much research was carried out to examine the effect of COVID-19 public health "lockdowns" and the associated changes in behaviours that could impact food waste. In general, the studies highlight the adoption of behaviours considered beneficial for reducing food waste: preparation and management of food, and the use of leftovers, likely influenced by increased time availability. At the same time, behaviours such as panic buying early in the pandemic, stockpiling and increased food deliveries could have led to increased generation of food waste (Iranmanesh et al. 2022; Borghesi and Morone 2023). Some authors suggested that the highlighted changes in behaviour were believed to be positive for food waste reduction, with the possibility for long-term behavioural changes (Iranmanesh *et al.* 2022). By contrast, a survey conducted among government and non-government experts from the Asia-Pacific Economic Cooperation (APEC) region during the pandemic showed that more respondents perceived that the aggravating effects of COVID-19 on food waste outweighed its mitigating effects (Chang *et al.* 2022).

How do these perceived changes in behaviour relate to the generation rates of waste? A separate review paper published in 2023 focused on the quantity and composition of household food waste during the pandemic and whether those amounts changed from previously (Everitt, van der Werf and Gilliland 2023)primarily collected through surveys. The average total amount of household food waste generated during COVID-19 was 0.91 kg per capita per week. Average avoidable food waste generation was 0.40 kg per capita per week and average unavoidable food waste generation was 0.51 kg per capita per week. Fruit and vegetables were the most wasted types of food. Only five studies reported statistically significant changes (actual or perceived. Crucially, in the 41 papers the authors consider, only 10 per cent (n=4) involved direct measurement. The large majority of studies (80 per cent, n=33) relied on survey methodologies (Figure 15).

Figure 15: Evaluation of the different research methods of papers evaluated in a 2023 review of articles that reported on household food waste during the COVID-19 pandemic



Source: Everett, van der Werf and Gilliland 2023.

Everitt, van der Werf and Gilliland (2023)primarily collected through surveys. The average total amount of household food waste generated during COVID-19 was 0.91 kg per capita per week. Average avoidable food waste generation was 0.40 kg per capita per week and average unavoidable food waste generation was 0.51 kg per capita per week. Fruit and vegetables were the most wasted types of food. Only five studies reported statistically significant changes (actual or perceived compared the self-reported studies (surveys and diaries) that demonstrated a perceived change and found there was no strong trend. Rather, the authors highlight that roughly an equal number of self-reported papers suggested a decrease in food waste as those perceiving no change, with a small number perceiving increased food waste. The biases of self-reported evidence, methodological variation across studies and lack of statistical tests make it difficult to determine whether these reflect real differences in experiences or differences in measurement and biases in perception.

The four identified direct measurement studies (three in Canada and one in the Czechia) found average food waste of 47 kilograms per capita per year, of which 21 kilograms per capita per year was "avoidable" food waste, composed primarily of edible parts. This is significantly lower than the average household food waste estimates in the present report (section 2.5). However, in the two studies with statistically significant results, the authors observed no significant *change* in the generation of total food waste, although it appears that a greater share of the waste under COVID-19 was "unavoidable" (i.e. inedible) than before the lockdown. As a result, Everitt, van der Werf and Gilliland (2023)primarily collected through surveys. The average total amount of household food waste generated during COVID-19 was 0.91 kg per capita per week. Average avoidable food waste generation was 0.40 kg per capita per week and average unavoidable food waste generation was 0.51 kg per capita per week. Fruit and vegetables were the most wasted types of food. Only five studies reported statistically significant changes (actual or perceived conclude that the COVID-19 pandemic "has probably not had a considerable impact on total household food waste generation."

2.5 Food waste amounts: measured estimates and extrapolation

In addition to evaluating national food waste datapoints, the Food Waste Index aims to estimate food waste for countries where there is no robust data available. The extrapolation of estimates to countries without data is described in the methodology (section) and in more detail in the Appendix.

Food waste estimates by country income level

Table 18 presents the average (mean) food waste, per capita, per year, in each of the World Bank income classifications for each sector. Note that this is the simple mean of the country estimates in that group, rather than the weighted average of the total waste in that group – that is, it does not account for different population sizes in different countries. For example, the estimated figures for China and the Dominican Republic have equal weight in the upper-middle income average, despite substantial population differences. The worldwide total, weighted by population sizes, is provided later this section.

As in the *Food Waste Index Report 2021*, there is insufficient data coverage and quality to confidently report the average food waste in any sectors in low-income countries, nor food service or retail in any countries other than high-income ones.

Table 18: Average food waste (in kilograms per capita per year), by World Bank income grouping

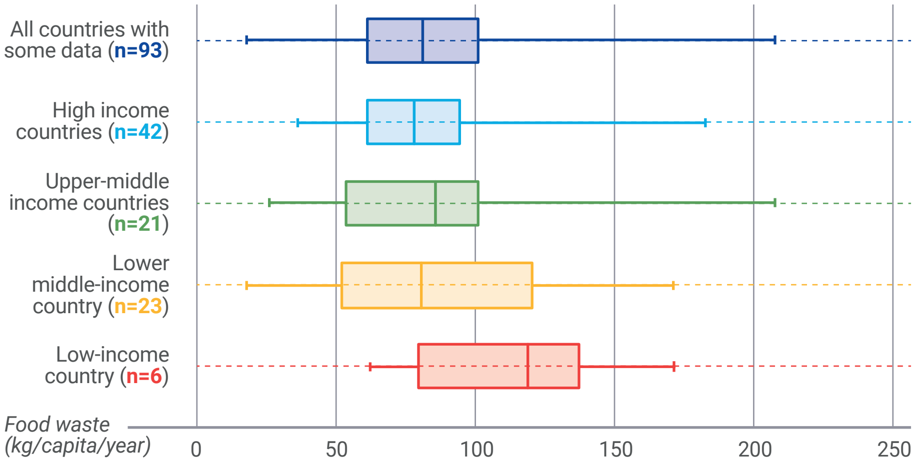
INCOME GROUP	HOUSEHOLD	FOOD SERVICE	RETAIL
High income countries	81	21	13
Upper-middle income countries	88	*Insufficient data*	
lower-middle income countries	86	*Insufficient data*	
Low income countries	*Insufficient data*	*Insufficient data*	

For extrapolation purposes at the household level, low-income countries used an average from the six low-income countries with datapoints in addition to estimates from lower-middle income countries. This came to 91 kilograms per capita per year. Due to the low coverage of low-income countries, more research is needed to understand how much food waste there is, and its causes.

In the three income groups with sufficient data coverage in the household sector, the average (mean) waste is remarkably similar, between 81 and 88 kilograms per capita per year. This range of 7 kilograms per capita per year is a variation of just around 128 grams per person per week.

Figure 16 presents the median and interquartile range of country-level estimates, where there is data informing them (i.e. *medium confidence, high confidence* classification and Eurostat estimates only) by income group. This further demonstrates the substantial convergence in the average estimates of different income groups, although the interquartile range (middle 50 per cent of estimates) gets progressively larger when moving from high income to upper-middle income and lower-middle income groups. In all income groups, substantial ranges are observed, with some countries being outliers (which may in some cases be driven by a single anomalous datapoint).

Figure 16: Box-plot distribution of high confidence and medium confidence household food waste estimates for countries



The increased variation in upper-middle income and lower-middle income countries, likely driven by individual datapoints, further demonstrates the importance of robust, representative national measurement to develop more accurate estimates for those countries.

On average, levels of household food waste (the total of edible and inedible parts) are similar for high income, upper-middle income and lower-middle income countries.

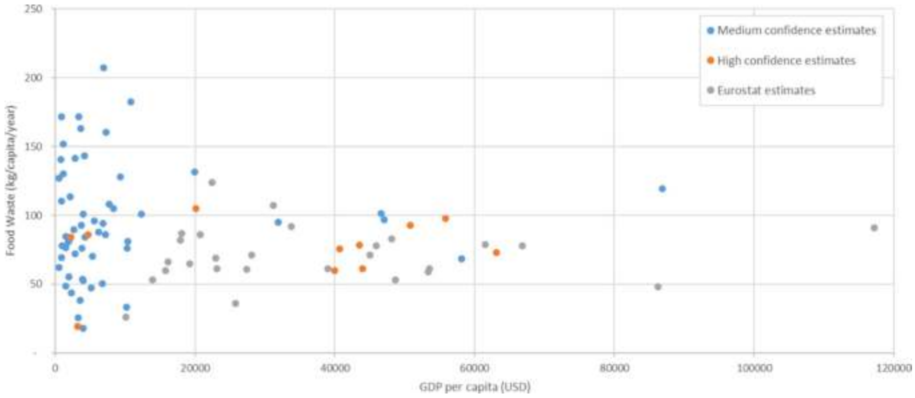
A major caveat is that these studies mostly do not separate edible and inedible parts of food waste, so the types of waste may be different among different income groups. Additional research that disaggregates *within* food waste is necessary to understand how much of this waste could have been eaten (see section 3.3 for guidance on how to measure this). What is known about edible parts is discussed below.

With the amount of data included having nearly doubled since the *Food Waste Index Report 2021*, the conclusions drawn in that report are reinforced rather than refuted by these findings, allowing the household conclusions to be drawn with greater confidence.

The *high confidence, medium confidence* and Eurostat-reported country estimates were correlated to gross domestic product (GDP) per capita (Figure 17). As in the *Food Waste Index Report 2021*, the only observable relationship is one of greater variation at lower income levels, with no discernible increase or decrease in household food waste as income levels rise. This could be due to a genuine wider variation of food waste in lower-income countries, or an artefact of the studies measuring food waste (e.g. smaller sample sizes leading to more variability in the measured value).

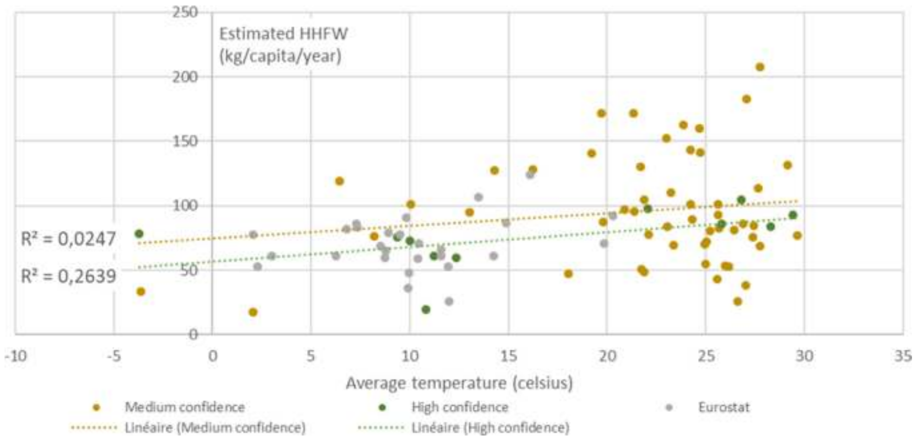
Plotting *medium confidence* and *high confidence* estimates, and Eurostat-reported estimates each separately, would reinforce this. The greatest variability is observed in *medium confidence* estimates, which are typically those measured among a small sample within a particular subnational region, such as a single city at a single point in time.

Figure 17: Relationship between household food waste and GDP per capita and year



If there is no observable relationship between income and food waste, perhaps there is one between climate conditions and food waste? To test this, the *high confidence*, *medium confidence* and Eurostat-reported figures were plotted against average country temperature.[14] Figure 18 shows the outcome of this. Caution is needed not to over-interpret this graph: the uncertainty in the country food waste estimates (especially the *medium confidence* estimates) is substantial, and this analysis does not control for any other possibly confounding factors.

Figure 18: Correlation between household food waste measurements and average temperature in country



As shown in Figure 18, a slight positive relationship was observed between the average temperature and estimated per capita household food waste, in both *medium confidence* and *high confidence* datasets. This relationship does not seem to be driven by levels of economic development: grouping the data by World Bank income classification rather than confidence classification still returns a slight positive relationship in high income, upper-middle income and lower-middle income countries. Only low-income countries did not observe this relationship, but data coverage in low-income countries is low, so this may reflect an absence of reliable data. The inconsistency in data quality and coverage means statistical inferences cannot be drawn with any confidence, but this is a relationship worth further exploration.

14 Taken from https://tradingeconomics.com/country-list/temperature

There are multiple possible explanations for why hotter countries could have higher rates of household food waste. It could reflect higher rates of cooking from scratch, which result in a higher inedible share. It could reflect the types of food consumed, such as heavier basic starch products wasted on a regular basis, or locally available fruits and vegetables. If more foods with thicker skins, and therefore heavier inedible wastes, are consumed in warmer countries (fruits such as bananas, pineapple and durian, for example) this could lead to more waste. For foods consumed globally, they may become spoiled or inedible sooner in hotter than in colder countries.

It could also be a reflection of access to infrastructure such as household refrigerators, or cold chain facilities throughout the supply chain, which impact the state in which food is received by the household. It could even be a result of higher tourism rates, although this may be intuitively expected to impact food service more than household waste. These are speculative suggestions: robust, national data gathering across more countries will ensure that there is greater confidence in comparisons. More analyses looking at the types of foods wasted and the causes of food waste are necessary to understand these dynamics.

There appears to be a slight positive relationship between average country temperature and amounts of household food waste. More research quantifying the amounts of food waste, the types of foods wasted and the causes of waste are needed to further investigate this.

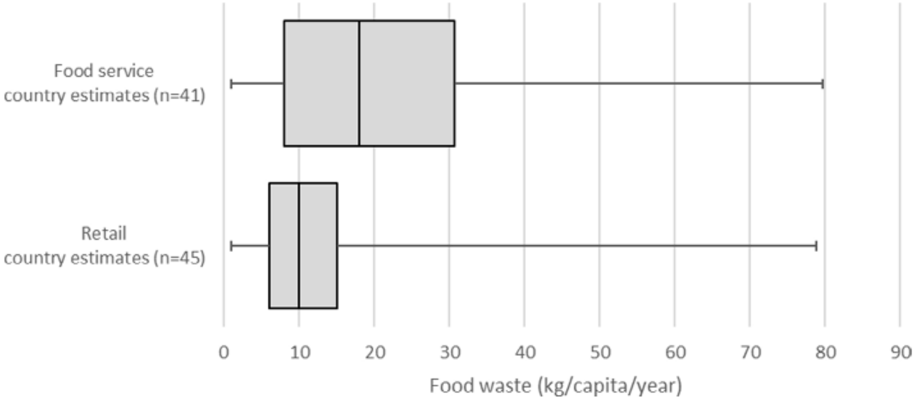
It is important to note that the Food Waste Index tracks *total food waste* – that is, food and its associated inedible parts. As was highlighted in the *Food Waste Index Report 2021*, and remains the case here, there are insufficient estimates in low- and middle-income countries that disaggregate between edible and inedible parts in order to make meaningful comparisons among countries or regions. What is known from the existing data is discussed below. Understanding how much food waste could have been suitable for human consumption is important for policymakers to consider how to best address food waste, and balancing efforts between prevention and circular uses of less commonly eaten and inedible parts. More research is needed to understand this split and to report it as part of SDG indicator 12.3.1(b). Guidance on measuring edible parts is provided in section 3.3.

Increase measurement efforts globally to disaggregate estimates of food waste into edible and inedible parts.

The data coverage in the food service and retail sectors was much more uneven and was concentrated in high-income and upper-middle income countries. Comparing country estimates with some data informing them (i.e. the *high confidence* and *medium confidence* estimates, and Eurostat data) the median food service waste is nearly double that of retail (Figure 19). In both cases, substantial variability was observed within the estimates. Due to the inconsistent data quality and coverage, at this point in time it cannot be stated with confidence whether the differences observed between countries are real differences, or rather reflect differences in methodology and scope.

As discussed in section , the diversity of subsectors in both food service and retail reduces comparability, as a country that includes more subsectors in its measurement is likely to have higher wastage overall. As a result, as more countries measure a greater range of subsectors in the future, it is likely that the expanded scope of measurement will lead to higher food waste estimates. To make more robust comparisons in the future, transparency and consistency about which sectors have been included and which have not will be important. Different subsectors and how to prioritize them in measurement studies is discussed in chapter 3.

Figure 19: Box-plot distribution of high confidence and medium confidence food service and retail estimates for all countries



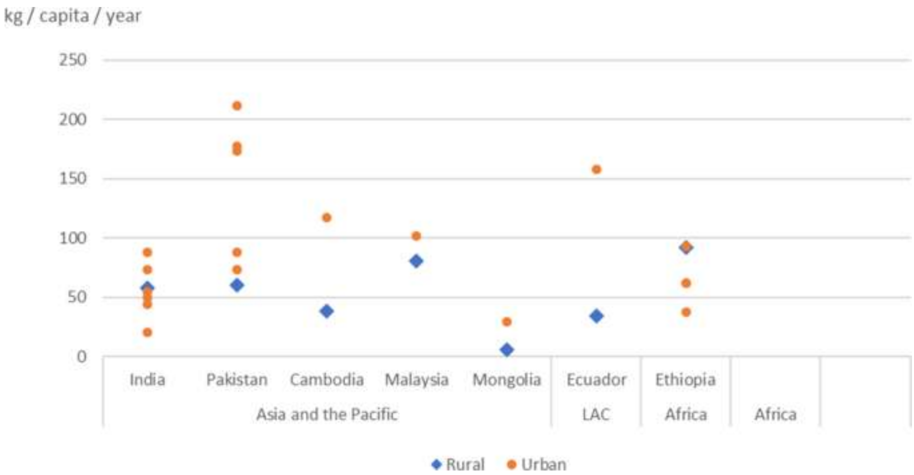
> **Improve the quality and comparability of food service and retail estimates through clear, transparent documentation of which subsectors are – and are not – covered by an estimate.**

Urban-rural split

There are 194 datapoints for household food waste estimations included in the dataset, of which 145 (75 per cent of the dataset) are from subnational studies. These were classified by type of region, as best as this was able to be discerned from information presented in the papers. Studies in urban areas make up the majority of subnational household food waste estimates, with 115 datapoints. Just 8 datapoints are from identified rural areas, along with 31 from mixed regions and 4 from suburban areas.

Seven countries have estimates from both rural and urban areas: Cambodia, Ecuador, Ethiopia, India, Malaysia, Mongolia and Pakistan, representing three regions (Asia Pacific, Africa, and Latin America and the Caribbean). Figure 20 shows the rural and urban estimates for household food waste in subnational studies for these countries. For countries that have just one urban and one rural estimate, the rural figure is consistently lower. In countries with one rural and several urban datapoints, there is more variation; the rural datapoint in Ethiopia is equal to the highest urban estimate, and the rural Indian estimate is slightly above the average of the urban datapoints, with Pakistan having the rural datapoint as the lowest of those identified.

Figure 20: Household food waste estimates (kilograms per capita per year) for countries with both rural and urban datapoints



This would suggest that, in middle-income countries, there may be variation between urban and rural populations, with rural populations wasting less, although in some cases the difference is quite small. Differences in the studies – different locations, years, seasons, sample sizes and so on – make accurately quantifying this difference challenging, and statistical inferences may not be possible until there is more confidence in the consistency of data. There is enough, however, to suggest that further study, including disaggregation of rural and urban estimates in national studies, is worthwhile. Similarly, few of the considered studies explicitly looked at the causes of high or low food waste, so more research is needed to form a deeper understanding of the drivers at play.

One possible cause of lower food waste in rural areas is the practice of feeding scraps to animals. The study in Khishig-Undur, Mongolia noted that it is "very common to give vegetable peels to livestock" (Guerber and Gursed 2021). Similarly, a nationwide waste audit in Bhutan, assigned a *high confidence* rating, suggested that in "rural areas where there are no waste collecting facilities […] they use food wastes as either animal food or dumped in vegetable gardens directly" (Bhutan National Statistics Bureau 2021). A study among the Orang Ulu indigenous peoples in Sarawak, Malaysia suggested that "food waste was mostly composed of vegetable stalks, fruit and vegetable peelings, and a little rice residue, which they would eventually use as their rearing and pets' food," with some food wastes "also used as fertilizers" (Kulleh and Manaf 2023).

What is particularly interesting about the Orang Ulu example is that the measurement was taken *before* the wastes were sent to their final destination. Therefore if residual food waste had been measured after scraps were fed to animals (as is usually the case), rural food waste would have been even lower, compared to urban areas. In this Malaysia study, in reporting under the Food Waste Index, surplus going to animal food or feed would be removed. The resulting estimate (81 kilograms per capita per year) is close to the average food waste observed globally. This would suggest that in rural communities, it may not be that food surplus is *avoided* through food preparation practices, rather that the ways of managing food scraps are more productive.

Food waste is an urban issue. With more than half of the global population now living in urban areas, the role of local governments in tackling food waste is expected to only increase in the coming years.

However, productive use of the scraps and food loss may not be widespread in all rural areas. The Iramba District in Tanzania, defined as a "mixed" area due to urban and rural inhabitants, had the highest per capita estimate of food waste in the dataset, believed to be due to the post-harvest losses generated by households engaged in agriculture without adequate recovery activities (see section 2.4 on "Africa"). This is a crucial point: a circular economy for food includes using surplus food generated for productive applications including feeding animals or biomaterial processing, and recycling whatever is left to recover nutrients to the soil. This may be already working more effectively in some rural communities and is worthy of further investigation.

In the cases of small family farms, composting may also play a role in reducing the amount collected, and additional research to understand home composting in line with Level 3 of the Food Waste Index may be necessary (see section 3.4). Increased access to local and environmentally preferable landfill alternatives such as composting and feeding scraps to animals is likely to have an impact on food waste data in rural areas, while it is not known whether cooking and preservation practices also play a role. Additional research may be beneficial to unpack differences between food waste generation and management in urban and rural areas, and how food waste solutions can be targeted accordingly.

Countries developing new studies or with existing nationwide estimates should, where possible, present information on food waste generation, causes and management practices in rural and urban communities separately. Circular approaches to food surplus, tailored to specific urban and rural populations, is likely to be a key opportunity to reduce food loss and waste.

Edible-inedible split

Disaggregating food waste between the share that is edible or inedible is important for developing a greater understanding of why food waste occurs and what can be done about it. Edible food is sometimes considered "avoidable" through business and consumer action, whereas addressing "inedible" food may take more work. This could include changing social norms around what is considered "edible" or "inedible" to make more of less commonly used parts (certain skins, seeds, offal, etc.). Alternatively this may involve improved food waste management practices to generate feedstocks that can used to keep food in the supply chain, for example helping to generate safe animal feed and other "circular" approaches.

Data on food waste is therefore important for directing policy initiatives and consumer interventions. Edibility is culturally determined rather than universal, and an item that is "edible" in one context may not be in another. Guidance is provided in section 3.3 on how to develop classification criteria in a given country.

Some datapoints included in the *Food Waste Index Report 2024* include data on the share of that waste considered edible. A summary of these estimates is in Table 19. Note that this will not be exhaustive of all edible/inedible estimates worldwide; there are many European countries that also have this data, but this was not included in the Eurostat data used to represent European countries in this report.

Table 19: Summary of the share of food waste considered "edible" in cited studies

COUNTRY	SOURCE	EDIBLE SHARE (%)
Brazil	(Gilbert and Ricci 2023)	31%
Indonesia	(Higgins and Harris 2022)	34% average (21% - 47% range over 6 datapoints)
Israel	(Elimelech, Ayalon and Ert 2018)	54%
Japan	(UNEP 2023)	33%
New Zealand	(Sunshine Yates Consulting 2018)	49%
Switzerland	(Beretta and Hellweg 2019)	77%
United Kingdom	(Devine *et al.* 2023)	71%

As can be seen, there is a substantial variation between the lowest (31 per cent) and highest (77 per cent) estimate. The small number of studies means that robust conclusions about differences between countries cannot yet be formed, but it is notable that the two upper-middle income countries (Brazil and Indonesia) had a lower "edible" share than most high-income countries (with the exception of Japan, which has been actively engaged on food waste reduction for a long time).

As well as income level, variation may be driven by food purchase and production practices. This is further backed up by descriptive evidence from Bida town, Nigeria (Saidu, Musa and Akanbi 2022) in which comparisons were made between "traditional" and "modern" areas. The modern areas had lower shares of food waste, which the authors suggest could be due to using more processed food materials than those traditional areas, which cook from scratch and therefore produce larger quantities of (partly inedible) waste. The high "edible" share in some high-income European countries such as the United Kingdom and Switzerland may be partly explained by consumption of more processed products.

In addition to direct measurement of the edible and inedible shares, in some cases measurements were undertaken with other specific categories from which approximate edible and inedible shares could be inferred. Due to definitional uncertainty, these are indicative and approximate only, but do provide some insights.

In one study in Malaysia (Watanabe 2012), food waste was split into three categories: "unused food," defined as being at least half of a whole item, which can be assumed to be primarily edible, "big fruit peels/core," which can be assumed to be primarily inedible, and "general food waste," which is likely to be a mixture of edible and inedible wastes. The results of this are shown in Table 20.

Table 20: Food waste categories applied in Watanabe (2012) in Malaysia, and the assumed edible/inedible composition

UNUSED FOODS	GENERAL FOOD WASTE	BIG FRUIT PEELS/CORE
Likely edible	Mixed edible and inedible	Likely inedible
18%	58%	24%

Source: Watanabe 2012.

In two studies from Latin America, waste is separated into "*restos vegetales*" (plant/vegetable remains), defined in one study as being legumes and fruit peels from the kitchen (Auquilla 2015). In both cases, a separate category for garden waste was quantified, meaning that the plant remains were likely kitchen-based. A separate category, "*restos de cocina*" or "*residuos de comida*" (kitchen/food waste) was also included. We can assume that plant/vegetable remains were primarily inedible, or at least purposefully removed from preparation, even if edible. The kitchen/food waste category is more uncertain and is likely to be a mixture of edible and inedible wastes. In both cases, the likely inedible plant/vegetable scraps were up to around one-third of the waste (Table 21). This suggests that scraps alone do not account for most of the waste, and measurement which disaggregated within kitchen/food waste to better understand the edibility of what is being wasted would be beneficial.

Table 21: Disaggregation within food waste categories in two studies

SOURCE	COUNTRY	KITCHEN/FOOD WASTE	PLANT/VEGETABLE WASTE
(Auquilla 2015)	Ecuador	73%	27%
(Sánchez et al. 2014)	Venezuela	67%	33%

Note: The Venezuelan estimate is calculated from the raw data in Table 1 and 2 of the cited publication.

Countries conducting measurement studies of food waste should disaggregate into the edible and inedible parts, to help prioritize food waste reduction activities. Reducing food waste, redistributing surplus, and more equitable distribution of the food already produced should be understood as crucial instruments for alleviating food insecurity worldwide.

The precise amounts that are edible or inedible will require much more data from a range of countries to accurately estimate. With the data summarized in Table 19, a rough approximation of the minimum amount of edible food waste can be derived. If it was assumed that worldwide, only 25 per cent of all food waste was "edible" parts – a very conservative estimate, as it falls below *all* of the measured estimates in Table 19 – as much as 158 million tonnes of edible food was wasted in households in 2022. In reality, it is likely to be much more than that, perhaps even double.

Assuming that the average meal weighs 420 grams (WRAP 2020b), then the equivalent of 376 billion meals of edible food is being disposed of in households alone each year. In other words, this amounts to more than 1 billion meals wasted worldwide per day. If 783 million people were impacted by hunger in 2021 (FAO 2023a), this amounts to 1.3 meals for each of those people being wasted every day, as a conservative estimate. This is further demonstration of the key role that food waste reduction can have in reducing food insecurity worldwide.

Food waste estimates by region

For the purposes of forming Level 1 estimates, income-group averages were combined with regional averages. These regional averages can be viewed in Table 22, presented alongside the number of countries informing the estimate, to assess the level of robustness.

The methodological differences of datapoints and inconsistent coverage of data requires that any comparisons are taken with substantial caveats. As most countries are still in the process of developing food waste estimates, it will be a number of years before sufficient numbers of robust country estimates exist. There may be many other factors that explain the relationships observed, including dietary habits, access to refrigerators and consistent electricity, logistics and distribution infrastructure, country average temperature and so on. It is only with more, consistently measured and nationally representative studies that more accurate comparisons can be made.

Table 22: Average household waste (kilograms per capita per year) in each region, derived from studies

REGION	NUMBER OF COUNTRIES WITH ESTIMATES INFORMING AVERAGE	AVERAGE HOUSEHOLD WASTE GENERATION
Northern Africa	3	140
Sub-Saharan Africa	14	93
Latin America and the Caribbean	10	95
Northern America	2	76
Central Asia	0	N/A
Eastern Asia	5	70
South-eastern Asia	8	70
Southern Asia	7	100
Western Asia	9	116
Eastern Europe	6	53
Northern Europe	9	69
Southern Europe	8	83
Western Europe	7	80
Australia and New Zealand	2	79
Melanesia	2	92
Micronesia	1	38
Polynesia	0	N/A

Due to the scarcity of data in food service and retail, the averages are not presented. Section 2.4 provides greater discussion on data availability in specific regions.

A list of all of the household estimates is provided in Annex 2 of this report (Table of datapoints), with a separate Appendix including all sectors.

Global estimates

As food waste has been estimated for every country in the world using the per capita figures and United Nations population statistics for 2022 (see section), these can be added together to obtain a global estimate of food waste. This combines the findings in countries with some data, and estimates based on extrapolations for countries without primary data.

Although advanced manufacturing is captured as part of the Food Waste Index, and countries should measure and report this to UNEP, there is currently insufficient evidence for reporting this here. As a result, a substantial quantity of food loss and waste generated in manufacturing is not accounted for in the estimated global figures.

The results indicate that 1.05 billion tonnes of food were wasted across the three sectors considered in this report in 2022 (Table 23), equal to 132 kilograms per capita per year. Around 60 per cent of this waste comes from households, 28 per cent from food service and 12 per cent from retail.

Table 23: Estimates of global food waste in 2022

	GLOBAL AVERAGE (KG/CAPITA/YEAR)	2022 TOTAL (MILLION TONNES)
Household	79	631
Food service	36	290
Retail	17	131
Total	**132**	**1 052**

The *Food Waste Index Report 2021* estimated that in 2019, 931 million tonnes of food waste were generated across the household, food service and retail sectors, with a per capita average of 121 kilograms per capita per year. **At this point in time, the change between that estimate for 2019 and this estimate for 2022 are not believed to represent a real increase in food waste per capita.** This applies both for individual country estimates and the aggregated totals.

The low certainty in most country estimates – driven largely by the lack of consistent, nationwide estimates – means that changes in the estimates for any particular country do not indicate that food waste has changed in that country. Rather, it is likely that the addition of more data gets us closer to an accurate estimate for that country. In particular, the uncertainty in the retail and food service sectors means that little can be said about those sectors on a global basis until more widespread data is available. The exception is in a small number of countries that have consistent time-series data – such as Japan, discussed in section 2.4.

The increase in global population between 2019 and 2021 means that total food waste would be expected to increase, even if per capita waste remained the same across time. SDG indicator 12.3.1(b) is measured on a per capita basis for this reason. The addition of estimates for countries without World Bank income classification, not estimated in the *Food Waste Index Report 2021*, further reduces comparability between the two years.

The household estimate is the most robust, due to considering 194 datapoints, representing countries with 85 per cent of the world population. Despite nearly doubling the total datapoints and the number of countries covered, the average household food waste per capita remains significantly above the average mass of an adult human (62 kilograms on average, from Walpole *et al.* (2012)). Note that, unlike the regional and income group estimates discussed earlier in section 2.5, this global average is weighted to account for the population sizes in different countries. The estimates for the food service and retail sectors are highly uncertain due to the smaller datasets, which are concentrated in high-income countries: much more work is required to develop a more complete understanding of global food waste in these sectors. Similarly, manufacturing not covered under the Food Loss Index, such as advanced manufacturing where multiple products are combined, is currently not able to be estimated, so there is additional food loss and waste not being accounted for here. Measuring of manufacturing is discussed further in chapter 3.

To improve the estimates of food waste – both globally and at a country level – more countries need to conduct national measurement studies across the supply chain and in households, using accurate methods and representative samples, following the methodologies outlined in chapter 3.

In all cases, confidence should not be overstated. Although household coverage is good, and is improved from the *Food Waste Index Report 2021*, most estimates come from small, subnational studies with limited samples. Most of these studies were conducted in urban areas: as discussed earlier, urban food waste *may* be systematically higher on a per capita basis than rural food waste. If this is the case, national estimates formed from primarily urban data may overstate the amount of food waste in many countries, and therefore total food waste could be overstated. These global estimates can only be tested and, if necessary, corrected, by the measurement and reporting of accurate, national studies in line with the methodologies in chapter 3.

The global totals estimated here can be compared with the amount of food available for consumption from FAOstat. Following the same approach outlined in the *Food Waste Index Report 2021*, the latest available data on "food" available for consumption was taken from FAOstat.[15] This was for the year 2020, and amounts to 5.5 billion tonnes. Comparing the total amount of estimated food waste here would suggest that as much as 19 per cent of food that reaches the consumption stage is subsequently disposed by retailers, food service and households.[16]

15 See "Food Balances" dataset, "Food" indicator at ***https://www.fao.org/faostat.***

16 The Food Waste Index Report 2021 estimated this as 17 per cent. As with the total estimates of food waste, the increase in share of "food" wasted from then is not believed to represent a real increase in waste, rather an increase in the accuracy of the estimate.

03 Index Levels 2 and 3: measuring food waste at the national level

A central objective of the Food Waste Index is for countries to measure and report food waste, allowing progress to be tracked in line with the SDG target 12.3. Levels 2 and 3 of the Food Waste Index refer to direct measurements of food waste in the relevant country and time frame, rather than to proxy data. Such measurements can form national baselines against which to track progress, and can inform food waste reduction strategies.

The Level 1 estimates presented in chapter 2 are not country baselines. Level 1 estimates provide an indication of the scale of food waste in a country and are therefore useful for making the case for action. However, modelling and extrapolation are insufficiently accurate for a country to track its food waste over time, and rarely provide a level of detail sufficient to enable policymakers to make key strategic decisions about how to prevent food waste in that country. In some countries, direct measurement of food waste is reported in the Level 1 estimates ("high confidence" estimates). In these cases, the evidence from those publications or research may be suitable for reporting to UNEP as a country baseline or update on progress.

3.1 Overview of data collection

To report on SDG indicator 12.3.1(b), "Food waste index," countries will fill out a separate table of the UNSD/UNEP Questionnaire on Environment Statistics (waste section). A pilot data collection was organized by UNEP in early 2023. The information requested and format of the questionnaire are presented in Figure 21.

Figure 21: Example of UNEP data capture form from 2023 pilot exercise

Table F1: Food Waste Generation and Management

Line	Category	Unit	2005	F	2006	F	2007	F	2008	F	2009	F	2010	F
1	**Total food waste generated (=2+3+4)**	tonnes												
2	*Amounts generated by:* Retail trade, except of motor vehicles and motorcycles (ISIC 47)	tonnes												
3	Food Service (ISIC 49-52, 55, 56, 84, 85)	tonnes												
4	Households	tonnes												
5	**Total food waste generated: edible parts (=6+7+8)**	tonnes												
6	*Amounts generated by:* Retail trade, except of motor vehicles and motorcycles (ISIC 47)	tonnes												
7	Food Service (ISIC 49-52, 55, 56, 84, 85)	tonnes												
8	Households	tonnes												
9	**Total food waste treated or disposed of (=10+11+13+14+15+16)**	tonnes												
10	*Amounts going to:* Codigestion / anaerobic digestion	tonnes												
11	Composting / aerobic process	tonnes												
12	*of which:* by households	tonnes												
13	Incineration / Combustion	tonnes												
14	Landfilling	tonnes												
15	Sewer	tonnes												
16	Other, please specify in the footnote	tonnes												
17	**Food loss generated at Manufacturing level**	tonnes												

Lines 1–4 refer to Level 2 estimates as outlined in the *Food Waste Index Report 2021*. These estimates involve direct measurement of food waste, which is sufficiently accurate for tracking changes at a national level. This data is the highest priority for reporting on SDG indicator 12.3.1(b). If a country can gather only a very limited amount of data, it should aim to gather data for these sections.

Lines 5–8, 9–16 and 17 refer to Level 3 estimates as outlined in the *Food Waste Index Report 2021*. They provide additional information to complement the total food waste arisings estimates (lines 1-4), including:

- Lines 5–8: the amount of "edible" food waste, by sector
- Lines 9–16: The destinations for disposal or treatment of food waste
- Line 17: Food losses generated at the manufacturing level not captured by the Food Loss Index, which focuses on the top ten commodities in each country.[17]

The remainder of this chapter explores the data requirements for each of these questionnaire categories in turn.

*17 Food loss covered by the Food Loss Index (FLI) includes losses along the food supply chain from the farm up to (**but not including) the retail stage**. As the FLI focuses on loss rates for the top ten commodities in a country, other manufacturing including advanced manufacturing (such as combining multiple products) is not captured there. As an important source of food loss and waste in some countries, data on other manufacturing sectors can be reported to the Food Waste Index, while still being termed "losses" as they occur prior to the retail stage.*

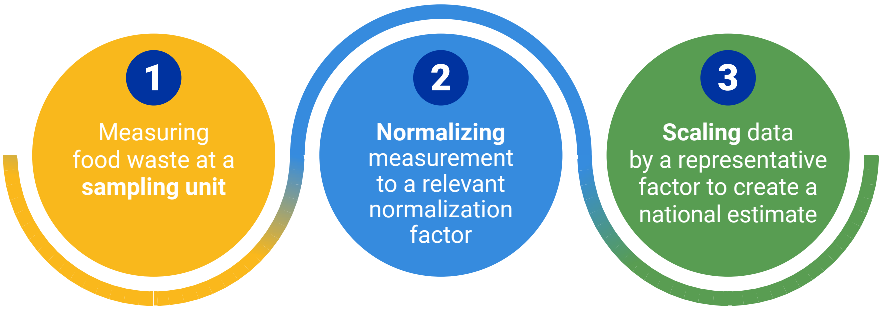
3.2 Measuring total food waste generated

This section explores how countries should measure and report the total food waste generated, by sector, allowing progress to be tracked in line with SDG indicator 12.3.1(b) ("Level 2"). It expands on the information provided in the *Food Waste Index Report 2021*, with additional guidance on sampling, measuring and scaling data in each sector. Some important principles around measurement, sampling and scaling that are applicable to all sectors are discussed in general terms first, before each sector is discussed with additional detail and examples.

Stages to form a national estimate

There are three broad steps to forming a national food waste estimate that is applicable to all sectors. These are summarized in Figure 22.

Figure 22: Common process for adjusting food waste measurements to form national estimates



Firstly, food waste needs to be **measured.** This measurement is done at a level called a **sampling unit.** This refers to the entity within the population from which food waste is measured. It could be, for example, an individual, or a household, market or restaurant through which food waste was collected, for example during a waste composition study. It could even be at the level of a grocery chain that measures and reports the waste generated in its own activities.

Secondly, this measurement is **normalized** by a **normalization factor.** This refers to the process of dividing the measured food waste by a relevant factor which can be used for scaling. It is therefore closely related to the third step, **scaling** to a national estimate, and should be conducted with the data required for scaling information in mind.

Box 7: Example of sampling units, normalizing and scaling

In households of multiple people, waste is typically collected at the level of a single household residence. If measuring household food waste, the **sampling unit** is likely to be the household. After food waste has been measured at this level, the total number of people in each of the households sampled can be used to **normalize** the measurement to the amount of waste per person for a particular time period. If the sampled households were representative of the wider country, these normalized "waste per capita" figures can be **scaled** using population statistics to form a national estimate of the total amount of waste generated by the total population in a year.

This process may be repeated multiple times for multiple territories or subsectors, with the final figures added together. In such cases, particularly in retail and food service, the measurement method, normalization factor and scaling factor **do not** need to be the same across all subsectors.

In many cases, it will be necessary for all three steps to be carried out for a new food waste measurement study. In cases where there is already existing research quantifying measurement at the level of a city, business, or subsector, it may be the case that only the second and third steps (normalizing and scaling) are required. The Level 1 analysis (chapter 2) includes a summary of known existing research in each country.

The remainder of this section describes important principles relevant to the three steps.

Quantification frameworks

There are two broad "frameworks" for quantification in the sectors involving businesses: manufacturing, retail and food service.

Firstly, specific studies can be conducted on business food waste. This could include the commissioning of new studies or using existing studies recently conducted by researchers in universities or consultancies. The outcomes of such studies would follow the three steps outlined in Figure 22. This is generally the preferable approach in smaller, less consolidated subsectors such as small, independent retailers or food service businesses.

The second framework is for businesses to record their own waste. This would involve the reporting of food waste by retail and/or food service businesses on a voluntary or mandatory basis. It is most applicable in sectors that are highly consolidated – that is, with a small number of big businesses controlling a large share of the market (as may be the case in supermarket retail or some food service sectors). Gathering data this way would require guidance for businesses to support their measurement, minimum threshold quality standards for how the measurement is conducted (such as following the methodologies in Table 25) and necessary enforcement to ensure the quality of the evidence gathered. Businesses measuring their own waste may follow the three steps outlined in Figure 22 within their own operations. Data gathered this way may still be subject to the second and third steps to scale to a national estimate, such as based on the market share of the reporting businesses.

Business-reported waste may be useful in reducing the costs required to conduct separate measurement studies in those establishments. For business-reported data to be used directly for national estimates by scaling up their data, it is recommended that the reported data represents at least 50 per cent of the subsector in question, as businesses reporting food waste are more likely to be involved in food waste prevention than those not reporting, leading to possible unrepresentativeness of the wider industry.

The approaches are not mutually exclusive, and both may be applied in different subsectors. For example, canteens in schools or hospitals that are government funded could be required to measure food waste, whereas independent restaurants may be better reached by commissioning studies, but the results of both approaches would contribute to the overall "food service" estimate.

Some advantages and limitations of each approach from the perspective of national government reporting are summarized in Table 24.

Table 24: Comparison of two "frameworks" for quantification in businesses from the perspective of national governments

	INDIVIDUAL STUDIES BY RESEARCHERS	BUSINESS SELF-MEASUREMENT
Potential benefits	Accurate estimates. Information available by subsector. Other useful data may be obtained. Leveraging existing work or research funding may reduce costs.	Low-cost method for obtaining data. Measurement may be relatively continuous. Measurement can be an important precursor to food waste prevention and engaging businesses.
Potential limitations	Expensive if commissioning studies. Relying on secondary data may lead to methodological variability and out-of-date estimates. Measurement in "snapshots" of time unless regularly conducted.	Mandatory reporting involves placing costs on businesses, which may be politically challenging. Public-private partnerships take time to establish and require high market coverage for tracking. Requires businesses to measure accurately, so data quality is uncertain.
Circumstances when suitable for tracking	Frequent studies with sufficient sample size required.	If measurement is sufficiently accurate and covers enough of the sector.

Measurement methods

For each sector, a method (or multiple methods) should be chosen to obtain food waste estimates that are sufficiently accurate for tracking over time. Other information could also be obtained at the same time to help a country in reducing food waste (for example, obtaining information on the types of food that are most frequently thrown away and the principal causes can support the development of a food waste prevention strategy).

Table 25 provides appropriate methods for different sectors; countries can use these methods, a combination of them, or any other method equivalent in terms of relevance, representativeness and reliability. These methods are also relevant for individual businesses, municipalities or other stakeholders looking to measure their waste in a way that could be beneficial for SDG 12.3 reporting.

Table 25: Appropriate methods of measurement for different sectors

<table>
<tr><th>SECTOR</th><th colspan="6">METHODS OF MEASUREMENT</th></tr>
<tr><td>Manufacturing (if included)</td><td rowspan="4">Direct measurement (for food-only waste streams)</td><td rowspan="4">Waste composition analysis</td><td rowspan="4">Volumetric assessment</td><td rowspan="2">Mass Balance</td><td></td><td rowspan="2"></td></tr>
<tr><td>Retail</td><td rowspan="2">Counting / scanning</td></tr>
<tr><td>Food service</td><td rowspan="2"></td><td rowspan="2">Diaries (for material going down the sewer, home composted or fed to animals)</td></tr>
<tr><td>Households</td><td></td></tr>
</table>

In addition, questionnaires, interviews and forms can be used to collate existing information, but are not sufficiently accurate for obtaining primary data in these sectors.

An overview of the methods presented in Table 25 is given below, with more detail in the Appendix:

- **Direct measurement:** using a measuring device to determine the mass of food wasted. This could involve weighbridges for collection vehicles or simple scales in a household setting.
- **Waste composition analysis:** physically separating food waste from other material to determine its mass and composition. This can be the most accurate way to gain deeper understanding into the differences in material type (edible and inedible parts) and types or categories of food wasted. Thus, even in a separate food waste stream, this method has some utility to achieve a narrower scope or provide greater detail.
- **Volumetric assessment:** assessing the physical space occupied by the food waste and using the result to determine the mass. In a situation where the entire quantity of food waste is likely to have the same composition, for example a waste stream from commodity processing, the density of that waste is likely to be consistent. Therefore, a value for mass can be determined by applying the density of the waste to the volume it occupies, potentially something like a residue collection vat in the above example. If a container is not completely full, the filling level will be relevant to determine volume occupied.
- **Mass balance:** inferring the amount of food waste (either in total or for one particular destination) by identifying all food-related inputs and all outputs (except for the one being quantified) for a site or sector. The food waste can be calculated by subtracting the outputs from the inputs, adjusting for any changes within the site/sector (e.g. evaporation; dry foods being boiled and absorbing water). This works best in situations requiring minimal adjustment. An example is the estimation of food waste in retail in the United States by the U.S. Department of Agriculture (Buzby et al. 2009).
- **Counting/scanning:** assessing the number of discrete food items that have been discarded and using the result to determine the mass. This could include scanner data or simply counting bags of waste.
- **Diaries:** a log in which quantities of food waste are recorded on a case-by-case basis as they are becoming waste. This can involve weighing or estimation/approximation by the person filling in the log. For example, in a household setting, the diary keeper could log three tortillas or "a handful" of ugali. The average mass of items for such reported measures would need to be used to convert the measure into grams. Diaries are not particularly accurate (see Quested et al. 2020) and therefore are not recommended for situations in which one of the above quantification methods is available (such as food waste present in solid waste streams). However, in some situations – for example, food waste from households being home composted or going to the sewer – they are the only tested method available. Diaries may also present additional useful information, such as on the causes of food waste, the disaggregation into different products and how much was considered to have been "edible," so may complement other methods.

Sampling

The guidance on sampling is primarily relevant for countries conducting new food waste analyses. However, the insights may be useful for municipalities, companies or industry groups interested in generating food waste data that is suitable for SDG 12.3 reporting.

What to sample?

The **sampling unit** refers to the granularity level at which food waste should be measured. Generally, this will be at the level of a discrete, definable entity that has a physical premise. This could be, for example, a household, a housing complex/block of flats (if all households have shared waste disposal), a restaurant, a hotel, a school, a supermarket, a street market, etc.

However, in some cases the sampling unit may be more granular. In food service, for example, sampling individual meals gives a much more detailed insight into waste arisings between customers at the same institution. Businesses may therefore choose a more granular sampling unit.

How to make a representative sample?

Sampled units should be **representative** of differences within a country and sector and different conditions. This includes:

Time-related representativeness: Samples should reflect variation in food purchase, consumption and wasting habits across the days of the week. Samples should therefore be taken across **at least one week.** The sample should also reflect variation across the year, such as different types of food being consumed seasonally, notably cultural/religious celebrations or tourist seasons impacting businesses. Ideally, measurements are spread out across a whole year. At a minimum, **two distinct phases or seasons** should be considered, with the sample split evenly across them.

Geographical and socioeconomic representativeness: samples should include households and businesses across **different geographical regions.** This can reflect different national regions if they have substantial variation. Different levels of urbanity should be considered. Related to both of these factors are income levels of different areas within a country: as a minimum, three **income levels** (low, medium, high) should be considered.

Type of household/establishment: Samples should account for different types of households or establishments present in a country, such as capturing single-family households, blocks of flats and any other notable housing type. It should also capture differences in waste infrastructure, such as between areas with door-to-door household waste collections and those without. Similarly, different types of retail and food service business that reflect ownership (chain, independent), size (small, medium, large) and type (supermarket, bakery, school, café, etc.).

How many units to sample?

The **size of the sample** refers to the number of *sampling units* considered – for example, the number of households, hospitals, schools, supermarkets, etc.

In statistics, as applied in waste sampling more generally, the size of the sample depends on two key parameters: the desired level of accuracy, and the extent of variation between sampling units. The desired level of accuracy will be determined in part by the intended purposes of the figures. For tracking national food waste and progress to SDG 12.3, a 95 per cent confidence interval (±10 per cent) is appropriate. The extent of variation refers to the standard deviation observed in the normalized food waste between sampling units, for example the waste (in grams) per meal compared between establishments or waste (in kilograms) per person in households. These two parameters are combined to calculate the sample size in the following equation:

$$Sample\ size \approx \left(2 * \frac{Standard\ Deviation}{Desired\ 95\%\ Confidence\ Interval}\right)^2$$

The standard deviation (measure of variance in relation to the mean) should, ideally, be informed by existing studies or pilot data collected within the specific sector and country being measured. This may not be practically possible in many cases for countries measuring food waste for the first time. Suggested minimum samples and their reasoning are further detailed in sector-specific guidance below. After initial measurements, data can be reviewed to form a country- and sector-specific sample size for subsequent measurements.

Normalization and scaling

The process of **normalization** helps to make comparisons between sampling units of very different sizes. A household of eight people is likely to have more waste than a household of one person, for example, just as a large canteen is likely to have more waste than a small café, and a hypermarket more than a corner store. Normalization refers to dividing the waste generated at the level of the **sampling unit** by a common factor. For example, dividing the waste generated by a household between the number of people in that household, to get waste per capita, or dividing supermarket waste by the monetary sales of the business to get food waste per unit of sales. Normalization is useful both to better understand where waste arises at different rates and for **scaling**.

Scaling involves the multiplication of **normalized data** by some relevant national statistic. For example, multiplying food waste per capita figures with the total population in a territory can form estimates on the total food waste arisings. Similarly, multiplying "food waste per unit of sales" measured in a sample of supermarkets by the total value of supermarket sales in a country can form an estimate of total supermarket food waste.

The process of normalization and scaling are closely linked. Unless new data can be gathered for the purposes of a national food waste estimate, scaling is likely to be limited by what data is already gathered. Therefore, when normalizing it is important to be mindful of what scaling factors are available so that the data can be effectively used. Potential normalization and scaling factors are discussed in light of particular sectors in following sections.

While this process is discussed with the forming of national food waste estimates in mind, the same principles for sampling, normalization and scaling could be applied within a business. In that case, normalization and scaling will be done by company-relevant data.

Retail

Scope

The scope of the "retail" sector as defined by the UNSD questionnaire refers to ISIC, REV. 4., 47, "Retail trade, except of motor vehicles and motorcycles." The relevant subsectors are outlined in Table 26. These subsectors effectively refer to supermarkets and convenience stores, specialized stores such as greengrocers and butchers, and outdoor markets and stalls respectively. They are all places in which food is sold to consumers.

Table 26: Subsectors within retail sector

ISIC, REV. 4., 47-11	Retail sale in non-specialized stores with food, beverages or tobacco predominating
ISIC, REV. 4., 47-2	Retail sale of food, beverages and tobacco in specialized stores
ISIC, REV. 4., 47-81	Retail sale via stalls and markets of food, beverages and tobacco products
(Retail excludes ISIC, REV. 4., 46-30, Wholesale of food, beverages and tobacco – this is covered under the Food Loss Index.)	

The relative importance of each subsector will depend on the structure of retail sale in a particular country. Generally speaking, supermarket channels (ISIC, REV. 4., 47-11) will be significant for most countries, and measurement is relatively simple do to with scanning of products. In many contexts, markets and stalls (ISIC, REV. 4., 47-81) play a large role in food supply and should be measured. Specialist stores such as butchers and bakers (ISIC, REV. 4., 47-2) may be important in some contexts where they are widespread. Specialist stores have the advantage of relative homogeneity of products, providing opportunities for effective utilization of surplus for feeding people or as an input into food "upcycling."

As a general principle, countries should look to measure and report the largest subsectors in the country and aim for at least 80 per cent coverage of the food retail sector.

Measurement methods

As outlined in Table 25, possibly suitable methods for measuring retail food waste are:

- Direct measurement of food-only bins
- Assessment of the filled volume of food-only bins
- Waste composition analysis for mixed waste streams
- Scanning / counting discrete items, such as by a barcode / QR code (for packaged items)
- Mass balance.

A comparison of these methods and their advantages and disadvantages for estimating the mass of waste is outlined in Table 27.

Table 27: Comparison of measurement methodologies in the retail sector

	ACCURACY OF MEASUREMENT	COVERAGE OF ALL FOOD WASTE IN SECTOR	DETAILED INFORMATION POSSIBLE?	COST?
Weighing	High	Only covers segregated streams	No	Low
Waste compositional analysis	High	High	Yes	High
Volumetric analysis	Often low: estimating volume and bulk density can vary substantially between different food waste streams	Only covers segregated streams	No	Low
Scanning/ counting	High	Only covers countable/ scannable items	Yes	High
Mass balance	Usually low	High	Yes	Low

These methods may be combined with other approaches that seek to answer additional questions, such as the types of foods wasted, the share that was edible, or the causes. For example, weighing of bins could be combined with visual estimation to disaggregate the approximate shares of different food categories. Similarly, a waste compositional analysis may be supplemented with a survey to understand the (perceived) causes of food waste in the business.

Packaging

In some cases, particularly in the retail stage, food may be disposed of in its packaging. This could be wholly unconsumed packaged food, or, in the household and food service sectors, partially consumed packages. The definition of food waste in the Food Waste Index does not include packaging, so it should be excluded from estimates where possible. There are different approaches to removing packaging from estimates. A "hierarchy of options" based on their accuracy is presented in the *FLW Protocol* (Hanson *et al.* 2016) and repeated below.

1. Remove packaging before quantification (most accurate)
2. Subtract estimated packaging weight from each item
3. Subtract estimated packaging weight from waste stream or existing data (least accurate).

The most suitable approach may depend on the approach to measurement and on the packaging in question. Scanning of items against a database including the weight of contents (as is normally labelled on a product) could avoid the need to de-package. Heavier packaging such as glass and metal will generally require greater adjustment than light soft plastics, for example, so efforts can be prioritized to adjust where it is likely to have the most meaningful impact.

Sampling and scaling

In the retail sector, the sampling unit should generally be at the level of a single shop premises, such as a large or small retailer. For street and farmers' markets, this could be at the level of an individual stall or at the level of a whole market, which contains multiple stalls. The appropriate level is likely to depend on the specific market. in a street market that combines retail and food service activities (selling both unprepared produce and prepared food for immediate consumption), sampling at the level of individual stalls may be needed to disaggregate between different business types.

Once the measurements of sampling units have been taken, the next objective is to scale this data to form a national estimate. The most accurate approach would be to normalize the data before scaling. This is important to accurately account for retail environments of different sizes (e.g. corner stores versus hypermarkets).

Which approach is most appropriate will depend on the subsector in question. Scaling by unit of floor space will be more appropriate for supermarkets than market traders, for example. For a normalization factor to be used to scale data, this information is required for the premises that were sampled and in total for the country (Table 28). Different normalization and scaling approaches may be taken for different subsectors and summed for a total estimate.

Table 28: Example of normalization factors and what data would be needed to scale in the retail sector

NORMALIZATION FACTOR	DATA NEEDED FOR SCALING
% of food sold (by net mass)	Net mass of total food sold
Amount of waste per unit of turnover	Total turnover in relevant businesses
Waste per trader, or per employee	Total number of employees in relevant businesses
Waste per unit of floor space	Total floor space in retail
Waste per market or per shop premise	Number of establishments, by type and size

It should be noted that "waste per shop premise" is one potential avenue for scaling. With sampling at the level of retail premises, no further normalization would be needed in this case. However, given the large variability in the size of retail establishments, scaling directly by number of premises is likely to be inaccurate, unless granular data is available on the number of establishments by type and size, which could be used to carefully design a representative sample.

Determining sample size follows the formula detailed in earlier. Ideally, existing data is available to inform the standard deviation in the country in question. If there is no available data, a pilot study of 30 establishments for each subsector of interest is recommended. This will give preliminary food waste data and the standard deviation of datapoints, which is needed to work out if a greater sample size is required or not.

Box 8: Worked example: Retail

A country is looking to establish its retail food waste baseline. In this country, there are two main ways of provisioning: supermarkets and farmers' markets. Supermarkets are open every day, with markets only on weekends. Markets are more common in rural areas.

Firstly, representative samples of each subsector would be designed. This would involve identifying a range of different geographic locations, establishment types and establishment sizes (a large and small supermarket, for example, and a small village market alongside a large city food market). One shop, or one market, may be the sampling unit.

Waste would be sampled in each establishment for at least one business week. For the weekend markets, the "business week" may just involve two days. The approach to measurement may be different in the different subsectors: in the supermarkets, the waste is scanned and counted using product barcodes by the businesses themselves that report this to the government. In markets, collection of the waste from randomly selected stalls within the representative markets and subsequent waste compositional analysis may be needed. Sampling and data gathering would occur across multiple seasons to ensure representativeness of different foods available across the year.

Once measurement has occurred at the level of the sampling unit, the data needs to be normalized. Because supermarkets and markets vary in scale so much, normalization is done by dividing the waste by the turnover/sales or other relevant factor of the sampling units. These are then scaled by national statistics, such as on the revenue of supermarkets and markets respectively. While preferable to scale subsectors by similar factors, data may not exist (e.g. for farmers' market revenue), and therefore the two subsectors may be normalized and scaled by different factors. The two estimates were conducted separately, but can be combined into a single "Retail" estimate for SDG 12.3 reporting.

Food service

Food service is a diverse and complicated sector. The types of wastes, the reason for their generation, the modes of disposal and the waste infrastructure will differ among businesses. A vendor of *arepas* in a busy street market, a coffee shop in a residential neighbourhood and a large workplace canteen will all have different challenges to accurate measurement. Getting a robust national food waste estimate is about addressing this diversity as best as possible within resource constraints. The diversity of subsectors, the expense of acquiring primary data and scaling those into national estimates can be challenging.

This section provides practical advice for countries conducting new measurement studies as to how to approach this, first by prioritizing subsectors, then measuring waste and scaling it.

Scope

Food service involves settings where food is consumed in substantial quantities outside of the home. This could include a large range of classifications. Table 29 outlines one way of categorizing subsectors, including the relevant ISIC, REV. 4., codes. Any classification system is likely to have some overlapping subsectors: hotels often contain restaurants, for example, and canteens in schools or universities can be very similar to those in offices. These high-level groupings could be further broken down where relevant within a particular context or where more nuance is desired, such as differentiating between different types of restaurants (high-end, quick-service and so on).

Table 29: Categorization of subsectors within food service

EXAMPLE SUBSECTORS	RELEVANT ISIC, REV. 4.,	EXAMPLES AND CHARACTERISTICS
Restaurants, cafés, bars	ISIC, REV. 4., 56: Restaurants, cafeterias, events catering, pubs and bars ISIC, REV. 4., 49-11; 49-21; 50-11; 50-21; 51-10; 52-23 for establishments in transport services	Restaurants typically serving meals from a menu. Can be for dining-in or eating-out purposes. Bars and cafés may be predominantly beverage-serving establishments with more limited food options. These may include establishments embedded in other services, such as restaurants and cafés in airports and train stations.
Staff catering and other canteens/ cafeterias	ISIC, REV. 4., 56: Restaurants, cafeterias, events catering, pubs and bars	Staff catering and other canteens typically have limited table service and involve selection from a limited menu of pre-prepared food. They may be situated in other establishments such as education, healthcare, corporate or retail settings.
Accommodation	ISIC, REV. 4., 55-10; 55-90: Accommodation both short term (hotels) and long term (school dormitories, worker hostels)	Hotels and other short-term accommodation involve provision of meals, including breakfast, for residents and often options for non-residents. Long-term accommodation may include canteen-style catering. Worker hostels and other long-term accommodation may capture food waste that would otherwise be "household" waste in other countries or regions.
Education	ISIC, REV. 4., 85: Education	Food served in educational institutions such as schools and universities. These often take the form of canteen-style catering serving most/all students with limited choices, but in some cases may operate more like cafés with variable customer numbers.
Healthcare	ISIC, REV. 4., 86: Human health activities* ISIC, REV. 4., 87: Residential care activities*	Hospitals and other healthcare settings may include meal services for patients and staff. In addition, canteens or cafés may be available on-site for visitors (where not covered by ISIC REV. 4., 56 above). Residential care, such as for elderly people or those with mental health conditions, may serve most or all meals with limited choices.
Sports and events	ISIC, REV. 4., 56: Restaurants, cafeterias, events catering, pubs and bars	Events including sports games, music festivals and conferences. Typically, the service moves between different locations or is not active on all days of the year.
Security (military and prisons)	ISIC, REV. 4., 84-22; 84-23: Armed forces and prisons	Military bases and barracks and prisons. Typically these serve most or all of the meals consumed by those on site.
Markets / street food	ISIC, REV. 4., 56: Restaurants, cafeterias, events catering, pubs and bars	Street food, markets and "food trucks." These often involve outdoor serving and consumption with disposable packaging.

** ISIC, REV. 4., codes 86 and 87 were not listed in the Food Waste Index Report 2021 but are of relevance for food service where not captured by ISIC, REV. 4., 56 (e.g. inpatient care in hospitals).*

Measuring in all possible subsectors may not be practical due to resource constraints. Therefore, it is possible for the purposes of the Food Waste Index to focus only on the most significant food service subsectors. This refers to the sectors with the most waste. How can the subsectors with the most waste be identified? The preferred approach would be to prioritize subsectors *using existing data*.

In general terms, there is likely to be more waste in the sectors where more food is served. The preferred data would be data on the *amount of food* or number of *meals served* in different types of food service establishments. If this is unavailable, other data could be used. This could include data on revenue in different subsectors, or data on number of customers in food service subsectors. If not available directly, other data about potential customers (such as number of students, number of hospital beds, number of sports or music festival attendees) can be combined with data on the share of those potential customers who eat at the relevant food service, whether measured or assumed, to form an approximate figure. This approach, with an example from schools, is discussed in section 3.2 "Food Service."

Repeating such processes for each subsector in the country will help determine which are likely to be the largest, and therefore help in the prioritization process.

If *no data is available* to inform this prioritization process, then sectors can be chosen based on expert judgement and reasoning. Such reasoning should consider how many meals could in theory be eaten in each setting, and the context in a country. In a country with a young population, for example, education may be particularly significant. In a country with an older population, meals in health care – particularly residential care homes – may be more significant. Some guidance on how to consider each subsector is listed in Table 30.

Table 30: Guidance for prioritizing food service subsectors in the absence of data

SUBSECTOR	RATIONALE
Restaurants	Often involves a large number of businesses that serve multiple meals across the day. Food is consumed by people of all ages and social groups. **These establishments are likely to serve the most food across the country.**
Staff catering and other canteens	In situations where there are large numbers of staff catering/canteens not covered under other sectors (education, healthcare, etc.), then these could be a priority. This is more likely in the case of large numbers of public or workplace canteens, such as in countries with large manufacturing sectors or other large workplaces.
Accommodation	Although hotels serve smaller numbers of people, they serve meals throughout the day, including breakfast. Wastage rates can represent a very high percentage of the food served. Countries with large tourism sectors may want to prioritize studying hotels. Where catered worker accommodation is relevant, this may effectively replace what would be "household" food waste in other countries, so it could be significant.
Education	Where school meals are widely available, such as through school feeding programmes, education facilities may be a significant source of waste. This is particularly the case if schools serve more than one meal (e.g. breakfast and lunch). Reducing wastage is important to ensure the intended impacts on children's nutrition.
Health care	Hospitals typically serve small numbers of people. For inpatients, however, many (or all) of their meals are served in the establishment. Wastage rates can be very high. Residential care homes may similarly serve many (or all) of a person's meals. In older populations with many care homes, this could be a significant source of meals and waste.
Prisons	Prisons typically serve a small number of people, although they serve many (or all) of the population's meals. This is unlikely to be a priority subsector in most countries.
Military	Military bases typically serve a small number of people, though they serve many (or all) of their meals. Unlikely to be a priority subsector in most countries.
Markets / street food	In some locations, markets and street food can be significant sources of food supply. There is comparatively little research on them to date, so more study in a diversity of locations will help understand the role they play in food waste.
Events (sports, festivals, event catering)	Event catering can feed large numbers of people, but often irregularly. As a result, total meals served are likely to be much lower than subsectors serving food continuously. In some cultural contexts, particular events (such as weddings) may involve large quantities of food waste. These may present opportunities for more study and interventions to reduce waste.

It is recommended that **at least three food service subsectors are included.** If sufficient resources are available to study more subsectors, this is to be encouraged. It should also be acknowledged that, by not studying all relevant subsectors, total food service food waste is almost certainly going to be underestimated.

If there is no data with which to inform the priority subsectors, the recommended priorities are: **restaurants, staff canteens and catering**, **accommodation**, **education** and **markets/street food**. Which among those are prioritized may depend on the relevance to a particular economy.

Measurement methods

As outlined in Table 25, methods that may be appropriate for measuring food service food waste are:

- Direct measurement of total food waste net mass in food-only bins
- Assessment of filled volume of food-only bins
- Direct measurement and assessment of single food and drink items, perhaps using a digital bin (or "smart bin")
- Waste composition analysis for mixed waste streams
- Scanning / counting discrete items, such as by a barcode / QR code (for packaged items).

A comparison of these methods and their advantages and disadvantages is outlined in Table 31. The methods for solid and liquid waste may vary depending on wastes that are packaged or not, and the density of liquid waste. Further information on liquid sent to sewer is discussed in section 3.4 and is reported under Level 3.

Table 31: Comparison of measurement methods in food service

	ACCURACY OF MEASUREMENT	COVERAGE OF ALL FOOD WASTE IN SECTOR	MEASUREMENT CAUSES BEHAVIOUR CHANGE?	DETAILED INFORMATION POSSIBLE?	SUITABLE FOR SOLID OR LIQUID WASTE?	COST
Direct weighing	High	Only covers segregated streams	Low	No	Solid and liquid waste	Low
Volumetric analysis	Lower	Only covers segregated streams	Low	No	Solid and liquid waste depending on density	Low
Direct weighing (digital bin)	High	High	High	Yes	Solid and liquid waste	High
Waste composition analysis	High	High	Low	Yes	Solid waste only	High
Scanning / counting	High	Only covers scannable / countable items	Low	Yes	Solid and packaged liquid waste	High

These methods may be combined with other approaches that seek to answer additional questions, such as the types of foods wasted, the share that was edible, or the causes. For example, weighing of bins could be combined with visual estimation to disaggregate the approximate shares of different food categories. Similarly, a waste compositional analysis may be supplemented with a survey to understand the (perceived) causes of food waste in the business.

What will be most appropriate may vary between settings, the waste infrastructure and what other wastes might be mixed alongside food. The method applied can be decided for each subsector separately. In most cases, direct measurement/ weighing by staff will be practical.

If companies are measuring their own waste as part of voluntary or mandatory reporting requirements, guidance on conducting measurement in line with the above approaches will be needed, as well as processes for verifying the accuracy and robustness of the self-reported data.

Sampling and scaling

In food service, the **sampling unit** could apply to an individual meal or to the waste generated per kitchen/service area, either for an entire premise (if it has more than one kitchen) or for an entire business (which may include multiple sites). Generally, measurement at the level of an individual meal is the most useful for a food service business to understand its own waste, as this creates a large and nuanced dataset to see the variance in waste among customers.

Businesses may also have an interest in understanding where waste arises in the meal service – that is, distinguishing between preparation waste in the kitchen and consumer waste left over on plates. This level of granularity may be less important when the objective is tracking food waste nationally. Measuring at the level of a kitchen or premise is likely to be the most practical for scaling to a national estimate. Different sampling units and their benefits and limitations are outlined in Table 32.

Table 32: Comparison of sampling units in food service

SAMPLING UNIT	BENEFITS	LIMITATIONS
Individual meal	Establishes large datasets, good for statistics. High resolution and allows observation of variation within customers at the same site.	More costly, due to the large number of measurements. Primarily captures plate waste – difficult to apportion preparation or serving waste to individual meals. Likely to miss drink waste unless captured separately.
Kitchen/ premise	Is the natural unit for measurement and scaling. Can capture waste from all stages of the food service. Can be normalized with data likely to be available from point of sale (POS) systems, such as number of covers or sales value. May capture drink waste even if disposed in a different area to food waste.	Does not capture variation between customers of the same site. If there are multiple kitchens in the same site, there is a need to understand the flow of food between them.
Business	Allows data for a large entity to be reported quickly. May capture drink waste even if disposed in a different area to food waste.	Requires additional data for normalization, comparison and scaling (e.g. number of meals served, turnover). If businesses gather data from waste contractors, may lose nuance on where waste arises.

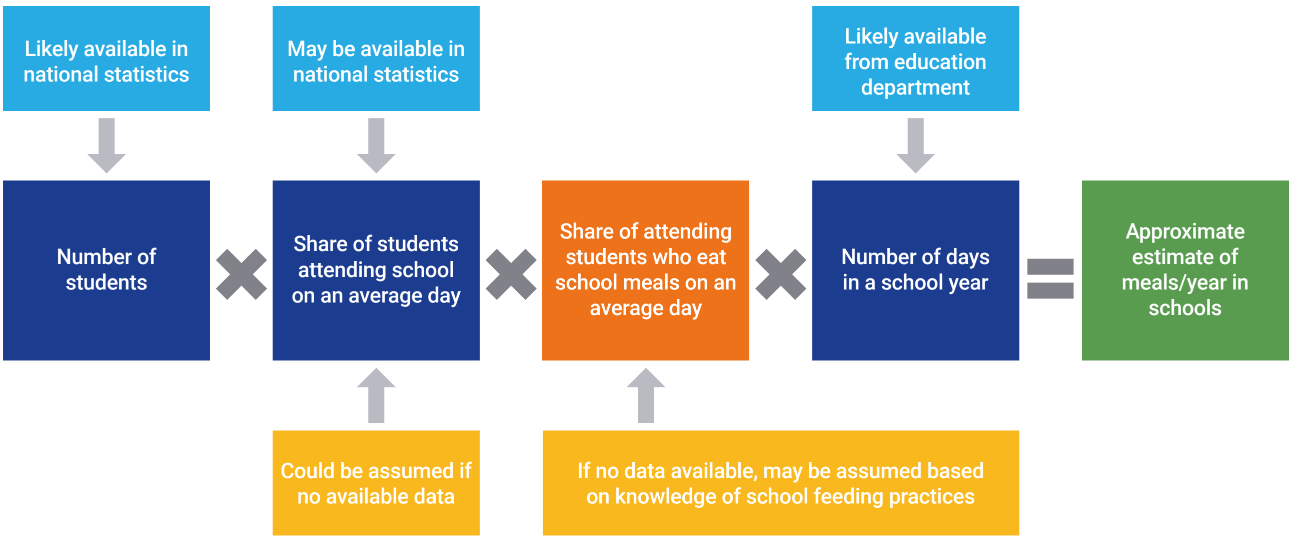
Regardless of sampling unit, data needs to be scaled from a sample to a population – that is, the entire subsector in the country. Doing this is likely to involve normalizing data, dividing the measurement by a relevant factor. This normalization should be attentive to what information is available on a national level for scaling purposes. This could include, for example, food waste as a share of food served, kilograms of waste per meal/portion, per customer or per site. The normalization factor does not need to be the same as the sampling unit, although it can be. There is a potential trade-off to manage between accuracy of measurement and likelihood of data being available for national scaling, summarized in Table 33.

Table 33: **Comparison of normalization and scaling factors in food service**

NORMALIZATION FACTOR	ACCURACY OF NORMALIZATION FACTOR	OBTAINING DATA FROM SAMPLING UNIT	OBTAINING DATA FOR A WHOLE COUNTRY
Amount of food served (mass)	High: Likely to be lower levels of variation when normalizing using the amounts of food	Might be recorded by kitchen/ business, or require conversion of existing data	May be collected as national statistics or by trade bodies
Meals/covers served	High: Likely to be lower variation when normalizing using meals	Likely to be recorded by point of sale (POS) system	May be collected as national statistics or by trade bodies
Number of kitchens/sites	Intermediate: kitchens and sites can vary in size, particularly if multiple kitchens are in a single site	Easy if sampling unit is a kitchen/site, although care is needed where one site contains multiple kitchens	Could be available as part of national statistics, although care is needed to account for site size and sites with multiple kitchens
Value of sales	Intermediate: some challenges that (a) food costs vary within subsectors (e.g. different types of restaurant) and (b) inflation can cause problems when comparing over time	Likely to be recorded by POS system, but may be commercially sensitive	Data likely to be available nationally
Number of employees	Intermediate: similar issues to turnover of variation within subsectors and changes over time	Likely to be recorded by POS, businesses or sites	Could be available as part of national statistics
Businesses	Poor: business size can vary enormously, as will level of food waste	Easy if sampling unit is businesses	Could be available as part of national statistics

In some cases, the necessary data for **scaling** estimates could be newly generated or based on assumptions and existing data. Consider the number of meals served in schools in a year: even if this data is not directly collected, there may be existing data that could be used to inform an estimate (Figure 23).

Figure 23: **Example equation to building an estimate of the number of meals served through existing data**



Box 9: Worked example: Food service

To study the waste generated in all restaurants in a country, the sampling unit is likely to be a number of business units, each of which are a single business site with one kitchen. All waste generated in preparation, service and plate waste would be sampled for a duration of at least one business week in those businesses. These weeks would be spread out over a period of time to reflect different seasonal variations in customer numbers and types of food served. This would give an estimate of the total food waste generated in that period. Dividing this total by the number of covers (customers) would give an average waste per meal.

If there is nationally representative data on the total number of similar-sized restaurants, or preferably the number of meals served in restaurants, these factors could be used to multiply gathered data and form part of the national estimate, to be combined with evidence from other subsectors. If there is not data available on the number of meals, the measured waste at the site could be normalized by another factor, such as sales value, to then be applied in national scaling.

Determining the **sample size** follows the formula as described earlier. The size of the sample will depend on the extent of variation observed in the *normalized* food waste between sampling units. Preferably, the wastage rate per unit of food mass served would be used; alternatively, for food service the variance may be in the wastage rate (in grams) per meal compared between establishments. For the desired confidence interval, it is recommended that the (minimum three) priority sectors aim for ±10 per cent precision. Additional studies on smaller subsectors, which may have a more limited impact on tracking overall waste arisings, could have slightly lower precision (e.g. ±20 per cent) should resources not allow for larger sample sizes.

Because the standard deviation is calculated based on the normalized food waste, the sample size is sensitive to how the data is normalized. This, in turn, may be constrained by what scaling data is available on a national basis. The results will be sensitive to specificities within a particular subsector and national context. As a result, general rules are difficult to establish. Findings of existing studies in particular subsectors may better inform the standard deviation in a particular country. If data is lacking, pilot studies of **around 30 establishments per subsector** can help generate initial data and inform if larger sample sizes are needed.

Household

Scope

For the purposes of the Food Waste Index, a household is any type of dwelling not covered by the other sectors (e.g. hotels, student residences).

A household is classified as either: (a) a one-person household, defined as an arrangement in which one person makes provision for his or her own food or other essentials for living without combining with any other person to form part of a multiperson household or (b) a multiperson household, defined as a group of two or more persons living together who make common provision for food or other essentials for living (UNSD 2020).

Capturing the diversity of household types will be important in designing the study sample. Important principles for this are covered later in this section.

Measurement methods

As outlined in Table 25, possibly suitable methods for measuring household food waste are:

- Direct measurement
- Waste composition analysis
- Volumetric assessment
- Diaries (for Level 3 destinations)

The suitability of each will depend in large part on the available waste infrastructure, and how consistent this is across a country. Direct measurement and volumetric assessment rely on there being a separate collection of food waste that can be directly analysed. Even in countries with separate food waste collections, it is unlikely that all food waste is collected that way. For example, in some areas food and garden waste may be mixed, or there will be contamination of the residual waste with food waste by some households.

As a result, waste composition analysis of mixed household waste is likely to be **relevant for all countries**. If substantial quantities of food waste are not collected from households, due to being disposed down the sewer or composted at home, then Level 3 reporting of waste destinations will be particularly relevant. This is discussed in section 3.4. The remainder of this section focuses on collecting household waste for composition analysis.

In many places, existing national standards exist for the quantification of household wastes, with guidance on the sampling procedure, methodology for conducting compositional analysis and categories in which to classify wastes. These can be followed where applicable, potentially with minor adjustments to ensure suitability for SDG 12.3 reporting, such as by ensuring that "organic" waste is further subcategorized to estimate the share that is "food waste," distinct from other organic wastes, such as those from gardens or livestock.

There are, broadly, three approaches to collecting household waste for sorting:

- Option 1: Collect waste directly from households
- Option 2: Intercept existing waste collections
- Option 3: Bulk sampling of waste collection routes.

These options, their advantages, disadvantages and scenarios in which they are most appropriate are outlined in Table 34.

Table 34: Comparison of methods for collecting household food waste for measurement

	WHAT IS IT?	ADVANTAGES	DISADVANTAGES	WHERE TO USE IT
Direct from households	Bags are distributed to households, which are instructed to put all waste in the bags. They are collected by researchers (daily or every few days), weighed for each household and sorted. Often, the first day is collected but not counted as it may contain waste from multiple days being "cleared out."	Can be deployed even where there are no formal waste collections. Can identify waste from specific households where they otherwise share bins (such as blocks of flats). Potentially covers all solid food waste, if solid food waste that is treated at home (such as composting) is also put in the bag.	By asking households to do something different, they might change their behaviour. Cannot determine what would have been the end destination of the waste unless otherwise asked of participants. Can be more costly due to higher level of engagement required.	Particularly useful for areas with low coverage of formal waste collection and/or it is difficult to identify waste from individual households (such as in flats). However, it can be used in most circumstances.
Intercepting existing waste collections	Arrangements are made with usual waste collection services for researchers to collect some household waste on the usual collection day. This is then weighed for each household and sorted.	Low level of interaction with households reduces chances of behaviour change. Data can be linked to specific households.	Only works where formal collections already exist. Limited in situations where waste cannot be identified to a specific household, such as in blocks of flats. Does not cover other waste disposal routes.	Where most food waste is found in formal waste collections AND there is knowledge of which households use the waste receptacles/bins.
Bulk sampling of collection routes	Specific waste sites or collection routes for households are chosen, with a load of waste then sorted. This can determine the share of waste that is food waste, but must then be applied to existing data on the amount generated by households.	Usually the cheapest option. Requires the least transport.	Cannot link data to specific households, only particular waste rounds or neighbourhoods. Food waste gets squashed in the process, making sorting more difficult. Does not cover all waste routes. Requires existing waste collection. Risk of contamination from non-household waste if collected. Requires additional data on number of residents in the relevant households to get accurate per capita figures.	Where most food waste is found in formal waste collections, but it is difficult to identify waste from individual households.

It may be appropriate to use different methods in different areas of a single country depending on how services and household structures vary. Generally, collecting direct from households can be applied in most locations and allows for synergies with the recommended methodology for SDG target 11.6 (the proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities), so data for both indicators can be collected together. Bulk sampling from collection routes or trucks is generally the least preferable approach due to the lack of household-specific data and the difficulties to identify food waste.

While the main interest for the purposes of the Food Waste Index is the food waste arisings per capita, this waste data collection could be useful for many purposes beyond just SDG reporting. These include identifying waste material streams for collection and recycling and planning improvements to waste services. Therefore in countries applying such methodologies on a regular basis for other purposes, corresponding synergies can reduce the extra costs for extracting detailed data on food waste.

Sampling and scaling

The **sampling unit** for households is in many cases an individual household. This could be a standalone building or a single household grouping within a larger housing structure, such as a single flat (whether filled by an individual, family or any other grouping) within an apartment complex.

In some cases, apartment blocks or neighbourhoods have shared waste receptacles, and these may be the most appropriate sampling unit. This is likely to cause some inaccuracies for normalization, as it may be more challenging to get precise estimates on the number of people who used the shared receptacle, and there is a risk of contamination by passersby or non-household wastes. Similarly, sampling from collection vehicles has increased risks of contamination from small supermarkets or stalls. Where possible, therefore, measuring food waste at the level of the household is advisable.

As detailed earlier, the samples should be representative of the national population. With a representative sample, the process of **normalization** and **scaling** should be relatively simple: dividing the waste gathered per household by the number of residents will form an estimate of waste per capita, which can be scaled by the total population to form an estimate across the entire population.

The **sample size** is determined by following the formula presented earlier. A key parameter is the standard deviation, a measure of variance in food waste arisings. Greater variation requires a larger sample size. The most relevant data to inform this parameter would be existing data or pilot data collection from the country in question. In the absence of country-specific data, insight from UK data collection could be used. In the UK data, considerable variation in the standard deviation of food waste at a household level was observed, such that the standard deviation was roughly the same as the mean (average) food waste.[18] As a result, the standard deviation/mean is . The desired 95 per cent confidence interval entails a precision of about ±10 per cent, leading to a confidence interval/mean of . With these figures, it is possible to derive some figures that can be applied for an initial study in most circumstances:

$$\textit{Sample size} \approx \left(2 * \frac{1}{0\ 1}\right)^2 \approx 20^2 \approx 400\ \textit{households}$$

Therefore, should a country have no food waste statistics with which to calculate a contextually accurate standard deviation, **it is recommended that an initial minimum of 400 households are sampled**. Smaller samples may be suitable in countries with less variation of the food waste in the organized waste collection, or those with relevant national or regional methodologies to follow.[19] Once completing a study, it is good practice to calculate the confidence intervals obtained in practice; if the desired confidence has not been reached, larger sample sizes should be considered for future studies.

This guidance is for establishing accurate tracking of food waste arisings at a national level. For more detailed information on types of food wasted, identifying differences and tracking changes in other subnational regions or social groups, larger samples are likely to be needed.

As discussed, samples should be representative of the wider population across multiple measures. For households, these include criteria such as:

- level of income (as a minimum, consider three groups: low, middle, high);
- urban and rural households;
- different regions, if they are likely to be particularly varied in food waste generation (e.g. different food cultures);
- different seasons (as a minimum, two seasons);
- type of waste collection (e.g. access to formal collections or not).

Within these constraints, areas and households should be picked randomly where possible.

Using **clusters of households** can help reduce the cost of sampling, by gathering multiple food waste samples from a smaller area. To be representative, a sufficient number of clusters is needed to capture the various differences in households.

18 Unpublished analysis of household food waste data from UK (WRAP).

19 For example, the common methodology for Waste Audits as elaborated by the Secretariat of the Pacific Regional Environment Programme (SPREP) (2020) suggests that, for Pacific Island Countries, a sample of 200 is recommended.

Box 10: Worked example: Household sampling

In this example, there is budget for sampling 500 households in 50 clusters, each cluster containing ten households. In this fictional country, the urban/rural divide and income level are believed to be particularly important. For designing the sampling, the researcher would first get data on what share of the population fits in each of the possible clusters.

	URBAN	RURAL
Low income	16%	35%
Middle income	19%	9%
High income	14%	7%

The researcher would use this information to allocate the 50 clusters in line with the population:

	URBAN	RURAL
Low income	8	17
Middle income	9	5
High income	7	4

The researcher would then follow three steps to identify the households. Firstly, selecting some provinces across the country that reflect these different socioeconomic groups. In this case, ten areas were chosen across the country.

The researcher would then create a list of districts/neighbourhoods/relevant administrative category for each grouping: one list of all low-income, urban areas; one of all low-income, rural areas (and so on). This step may require the assistance of the local governments of the ten areas. The clusters would be chosen across the ten areas, so five clusters studied per area. The number of clusters would then be used to randomly choose areas from those lists (e.g. eight low-income, urban areas would be chosen).

Ten households would then be randomly chosen from within each cluster.

Half of these clusters would be sampled in the dry season and the other half sampled in the wet season, with the divide in clusters being evenly spread across each category (e.g. four urban low-income clusters in dry season, four urban low-income clusters in wet season).

Depending on the existing infrastructure, the sampling would either take place on the day of normal waste collection, or by providing households with bags that are periodically collected. The wastes are then sorted and categorized shortly (i.e. no more than a few days) after collection.

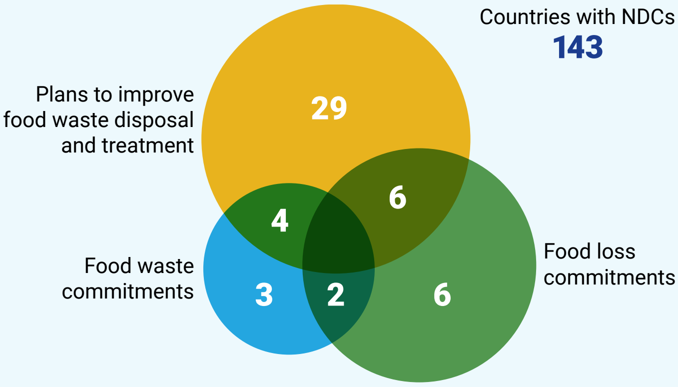
Box 11: Food waste in Nationally Determined Contributions

Food systems contribute an estimated one-third of anthropogenic greenhouse gas emissions (Crippa *et al*. 2021), with food waste alone amounting to around 8-10 per cent (FAO 2013) or more (Zhu *et al*. 2023). Despite this, as of 2022, only 21 out of 193 countries that have submitted Nationally Determined Contributions (NDCs) to the United Nations as a requirement of the Paris Agreement have so far included commitments to reduce food loss or waste directly in their NDCs (Figure 24) (WRAP 2022a):

- 7 countries have food waste commitments only;
- 12 countries have food loss commitments only;
- 2 have both food waste commitments and food loss commitments.

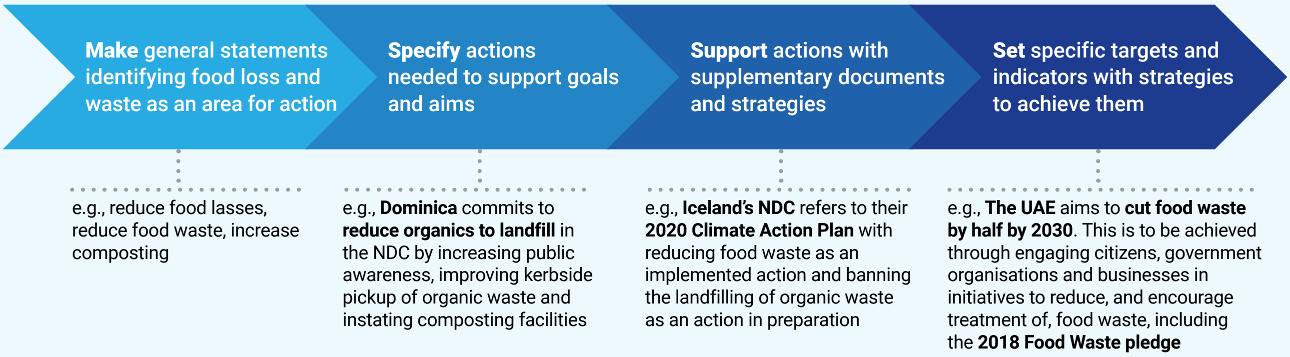
An additional 29 NDCs mention plans to improve food waste disposal and treatment, such as increased composting of food waste and diverting organic waste from landfill. There are also countries such as the United Kingdom, South Africa and Iceland that refer to secondary policy documents where food loss and waste reduction is discussed, but it is not directly within their NDC, whereas other countries, such as Norway, have made commitments in policy documents not referenced in the NDC.

Figure 24: Number of NDCs mentioning food loss or waste



UNEP encourages all governments to include food loss and waste reduction in their NDCs at the earliest opportunity. WRAP has published a "best practice" guide for implementing this (Figure 25) (WRAP 2022). The guide operates on a scale from lowest ambition to the highest ambition.

Figure 25: Best practice guide for integrating food loss and waste into Nationally Determined Contributions



Examples of direct commitments to reduce food waste within NDCs:

- **Cabo Verde:** Plans for improving "means and equipment for solid and organic waste control, reduction management and awareness raising among households and communities."
- **China:** "The Code of Conduct for Environmental Protection (Trial) was released to encourage the public across the country to practice low-carbon lifestyles through measures such as energy conservation and green consumption." The "Clean Plate campaign has been launched nationwide to reduce food waste."
- **Namibia:** Proposed future adaptations in Namibia's blue economy include to "Promote innovations in food processing, food losses and waste" within their adaptation measures.
- **Sierra Leone:** Commits to improving value chains through "technologies and tools for reducing food waste."
- **United Arab Emirates:** Aims to cut food waste by half by 2030. "The UAE has taken a comprehensive approach to reducing food waste by engaging local residents, government organizations and businesses in initiatives to reduce, and encourage treatment of food waste." The nationwide Food Waste Pledge launched in 2018 encourages the hospitality sector to adopt efficient food production practices.

https://ndcpartnership.org

The 2025 revision of NDCs provides an important opportunity to raise climate ambition by integrating food loss and waste.

3.3 Edible and inedible waste

Disaggregating food waste into "edible" and "inedible" parts is an optional step that can be included in Level 3 reporting, and is reported *separately* (lines 5–8) from total food waste estimates (lines 1–4). SDG indicator 12.3.1(b) is based on total food waste, but reduction in edible food waste may be instructive for public policy objectives.

Classifying inedible parts

Classifying "inedible parts" does not refer to the edibility of the food at the time of disposal, such as for fruits that have developed mould. Rather, "edibility" in this case refers to separating the parts that are not generally eaten from those that are. Edibility is culturally defined: some foods are commonly consumed in some areas but unavailable or not widely consumed in others, such as chicken feet. As a result, there is no single answer to classify the same food as "edible" or "inedible" in all places, as there may be "borderline" cases that cause disagreement.

For most foodstuffs, it will be possible for experts from the country to judge what is considered "edible": animal bones and orange peels will likely be considered "inedible," whereas apple peels will likely be considered "edible" even if some people prefer to eat apples without the peels. For "borderline" items where there is more disagreement, a survey-based approach can be used. The suggested approach, taken from Nicholes *et al.* (2019), involves asking respondents, for each borderline item:

- Which of these items do you eat, assuming they are appropriately cooked and in good condition?
- Which of these items do you consider inedible and which could possibly be eaten, even if you don't eat them yourself?

Following the methodology of Nicholes *et al*. (2019), a score of 1 can be given to responses suggesting that an item is "always" consumed or perceived as edible in all circumstances, and a score of 0 for "never" consumed or perceived as always inedible, with intermediate scores of 0.67 and 0.33 for intermediate responses (of "often" eating or "occasionally" doing so). Taking the average score across the two questions, if it is greater than 0.5 the part would be classed as "edible," and if smaller than 0.5 it would be classed as "inedible." The survey results can be used to extrapolate to other comparable parts.

This approach provides an objective classification of a subjective issue, which can be applicable across any context. If taking this approach to classify food parts, it is recommended that the classification survey is done *before* any waste composition analysis. This would allow for guidance to be provided for those sorting the waste so that they can group parts accordingly. If conducting a new sample, it is important that it is representative of the different regional and cultural groups, including respondents of different genders, with a minimum sample size suggested of 300 people.

Applying the classification

After forming a classification of edibility for different food items, these need to be applied to food waste data. There are two main situations in which inedible parts may arise, and each situation may require different approaches to measurement. These are summarized in Table 35.

Table 35: Comparison of the two main situations in which "inedible parts" arise

	DESCRIPTION	RELEVANT SCENARIOS
Purposefully removed parts	The purposeful removal of a food part. This may be during food preparation, such as the removal of an onion skin before chopping an onion. It may also be removal during the meal, such as leaving bones after consuming the meat on them. Not all purposefully removed parts are inedible: items may be removed during preparation or left over during a meal due to personal preference.	Primarily relevant in situations where food processing or consumption takes place. Likely to be found in the food service and household sector. This type of inedible part is typically less relevant in the retail sector, where most food is sold as discrete items to be subsequently prepared or consumed. However, some retail settings may involve some processing, such as butchers, fishmongers and greengrocers, and these are in some cases located within supermarkets.
Disposal of discrete items, including inedible parts	When a food item is disposed as a whole item, including edible and inedible parts, such as an entire banana (with skin) being thrown away. This is particularly relevant in situations where food has "gone off" and become unsafe to consume. Note: a whole item that is disposed due to mould or degradation may be "inedible" at the time of disposal, but should be classified into edible/inedible parts just as a non-mouldy item would be, as the degradation may be a result of human (in)action.	Relevant in all situations where food may be disposed of as whole items: • Most items in retail, particularly fresh/unprocessed produce • Food service, particularly waste from the inventory/storage, or decorative plates/buffets such as fruit bowls • Household food disposed before being prepared.

In many cases, when conducting a waste composition analysis, the items sorted will contain both edible and inedible parts. This will both be through the discrete items disposed, but also through purposefully removed parts that are a mixture of edible and inedible parts; consider a bone that still has meat attached, for example. There are different options for how to approach measuring such items, which typically involve a trade-off between specificity and resource requirements. The main options are listed below, from most accurate and most expensive to cheapest and least accurate:

- Physically separate food items in sufficiently good condition into edible and inedible parts and weigh those separately. Likely to be practical only for purposefully removed parts, and requires more time and effort.
- Estimate what shares of items are edible and inedible parts. For purposefully removed parts, this can be estimated visually. For discrete items, food composition tables can be used to divide items into edible and inedible parts. A list of resources to assist in this process relevant to specific regions can be found, for example, in the Food Loss and Waste Protocol, Appendix B (Hanson et al. 2016) and the FAO's INFOODs food composition table / database directory.[20]
- Sort into the category of the largest part and attribute the whole mass to "edible" or "inedible." For example: a bone that still has some meat on it would all be classed as "inedible," and a whole banana disposed with skin still on would be classed as "edible." This is the cheapest method but causes the most uncertainty.

Applying the classification in retail

In the retail sector, most food waste will be discrete items disposed before they could be used. In some retail subsectors, such as butchers or greengrocers, there may be a degree of processing on-site before consumers purchase the food, which may lead to the generation of inedible parts. Overall, it is likely that the majority of the waste will be "edible," as it is sold for consumption, with only parts from some fruits, vegetables or meat being considered "inedible."

As a result, making a distinction between edible and inedible wastes is less significant in retail than for the other sectors. If food waste data comes from counting or scanning items at the level of the product, it is likely that a food composition table can be used to form specific estimates of how much waste is edible. In some cases in retail, packaging will be relevant. Approaches to addressing packaging are discussed in section 3.2.

Applying the classification in food service

In the food service sector, the type of waste is likely to depend on where in the service it is generated. Food service food waste can be broadly split into three categories: inventory waste, preparation waste and plate waste.[21]

- Inventory waste includes items stored but not fully used, such as milk that has gone sour. Such items are likely to be disposed of as discrete parts, which may be wholly edible in the case of prepared foods such as sauces, or a mixture of edible and inedible parts, such as in the case of unprocessed fruits and vegetables. These can be classified much like retail waste, using visual estimation or food composition tables.
- Preparation waste includes all parts removed during the cooking process. It is likely that much of this will be inedible in most settings. However, there are likely to be a large number of borderline parts (the skins from carrots and potatoes, for example) that are purposefully removed in preparation but may be judged as "edible" in a classification process. In waste composition studies, these parts would be grouped into edible and inedible categories and directly weighed through visual estimation or sorting based on the largest part.
- Plate waste includes items left behind by consumers, whether on a plate, in a bowl or in any other serving medium. These are likely to be primarily edible parts, other than in circumstances such as meat served on the bone or particular seafood such as mussels or oysters. In such cases, visual estimation or sorting based on the largest part for weighing should be sufficient.

Applying the classification in households

In households, people will dispose of both whole discrete items that have not been consumed (such as fruits and vegetables that have "gone off") as well as purposefully removed parts during preparation, or left after a meal. As most household estimates are likely to use composition analysis methods, classifying borderline parts before the composition analysis is important. Visual estimation or sorting based on the largest part will be practical in most instances, for the edible and inedible categories to then be weighed.

In some cases, household food waste may be disposed of in its packaging. This should be removed from estimates wherever possible: approaches to account for packaging are discussed in section 3.2.

20 *https://www.fao.org/infoods/infoods/tables-and-databases/en*

21 *These categories are not exhaustive for all subsectors. In canteens or buffets, for example, there may be additional "service" waste of foods that are prepared but then not chosen by consumers, which will largely be edible in most cases. Similarly, cakes, pastries and similar goods prepared on site in a café may be prepared on site but never served before expiry.*

3.4 Destinations of surplus and waste

Lines 9–16 of the SDG indicator 12.3.1(b) questionnaire focus on the disposal destinations of waste. Quantifying the exact quantities going to each destination in every sector is an optional step (Level 3) that can provide a greater level of insight into how food waste is treated, the associated environmental damages and opportunities for improvement. However, awareness of the scope of "waste" destinations and what should be counted is important for conducting measurement in all sectors (section 3.2).

For the purposes of the Food Waste Index, food waste is defined as edible parts (i.e. wasted food) and associated inedible parts going directly to the following destinations (Figure 26):

- Co/anaerobic digestion
- Compost / aerobic digestion[22]
- Controlled combustion
- Land application
- Landfill (including licenced and unlicenced landfills)
- Litter discards/refuse
- Sewer[23].

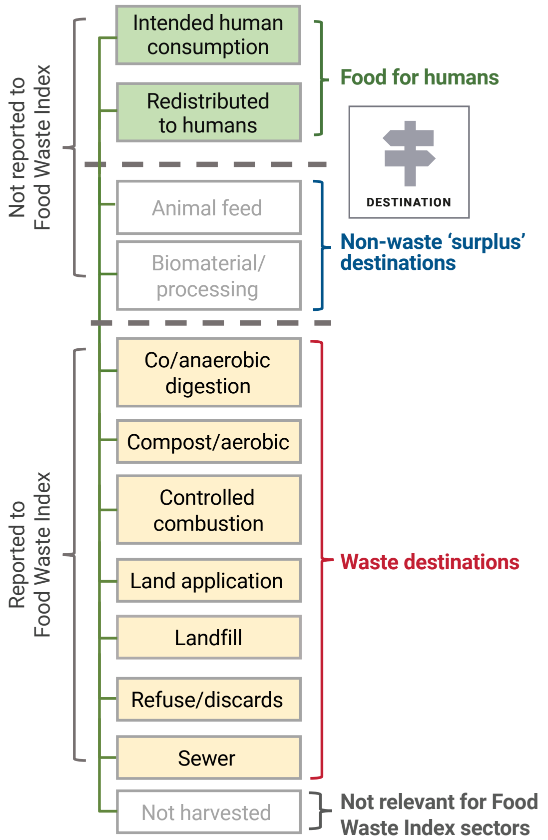
Full definitions of all destinations can be found in the Appendix.

Only relevant destinations need to be included. For example, in some countries, food waste from households will not go to land application or controlled combustion. In such cases, only the destinations where the food waste goes should be quantified.

22 *For households, food waste composted at home can be omitted from Level 2 due to its low prevalence in most countries where it has been measured. For example, estimates for the European Union suggested that home composting accounted for 8 per cent of total household food waste. Other forms of composting from households (i.e. industrial composting of food waste collected from households) should be included. Household home composting can be included under Level 3. Preliminary research may identify that it is significant for some countries or populations, such as homes that produce their own food in rural areas, and may therefore be important to include in some cases.*

23 *For Level 2, it is not essential to measure food waste going to the sewer. This is because it requires additional resources to measure, and – for some sectors – can represent a small proportion of total food waste. However, it is included under Level 3, and countries are encouraged to measure it where possible. As an example, the amount of food discarded to sewer was 23 per cent of household food and drink waste in the United Kingdom in 2015 (WRAP 2018) or 11 per cent in Germany in the same year (Schmidt, Schneider and Leverenz 2019); the amount will vary between countries depending on culture, foods eaten and the prevalence of waste disposal units that discharge to the sewer.*

Figure 26: Food and food waste destinations, adapted from the Food Loss and Waste Protocol Standard



Source: Hanson et al. 2016.

All food produced ends up in some form of "destination." The intended destination for most food is human consumption. For food that does not reach this initial human consumption ("surplus" food), there are a range of other destinations to which the food can be diverted. Some of these destinations of surplus food are *not considered waste*. This includes:

- Food redistributed for human consumption – such as soup kitchens or food banks;
- Animal food and feed – both directly or after processing;*
- Biomaterial/processing – sometimes termed "upcycling," converting material into industrial products for food and non-food purposes.

** Some queries were received from stakeholders about the scope of "animal feed." For the purposes of the Food Waste Index, "animal feed" is understood to include both feed for livestock animals and food for pets and other non-livestock animals. Food surplus that is converted into animal feed through insect-based processing (for example, using black soldier fly larvae) is considered as animal feed and therefore not waste.*

For SDG 12.3 reporting, only the quantification of *waste* destinations is required. However, quantifying the amounts going to surplus destinations may be of interest for governments, national agencies, municipalities, non-governmental organizations and businesses. Data on this may help understand the impact of measures or interventions, such as redistribution schemes, or to understand how much surplus food is being produced that does not reach its initial intended destination.

The remainder of this section considers how to quantify surplus and waste destinations in each of the three sectors.

Retail

Waste destinations: In most cases, a single retail sampling unit (see section 3.2) will collect all of its food waste, which may or may not be mixed with other wastes, and pass them over to another entity for collection and disposal. In some cases, the entity doing the collection and disposal is part of the municipal waste collection. In other cases, retailers will have contracts with private waste collectors. In some cases, it may be a combination of both: the particular waste and regulatory regime is likely to substantially vary between, and sometimes within, countries.

While sampling retail sites, or aggregating data from retailers, it is important to collect information on what is known about how that waste is subsequently treated. If the retailer does not know this directly, it may be able to give information about the contractor that does know the disposal route. Designing a representative sample of retail sites (see section 3.2) is therefore key to generate representative data on disposal methods.

Surplus destinations: In the retail sector, the role of food redistribution is likely to be more significant than for other sectors included in the Food Waste Index. This includes the donation of food to food banks and charities to tackle food insecurity as well as other redirection to human consumption from sharing economy initiatives. Food surplus donated for human consumption is *not reported as waste* for the purposes of the Food Waste Index, and so should not be included in national inventories.

However, quantifying the amounts of surplus food generated and redistributed may be important to understand the role that redistribution organizations are playing. Retailers, particularly formal retailers such as supermarkets, may collate data on the quantity of food donated for their own stockkeeping and environmental, social and governance (ESG) reporting, and may be willing to share anonymized/aggregated data for national statistics. Alternatively, redistribution organizations such as food banks may keep records of the quantities of food received from specific companies. This could provide an indication of how much is being redistributed.

Food service

Waste destinations: Food service is broadly similar to retail, in that the destinations are likely to depend on the waste arrangements of each particular site. Food waste may be separated or mixed with other wastes, and passed on to another entity for collection or disposal. This entity may be part of municipal solid waste collection, or private companies. Disposal information can be gathered from a representative sample of sites, such as those being sampled for waste quantification (see section 3.2).

Where food service is unique is that, in some subsectors, drink waste that is going to the sewer is likely to be particularly relevant. This is the case for drinks-centred businesses, such as bars and bubble tea shops, as well as those serving broth-based soups such as *ramen* or *phở*. While reporting waste to the sewer is not mandatory under Level 2 reporting, prioritizing studying liquid waste in such businesses may be worthwhile. Direct and volumetric measurement is likely to be most applicable here, such as by sampling liquid wastes in buckets that can be measured.

Surplus destinations: The relevance of surplus destinations to the food service sector will largely depend on the regulatory regime in a particular territory. In many cases, food safety regulations will limit what surplus food can be safely donated. As with retail, particular sites may keep records of food donated, or redistribution organizations may have records that can be aggregated.

In some cases, food service businesses generate largely homogenous waste streams. In these cases, in a circular economy the waste streams and inedible parts associated with food service could be effectively used for biomaterial/processing destinations, such as "upcycling" surplus into new food.[24] Consider coffee shops, for example: the large quantities of used coffee grounds may be given or sold to producers that use it for other products such as cosmetics. If resources are collected for such uses in sampled businesses (section 3.2) it is important to capture this and *exclude* those streams from the quantification of food waste, as biomaterial/processing is not a "waste" destination.

24 "Upcycling," as defined by the Ellen MacArthur Foundation, "denotes a process of converting materials into new materials of higher quality and increased functionality." This definition and others are discussed by the Upcycled Foods Association (2020) in its definition of "upcycled foods."

Household

Waste destinations: Accurately quantifying the destinations of household food waste requires information gathered in a few steps:

Firstly, consider what waste collection regimes exist in a country. These could vary between having no formal collection (as may be the case in rural areas or slum neighbourhoods), having a single mode for waste disposal, or separate collection of food waste (whether mixed with other organic wastes or not). Even within a single collection regime, different locations may treat the waste differently: some municipalities may take mixed waste to landfills, for example, whereas others may take mixed waste for incineration ("controlled combustion"). Data on populations living under different waste regimes may be available nationally, or with the assistance of municipal governments.

Secondly, identify whether people living under different waste collection regimes generate waste at different rates. Designing a representative sample of households (see section 3.2) will already have considered the type of waste collection. With a representative sample, the data collected on food waste arisings collected from households should be combined with what is known about the different treatment avenues. A worked example is discussed in *Box 12*.

Box 12: Worked example: Household food waste destinations

Consider a fictional country of 1 million inhabitants (column A). In the most rural areas, accounting for 20 per cent of the population, there is no formal waste collection service, so waste is either dumped or composted locally. In the capital city, also accounting for 20 per cent of the population, waste is collected and incinerated for energy recovery. In the remainder of the population, waste is collected and sent to landfills (column B). Some households feed vegetable scraps to livestock or pets, but these are not counted as waste, so are not included in the calculations.

Based on the samples of different household types, average household food waste generation per inhabitant in each of these territories is calculated (column C). By combining these figures, we can form an estimate of the amount of household food waste that is going to each of the three destinations in this country (column D). Note that this approach accounts for the differing amounts of household food waste generated in different households. Although the most rural households with no waste collection represent 20 per cent of the population, their food waste only represents 16 per cent of the household food waste, because they generate less per person than those in the capital city whose waste is incinerated, who are 20 per cent of the population with 22 per cent of total food waste.

	A: Population of country	B: Share of population in waste collection regime	C: Household food waste generated (kg/capita/year)	D: Amount of waste going to each waste destination (tonnes) (AxBxC /1 000)
No collections: local refuse or composting	1 000 000	20%	50	10 000
Collection and sent to landfill		60%	65	39 000
Collection and sent to incineration (controlled combustion)		20%	70	14 000

This is a simplified example, but it shows the process required for all relevant disposal avenues.

The Level 2 methodologies, which form the minimum measurement for the Food Waste Index, focus on the measurement of solid food waste, such as waste that would normally be disposed of in the residual waste collection. However, this may not be the only avenue of food waste disposal. Measuring other destinations falls under Level 3 reporting. There are two main other avenues for waste that should be considered:

- Disposal of waste liquids or crushed solid food waste to the sewer, and
- Treatment at the home, such as through home composting.

Sewer

The importance of food being disposed down the sewer will depend on cultural contexts and household infrastructure. In food cultures that consume more foods with soups, broths, or sauces, there may be more food down the sewer than in other food cultures. Similarly, in some countries it is common to have waste disposal units that shred food waste for disposal down the sewer. It can be reasonably expected that in these places a greater share of solid food waste that would otherwise be disposed of in waste bins is going down the sink into sewage systems. Measuring only solid waste in such cultural contexts may therefore underestimate the extent of food waste. In all countries, drink waste is unlikely to be captured by Level 2 measurement methodologies.

Food waste diaries are the recommended method to understand waste going to the sewer. Further guidance on diaries is provided in ***Box 13***.

Treatment at home

For treatment at home, food waste **diaries** are the recommended method. These can be used to record instances of waste generation, the amount generated and the destinations of the waste. This can be used to calculate what share of waste is disposed via each route, including home composting, being fed to animals and going down the sewer. It has the added advantage of also being able to generate data on the types of food wasted and the causes of waste, which are important to better understand why food waste happens, its impact and how it can be addressed. Guidance on conducting diary studies is available in Box 13.

If collecting waste directly from households by providing collection bags, households can be asked to put all food surplus in the bags, including those parts that they would normally treat at home. This gives a more complete understanding of food surplus generated, but additional steps would be needed to understand how much goes to each treatment destination. This could be through **surveys** asking the same households how they normally dispose of food (providing percentages for the amounts disposed, composted or fed to animals). Alternatively, **separate bags** or buckets of waste could be provided for each normal disposal avenue. This approach is more accurate but would increase the burden on participating households, possibly negatively impacting engagement.

Note that food fed to animals is not considered to be "waste" for the purposes of the Food Waste Index, so household food surplus that goes to animals should be removed from the "waste" estimate and reported separately.

Box 13: Food waste diary guidance

Food waste diaries are important for gathering Level 3 data. For a week-long diary, a sample of 300 households should be sufficient in contexts without substantial variation in available disposal routes or household food practices. In countries or regions with more variation, or for a shorter diary period, a larger sample would be needed. Existing research or pilot studies can help inform if the extent of variation is not known. Any sample should reflect the population in the same way that household measurement should (see section 3.2 for sampling guidance). Sampling should take place in at least two points during the year to reflect seasonal differences. Updating diary figures are likely to be needed less frequently than waste compositional data.

Diaries are known to lead to underestimation of food waste amounts when compared to waste compositional analysis (Quested *et al*. 2020). There are a number of reasons for this, some of which can be minimized through how studies are designed.

- Behavioural reactivity: Households waste less during the diary period. This can be minimized by explicitly asking households to not do anything differently, and making it clear that they will not be judged for their results (such as through anonymizing data).
- Misreporting: Not all food waste recorded in the diary. Ask participants to involve all members of their household. Designing the diary to maximize interaction, such as by a physical diary that can be placed next to the bin, or a digital/app-based diary that can be installed on the smartphones of all members of a family. Reminders throughout the study period help ensure consistency.
- Measurement bias: Amounts recorded are inaccurate. Providing quick, accurate measurement methods and materials. This could include providing digital scales or a measuring jug for liquids.
- Self-selection bias: Those completing the diary are not representative of the wider population. Consider ways to maximize participation of those approached. These could include steps to reduce participant burden; a well-designed “first contact”; or incentives for participation.

Misunderstanding of system boundaries: Those participating have different perceptions of what should be measured. Make sure that there is a clear guidance of what should be included and what is excluded in the diary.

3.5 Food manufacturing

For countries that are able to, there is the additional option of reporting "Food loss generated at manufacturing level" in the Food Waste Index. This is "Level 3" data similar to disaggregating edible parts (section 3.3) and the disposal destinations of waste (section 3.4).

The process for forming a nationally representative "Manufacturing" estimate follows the same process as the retail, food service and household sectors (section 3.2), in which waste is:

1. Measured at the level of **sampling units**
2. **Normalized** to a relevant normalization factor
3. **Scaled** by a representative scaling factor to form a national estimate.

This process is described below for a national entity, although the same principles could be applied to a manufacturing business with multiple sites of production looking to estimate its company-wide waste.

Scope

Manufacturing of food and drink products are covered by ISIC, REV. 4., divisions 10 and 11 (Table 36).

Table 36: ISIC, REV. 4., divisions relevant for "Manufacturing"

ISIC, REV. 4., 10	Manufacture of food products	This division includes the processing of the products of agriculture, forestry and fishing into food for humans or animals, and includes the production of various intermediate products that are not directly food products. The activity often generates associated products of greater or lesser value (for example, hides from slaughtering, or oilcake from oil production).
ISIC, REV. 4., 11	Manufacture of beverages	This division includes the manufacture of beverages, such as non-alcoholic beverages and mineral water, manufacture of alcoholic beverages mainly through fermentation, beer and wine, and the manufacture of distilled alcoholic beverages.

Within these divisions, ISIC, REV. 4., classes provide additional breakdown of activities (Table 37). Where possible, countries should aim to measure all of these classes, excluding only those irrelevant to the production in that country (e.g. "11-02 Manufacture of wines" in a country that does not produce wine) or conducted at a small scale.

The focus for the purposes of the Food Waste Index is on manufacturing not captured by the Food Loss Index. Which processing or manufacturing stages *are* captured by the Food Loss Index will depend on the "basket of commodities" used for the Food Loss Index in a particular country. In many cases, the processing and preserving of some meat, fish, and fruits and vegetables (ISIC, REV. 4., 10-10, 10-20, 10-30) will be covered by the Food Loss Index, and manufacture of other foodstuffs with limited additional inputs (dairy products 10-50, grain mill products 10-61, sugar 10-72) may also be included in the Food Loss Index.

Table 37: ISIC, REV. 4., classes relevant to "Manufacturing"

ISIC, REV. 4.,	DESCRIPTION
10-10	Processing and preserving of meat
10-20	Processing and preserving of fish, crustaceans and molluscs
10-30	Processing and preserving of fruit and vegetables
10-40	Manufacture of vegetable and animal oils and fats
10-50	Manufacture of dairy products
10-61	Manufacture of grain mill products
10-62	Manufacture of starches and starch products
10-71	Manufacture of bakery products
10-72	Manufacture of sugar
10-73	Manufacture of cocoa, chocolate and sugar confectionery
10-74	Manufacture of macaroni, noodles, couscous and similar farinaceous products
10-75	Manufacture of prepared meals and dishes
10-79	Manufacture of other food products n.e.c.
10-80	Manufacture of prepared animal feeds
11-01	Distilling, rectifying and blending of spirits
11-02	Manufacture of wines
11-03	Manufacture of malt liquors and malt
11-04	Manufacture of soft drinks; production of mineral waters and other bottled waters

The subsectors least likely to be captured by the Food Loss Index include those where more than one commodity is combined into new, complex products. Examples include the manufacture of bakery products (10-71), confectionary (10-73) and prepared meals and dishes (10-75). Within these classes there will be wide ranges of activities: national statistics and business records can help to identify which types of production are most significant.

As with food service (see section 3.2), a judgement may need to be made about which manufacturing subsectors are most significant to allocate limited resources. Data on the number and capacity of manufacturing sites within the country can inform this prioritization.

Measurement methods

As detailed in Table 25, there are a number of suitable methodologies for measuring manufacturing waste:

- Direct measurement (weighing of food-only waste streams)
- Waste composition analysis (for mixed waste streams)
- Volumetric assessment
- Mass balance.

Direct measurement and **waste composition analysis** are generally the most accurate for most applications. In many cases, manufacturing sites will have more homogenous waste streams than those in the retail, food service or household sector, since sites use a limited number of inputs to produce a limited number of outputs. This is particularly the case in the processing of commodities (e.g. sorting and canning vegetables) or large-scale production of a limited number of complex commodities (e.g. factories producing chocolate bars).

As a result, as long as packaging wastes are separated from food wastes, direct mass measurement of waste bins may be an effective, lower-cost way to estimate waste arisings. In sites that dispose food wastes mixed with non-food wastes, or that produce a range of products using many different inputs, waste compositional analysis may be necessary to understand what is being wasted. In some cases, trained visual estimation may be suitable to disaggregate a waste stream between different products or different food categories.

Volumetric assessment, similar to direct weighing, will be most appropriate in cases with largely homogenous waste streams that are separated from non-food wastes. The relative homogeneity is required to ensure that the entire waste stream has the same composition, allowing a mass value to be determined by applying the density of the waste to the volume it occupies. One benefit of volumetric assessment in manufacturing is the ability to record wastes that may be disposed of as a liquid or sludge.

Mass balance is the least accurate but lowest-cost approach. This can be calculated by subtracting the outputs from the inputs, adjusting for any changes within the site/sector (e.g. evaporation; dry foods being boiled and absorbing water). This approach is therefore most applicable in situations with limited changes in mass on-site, such as sorting, chopping and packaging fresh produce. In manufacturing sites that conduct processes that change mass, it is advisable to use a different approach.

Sampling and scaling

In manufacturing, the most appropriate **sampling unit** is likely to be that of a single production site/unit. This is because each site/unit may have its own waste disposal processes and infrastructure, which facilitates most measurement methods (section 2.5). In some cases, multiple sites may share waste infrastructure, such as a number of smaller producers in an industrial park or multiple sites of the same manufacturer that carry out different processes. In these cases, measurement for the collection of businesses or units within a larger site may be more practical. However, measuring at the level of specific units would generate more valuable data for businesses.

Businesses may choose a more granular sampling unit to help them identify where and why losses and waste arise, such as by sampling at the level of a process. Consider a site that produces canned beans: upon arrival at the processing plant, they may be quality checked and sorted, blanched/pre-treated, before being cooked and canned, and then labelled. Food loss may arise at any of those stages for different reasons, and for a business looking to improve its practices, understanding this would be valuable. For the purposes of forming a national estimate, however, only the total waste generation is necessary.

This data from sampling units then needs to be **normalized** to be subsequently **scaled** to a national estimate. This should be done separately for each ISIC, REV. 4., class (section 2.5), with the results then summed. The same normalization and scaling factor does not need to be used for each ISIC, REV. 4., class, and the approach can be determined by what is most appropriate and available.

As with the retail sector (section 3.2), scaling on the basis of business or site numbers is likely to be inaccurate due to substantial variation in the size of sites and the amounts of food they process. Normalization and scaling factors that can be applied to sites of all sizes is beneficial. Using records of the amount of food entering and exiting a processing or manufacturing site (with appropriate adjustments for cooking processes that change mass) is the approach most closely aligned to the data required for the Food Loss Index, which uses loss rates (expressed as a percentage) for each stage of the supply chain, including processing. Therefore, new measurement studies – particularly those in subsectors that are relevant to the Food Loss Index – should seek to establish representative loss rates. Different options and their benefits are summarized in Table 38.

Table 38: Table of normalization and scaling factors in the "Manufacturing" sector

NORMALIZATION FACTOR	DATA NEEDED FOR SCALING	COMMENT ON ACCURACY
% of food handled	Total food entering manufacturing stage and/or total food leaving manufacturing per ISIC, REV. 4., class	High: Likely to be lower levels of variation within subsectors. May require adjustment for mass changes in manufacturing (e.g. water retention or loss); This is closely aligned with the data required for the Food Loss Index (loss %). This is the preferred approach.
Amount of waste per unit of turnover	Total turnover of food manufacturers per ISIC, REV. 4., class	Intermediate: Food costs vary within subsectors and inflation can cause problems in comparing over time
Waste per employee	Total number of employees per ISIC, REV. 4., class	Intermediate: Likely to vary within subsectors, with a non-linear relationship between increase in workforce and increase in manufacturing capacity. May change over time with increased automation.
Waste per unit/ site	Total number of sites per ISIC, REV. 4., class	Poor: Is likely to be inaccurate unless data is available for a range of different unit/site sizes.

Determining the **sample size** follows the same formula as described in section 3.2. The size of the sample will depend on the extent of variation observed in the normalized food waste between sampling units. For the desired confidence interval, it is recommended that the largest subsectors aim for ±10 per cent precision. Additional studies on smaller subsectors, which may have a more limited impact on tracking overall waste arisings, could have slightly lower precision (e.g. ±20 per cent), should resources not allow for larger sample sizes.

Because the standard deviation is calculated based on the normalized food waste, the sample size is sensitive to how the data is normalized. This, in turn, may be constrained by what scaling data is available on a national basis. The results will be sensitive to specificities within a particular subsector and national context. As a result, general rules are difficult to establish. Findings of existing studies in particular subsectors may better inform the standard deviation in a particular country.

If data is lacking, studies of **around 30 sites per subsector (ISIC, REV. 4., class)** can help generate initial data in settings where there are a large number of sites. In some countries and industries, there will be a very small number of sites. In cases where there are fewer than 60 sites, sampling **half of the sites in the subsector** would be appropriate. Pilot studies can help identify the variation to inform country-specific sample sizes.

04 Solutions focus: public-private partnerships

The global food system is a complex web of stakeholders and activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products. Food loss and waste are problems emerging across the whole system, across multiple stakeholders, often with separation between the root cause of the waste and the supply chain stage in which it arises. Due to this complex and interlinked nature, collaborative action is fundamental to the delivery of SDG 12.3 and the systemic changes required throughout the global food system.

This section details one approach that has been shown to help drive food waste reduction across the entire food supply chain: public-private partnerships. A public-private partnership (PPP), sometimes known as a “voluntary agreement,” is about working together to deliver a shared goal. In tackling food loss and waste, this means a “collaboratively agreed, self-determined ‘pact’ or agreement to take action on food waste generated at different stages of the food system” (adapted from REFRESH 2021). This involves bringing together stakeholders either across the whole food supply chain, or within a particular sector or stage of the supply chain.

By uniting stakeholders around common goals, a PPP aims to overcome challenges of food system fragmentation. The establishment of a PPP is an explicit recognition that we all have a role to play in food loss and waste reduction: from international organisations and national governments through to large and small businesses all the way to consumers. This is an approach that is already operating across the globe and having meaningful impacts on food waste reduction, tackling food insecurity and reducing costs.

Box 14: Box 14: The Courtauld Commitment

- Country: United Kingdom
- Established: 2005
- Lead delivery organization: WRAP
- National targets – latest iteration:
  - 50% per capita reduction in food waste by 2030 versus the United Kingdom 2007 baseline
  - 50% absolute reduction in greenhouse gas emissions associated with food and drink consumed in the UK by 2030 (against a 2015 baseline)
  - 50% of fresh food is sourced from areas with sustainable water management
- Number of signatories: Over 100, includes major retailers, brands and hospitality
- Government engagement: UK and devolved nations
- Funding model: Mixture of government and private sector (signatory) contributions
- Reported impact: Regular milestone reporting*
- Key facts and figures:
  - 2007-2018 reduction in food waste of 23% per capita in total
  - 2007-2018 reduction in household food waste of 27% per capita
  - Rebound in household food waste during COVID-19 crisis, with a per capita reduction of 17% during 2007-2021
  - By 2021, supply chain food waste has reduced by 20.7% per capita (414,000 tonnes)
  - 8.5% reduction in retail and 9.2% reduction in manufacturing waste per capita between 2018 to 2021 (146,000 tonnes)
  - Over three-fold increase in surplus food redistribution between 2015 and 2021, with the equivalent of 1.4 billion meals redistributed since 2015
  - Cost-benefit analysis of the Courtauld Commitment 2015-2018 including government spend and operational costs suggests that there is a £7:1 benefit-to-cost ratio.

** https://wrap.org.uk/taking-action/food-drink/initiatives/courtauld-commitment.*

Source: Devine et al. 2023; WRAP 2022b; WRAP 2023.

Box 15: Australian Food Pact

- Country: Australia
- Established: 2021
- Lead delivery organization: Stop Food Waste Australia, governed by Fight Food Waste CRC
- National targets:
  - 50% per capita reduction in food waste by 2030
  - Encourage an increase in the amount of food donated across the supply chain
- Number of signatories: 32, includes major retailers, brands and hospitality
- Government engagement: Australian Government Department of Climate Change, Energy, the Environment and Water
- Funding model: Mixture of government and private sector (signatory) contributions
- Reported impact: Signatory food waste measurement established and comparative assessment of annual data is under way and will be reported.

Box 16: The South African Food Loss and Waste Initiative

- Country: South Africa
- Established: 2020
- Lead delivery organization: Consumer Goods Council for South Africa (CGCSA)
- National targets:
  - 50% per capita reduction in food waste by 2030
  - Encourage an increase in the amount of food donated across the supply chain
- Number of signatories: Over 100, includes major retailers, brands and hospitality
- Government engagement: South African Government: Department for Forestry, Fisheries and the Environment (DEFF) and the Department of Trade, Industry, and Competition (DTIC)
- Funding model: Post-seed funding, contribution from CGCSA membership fees

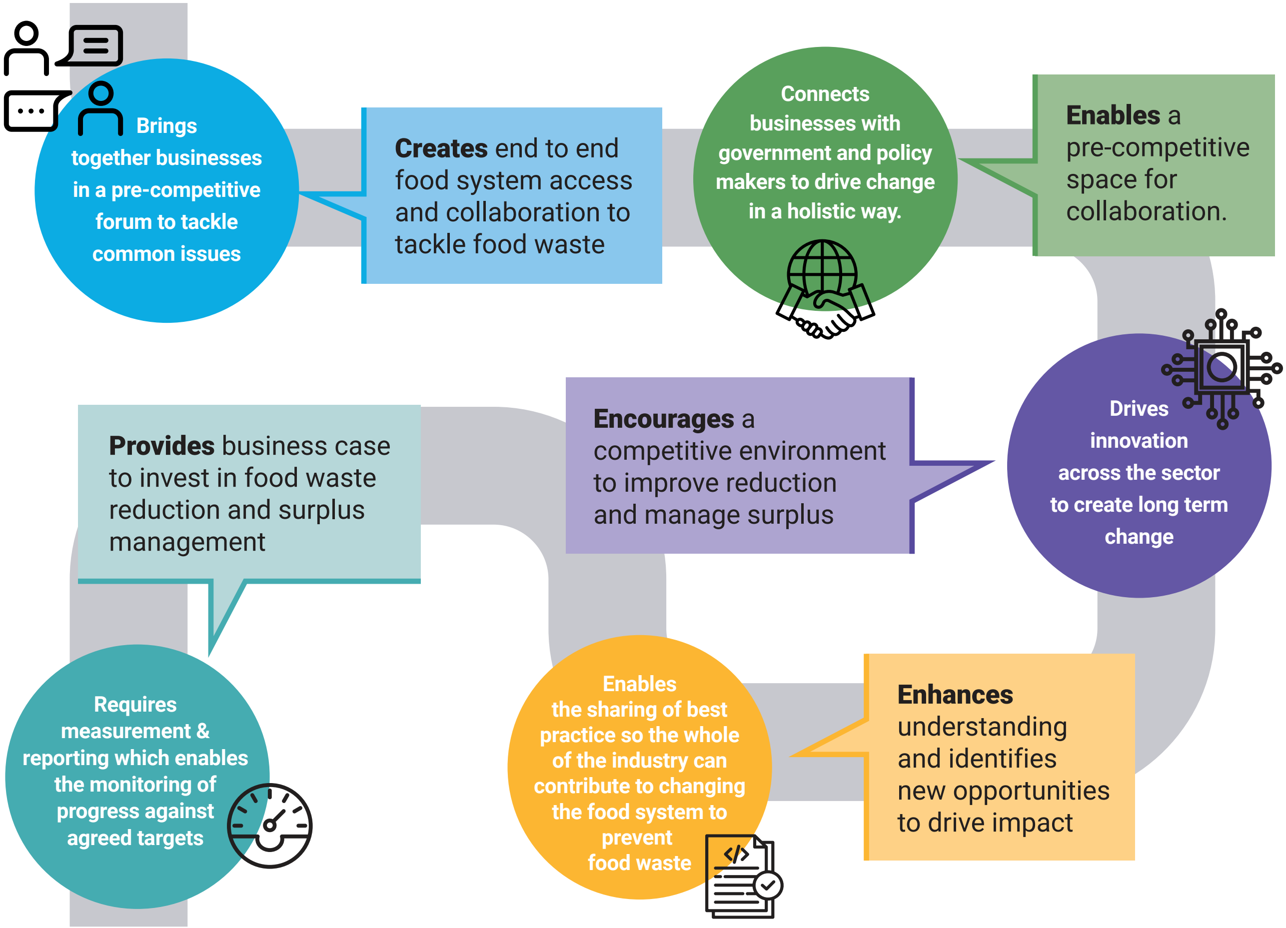
Reported impact: Signatory food waste measurement established and comparative assessment of annual data is under way and will be reported.

This section outlines an introduction to PPPs and how they can be a solution to reduce food waste. It presents a framework of how PPPs operate (section 4.1) and the various stakeholders (section 4.2), followed by a guide to implementing PPPs (section 4.3).

4.1 The public-private partnership model

By working together to achieve collective goals, organizations from across the food and drink sector can learn from each other, collaborate, and deliver change in the most efficient and effective way (REFRESH 2021). The PPP model, done well, has a number of qualities that enable and drive collaborative impact, displayed in Figure 27.

Figure 27: Qualities of the public-private partnership model

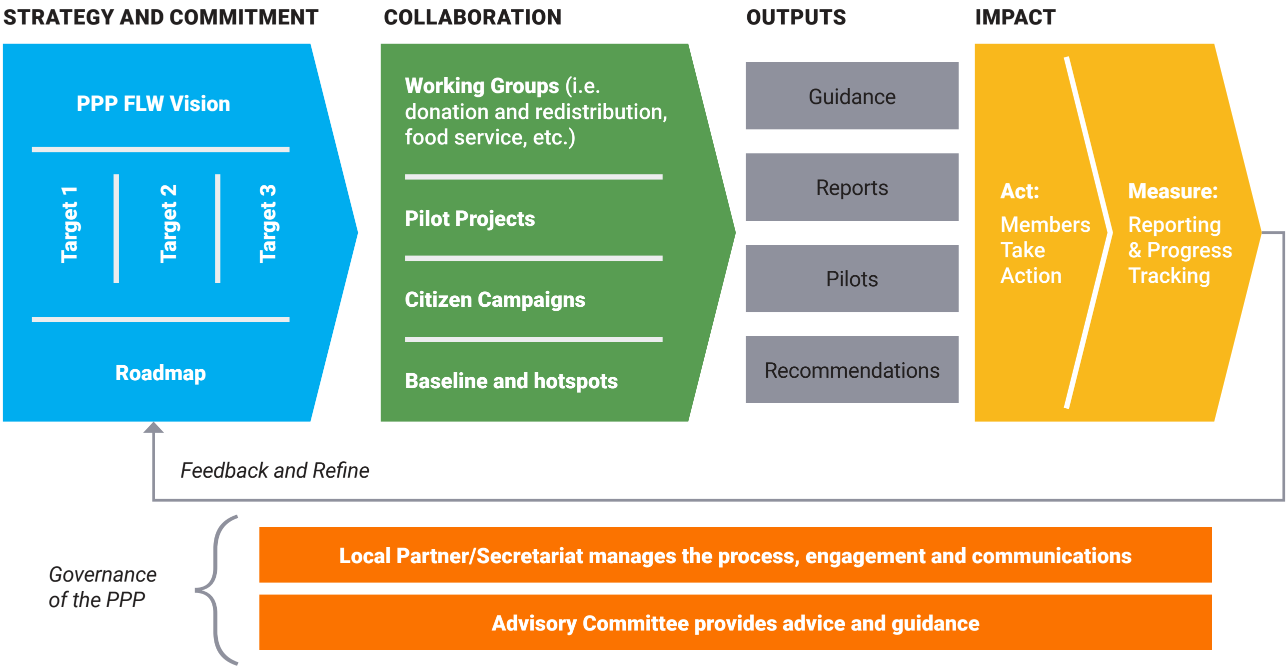


Authors' elaboration.

The framework of a PPP addressing food surplus, loss and waste is presented in Figure 28. This is based on research carried out in multiple countries and uses the "Target, Measure, Act" approach (Flanagan, Robertson and Hanson 2019). This sets clear targets, ensures that signatories measure food loss and waste using a common methodology and acts to reduce food loss and waste. The framework encompasses four complementary parts that can be tailored to the local context:

- **Strategy and commitment:** The aims and objectives of the PPP are underpinned by agreed collective targets, such as a commitment to delivering SDG 12.3 and a delivery roadmap to ensure the targets can be achieved.
- **Collaborative activity:** The delivery roadmap will detail what interventions are required to achieve the targets; this will include members' individual contribution and collaborative effort through action-oriented working groups, projects, campaigns and reporting.
- **Outputs:** All PPP activity is designed to support the delivery of targets. Outputs might include guidance and reports to support wide adoption, pilot activity to test and develop approaches within the local context, and the provision of industry recommendations.
- **Impact:** The best practice generated and shared, supported with technical assistance, provides members with the inspiration, confidence and commitment to act. The impact of these actions are captured on an annual basis to inform progress of the overall vision.

Figure 28: Framework for food waste public-private partnership

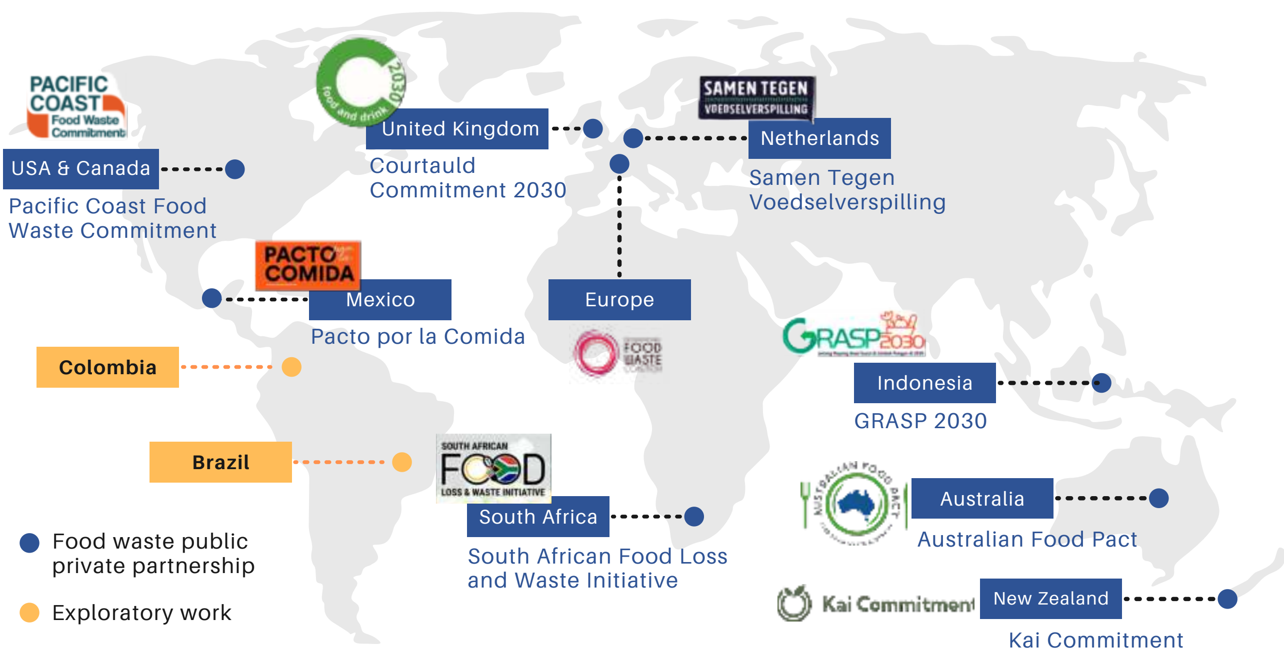


Authors' elaboration.

The model is designed to drive continuous improvement through regular review and refinement to ensure that impact is maximized. This is delivered through a governance structure, guided by representatives across the food system, or sectors relevant to the PPP.

The PPP model has been adopted across the world. To date, initiatives are established in six continents (Figure 29), with others in development.

Figure 29: Food waste public-private partnerships and exploratory work across the world



4.2 Stakeholders

A PPP is collaborative action towards a shared goal; therefore, stakeholders must work together to ensure the PPP's success. In the current context, food and drink organizations are at the heart of the PPP, although the public sector also has a role to play. This section discusses the role and responsibilities of different stakeholders and relevant examples.

Private sector

From inception, PPPs are shaped by the signatories, through agreeing on collective targets. PPPs should then evolve as the signatory base grows. Successful PPPs enlist organizations throughout the supply chain including manufacturers, retailers, wholesalers, food service organizations, waste management companies, trade bodies, agricultural businesses and farmers. In addition to ensuring that members span the food supply chain, recruitment should be carefully planned and strategic. Recruiting high-profile organizations can build confidence in the agreement and attract additional members.

Businesses should fully participate and engage with existing agreements in their countries of operation and incorporate the most impactful changes identified through the work of those agreements. Where there is not yet an agreement, businesses can demonstrate leadership in delivering SDG 12.3 by proactively encouraging the formation of one, engaging with government, their peers and global experts such as UNEP and WRAP to establish an agreement in line with the best global models.

Fundamentally, PPPs will not exist without a continuous, stable source of funding, and signatory contributions (membership fees) are a key component of the mixed funding model for PPPs. The business cost should be seen as an investment, with the financial benefit outweighing the cost. Research has suggested that for every $1 invested in food loss and waste reduction, a $14 return can be achieved (Hanson and Mitchell 2017).

Companies are using innovative solutions to transform food waste into a business opportunity. In the Australian Food Pact, Kerry Group is working with the PPP to identify food surplus for certified food "upcycling." The membership fees should be established in consultation with stakeholders and be appropriate to the resource required for delivery and the value delivered. Annex 1 (Business Case Study) provides an assessment of benefits and added value associated with being a PPP signatory, based on evaluation of Courtauld Commitment signatories from across the food supply chain.

Public sector

PPPs also require government collaboration and support. How governments can engage with PPPs can be multifaceted but can include providing an evidence base to support the creation of a PPP, bringing organizations together to build and maintain a PPP and by providing funding support. In regard to funding, research has suggested that PPPs with financial support from governments as well as private members are more likely to be stable and effective, as PPPs that are solely privately funded are at risk of being designed to accommodate the priorities of the largest funders (Pitas *et al*. 2018). Aligning the objectives of a PPP with government policy can also lead to quicker implementation and greater impact (REFRESH 2021).

Governments have much to gain from the PPP model in terms of savings, operational sustainability and food security. PPPs can deliver significant carbon benefits so help to meet greenhouse gas policy objectives; they also help to reduce costs of waste disposal for cities. Governments and jurisdictions have gained significant benefits from supporting the PPPs in their locality, and could seek to assign budget of the scale needed to deliver on SDG 12.3. The return on investment financially, socially and environmentally is compelling.

Food PPPs often span multiple government departments, for example food, environment, food safety, health agriculture, economy, competition and consumer protection. It is important to map the government stakeholders and to undertake cross-sector engagement to develop interest and responsibility for the PPP. This process has already started as part of the exploratory work in Colombia and Brazil (section 4.2). Government departments and jurisdictions in geographies with an existing PPP, or exploratory work on developing a PPP, should engage with this process. Where a PPP is not yet in development, through dialogue with UNEP, a pathway to implementation can be established, appropriate to the country context.

Third parties

Third parties such as non-governmental organizations, trade associations and research organizations often also play a key role in PPPs and can increase the credibility of a PPP (Bryden *et al.* 2013). Third-party bodies can be set up specifically to deliver a PPP; they do not need to be existing organization. Researchers and academia can have an important role in the creation and delivery of PPPs, sitting on working groups or committees. The responsibilities of a third party vary and can include negotiation, implementation and administration. The benefit of a third-party intermediary is that they are neutral, providing integrity, and can offer independent advice that is confidential and does not have competing interests.

An example of third-party collaboration is the PPP Samen Tegen Voedselverspilling foundation (Together Against Food Waste) in the Netherlands. The Samen Tegen Voedselverspilling foundation facilitates collaboration among companies, knowledge institutions governments and citizens; implementing initiatives to decrease food waste at restaurants and retail establishments, boost food redistribution operations, and decrease food waste at homes.

4.3 Implementing a public-private partnership

Developing a public-private partnership: Five-step model

There are five key steps to develop an effective PPP, shown in Figure 30. This five-step model is taken from the REFRESH research project (REFRESH 2021). This section discusses each step in turn.

Figure 30: Five key steps for developing a public-private partnership

Step 1: Initiation and set-up

An initial exploratory study is undertaken to assess the readiness and willingness of stakeholders to develop a PPP. The study will gather data to understand the local context and map key stakeholders and current policies. This stage is described in more detail in REFRESH (2021).

From this, an implementation plan should then be developed that details the:

- Vision and purpose for the PPP
- Trajectory of food surplus, loss and waste reduction required over the PPP
- Commitment required from signatories
- Types of signatories needed
- Priority collaborative working groups and
- Timeline of key delivery milestones, including launch and establishing the baseline.

In establishing the vision and purpose, the scope of the PPP is defined. The reduction of food waste may not be the only priority of the PPP. It could also act as a body to support improving food security through production and distribution, or as a forum for improving standardization in other areas such as greenhouse gas quantification and reporting in the food and drink sector. It should reflect local priorities. Engagement with government, whether national or local, is often important as the PPP can be a cost-effective way to make progress towards policy goals.

Step 2: Ambitions, goals and targets

Next, the ambition and target of the PPP should be determined. It is common to use SDG 12.3 as the benchmark for action, with PPPs contributing to the target of halving per capita food waste at the retail and consumer levels and reducing food losses along production and supply chains.

To meet this target, collaborative and concerted efforts to reduce food waste are required. Each business will want to assess what target will be achievable in its own operations, and understand how the waste that it generates contributes to the national targets and SDG 12.3. Setting reduction targets in line with SDG 12.3, i.e. 50 per cent reductions, is a simple way for a business or industry to be confident in its contribution.

Businesses are then encouraged to help their suppliers and customers to reduce food waste. Retailers and wholesalers in particular can have a substantial influence both on upstream losses in agriculture and downstream waste in consumer homes. For example, the Champions 12.3 "10 x 20 x 30" initiative involves food retailers each engaging 20 of their priority suppliers on food loss and waste (Champions 12.3 2019).

Step 3: Governance and funding

Successful PPPs need a strong governance structure, which should include a Steering Committee and a Secretariat, to organize and run key activities including working groups, technical projects, monitoring and reporting, and communications and events.

The Steering Committee, sometimes called an Advisory Group, provides oversight, advice and insights to guide the successful delivery of the PPP targets. It reviews and agrees on the overarching work programme and its outputs with the aim to ensure sufficient progress towards the PPP's targets. The Secretariat establishes and maintains the governance structures for the PPP. It also provides the day-to-day management of resources and structures required to co-ordinate and run the PPP. The Secretariat needs to be an independent, neutral entity to coordinate and retain the trust of signatories. Running a public-private partnership is a large undertaking and requires a wide variety of specialist skills, including project management, account management and communications.

Step 4: Establishing actions

As outlined in REFRESH (2021), the PPP should research existing initiatives and undertake a gap analysis to identify where most food waste arises and where it has the greatest environmental and economic impact. The research conducted in the formation of a national food waste baseline for SDG 12.3 reporting (see chapter 3) will be useful in informing this analysis. This research can be used to develop a roadmap or overarching delivery plan for the PPP that will inform the themes for the working groups and provide guidance to signatories.

Businesses committing to PPPs are required to develop and implement a realistic Action Plan to deliver the target on food waste reduction. The agreed actions must focus on delivering the targets of the PPP and tackle identified hotspots.

There are three key action areas for each business:

- Own Operations – strategic, operations, staff;
- Customer/Consumer Engagement – at home and out of home, where relevant; and
- Supply Chain Engagement – upstream and downstream of the business.

It is recommended that signatories undertake or develop a minimum of three actions over a period of six months. Following the initial six-month period, the signatory should review and provide evidence to the PPP, then (once the action has been achieved) select a further three actions as part of the continuous improvement cycle.

Step 5: Measurement and evaluation

Anonymized and aggregated progress towards targets is captured from businesses and published annually by the PPP in order to provide a public record of the collective action taken by the membership and the overall impact of the PPP. All public reporting of progress is dependent on meeting thresholds for anonymity, such as market share and number of reporting entities. Measurement and reporting activities by the PPP include:

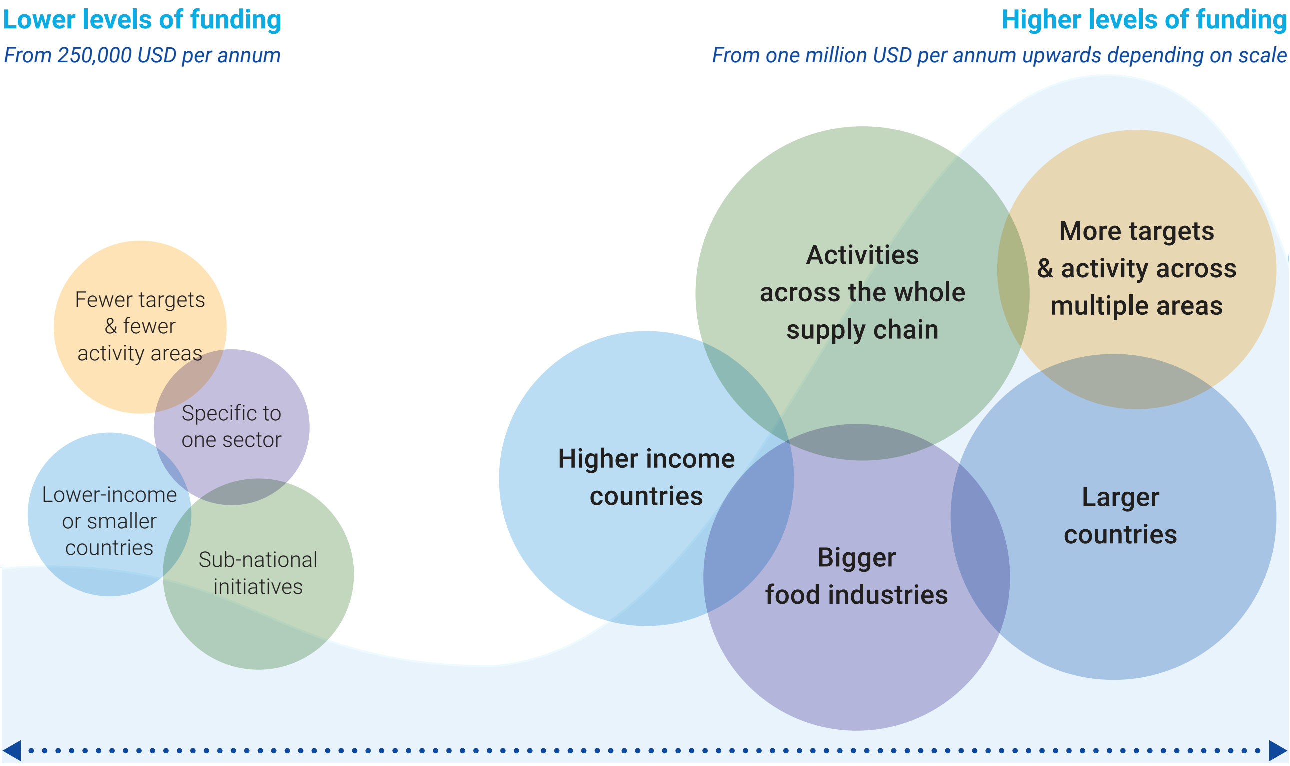
- Developing measurement and reporting tools, resources and systems
- Establishing a baseline against which progress is measured
- Collecting and processing data required to track progress and impact
- Trouble-shooting with signatories to help ensure timely, accurate data collection
- Analysing results for publication in the Annual Progress Report and using analysed results to inform signatory technical support projects.

As discussed in section 3.2, data reporting by a sufficiently large market share of a subsector through a PPP (typically > 50 per cent) could be used to inform national food waste estimates and SDG 12.3 reporting. There are therefore opportunities for synergies between PPP activities and government SDG reporting.

Financing a public-private partnership

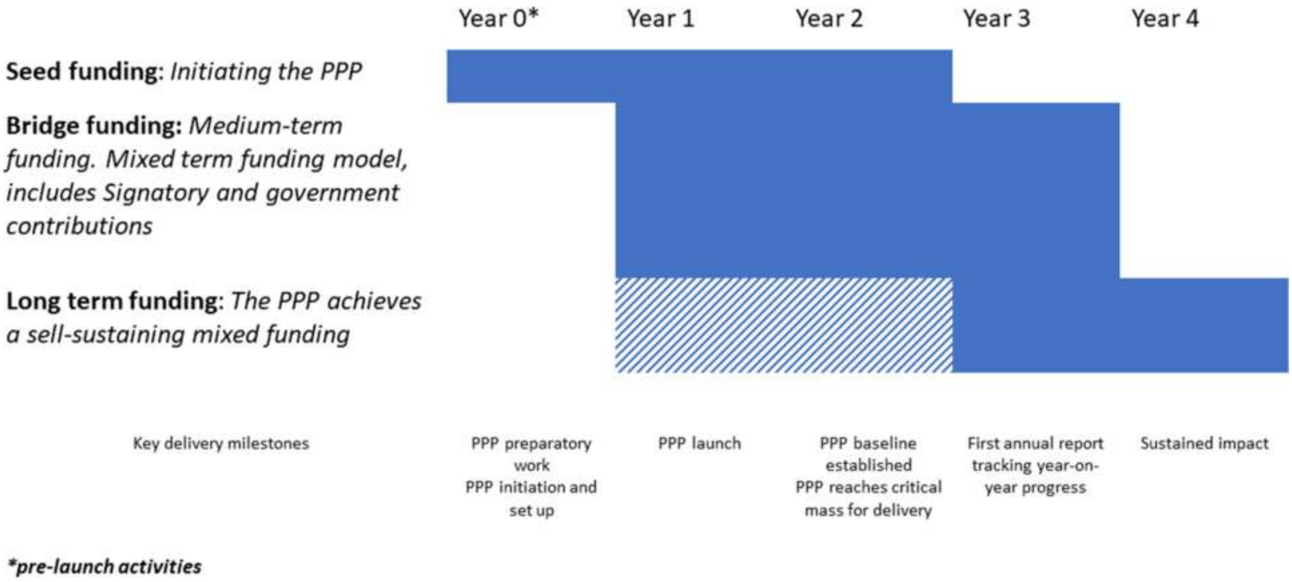
The PPP model is a proven delivery mechanism for reducing food waste and achieving SDG target 12.3. However, the model can only be successful with appropriate financial backing to enable the activity to accelerate and scale. What "appropriate" financial backing is will depend on local circumstances and the scope and ambition of the PPP in question. In broad terms, PPPs in larger countries or those with bigger agri-food industries, such as major exporting countries, and PPPs that seek to address multiple issues across the whole supply chain will require more funding than those in smaller, lower-income countries or with a more restricted scope (Figure 31).

Figure 31: Illustrative figure of lower- and higher-level PPP funding and the situations in which they might apply



With the urgency to deliver SDG 12.3 and the scale of action required within the time available, PPP funding needs to match ambition. Responsibility for funding need to be a shared responsibility and consider multiple sources that may evolve over time. Figure 32 shows an indicative example of what a financially viable PPP funding model could look like, and this section briefly considers how this can be achieved.

Figure 32: Overview of funding requirements and key milestones



Seed funding is the financing required for the initiation and set-up phase. The purpose of this phase is to establish a strong value proposition that will appeal to other funders. Therefore, the seed funding should be used to develop the exploratory study, implementation plan and approach to recruitment (Step 1 of the five-step model). There are a number of possible avenues for seed funding, not all of which will be appropriate for all markets.

- Government actors often play a role in seed funding due to the potential of PPPs to leverage private sector resources towards delivering social and policy objectives. However, reliance on government funding may leave the PPP vulnerable to competing policy priorities or changing governments.
- International organizations and international aid or development funding can also play a role in some markets, particularly if a food waste PPP has a focus on redistribution and alleviating food security.
- Trusts and foundations can be another source of seed funding, especially if their objectives align with the PPP, although it can be an unpredictable source of funding that does not always fit the scope and time frame of what is needed to deliver a PPP.
- Private sector funders could be appropriate in some cases. Reaching this funding opportunity may require re-framing the objectives of the PPP to better appeal to their objectives. For instance, the measurement and reporting of food waste in a PPP involves upskilling a cohort of businesses, with food waste reduction carrying financial, social and environmental benefits to those businesses.

This is not an exhaustive list, and some of these funders may also be appropriate for **bridge** and **long-term** funding depending on the local context. Table 39 provides some international examples.

Table 39: Seed funding used to develop existing food waste reduction public-private partnerships

PPP COUNTRY	SEED FUNDING SOURCE
	Australian Government
	International organization: P4G Private sector: Avery Dennison
	International organization: P4G Trust and foundations: Roddenberry Foundation
	International organization: P4G and SA-EU Dialogue Facility Trade association: Consumer Goods Council of South Africa (CGCSA)
	New Zealand Government
	UK Government

Bridge funding involves the development of a mixed funding model as the PPP moves from initiation to delivery. Here, seed funding is replaced by a consistent operational budget higher than the seed funding. The two stakeholders with arguably the most to gain from the PPP model in terms of savings, operational sustainability and food security are governments and businesses, and it is from these sources that much of the bridge funding is likely to come.

For governments, the PPP's operation and associated food loss and waste reduction can be a cost-effective way of delivering on social and environmental objectives. Socioeconomic benefits could include increased redistribution of surplus food to alleviate food insecurity, or the development of jobs and industry in food surplus upcycling and waste recycling. Food waste has all of the environmental impact of food, without any of the benefits of people being fed, so environmental benefits from food waste reduction could include the reduction of greenhouse gas emissions, land use and water consumption from the production of food that is not consumed, as well as a reduction in methane emissions from organic waste going to landfill, contributing to the delivery of "pathways" under the Global Methane Pledge.[25]

Businesses that are part of the PPP, termed signatories, would make contributions that support the long-term financial stability of the PPP. It is therefore important to establish the concept of business contributions from launch, as introducing fees at a later stage could risk resistance from the business signatory and detract from delivery and impact. The contribution of specific businesses would be locally determined and should be fair to businesses of very different sizes, such as by being based on sales turnover in the relevant market. All businesses in the PPP benefit from reducing their own costs, learning from the collective experience of businesses in the PPP as well as improving their image and reputation. For businesses, therefore, funding and engaging with a PPP is an investment in their sustainability.

Long-term funding will build on the bridge funding. A large, committed signatory base will be important in providing long-term stability, as will diversified sources of funding (national government, municipal governments, international financing, etc.). A diversified funding model is the most resilient, to protect against changes with any one funding source, such as a change of government. Additional external "seed" funding could be used in an established PPP should the partnership expand its scope, to cover more sectors in the food supply chain, or a wider range of topics beyond food waste reduction.

25 https://www.globalmethanepledge.org

Examples: Brazil and Colombia

An international network of PPPs could play an important role in delivering SDG 12.3, securing and enabling collaborative action from respective food system stakeholders. UNEP has provided seed funding to conduct exploratory work for establishing PPPs in Brazil and Colombia, which is summarized here to demonstrate the sorts of information needed to investigate the feasibility of a PPP.

Brazil

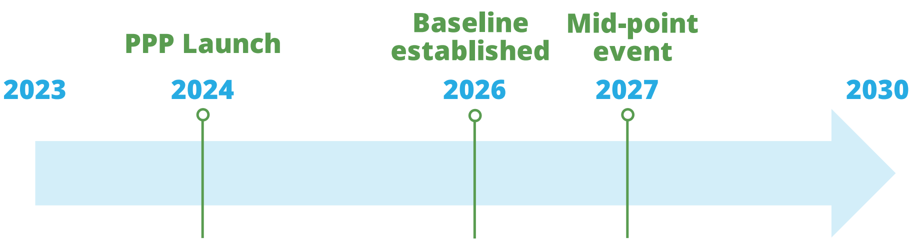
- **Understanding the context:** The average annual amount of food loss and waste in Brazil is unknown, with estimates varying from 23 million tonnes (Canatella 2021) to 82.1 million tonnes (Dal' Magro and Talamini 2019). A household food waste baseline is being developed in 2024.
- **Understanding the initiative's landscape:** An opportunity to advance action on SDG 12.3 given revision of the Intersectoral strategy on Food Loss and Waste in 2024 and the new Organic Waste Strategy.
- **Understanding the requirements:** Consistent data on food loss and waste across value chains would support systemic action. The PPP must avoid replicating existing work on food redistribution and donation and support connections among stakeholders that already work together in Brazil.
- **Understanding the potential participants:** A number of multinational food businesses operate in Brazil alongside major domestic businesses across the supply chain. There are existing coalitions working on hunger relief and/or food waste mitigation such as Pacto Contra a Fome and Todos à Mesa, and a PPP could offer the opportunity to join efforts and amplify their impacts.
- **Understanding the funding:** The suggested seed funding required for the Brazil Food Waste PPP is around $500,000 to launch, mobilize the agreement and establish the baseline over a two-year period. For the agreement to reach its full potential, the aim should be to secure funding in the region of $1-2 million per year, depending on the scope of the PPP. Part of this funding would be leveraged through signatory contributions (food businesses) when the PPP launches.

Colombia

- **Understanding the context:** New research is required to gain more up-to-date understanding and insight into the causes and extent of food loss and waste. Most of the quoted food waste data is based on a 2012 FAO report, which is based on a 2010 food census that 33 per cent food is lost post-harvest (12 per cent waste and 21 per cent loss) (DNP 2016).
- **Understanding the initiative's landscape:** The government has made efforts through policies and programmes aimed at reducing food loss and waste, particularly the recent Law 1990, 2019 "anti-desperdicio" ("anti-food waste"), which is still being regulated, and no major progress has been made to date. The private sector participates in other food programmes and initiatives, primarily on food donation, and major businesses are part of some international agreements and commitments, although there is a lack of a holistic approach that enables systemic changes in the food value chain.
- **Understanding the requirements:** Stakeholders consulted believe that a food waste PPP would be an appropriate and needed approach for Colombia to reduce food loss and waste. Brands and retailers indicated that they would welcome an initiative that aligns with and builds from what is already happening, avoiding duplication of efforts.
- **Understanding the potential participants:** A number of multinational food businesses operate in Colombia, alongside major domestic businesses across the supply chain.
- **Understanding the funding:** The funding recommendations provided for Brazil above also apply for Colombia.

The agreements in Brazil and Colombia will follow similar timescales as set out in Figure 33, subject to confirmation of funding.

Figure 33: Timescale for Brazil and Colombia public-private partnership



Securing funding is the most critical element to establishing the agreements in Brazil and Colombia. Commitment of business contribution fees from the outset will enable the PPP coordinator to focus effort on delivering the agreement.

For both food waste PPPs to effectively establish and scale, the following best practice should be followed:

- Develop a compelling business case for signatory participation, clearly demonstrating the unique qualities of the agreement and alignment with other initiatives.
- Develop an agreement offer that will attract targeted stakeholders, deliver impact and demonstrate value.
- Establish clear governance with responsibilities of public agents and actors involved to avoid working in silos or lack of clarity as to which ministry or government entity holds responsibility for the partnership.
- Develop a governance structure for how interaction with the private sector takes place to ensure a minimization of conflicts of interest.
- Develop a communications strategy to support the recruitment and development of the agreement.
- Undertake a holistic approach to recruitment, investing time in both public and private sector targets to enable a representative signatory base to form. For private sector targets, the priority is large, influential businesses within the geographical context.
- Develop a signatory onboarding programme to enable recruited stakeholders to turn their commitment to action. This demonstrates to prospective signatories what they can expect.
- Ensure that the agreement delivery team has the resource and technical capacity to deliver the calendar of activity effectively.
- Utilize the wealth of experience and insights from the international network of food waste PPPs – that is, approaches to enable signatories to enable "Target, Measure, Act."

The most critical aspect for implementing public-private partnerships in Brazil and Colombia – or indeed any market – is to engage with potential funders to secure the long-term financial sustainability for the agreement. With funding and backing of local stakeholders, the exploratory work can recruit a local coordinator and continue to scope and develop the PPP with a view to launching in 2024. It is hoped that other new PPPs will be able to follow in close succession.

4.4 Conclusion

The complex challenge of food loss and waste requires a systemic approach. Effective collaboration through a public-private partnership is one potential solution to the reduction of food loss and waste, alleviation of food insecurity and delivery of environmental benefits. To take a collective approach is to recognize that no one actor can solve the problem alone, and that collaboration can create a movement that is more than the sum of its parts.

Box 17: Exploring the intersection between food waste and justice, equity, diversity and inclusion

Food waste reduction efforts often intersect with justice, equity, diversity and inclusion issues. As public-private partnerships work to reduce food waste, it is important that transitions are equitable and inclusive for both consumers and change agents alike. Research into this area is limited; therefore this box does not aim to explore all the inequalities that people may face in reducing food waste globally. A recent publication by U.S.-based nonprofit ReFED is helping to shape the discussion and informs this piece (Herd, Costantino and Leslie 2023).

Change agents

Frontline workers in all sectors of the food system are frequently responsible for implementing food waste reduction interventions, yet they often face systemic inequalities. These inequalities include poor or unsafe working conditions, receiving low wages for long or unsociable working hours, limited benefits and lack of opportunities for progression. Due to working conditions that prioritize efficiency or maximum output, those on the frontline are often unable, or unmotivated, to implement best practices to mitigate food waste generation.

This can be exacerbated for women, as a significant proportion of roles within the food system are held by women, both formally and informally and their working conditions tend to be worse than those experienced by men (FAO 2023b). Improving working conditions, working with employees to develop solutions based on their first-hand experience, and rewarding positive action may empower and enable frontline workers to deliver food waste reductions.

Regarding executive and leadership roles, there is evidence that start-ups and nonprofits with leaders from marginalized groups receive less investment and grant funding (Herd, Costantino and Leslie 2023). Excluding ideas and innovation from proportion s of the population is likely to exclude impactful solutions. Further, only investing in non-marginalized groups risks developing and implementing interventions that only resonate with a proportion of the population.

Consumers

Food donation is an important near-term fix for food waste, as it allows surplus food that would have become waste to be redistributed to people, oftentimes to those who are food insecure (although food sharing models exist that make surpluses available to all, often purchased at a discounted price). Often, donated items are those that are at risk of becoming waste in the short term, i.e. products with short remaining shelf lives, so may not always be appropriate to the recipient. For instance, food may not be dietarily, culturally or religiously appropriate. There is evidence that a significant proportion of people with disabilities use food banks or food assistance (Loopstra and Lalor 2017), therefore those with disabilities are more likely to suffer the lack of dignity that is associated with freedom of choice.

These challenges can be redressed by service design: solutions such as social supermarkets, often set up like a traditional food retail outlet allowing those in need to choose items from shelves for a heavily discounted price, rather than receiving a predetermined food parcel, are common practice in some countries. Social supermarkets can also afford dignity through reserved time slots by appointment. This would allow marginalized groups, such as senior citizens who are an overrepresented population among food donation recipients, to have priority. As with other food assistance programmes, social supermarkets utilize surplus items that would have become waste. This model gives consumers choice and can in turn lead to reductions in household food waste (Knežević, Škrobot and Žmuk 2021). Another consideration should be location, to avoid food banks or other food assistance programmes being placed in inaccessible locations, with limited public transport links.

Significant proportions of food waste occur at the household level (estimated as 60 per cent in 2022, see section 1.5) across all income levels. Ensuring that lower-income households in particular have the food management skills to use up all their food could help them stretch their budgets. Consumer education interventions must be designed to be inclusive for all, considering cultural appropriateness, language and accessibility of information. In mixed-gender households, women are more frequently responsible for food management (Cantaragiu 2019). Efforts to reduce household food waste are likely to increase the domestic workload for women, resulting in feelings of guilt when food is wasted (Fraser and Parizeau 2018). Therefore, when designing household food waste interventions there should be consideration not to exacerbate gender inequalities.

05 Conclusions

Food waste is an economic, environmental and social problem. Reducing food waste is an opportunity to reduce costs and tackle some of the biggest environmental and social issues of our time: fighting climate change and addressing food insecurity.

The *Food Waste Index Report 2024* builds on the *Food Waste Index Report 2021* by presenting the state of data measuring food waste in retail, food service and household settings. It expands on the measurement methodology outlined in the 2021 report to provide additional guidance for countries establishing food waste baselines so that they can approach food waste using the "Target, Measure, Act" approach. Finally, it looks at solutions, providing an explanation of how public-private partnerships are structured and the important role they can play in navigating food waste reduction across multiple, diverse sectors.

A clear thread is common throughout: the importance of collective effort. The evidence in chapter 1 strongly suggests that household food waste is a worldwide problem. Although more data is required to understand how much of this food waste was edible parts, if even just 25 per cent was edible (a very conservative assessment, lower than any of the observed rates of edibility from countries where it has been measured), then across the world the equivalent of 1 billion meals of edible food is being thrown away by households every single day. This is likely to be a minimum estimate, and the real amount could be much higher. The problem is everywhere and requires solutions everywhere. Governments across the globe, cities, municipalities and food business of all sizes have a role to play in working collaboratively to reduce food waste and help householders to act.

The "Solutions Focus" in chapter 4 showed what working collaboratively can look like in action. The public-private partnership model is an established one with a proven track record of delivering food waste reductions. A partnership that works towards a shared goal can overcome the complexities and challenges of coordination across multiple sectors. Halving food waste is a job too large for any one stakeholder, but it can be achieved through concerted, collaborative effort. We all have a role to play.

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Annex 1: Business case study

A WRAP assessment of what Courtauld Commitment signatories (across food sectors) value from being part of public-private partnerships (PPPs) is detailed below:

AREA	IDENTIFIED VALUE
Financial return on investment (£ contribution and time), increasing profitability.	• Get help in identifying what I can do differently on waste reduction and management to cut costs; show me the return on investment for specific actions that I can take. • Share costs (with other businesses and with governments) to tackle an issue that my business would otherwise need to solve on its own (at much higher cost) and influence the selection of issues that will be tackled. • Share insights with my peer group (while complying with Competition Law) to provide a cost-effective way of solving my practical problems; under the rules of a PPP, I can meet my competitors to share and learn. • Be able to quantify the most effective interventions for my business to invest in and be able to measure and benchmark my progress (using robust tools and data provided by the PPP). • Consistent action across my peer group (convened by the PPP achieves influence with suppliers to get them to reduce their waste and hence costs. • Collective action across the whole chain delivers efficiencies (whole system change) that as an individual business I lack the power to achieve. • Get some bespoke technical advice on my options and access to WRAP's expertise. • Help me understand how to make advance changes that will minimize my exposure to future taxes.
Mitigating reputational risks.	• Increase the visibility of my actions to help mitigate risks from stakeholder scrutiny; get recognition for acting on the global challenges and goals (in my own business and by helping citizens); reinforce/protect my corporate reputation and hence product sales. • Be able to measure and report the impact of my actions. • Gain the reputational benefit from public evidence that, as a PPP signatory, I out-perform my non-signatory peers. • Give me a badge (e.g. "Pact member") that I can use to claim corporate leadership (to staff, media, governments, consumers and shareholders) on a critical environmental and social issue.
Competitive advantage (or avoiding being left at a disadvantage).	• Use the same robust evidence to inform my future actions that is available to my peer group; share understanding by being at the same table; check/ benchmark my strategy against my peers. • Understand how the market is likely to develop and what changes I will need to make; help me identify my position (relative to others) and next steps on the journey/roadmap. • Help me engage my citizen customers in the most effective way to benefit them and hence win me brand loyalty; give me low-cost access to tailored explanation of consumer insights that will inform my marketing campaigns. • Show me that my actions in the United Kingdom will be consistent with likely developments globally (so that I can roll out common solutions across my global business).
Regulatory compliance.	• Avoid imposition of onerous new regulations if government treats the PPP as "voluntary regulation" and I am seen to deliver against government policy objectives. • Understand the roadmap of what my business needs to do to navigate complex future policy developments; be able to hear directly from government policy leads.
Corporate objectives / personal objectives of sustainability lead.	• Help me meet my own corporate responsibility objectives (which align with PPP objectives). • Help me (as sustainability lead) to gain buy-in elsewhere in my business, by helping me engage other teams and senior managers. • Tell me clearly what my business needs to do to meet expected policy and market changes. • Help me develop my future corporate strategy on sustainability.

The values identified are transferable around the world and have been recognized in other food waste PPPs. The rationale for multinational businesses to participate with numerous food waste PPPs in the countries in which they operate are:

- Recognition that a market within business is leading on food loss and waste as a result of PPPs.
- Value attained from initial PPP engagement.
- Recognition of PPPs as a mechanism to shape and deliver global corporate strategy.
- Ability to leverage impact through collaboration.
- Enabling best practice to be widely created, shared and adopted within business.
- Delivering on global customer expectations and mitigating external international pressures.

Internally, multinational businesses make an informed decision to partake in numerous food waste PPPs by:

- Sharing insights, experiences and outputs of PPP engagement between markets.
- Assessing delivery of corporate strategy and local market ambitions.
- Assessing technical and resource requirements to tackle food loss and waste and partake in PPPs.
- Assessing value and benefits (environmental, social and financial) within local context.
- Speaking with suppliers and local food system stakeholders to determine external insight.

Around the world, retention of food waste PPP signatories is high (around 90 per cent on average), demonstrating that those that engage are committed for the long term with value sustained. Against the UN SDG 12.3 target, multinational businesses need to demonstrate leadership on tackling food loss and waste by engaging in developing and established PPPs in each country in which they operate. This will influence supplier participation in each country and enhance the collaborative effort within the local setting.

Annex 2: Table of datapoints

Household datapoints

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Alayam 2018)	Bahrain		The source link is to a newspaper that which refers to a report by the Center for Waste Management. The original report could not be found. However, the infographic (clearly copied from the original report) and the article make clear that a waste compositional analysis was undertaken, referring to the sorting of "huge quantities of household waste collected from the various region of Bahrain." The inability to find the source paper means we cannot have high confidence in the results.
(Salam et al. 2012)	Bangladesh	Chittagong	55 households in five different socioeconomic groups across three different areas had their waste sampled daily, using plastic bags provided to them. It was unclear for how long the sampling ran for each household. This small sample size and unknown duration means we cannot have high confidence.
(Sujauddin, Huda and Hoque 2008)	Bangladesh	Chittagong	75 households across five socioeconomic groups in the Rahman Nagar Residential Area had their waste sampled. The length of sampling is unknown. The small sample with unknown duration means we cannot have high confidence in the results.
(Inter-American Development Bank [IDB] 2011)	Belize	San Ignacio / Santa Elena	174 households across three socioeconomic groups had their waste sampled, with at least 100 kilograms collected each sampling day. Measurement was for eight days.
(IDB 2011)	Belize	Caye Caulker	132 households across three socioeconomic groups had their waste sampled, with at least 100 kilograms collected each sampling day. Measurement was for eight days.
(IDB 2011)	Belize	San Pedro	169 households across three socioeconomic groups had their waste sampled, with at least 100 kilograms collected each sampling day. Measurement was for eight days.
(IDB 2011)	Belize	Belize City	183 households across three socioeconomic groups had their waste sampled, with at least 100 kilograms collected each sampling day. Measurement was for eight days.
(Environment and Climate Change Canada 2019)	Canada		56 different waste compositional analyses studies were analysed and averaged to form a national average. The studies analysed involved a mixture of analysis at curbside and at sorting facilities. The share that is food waste was multiplied by the total residential waste to form a food waste estimate.
(Gu et al. 2015)	China	Suzhou	140 households participated in a compositional analysis. This involved their waste being collected each day for a week, and was repeated in each season. They also completed a survey. The household sizes are considered representative of the wider city.
(Lo and Woon 2016)	China, Hong Kong Special Administrative Region	Hong Kong	The paper cites the Hong Kong Environment Bureau's official statistics. It is assumed to be from Waste Compositional Analysis but is not made explicit, nor were other details of the method provided (such as sample).
(Qu et al. 2009)	China	Beijing	113 households across six districts in Beijing city had their waste collected and analysed daily for a period of 10 days.
(Zhang et al. 2020)	China	Urban China total	The household estimate uses a huge range of local municipal solid waste (MSW) figures and studies, estimating the share of household food waste in the entire MSW. 196 samples were obtained from the literature across 2001-2016. (Supplementary Info, Table S21-2). All literature values cited reported the value of Household Food Waste in MSW, although it is unclear how it was disaggregated if samples were taken at landfill or transport sites. The per capita figure only applies to the urban population, as this was where the study was concentrated.
(JICA 2013a)	Colombia	Bogota	The paper cites 3,259 samples, although it is unclear if this is referring to households or individuals, taken across a single 24-hour period, across 19 localities and 6 socioeconomic categories. While the duration of sampling was small, the size was considered to compensate for this.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Assefa 2017)	Ethiopia	Laga Tafo Laga Dadi town, Oromia	Bags were distributed to 92 "residential households" in Laga Tafo Laga Dadi (sometimes written Legetafo Legedadi) town, in a small area on the outskirts of Addis Ababa, for waste collection and sorting every day. From this waste compositional data, food waste can be derived. It is unclear for how long this compositional analysis took place. Note: different "residential" groups are included in the paper, including "real estate residential" and "ropack village residential." Due to some confusion over the terminology and these types having very high bone waste, only "residential households" were considered here.
(Denafas et al. 2014)	Georgia	Kutaisi	Each month for a period of a year, 400-600 kilograms of residual waste from residential areas was taken and sorted. Compositional information combined with MSW data to understand total waste. The paper does specify these samples came from residential areas, but they were collected from waste trucks rather than homes directly, leading to some increased uncertainty.
(Miezah et al. 2015)	Ghana		1,014 households representing 6,083 people were randomly selected in 10 different districts across three socioeconomic groups (low, medium, high). The households were provided with two bags, one for biodegradable waste and one for other waste, and were taught how to separate accordingly. Employed sorters then collected and did further sorting and disaggregation between every two days and twice a week for a period of five weeks, including sorting the biodegradable waste into a food subcategory. The per capita figure taken is the average across the socioeconomic groups provided in the paper.
(Grover and Singh 2014)	India	Dehradun	144 households across three different socioeconomic groups in Dehradun city were given a large bag in which to dispose their waste, which was then sorted and classified. It is unclear for how long the survey took place, so is assumed to have not met the "700 waste day" baseline and we therefore cannot have high confidence in the estimate.
(Ramakrishna 2016)	India	Rajam, Andhra Pradesh	25 households from 5 different segments of Rajam town were given two bags; one for wet and one for dry waste, collected each day. Participants segregated their waste for seven consecutive days, which was then taken for sorting.
(Suthar and Singh 2015)	India	Dehradun	144 households from 11 major blocks of Dehradun city were provided with waste bags in which to put their waste from a 24-hour period, which was then sorted and classified.
(Dhokhikah, Trihadiningrum and Sunaryo 2015)	Indonesia	Surabaya	100 households in Surabaya were provided with bags in which to put all of their daily waste for a period of 8 consecutive days. This was then collected and sorted, including into a separate food waste category.
(Al-Rawi and Al-Tayyar 2013)	Iraq	Mosul	60 households, 10 from each sector of Mosul, were given plastic bags and told to collect their waste over a 24-hour period. It is unclear if this was repeated for individual houses and for how many days, although the paper said the study period was between February and July, which would suggest it was repeated for households for some duration. A total of 1,680 solid waste samples were collected.
(Al-Mas'udi and Al-Haydari 2015)	Iraq	Karbala	70 households in Karbala were given plastic bags in which to put their waste from a 24-hour period. This was repeated once a month for three months in winter and three months in summer.
(Sulaymon, Ibraheem and Graimed 2010)	Iraq	Al-Kut City	80 households across three income groups in Al-Kut had their waste collected daily for a period of one week, which was repeated one week per month for seven months. While this is a large sample, there remains some uncertainty around definitions as to whether food or organic waste was measured, which could explain the substantial waste generation. As a result, we cannot have high confidence in the estimate.
(Yasir and Abudi 2009)	Iraq	Nassiriya	65 households representing 417 people across three income groups in Nassiriya were randomly selected. They were given plastic bags in which to put waste, which were collected daily and replaced over a period of seven months.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Elimelech, Ayalon and Ert 2018)	Israel	Haifa	192 households across three neighbourhoods in Eastern Haifa, primarily middle-class households, were provided with waste bags that were collected daily for the period of one week. Because the study was within a specific unrepresentative area, we only have medium confidence.
(JICA 2010)	Kenya	Nairobi	150 households were sampled across five income groups (High, Middle, Low-Middle, Low, Slum), which are grouped into three residential groups (High, Middle, Low), with a subset of those sampled for composition. Collection occurred over a total of eight days, but the first one was discounted as not representing daily generation, so the result was seven days of sample. A subset of this waste was then sorted and classified.
(Takeuchi 2019)	Kenya	Nairobi	90 households across three income areas (high, middle, low) received plastic bags for disposing daily waste. Collection occurred over a total of eight days, but the first one was discounted as not representing daily generation, so the result was seven days of sample. This waste was then sorted and classified.
(Jereme et al. 2013)	Malaysia		Table 1 cites the Ministry of Housing and Local Government (2011), estimating food waste generation by source. This was not findable by the bibliography nor through a direct internet search. As a result, we cannot have high confidence in the estimate.
(Watanabe 2012)	Malaysia	Bandar Baru Bangi	282 households were sampled across four neighbourhoods, which represent a mixture of different housing types (terraced housing, bungalows, flats). These were all in Selangor, described as a typical suburban area in the Kuala Lumpur area. Waste from a single day was sampled in each area, sourced from the normal disposal routine rather than asking households to dispose of their waste differently. Panel 3 shows a breakdown of food into "Unused food" (7.71% of total household waste), "General kitchen waste" (24.83% of total household waste), "big fruit peels" (10.32% of total waste). Although this has a large sample, it is geographically restricted to one area so can only have medium confidence when used for the whole of Malaysia.
(Kneller et al. 2019)	Mexico		This figure combines a number of sources, detailed in Appendix 5 of the report. Studies were identified in 3 states and 5 municipalities that directly measured the share of waste that was food waste at the household level. This was then scaled up using figures from the urban solid waste, which is primarily but not exclusively household waste: some small businesses and some larger ones (operating illegally) dispose of waste in the household municipal waste. The scale of non-household contamination is not known. As a result, it is no more than a medium confidence estimate for household food waste that likely slightly exaggerates its extent (in urban solid waste).
(Sunshine Yates Consulting 2018)	New Zealand		597 households across six different local authorities had their waste audited. This only considers the curbside domestic waste.
(Orhorhoro, Ebunilo and Sadjere 2017)	Nigeria	Sapele	100 households covering a total of 334 people were selected by stratified random sampling, all in the Sapele area. Waste was collected from households after seven days and sorted.
(JICA 2015b)	Pakistan	Gujranwala	60 urban households across three income groups (high, middle and low) were provided with plastic bags that were collected daily for eight days, although the first bag was disregarded for containing more than one day's waste. The sample was repeated across three seasons to account for variation. Rural households were considered in the study and treated as a separate datapoint. Because the study is specific to a smaller geographic area, it is considered medium confidence for analysing the whole of Pakistan.
(JICA 2015b)	Pakistan	Gujranwala	10 households in rural areas were provided with plastic bags in which to deposit waste, which was collected for eight days, although the first day was discounted due to covering more than a day's waste. The survey was repeated across three different seasons to account for variation. The small sample means we cannot have high confidence. Urban households were also studied but treated as a separate datapoint.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Tiarcenter 2019)	Russian Federation		The paper cites what is assumed to be a waste composition analysis by the Higher School of Economics (which was not found when searched for) and data from Rosstat. The shares of waste at each stage were calculations based on data from Russian Agriculture Ministry (2017). The estimate provides a total food waste estimate as well as the amount of waste at each stage of the chain; these were then combined to form sector-specific estimates. The inability to trace the original source data and the lack of transparency on the calculations means we cannot have high confidence in this estimate.
(Mucyo 2013)	Rwanda	Kigali	90 households were surveyed in 3 districts, including, for each district, 10 households from each socioeconomic group (low, medium, high). Bags and scales were distributed to the households, which were told to separate food waste and other waste. The households weighed this each day for a period of two weeks but regularly received visits from the researchers.
(SAGO 2019)	Saudi Arabia		This study forms the Saudi waste Baseline, conducted by Saudi Grains Organisation (SAGO). 20,090 samples of domestic consumption were taken across 19 food products across 13 regions in Saudi Arabia. These were separated and weighed. Although it is unclear from how many households these samples arise. This compositional analysis was supplemented by a behavioural study. The household estimate is the share of waste attributed to "Consumption." Additional information and images to supplement the main study can be found at: ***https://www.macs-g20.org/fileadmin/macs/Activities/2020_FLW_WS/4_Session_3_FW_at_HH_level_small.pdf***.
(Nahman et al. 2012)	South Africa		This paper combines a literature review of waste compositional analyses disaggregated by income group across three cities (Cape Town, Johannesburg and Rustenburg). These are then scaled by the waste generation of those specific income groups nationally. Due to the comparison with other datapoints from South Africa and their large variation, this was not considered an estimate in which we could have high confidence.
(Oelofse, Muswema and Ramukhwatho 2018)	South Africa	Johannesburg	44,927 households across 74 collection routes were sampled during a six-week period, with random-grab subsamples from municipal waste collection trucks in residential areas, which were then analysed for composition. The result is particularly low, which is notable when compared to other studies in nearby countries. This could suggest that some other waste (such as from small businesses, or illegal dumping) is being collected as part of the household waste stream.
(Oelofse, Muswema and Ramukhwatho 2018)	South Africa	Ekurhuleni	20,439 households across 41 collection routes were sampled during a six-week period, with random-grab subsamples from municipal waste collection trucks in residential areas, which were then analysed for composition. The result is particularly low, which is notable when compared to other studies in nearby countries. This could suggest that some other waste (such as from small businesses, or illegal dumping) is being collected as part of the household waste stream.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Ramukhwatho 2016)	South Africa	Tshwane Metropolitan Municipality	123 households across 5 areas had their food waste collected separately and weighed on a weekly basis for a period of 3 weeks. The sample of 123 are out of 133 respondents on a survey who indicated that they wasted food. Another 77 respondents indicated that they did not waste food, and were seemingly not asked to weigh their waste. This may bias the results by only auditing those who self-describe as those who waste food, and not including measurements from much smaller waste generators. The paper does not present a single waste figure. Instead, it has been derived from Table 4.9 using the waste generation rate per household, number of people in household and share of that household size in the sample to get a weighted per capita estimate (the sum of [household waste / number of people in household] * [share of total sample which is this household size] for each household size). The paper does include some disposal method information but not enough to adjust the figures. For example, 14 per cent of respondents claimed they fed food waste to pets, but this does not clearly translate to 14 per cent of food waste being fed to animals. As a result, no adjustment was carried out.
(JICA 2016)	Sri Lanka	Jaffna	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS (Science and Technology Research Partnership for Sustainable Development) in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Nuwara Eliya	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Kataragama	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Thamankaduwa	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Katunayake	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(JICA 2016)	Sri Lanka	Moratuwa	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Kesbewa	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Dehiwala Mt Lavinia	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Kurunegala	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(JICA 2016)	Sri Lanka	Trincomalee	The study refers to a range of locally conducted surveys on waste generation units and waste composition, combined with waste generation rates obtained by SATREPS in 2014, a previous JICA project. The methodological details of the locally outsourced surveys are not clear. Although the waste generation rates are captured at a household level, it appears as though the compositional analysis may have been done at an aggregated level, such as at the landfill. This and the methodological uncertainty reduces our confidence in the estimates, so they are rated "medium confidence."
(Oberlin 2013)	United Republic of Tanzania	Kinondoni municipality, Dar es Salaam	75 households in middle- and low-income settlements, mainly in high population density informal settlements, were provided with waste bags for three different days, which were collected and sorted.
(Thanh, Matsui and Fujiwara 2010)	Viet Nam	Mekong Delta	100 households across ten different sampling points were selected. The sample is considered to be representative of Can Tho City in terms of household size. They had their waste analysed once in the dry season for a month, and once in the rainy season for a two-week period.
(Zakarya et al. 2022)	Viet Nam	Da Nang	120 households were provided with plastic bags in which to put household waste, which were collected daily for the period of one week. Satellite imagery on the distribution of housing types in Da Nang were used to scale the data according to those housing types and form an estimate for the city.
(Edema, Sichamba and Ntengwe 2012)	Zambia	Ndola	60 households across three areas (distinguished by housing density) sorted their waste weekly for a period of one month. The households were given plastic containers for different wastes: food, plastics, paper, textile, grass and other wastes. They therefore separated it themselves, but did not weigh or estimate it themselves.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Kulleh and Manaf 2023)	Malaysia	Sungai Asap, Belaga, Sarawak	In this study among Orang Ulu community, a total of 150 households across three different longhouses were sampled (50 households from each). Each longhouse represented a different ethnicity group. Households were given plastic bags to separate wet and dry wastes, from which the waste was categorized into six categories and weighed. Waste was measured daily for 14 days. Results presented are overall. The authors state that "the food waste was mostly composed of vegetable stalks, fruit and vegetable peelings, and a little rice residue, which they would eventually use as their rearing and pets' food," and "some of the food wastes were also used as fertilizers by the villagers."
(Saidu, Musa and Akanbi 2022)	Nigeria	Bida town, Niger State	400 households in eight wards were classed as either "core traditional" or "modern" settings. Household waste was weighed in these houses "for three consecutive days for four months." This is assumed to mean that measurements took place over a four-month period, but each household had only three days of waste measured. The waste was sorted and weighed. Results are presented by each ward and the overall average generation presented in the paper is the average of these results. The average food waste results are calculated from Table 1. The authors state that "Food waste mainly includes leftover food residue, vegetable waste, leaves and decayed vegetables." They also note that "Modern" areas had lower shares of food waste and lower waste generation, and this may be due to using more processed food materials than those in "core traditional" settings.
(Eurostat 2023)	Belgium		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both EU Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Bulgaria		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Czechia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Denmark		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Germany		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Estonia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Ireland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Greece		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Spain		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. It is flagged by Eurostat as being "estimated," and the Eurostat metadata describes that this datapoint used the "Food Waste Panel" survey (it is unclear if this is a survey, diary or other approach), and that it only partly takes account of inedible food waste; it accounts for food "thrown away as purchased" and "food thrown away as cooked (including their inedible parts" but does not include inedible parts of uncooked foods (banana peel) or discarded in cooking or inedible parts like bones. As a result, this datapoint is adjusted to try and counteract the underreporting.
(Eurostat 2023)	France		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Croatia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Italy		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," and the Eurostat metadata explains that this estimate came from weighing waste arisings (i.e. MSW) and subtracting the retail and food service estimates, so it has not been directly measured at households.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Cyprus		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way. The Eurostat metadata mentions that information came from 68 households, but offers no further information.
(Eurostat 2023)	Latvia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Lithuania		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Luxembourg		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Hungary		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Malta		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Netherlands		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Austria		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Poland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Portugal		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Slovenia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Slovakia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Finland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Sweden		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Household, it allows direct measurement, waste composition analysis and diaries). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Norway		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UNEP 2023)	Japan		The Ministry of the Environment conducts annual surveys on the amount of generation and recycling of household food waste that are issued to municipalities. Some municipalities conduct separate food waste collection; in some cases the household waste is collected as mixed waste and then sorted in composition analyses. Some municipalities conduct additional research on the amount of edible parts of food waste, which are used to form the national estimate of edible food waste. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection.
(U.S. EPA 2023)	United States of America		Data are taken from studies conducted on food waste in specific sectors (state, municipal governments, industry groups, academics, etc.) that are correlated to facility-specific characteristics. This develops equations expressing generation factors, which are scaled up by applying national, sector-specific statistics. Multiple estimates are formed per sector, from which an average is taken. No new literature was identified for the 2019 estimates, so sectors retained the same generation factors as in the 2018 "wasted food report," and key changes will be in national statistics for each sector. Totals are taken from Table 3 then adjusted to remove the shares going to "non-waste" destinations. The authors discuss limitations of data associated with using existing generation factors, with inaccuracies for certain destinations such as food sent to the sewer. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection. NOTE: this includes estimates of food waste going to the sewer, which is not believed to be covered in most of the datapoints reported here, so comparison is not advised.
(Ullah et al. 2022)	Afghanistan	Kabul City	Waste was collected in plastic bags from 60 households each day for 10 days in January 2021 and weighed. Of these 60 households, 15 were from high-income areas, 15 from middle-income areas, 15 from low-income areas and 15 from rural areas. For physical composition analysis, standard method ASTM-D5231-92 was used, and a reduction process was used to get a sample of 200 kilograms which was then divided into 15 waste types (including food waste) and weighed.
(Jadoon, Batool and Chaudhry 2014)	Pakistan	Gulberg Town, Lahore	Solid waste from 45 households (15 each from low income, middle income and high income) was collected for 7 consecutive days in four seasons in 2008-2009 (a total of 1,260 sample days). The selected households were given collection bags (capacity 10-15 kilograms), which were then collected and classified into 19 main fractions, based on physical composition, and weighed on a digital scale.
(Tsheleza et al. 2022)	South Africa	Mthatha city	206 households (98 from informal settlements and 108 from formal settlements) were provided with one refuse bag to collect all of their solid waste for a period of one week. All types of solid waste were mixed in one bag except food waste. A team of researchers visited each selected household after seven days to record the waste generated, which was then manually sorted, classified and weighed using a spring balance for each household.
(Kamran, Chaudhry and Batool 2015)	Pakistan	Shalimar Town, Islamabad	In Lahore, household waste is mainly collected by the City District Government Lahore from communal containers placed in different parts of the town. For this study, waste samples were collected for a period of one week from these open steel containers. A total of 84 samples were collected, covering three socioeconomic levels (4 low income, 3 middle income and 3 high income) for all four seasons, with a total sample size of 8,400 kilograms. The study used ASTM Method D5231-92 to conduct a waste composition analysis with 13 waste types. As the waste was collected from open containers, there is a risk of that some non-household waste could have been included. It was also observed that scavenging was very active between 7:00 a.m. and 9:00 a.m., but the effects of this were minimized by collecting samples early in the morning, starting at 6:00 a.m.
(Alias et al. 2014)	Malaysia	Sabah	Plastic bags were distributed to 150 households in three water villages in Sabah. Households put their waste in the plastic bag and this was then collected and weighed daily. Once the waste was collected, the samples were sorted into six categories (food waste, paper, plastic, glass, metal and others), and the weights for each category was recorded.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Khan, Kumar and Samadder 2016)	India	Dhanbad	30 households were selected to represent the overall socioeconomic status of the study area. Each household was given two plastic bags (one for biodegradable and non-biodegradable), which were retrieved after 24 hours and replaced. Wastes were segregated and weighed. This was repeated every day for seven days.
(Nell, Schenck and De Waal 2022)	South Africa	Stellenbosch Local Municipality	Household solid waste was collected from 1,543 households from 10 suburbs. Samples were collected on the same day as scheduled municipal refuse removal day, representing seven days' waste, and were then sorted into seven major waste fractions including organic. Organic waste was then sorted further into food waste, garden waste and leachate.
(Kihila, Wernsted and Kaseva 2021)	United Republic of Tanzania	Dar es Salaam City	80 houses were provided with plastic bags for waste. Waste was collected and sorted into 10 waste categories and weighed. It is unclear how many times waste was collected from each household: the paper states, "The average solid waste generation rate for Kimara was established to be 0.53 Kg/capita/day (n = 470, sd 0.26)," but a sample of 470 is not clearly divisible by the 80 households, so it is unclear where this comes from, unless some households did not provide waste on every day of the study. The total waste recorded was 401.62 kilograms. If 470 is the number of waste days, this would suggest only 1.61 people per household, which would be very low.
(Balilo et al. 2023)	Ethiopia	Shone Town	120 households were given two plastic bags, one for dry waste and one for wet waste. Each morning for eight consecutive days, the solid wastes were collected from selected households using donkey carts, transported to a temporary sorting site, sorted and weighed.
(Aziz et al. 2011)	Iraq	Erbil	72 solid waste samples were collected from households in plastic bags over the period of a year. The number of samples collected from high-, medium- and low-income quarters were 27, 21 and 24, respectively and the number of days waste collected varied between households from 1 to 7 days, with 129.65 days in total (summed from the table). The methodology for the collection and sorting of waste is unclear, but values are provided for the weight of food, plastic, paper, metal, glass and clothes.
(Ojeda-Benítez, Vega and Marquez-Montenegro 2008)	Mexico	Mexicali	125 families were given 48-gallon plastic bags in which they were asked to deposit their daily waste in for nine days, with eight days included in the final study. Of the final sample, 67 were nuclear families, 45 were extended families, and 13 were monoparental families. Plastic bags were collected between 6:30 a.m. and 9:30 a.m. and replaced by project staff. Samples were collected during March and April, and different income levels were analysed at different times. A total of 682 plastic bags, containing 2,674 kilograms of waste, were collected. Waste was sorted into five main categories and further subcategories and weighed. Only family units or households that provided a minimum of five 48-gallon plastic bags containing the solid waste generated were included in the study (125 out of an original 197).
(Rawat and Daverey 2018)	India	Rishikesh, Uttarakhand	47 households from 5 areas of Rishikesh, Uttarakhand were sampled. Each household was given two polythene bags for biodegradable and non-biodegradable wastes, which were collected daily for eight consecutive days, with the waste from the first day excluded from the measurements.
(Emeka et al. 2021)	Nigeria	Port Harcourt	The household waste from 4,931 street buildings and 16,016 houses was sampled. "The waste generated weekly by each household was being determined by direct measurement with weighing scale (measuring up to 50kg). Wastes were sorted into the various sources of generation: Food, Tins, Can, Plastics, Sachets, Paper (including Cardboard), Electrical Items, Green Waste and Others (nappies, wood and glass); and the weight of each type determined from the different bin liners they were collected." Waste was collected from houses, community bins, or the curbside, or delivered directly to disposal sites or transfer stations. The methodology is not completely clear as to whether houses were trusted to accurately sort their own waste, or whether researchers conducted their own waste composition analysis from a sample of the wastes. There is no description of the latter, so it is likely the former, which may underestimate food waste if people have not sorted waste streams correctly.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Parizeau, Maclaren and Chanthy 2006)	Cambodia	Siem Reap	Residents of 49 households were asked to collect their waste (any materials they would normally burn, bury, or throw in the river or other public spaces) each day for a week in the summer of 2004. Eight plastic collection bags were provided to each household, one for each day of the study and one extra bag in case it was required. Researchers weighed the collected waste at each household, then brought it to a sorting area where it was separated and weighed again. Materials were sorted into 12 categories including "high nitrogen organics (such as fruit peels and other kitchen wastes) and high carbon organics (such as dry leaves)." Only the "high nitrogen organics" is included here, on the assumption that this corresponds to food waste and "high carbon" to garden waste. Sixteen households had 1-2 days of non-participation, and values for these days were not included in the analysis. Being during the dry season, it was noted that the wastes may be lower than other times of the year.
(Elimelech, Ert and Ayalon 2019)	Israel	Haifa Municipality (Neve Sha'anan, Ramat Remez, and Yizraelia)	Waste from 187 households was collected from the household's doorstep each day for one week. Samples were unloaded at a sorting tent located at an operational site of Haifa Municipality, and food waste samples were classified into avoidable and unavoidable food waste and were weighed. The paper only provides a figure for avoidable food waste, so an appropriate weighting factor has been applied to estimate total food waste.
(Adelodun, Kim and Choi 2021)	Republic of Korea	Daegu	Waste samples were collected from 84 households (33 from apartments, 31 from villas, and 20 from single-family houses) for two weeks each season for four seasons, with a total of 336 samples. A shelf was placed beside each of the shared food waste bins in the apartment and the villa. Plastic food waste containers of 2-litre capacity were arranged on the shelf, each with tags bearing the house numbers of the participating households. Each household was asked to put its daily food waste in the plastic container with their house number tag instead of disposing it in the shared food waste container for the study period. For households in single-family housing with no shared food waste collection system, their food wastes were sampled and characterized three times per week, according to their existing food waste collection schedules. The food wastes were characterized on a flat plastic table, and the components were weighed using electronic scales.
(Moftah et al. 2016)	Libya	Tripoli City	Household solid waste was collected from 150 families (947 people) in three areas (low, middle and high income) during one week in summer, autumn and winter 2011/2012. A total of 4,650 kilograms of household solid waste was collected. from each sample area, 10-15 plastic bags were chosen randomly, then opened and emptied, spread on the plastic sheet, separated and weighed. This procedure was repeated every day during the study week each season. In total, 1,464.5 kilograms (around a third of total waste collected) was separated and weighed.
(JICA 2003)	Panama	Panama City	This report includes a Waste Amount Survey in which the waste from 60 households (20 high income, 20 middle income, 20 low income) was sampled over seven days in the dry season and seven days in the rainy season. Not all households produced samples for both seasons for all days, so the effective sample was 826. The wastes used in the Waste Amount Survey were then used for the Waste Composition Survey. Wastes from each source were gathered and mixed by category, and one sample was extracted from each category by using a waste reduction method. The physical composition was measured in the "wet base" (as discarded state, before the waste had a chance to dry), and samples were divided into 10 components (including kitchen waste) and weighed.
(Warmadewanthi and Kurniawati 2018)	Indonesia	Sukomanunggal Subdistrict	Waste was collected from 110 households over eight consecutive days, then the composition of the waste was analysed.
(J-PRISM II 2018)	Vanuatu	Port Vila	Waste from 105 households (32 low income, 29 middle income, 41 high income, 3 unknown) was collected over a period of eight days, discarding the first day to reduce biases/waste accumulation. All samples were weighed, with waste volume and composition studied in randomly selected bags.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Environment Unit n.d.)	Solomon Islands	Tulagi Town	The study covered 32 households and collected waste samples for eight days, discarding the first day to reduce biases/waste accumulation. The sample size was based on a total population of 1,251 people. Samples were weighed, then a subsample was selected for compositional sorting. It included sorting into kitchen waste, but this was not reported in all figures: calculated figures are based on a Household Waste Composition table in Annex 4.
(J-PRISM II 2017)	Micronesia (Federated States of)	Pohnpei	The study sampled 20 households (10 in Kitti, 10 in Kolinia), although it is unclear for how many days. The report estimates "kitchen waste" as 75 grams per capita per day, but it also gives kitchen waste as a share of household waste (29.4%), which, if combined with the reported total waste (356 grams per capita per day), is not equal to the reported 75 grams. The figures here are the (higher) estimate based on data available in Figure 9.
(Guerber and Gursed 2021)	Mongolia	Khishig-Undur	The study sampled 36 households in summer and 35 households in winter, or around 10% of the town centre of 367 households sampled each period. Participating households were asked to keep all the waste produced over one week and to sort it themselves into 14 different categories. The waste was then collected and analysed alongside some survey information. Results were reported per household, per person in the household and per adult. The per person figures are used here. Only sedentary households were quantitatively studied, with nomadic villagers qualitatively studied. There was a notable seasonal difference, with food waste two times larger in winter, which the authors suggest is due to more meat being eaten in winter (and associated bones), versus more vegetables eaten in summer. The output report says that it is "already very common to give vegetable peels to livestock," which might explain the low figures as this waste would not have been collected.
(Moosa 2021)	Maldives		Household estimate combines data on waste generation from the National Solid Waste Management Policy on waste generation, divided by waste composition for households from an audit undertaken by public waste collection company WAMCO, and a separate feasibility study. This audit study was not accessible online, but archived information (*https://archive.mv/en/articles/Vx908*) suggested that around 336 households were audited. The report was submitted to the United Nations Economic and Social Commission for Asia (UN ESCAP) and the Pacific by the Maldives National Bureau of Statistics. The figures are written as both "tons" and "tonnes" at different points in the report, and metric tonnes have been assumed.
(Moosa 2021)	Maldives		Household estimate combines data on waste generation from the National Solid Waste Management Policy on waste generation, divided by waste composition for households from an audit undertaken by public waste collection company WAMCO, and a separate feasibility study. This audit study was not accessible online, but archived information (*https://archive.mv/en/articles/Vx908*) suggested that around 336 households were audited. Report submitted to UN ESCAP by the Maldives National Bureau of Statistics. The figures are written as both "tons" and "tonnes" at different points in the report, and metric tonnes have been assumed.
(Bhutan National Statistics Bureau 2021)	Bhutan		The results presented in the Bhutan Waste Accounts report cite the National Waste Survey study. Stakeholders received a questionnaire about their perception of waste generation and management. They were provided bags to store generated waste. For households, it was for seven days. Collected wastes were then sorted and weighed. Households were sampled across seven dzongkhags (administrative districts) across multiple regions, with households then sampled from those. In total, 1,584 households were sampled for waste generation, and all samples were taken in November-December 2019, so the study lacks seasonality. The Waste Accounts report states that, "In rural areas where there are no waste collecting facilities [...] they use food wastes as either animal food or dumped in vegetable gardens directly." If some households continued to use waste for feed or dumping rather than providing waste for the researchers, the waste could be underestimated.
(Letshwenyo and Kgetseyamore 2020)	Botswana	Extension 7 Suburb, Palapye	Waste bags were collected twice a week for composition analysis from 30 households (10 each from low-, middle- and high-income households).

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Abdallah et al. 2020)	Egypt	Gharbiya	Household waste was collected for 8 consecutive days from a sample of 300 households from the urban centre, and around 25 per cent of the collected waste was randomly selected and sorted to determine composition. The paper states that "low-income households in the surveyed areas dispose of their livestock wastes as MSW." It is believed that this was captured in the "Other" category (16-23 per cent of waste), but there is a chance this has impacted the results
(Abdallah et al. 2020)	Egypt	Asyout	Household waste was collected for 8 consecutive days from a sample of 300 households from the urban centre, and around 25 per cent of the collected waste was randomly selected and sorted to determine composition. The paper states that "low-income households in the surveyed areas dispose of their livestock wastes as MSW." It is believed that this was captured in the "Other" category (16-23 per cent of waste), but there is a chance this has impacted the results
(Abdallah et al. 2020)	Egypt	Kafr El-Sheikh	Household waste collected for 8 consecutive days from a sample of 300 households from the urban centre, and around 25 per cent of the collected waste was randomly selected and sorted to determine composition. The paper states that "low-income households in the surveyed areas dispose of their livestock wastes as MSW." It is believed that this was captured in the "Other" category (16-23 per cent of waste), but there is a chance this has impacted the results
(Abdallah et al. 2020)	Egypt	Qena	Household waste collected for 8 consecutive days from a sample of 300 households from the urban centre, and around 25 per cent of the collected waste was randomly selected and sorted to determine composition. The paper states that "low-income households in the surveyed areas dispose of their livestock wastes as MSW." It is believed that this was captured in the "Other" category (16-23 per cent of waste), but there is a chance this has impacted the results
(Ali et al. 2023)	Pakistan	Peshawar	Primary data was collected from waste management services for 78 households, with 27 each from high- and middle-income families and 24 from low-income families. The collected waste was weighed, and per capita generation calculated. Composition was determined using "load count analysis."
(The Asia Foundation 2019)	Mongolia	Ulaanbaatar	Waste was collected from households over two weeks, one in the summer (from 131 households) and the other in the winter (from 130 households), in six central districts. Participants were trained how to segregate their waste into separate categories and were provided with different bags for each, which were then collected from the households every day for a week for further segregation.
(Dikole and Letshwenyo 2020)	Botswana	Palapye	Waste was collected on Mondays and Fridays from households for waste characterization over a four-week sampling period, to evaluate weekday and weekend waste generation. Households were grouped by income., although it is unclear how many households were sampled. Generation rates and waste composition are presented separately by each income group and weekday/weekends. The generation rates are presented on a graph without figures, and only some of the numbers are in the text. The remaining figures were read from the graph (using the "WebPlotDigitizer" website), so may have inaccuracies. Information on the size of the three income groupings was not provided, so the average was taken.
(JICA 2022)	Ethiopia	Addis Ababa	The paper cites a survey of waste generation by Global Environmental Solution (a consultancy). The original file was not able to be identified or accessed online. As a result, the sample size of the study is unknown. However, the JICA report presents some information for the household results. Table 4-10 has residential per capita solid waste generation; Figure 4-7 has household waste composition.
(JICA 2015a)	Lao People's Democratic Republic	Vientiane	Limited detail was available in the publication. Section 1.1.1 of Project Completion Report Supplement 1 refers to a Waste Amount and Composition Survey (WACS) conducted in September 2011 at the household level, but does not detail the sample size of households or length of study. Results are presented in Tables 3-2 and 3-3. The report states that most households do not separate organic wastes, but some do feed their animals with it.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(JICA 2015a)	Lao People's Democratic Republic	Luang Prabang	Limited detail was available in the publication. Section 1.1.1 of Project Completion Report Supplement 2 refers to a Waste Amount and Composition Survey (WACS) conducted in September 2011 at the household level, but does not detail the sample size of households or length of study. Results are presented in Tables 3-3 and 3-4. The report states that most households do not separate organic wastes, but some do feed their animals with it.
(UNEP and Uganda Cleaner Production Centre 2021)	Uganda	Kampala	The study involved direct weighing of food waste across seven days from 100 randomly selected households in Kampala districts. The project aimed to include edible/inedible separation. It discusses causes for waste, with 65 per cent happening in the "kitchen," 20 per cent being "plate waste" and 15 per cent in "store" (i.e. food that has gone off or was rejected).
(Beretta and Hellweg 2019)	Switzerland		The results combine two methods. One approach uses Swiss-based waste compositional analyses, with adjustments to apply to 2017 and using insights from studies from multiple countries (Switzerland, the United Kingdom, Austria) to inform the "avoidable" and "unavoidable" waste shares. The second approach uses insights from the United Kingdom on waste rates per food category, combined with Swiss consumption data. The mean of the two approaches is taken. The report only presents "avoidable" waste, and the approximate "unavoidable" waste was supplied through personal communications from the authors.
(Higgins and Harris 2022)	Indonesia	Cianjur	The study sampled 100 households in each of six regencies for eight days, with the samples then weighed and sorted by composition. The results, broken down by income groups, are in Table 1. They include subdivision into edible/inedible split by income group, which is combined with share of population to get an average edible/ inedible split (Tables 2 and 3).
(Higgins and Harris 2022)	Indonesia	Cirebon	The study sampled 100 households in each of six regencies for eight days, with the samples then weighed and sorted by composition. The results, broken down by income groups, are in Table 1. They include subdivision into edible/inedible split by income group, which is combined with share of population to get an average edible/ inedible split (Tables 2 and 3).
(Higgins and Harris 2022)	Indonesia	Pekalongan	The study sampled 100 households in each of six regencies for eight days, with the samples then weighed and sorted by composition. The results, broken down by income groups, are in Table 1. They include subdivision into edible/inedible split by income group, which is combined with share of population to get an average edible/ inedible split (Tables 2 and 3).
(Higgins and Harris 2022)	Indonesia	Purbalingga	The study sampled 100 households in each of six regencies for eight days, with the samples then weighed and sorted by composition. The results, broken down by income groups, are in Table 1. They include subdivision into edible/inedible split by income group, which is combined with share of population to get an average edible/ inedible split (Tables 2 and 3).
(Higgins and Harris 2022)	Indonesia	Blueleng	The study sampled 100 households in each of six regencies for eight days, with the samples then weighed and sorted by composition. The results, broken down by income groups, are in Table 1. They include subdivision into edible/inedible split by income group, which is combined with share of population to get an average edible/ inedible split (Tables 2 and 3).
(Higgins and Harris 2022)	Indonesia	Karangasem	The study sampled 100 households in each of six regencies for eight days, with the samples then weighed and sorted by composition. The results, broken down by income groups, are in Table 1. They include subdivision into edible/inedible split by income group, which is combined with share of population to get an average edible/ inedible split (Tables 2 and 3).

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UNEP Regional Office for West Asia 2022)	Qatar		The study was conducted in Doha, which represents about 42% of the country's population. Food waste estimates were taken from 437 households across 10 zones of Qatar in two phases (one during Ramadan). Eight days of waste were collected across a nine-day period. The differing Ramadan and non-Ramadan estimates were scaled to a year-wide estimate based on the number of holidays or social/religious occasions per year and the number of regular days. The study results were normalized based on different housing types (villas and apartments), which are then scaled by national figures of those housing types to form the national estimate.
(Yakubu, Woodard and Aboagye-Nimo 2023)	Nigeria	Jos	Waste was collected for one week from 74 households in 6 low-income areas, then weighed and sorted. By only looking at households in low-income areas, the results may not be representative of the wider country.
(Emeka et al. 2021)	Nigeria	Port Harcourt	Waste from 4,931 street buildings and 16,016 households (all residential) was determined by direct measurement, then sorted to determine composition.
(La Rosa Caballero 2022)	Peru	Punta Hermosa, Lima	Waste from 113 households was collected daily for eight days, with the first day removed from the sample to reduce biases from accumulation before the study period. Collected waste was then sorted into a wide range of categories. The figures on kilograms per capita are from Table 6, and the shares of food waste are from Table 10.
(Auquilla 2015)	Ecuador	Zaracay, Santo Domingo	Waste compositional analysis was conducted within a single housing development, with 54 families separating their organic and inorganic waste for six days. The first day was a test and was removed from the sample (five days were included in the analysis). The organic waste was then quartered and assessed for composition. The captured figures contain both the share that is "restos vegetales" and "residuos de comida." "Restos vegetales" is defined elsewhere as being vegetable and fruit remains and peels "made in the kitchen," with a separate category for garden waste.
(Castro 2023)	Ecuador	Balsapamba, San Miguel	Samples were taken of 34 households (in a town with around 3,000 inhabitants total). Waste was collected daily for eight days, with the first day removed from the sample to reduce biases from accumulation before the study period. Compositional analysis by quartering of collected waste. Annex 6 contains the percentage of waste which is food waste.
(García 2018)	Dominican Republic	Salcedo Municipality	Sample taken from 87 households, selected from three different socioeconomic groups based on the municipal population. Waste collected daily for eight days, with the first day removed from the sample to reduce biases from accumulation before the study period. The waste was then analysed for composition.
(Sánchez et al. 2014)	Venezuela	Chacao, Miranda State	The study sampled 52 households, randomly selected within three socioeconomic groupings weighted by population size, and categorized by the construction materials of their households. Participants were requested to separate their waste during eight consecutive days of measurement, which was then weighed and visually inspected for consistency with results. Table 2 reports the composition findings by social grouping. The shares for "restos de cocina" and "restos de vegetales" are combined and used to form a share of the arisings/capita/day (also in Table 2) per social grouping, which is then weighted by the share of population in each grouping from Table 1. Note that the overall waste/capita presented in the paper does not equal the weighted average using data from Table 1. The figures included here are a calculation from Table 1.
(Cutipa 2016)	Peru	Macusani	Waste was collected from a sample of 335 homes for seven consecutive days across four zones, then sorted for composition. Figures reported here include both kitchen remains and bones.
(Aguilar, Moreno and Moreno Pérez 2017)	Mexico	Berriozábal, Chiapas	Waste was collected from 91 households daily for eight days, with the first day removed from the sample to reduce biases from accumulation before the study period. The composition, in Table 5, refers to being "domestic solid waste," but elsewhere the same figures are referred to as the composition of municipal solid waste.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Aguilar Virgin et al. 2010)	Mexico	Ensenada, Baja California	Waste composition analysis was conducted at a landfill based on arriving trucks that had been collecting domestic waste. Five consecutive days of sampling occurred from trucks from three socioeconomic strata. This was scaled to total estimates for the city and divided by population to provide a per capita estimate
(IDB et al. 2022)	Jamaica		Samples were taken over three seasons (moderately wet, wet, dry) at four waste disposal sites, one in each watershed in Jamaica. The household samples (described as "municipal solid waste") were taken from three socioeconomic groupings, with separate samples of business waste (institutional-commercial-industrial, ICI). The samples were 250 kilograms in size, taken from waste disposal trucks, and therefore capture multiple households. Bike-men followed the collection trucks on their route to record the number of households and, where possible, number of residents, to derive kilogram per capita estimates. In total, 102 samples of household (MSW) were taken across the three seasons. Some of the results are presented as both household and ICI, but Appendix 3 splits out the composition into subcategories for household separately. Results taken from the weighted averages for Jamaica as a whole are presented in the report.
(Bontinck, Grant and Lifecycles 2021)	Australia		Mass balance model of the whole Australian food supply chain was conducted, building on and adjusting the 2019 baseline study. A total of 169 sources were used throughout the whole supply chain analysis, including industry data, government data, scientific publications and official statistical data. For households, this includes a compilation of state and official data from direct measurement, with the addition of waste being composted at home and discarded to the sewer.
(Ghaforzai, Ullah and Asir 2021)	Afghanistan	Kabul City	For this research, solid waste was sampled for one day each from 216 households (4 households per location, with 18 locations in high-income, 18 in middle-income and 18 in low-income areas). The quantity and material composition of the waste was determined using the standard method ASTM D5231-92. A reduction technique was applied to the original sample to produce a representative sample, and this was then sorted and the different waste types weighed. The wastes were only sampled for one day and so may not be representative. The authors also note that "the higher proportion of food waste was mainly attributed to the occurrence of huge quantities of cores of locally grown seasonal honey melons and water melons that were consumed in higher amounts during the survey period due to their cheaper availability," but that food waste included "both the unavoidable food waste" and "the avoidable unconsumed fraction."
(Leket Israel 2022)	Israel		Footnote 23: "Based on the food value chain model developed by BDO, using weighted data from the Central Bureau of Statistics for 2021, a national survey of the composition of household garbage conducted by the Ministry of Environmental Protection for 2012-13, the findings of a Geocartography survey conducted in January 2019, and a study on household garbage in Israel conducted by Dr. Ofira Ayalon and Efrat Elimelech, "What gets measured gets managed: A new method of measuring household food waste." Waste Management 76 (2018): 68-81."
(Singapore National Environment Agency 2017)	Singapore		A press release for the study suggests 279 households had waste samples collected over three days in a week in 2016-17, which were then sorted into avoidable and unavoidable food waste. Data on the exact results were not reported in the webpage, and the original study cannot be accessed online. The press release does not give detailed figures, only that the "Avoidable" waste was equivalent to 2.5 kilograms per household per week and that 3.35 people are in the average household. These figures are combined to form a per capita estimate for edible/avoidable waste, which is then adjusted to try and create a full estimate.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(JICA 2013b)	Zimbabwe	Chitungwiza	The report includes a waste amount survey in which waste samples were taken each day for eight days from 60 households (20 high income, 20 middle income, 20 low income), with the sample for the first day excluded from the analysis. The survey intended to sample 480 household samples, but 455 samples were collected. For the waste consumption analysis, three samples (one from each income group) were taken each day for eight days.
(Noufal et al. 2020)	Syrian Arab Republic	Homs	Household waste was collected from 300 households for 14 consecutive days and hand sorted.
(UN-Habitat 2021a)	Dominican Republic	Santo Domingo	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
UN-Habitat 2022b)	Senegal	Dakar	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021f)	Nigeria	Lagos	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet..
(UN-Habitat 2021c)	Democratic Republic of the Congo	Bukavu	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UN-Habitat 2021h)	Zimbabwe	Harare	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2023c)	Rwanda	Musanze	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021g)	United Republic of Tanzania	Dar es Salaam	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2023a)	United Republic of Tanzania	Iramba District	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2023b)	Kenya	Homa Bay	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UN-Habitat 2020a)	Kenya	Kiambu County	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2020b)	Kenya	Mombasa County	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2019a)	Kenya	Nairobi City County	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2022c)	Kenya	Taita Taveta County	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2019b)	Seychelles	Victoria	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UN-Habitat 2021d)	Ethiopia	Addis Ababa	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021e)	Ethiopia	Bahir Dar	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2022a)	Egypt	Alexandria	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021b)	Tunisia	Sousse	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021k)	Pakistan	Karachi	The method is not detailed in the "factsheet," but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/ park" and "wood." Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UN-Habitat 2021i)	Bangladesh	Khulna	The method is not detailed in the “factsheet,” but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including “kitchen/canteen” as distinct from “garden/park” and “wood.” Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021l)	Thailand	Chonburi	The method is not detailed in the “factsheet,” but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including “kitchen/canteen” as distinct from “garden/park” and “wood.” Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021m)	Viet Nam	Hội An	The method is not detailed in the “factsheet,” but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including “kitchen/canteen” as distinct from “garden/park” and “wood.” Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021n)	Viet Nam	Tam Kỳ	The method is not detailed in the “factsheet,” but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including “kitchen/canteen” as distinct from “garden/park” and “wood.” Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.
(UN-Habitat 2021j)	Malaysia	Seremban	The method is not detailed in the “factsheet,” but the Waste Wise Cities Tool has a separate methodology guidance document. This suggests a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including “kitchen/canteen” as distinct from “garden/park” and “wood.” Separate results are presented for each income grouping, with the average kilograms per capita of food waste taken from the data presented in the factsheet.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UN-Habitat unpublished)	Cambodia	Kep	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Cambodia	Sihanoukville	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Egypt	Dakahlia	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	India	Mangalore	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	India	Thiruvananthapuram	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Indonesia	Bogor	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UN-Habitat unpublished)	Indonesia	Depok	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Lebanon	Tyre	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Philippines	Cagayan de Oro	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Philippines	Legazpi	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Philippines	Ormoc	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Thailand	Hatyai	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(UN-Habitat unpublished)	Thailand	Samui	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Thailand	Songkhla	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Thailand	Surat Thani	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Uganda	Kampala	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."
(UN-Habitat unpublished)	Viet Nam	Hue	The datapoint is not yet in a published report, but results were shared by UN-Habitat for the purposes of the Food Waste Index. The Waste Wise Cities Tool methodology guidance document explains the common approach: a sample size of 90 households (10 households from 3 survey areas, with 3 income groups each), increasing to 150 households (5 survey areas) in megacities. Bags were given to households to store all waste generated in the home for eight days, with the first day discarded as it may involve wastes generated before the start of the survey. The waste was sorted into 12 categories, including "kitchen/canteen" as distinct from "garden/park" and "wood."

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Xue et al. 2021)	China		The paper considers food loss and waste across the entire food system. Household food waste was quantified by two approaches. One is top-down, based on mass balance, using the quantity of food entering consumption in household and food service sectors, with waste ratios from field surveys and literature data. The second approach is bottom-up, based on primarily data estimation in rural and urban households. This second approach scales up per capita food waste amounts from sampled rural and urban households to the national scale. The sample for direct weighing in rural households was 210 households in 21 villages in Shandong in 2017, with each tracked for three days. The sample for urban households was 309 households in three districts in Zhengzhou in 2018, weighing and recording food discarded for three days. The tonnes of food waste per sector was taken from the supplementary information for Figure 2c. The average population for 2014-18 is used to derive kilogram per capita estimates. All wasted food is converted to agriculture food-product equivalents based on conversion factors from the literature, i.e. to account for the addition/loss of water in cooking. Only edible food waste is considered, so an adjustment is made to scale this up to total food waste.
(Gilbert and Ricci 2023)	Brazil	Rio de Janeiro	Food waste was collected from households for eight consecutive days, with data collected for seven (discarding the first day). A total of 86 households completed the assessment across three income levels and five districts in Rio. Food waste was assessed into four categories (Fruit & Veg; Meat & Fish; Dairy; Bakery). A subsample was also evaluated for edibility each day, for each of the subcategories.
(Devine et al. 2023)	United Kingdom of Great Britain and Northern Ireland		Household data comes from a combination of data on the composition and weight of residual and organic recycling schemes from local authorities. This estimate contains only waste streams collected by local authorities, and therefore does not include the estimated amount being composted at home or going to sewer. The report states that uncertainties in the 2021 estimates of sewer and home composting waste lead these to being excluded as they are not sufficiently accurate to track over time.
(Vujić et al. 2021)	Serbia	Belgrade	Four municipalities across Belgrade were chosen based on different income level and housing type (based on the split of individual households and apartment blocks). A total of 100 households were sampled for a period of seven days. The households were provided bags for their food waste, which they collected separately and handed to researchers each day. Food waste was sorted into six food categories. Using data on household size and number in all city municipalities, a projected composition of food waste for Belgrade was estimated. This projected result for Belgrade, weighted by the population, is the figure recorded here. A separate survey to classify food categories as edible or inedible based on the methodology in Nicholes et al. (2019) was applied, although this was not combined with results to get an estimate of how much waste was edible or not.

Food service datapoints

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Zhang et al. 2020)	China	East China	The paper aggregates 47 "catering waste" papers in total from various areas of China. It uses a mixture of surveys, official statistics, author's calculations, etc. to create data on catering food waste across different regions. This is then associated to a number of correlates that are used to predict growing food waste in future. The authors worked with datapoints from a range of years and other data to form a 2019 estimate, which is what is used here.
(Zhang et al. 2020)	China	Middle China	The paper aggregates 47 "catering waste" papers in total from various areas of China. It uses a mixture of surveys, official statistics, author's calculations, etc. to create data on catering food waste across different regions. This is then associated to a number of correlates that are used to predict growing food waste in future. The authors worked with datapoints from a range of years and other data to form a 2019 estimate, which is what is used here.
(Zhang et al. 2020)	China	West China	The paper aggregates 47 "catering waste" papers in total from various areas of China. It uses a mixture of surveys, official statistics, author's calculations, etc. to create data on catering food waste across different regions. This is then associated to a number of correlates that are used to predict growing food waste in future. The authors worked with datapoints from a range of years and other data to form a 2019 estimate, which is what is used here.
(Zhang et al. 2020)	China	Urban China Total	The paper aggregates 47 "catering waste" papers in total from various areas of China. It uses a mixture of surveys, official statistics, author's calculations, etc. to create data on catering food waste across different regions. This is then associated to a number of correlates that are used to predict growing food waste in future. The authors worked with datapoints from a range of years and other data to form a 2019 estimate, which is what is used here. The total waste figure itself is not listed in the text but was confirmed with the authors as being 38 million tonnes. This refers only to urban catering waste.
(Zhang et al. 2020)	China	Northeast China	The paper aggregates 47 "catering waste" papers in total from various areas of China. It uses a mixture of surveys, official statistics, author's calculations, etc. to create data on catering food waste across different regions. This is then associated to a number of correlates that are used to predict growing food waste in future. The authors worked with datapoints from a range of years and other data to form a 2019 estimate, which is what is used here.
(JICA 2010)	Kenya	Nairobi	Across retail and out-of-home consumption, the waste from 90 locations was analysed for a period of seven days; this which was preceded by a one-day test measurement, which was excluded from analysis. The figure presented is the sum of Restaurants, Hotels, and Public Facilities, each of which had a distinct waste generation rate and food waste generation share. The original study scales this by the number of institutions in Nairobi.
(Jereme et al. 2013)	Malaysia		Table 1 cites the Ministry of Housing and Local Government (2011), estimating food waste generation by source. This was not findable by the bibliography nor through a direct internet search. As a result, we cannot have high confidence in the estimate.
(Bogdanović et al. 2019)	Serbia		Interviews were conducted with around 100 hotels, restaurants and caterers to determine the share of food waste at the stages of kitchen preparation and plate waste. It is unclear to what extent survey respondents were estimating or the results were based on internal measurement. The waste generation factors from this were applied to CEVES estimates on food purchases in Serbian Hotels, Restaurants and Canteens.
(Eurostat 2023)	Belgium		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Bulgaria		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Czechia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Denmark		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Germany		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Estonia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Ireland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Greece		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Spain		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	France		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Croatia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Cyprus		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," and the metadata explains that it is based on statistical data related to number of companies and production value, as COVID-19 limitations meant direct measurement was not possible.
(Eurostat 2023)	Latvia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Lithuania		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Luxembourg		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Hungary		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Malta		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Netherlands		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Austria		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Poland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Portugal		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Slovenia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Slovakia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

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(Eurostat 2023)	Finland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Sweden		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Norway		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Food Service, it allows direct measurement, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(UNEP 2023)	Japan		Food-related businesses generating more than 100 tonnes of food waste per year are required to report quantities generated to the national government in accordance with the Food Recycling Law. For businesses producing less than 100 tonnes, the amount if separately estimated by multiplying the results of a sampling survey by the growth rate of waste generated by those businesses reporting 100 tonnes or more. Questionnaire surveys are used for those submitting reports to understand the share of edible parts. The amount of food waste is calculated for each of 12 subsectors in the Food Service industry. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection.
(U.S. EPA 2023)	United States of America		Data are taken from studies conducted on food waste in specific sectors (state, municipal governments, industry groups, academics etc.) that are correlated to facility-specific characteristics. This develops equations expressing generation factors, which are scaled up by applying national, sector-specific statistics. Multiple estimates are formed per sector, from which an average is taken. No new literature was identified for the 2019 estimates, so sectors retained the same generation factors as in the 2018 "wasted food report," and key changes will be in national statistics for each sector. Totals are taken from Table 3, then adjusted to remove the shares going to "non-waste" destinations. The authors discuss limitations of data associated with using existing generation factors, with inaccuracies for certain destination such as food sent to the sewer. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection.
(Zakarya et al. 2022)	Malaysia	Desa Pandan Kuala Lumpur	In the study, 10 restaurants in Kuala Lumpur were given 120-litre garbage bags every day for a six-day period, into which they were asked to put all food waste. The food waste was then sorted into food categories and into cooked and uncooked food. Note that the weighing was over the period in which Chinese new year celebrations occurred so may not be representative of a "normal" week.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Filimonau et al. 2023)	Iraq	4 major cities: Mosul, Tikrit, Babel, Al-Muthana	Food waste from 18 restaurants was measured on four consecutive days (Wednesday-Saturday) from January to April 2021. The research team members separated the edible food waste from non-edible fractions in-situ and then split the edible food waste into different food types. Interviews with food industry workers were used to establish whether the food waste measurements obtained may have been affected by seasonality. The authors then scaled this to an Iraq-wide estimate based on the total number of food service operators (i.e. applying the waste per establishment to other subsectors as well). The data was collected during COVID-19 restrictions and may not be representative of normal conditions, and only edible food waste was included so a scaling factor has been applied.
(Filimonau and Ermolaev 2021)	Russian Federation	Study in Kemerovo, figures scaled to nation-wide	In the Russian Federation, food waste is collected and organizations pay for the weight of waste collected. For the study, 21 food service businesses (for-profit restaurants only, public sector excluded) provided their financial records for an estimate of food waste generated to be calculated. In-situ observations were also made. The figures are then scaled by data on the number of restaurants in the country to form a national estimate.
(Moosa 2021)	Maldives		The "Tourism" sector estimate used waste generation factors by resort and guest houses from the National Solid Waste Management Plan, divided using composition information from a separate feasibility study. It indicates that these are "assumptions given" in the feasibility study, so may not be directly measured. However, the feasibility study could not be accessed, so the exact methodology is not clear. The report was submitted to UN ESCAP by the Maldives National Bureau of Statistics, so is authoritative. The figures are written as both "tons" and "tonnes" at different points in the report, and metric tonnes have been assumed.
(Moosa 2021)	Maldives		The "Tourism" sector estimate used waste generation factors by resort and guest houses from the National Solid Waste Management Plan, divided using composition information from a separate feasibility study. It indicates that these are "assumptions given" in the feasibility study, so may not be directly measured. However, the feasibility study could not be accessed, so the exact methodology is not clear. The report was submitted to UN ESCAP by the Maldives National Bureau of Statistics, so is authoritative. The figures are written as both "tons" and "tonnes" at different points in the report, and metric tonnes have been assumed.
(Beretta and Hellweg 2019)	Switzerland		The study combines data from multiple sources: Baier and Deller (2014) based on 83 catering establishments in Switzerland, and additional data from establishments in Austria, England, Finland, Germany, and Switzerland, with loss rates for specific products applied to Swiss consumption data. Data are provided in Figure 11. The report only presents "avoidable" waste, and approximate "unavoidable" waste is supplied from personal communications with authors.
(Bontinck, Grant and Lifecycles 2021)	Australia		This is a mass balance model of the whole Australian food supply chain, building on and adjusting the 2019 baseline study. A total of 169 sources were used throughout the whole supply chain analysis, including industry data, government data, scientific publications and official statistical data. For food service, this was updated from the 2019 report with audit data from schools, data from higher education and hospitals, as well as new data for hospitality based on a more in-depth audit than the previous baseline estimate.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Leket Israel 2022)	Israel		The study integrates a combination of some measurement and other data into a flow model: "A comprehensive value chain model for various food production and consumption stages was designed to assess food waste and the potential for food rescue in Israel. The model is based on a bottom-up approach, and includes analysis of data relevant to agricultural production, import, export, industry, distribution and a sample of consumption patterns of 50 different types of food." [...] "For each type of food, the volume of input and output was measured in terms of gross agricultural product and loss rate for every stage of the value chain in the food production, distribution and consumption process." [...] "This data is indicative and intended to serve as the basis for public debate, and for further research and study."
(Garduño et al. 2023)	Mexico	Baja California Sur	The authors distributed questionnaire surveys to actors across the food chain, based on statistical records of businesses, in an attempt to be representative of the various establishment types. Perceptions of wastage rates by specific product groups at specific business types were gathered. These were then used as waste factors for those products/business types, and scaled by relevant business data to get an estimate for the sector. It included 52 surveys across food service businesses. The authors highlight the limitations of being built on the perceptions of the stakeholders.
(Gooch et al. 2019)	Canada		The study uses Canadian Industry Statistics to gather data on the food service industry for Hotels, Food Service Contractors, Restaurants/QSR, Catering/Event services and Beverage. Surveys were sent to industries asking if they measured their food waste and to provide data. Around 68 responses from Food Service (based on a total of 618 responses across the whole value chain, of which 11% were from Food Service, in Appendix 2 section 3.3). Around 20% of Food Service participants responded and gave data. As part of a whole-chain Mass Balance model, the % loss factors on a product level were used to inform estimates of food waste. Table G (Appendix 1) shows the summary loss factors for each stage in the supply chain. Results are split into preparation and plate waste. Results were subsequently tested and validated through interviews. Note: the "scope" (Figure C, Appendix 2) suggests that food sent to animal feed and biomaterial processing was included; this has been manually removed based on the utilisation of food loss and waste destinations across the value chain, as reported in Figure 3-9. These % shares were read from the graph (using computer software) so may be imprecise. Due to possible issues with self-reported loss rates (acknowledged in the paper) and differences in scope, this is assigned "medium confidence."
(Xue et al. 2021)	China		The paper considers food loss and waste across the entire food system. Food service is quantified by two approaches. One is top-down, based on mass balance, using the quantity of food entering consumption in food service sectors, with waste ratios from field surveys and literature data. The second approach is bottom-up, based on primarily data estimation in restaurants. This second approach scales up per capita food waste amounts from sampled restaurants to the national scale. The sample for restaurants was 6,983 tables across small, medium and large restaurants in Beijing, Shanghai, Chengdu, and Lhasa across 2013-2015, recorded separately for residents and tourists, and scaled separately based on resident and tourist populations. This restaurant figure is then scaled to account for other food service settings, such as canteens, by using an adjustment figure from a separate literature source that suggests that food loss and waste in other Food Service settings was around 61% of that created in restaurants. The tonnes of food waste per sector was taken from the supplementary information for Figure 2c. The average population for 2014-18 is used to derive kilogram per capita estimates. All wasted food is converted to agriculture food-product equivalents based on conversion factors from the literature, i.e. to account for the addition/loss of water in cooking. Only edible food waste is considered.
(Devine et al. 2023)	United Kingdom of Great Britain and Northern Ireland		Food waste data is re-modelled based on WRAP's 2013 analysis of food waste in the hospitality and food service sector, a study that employed waste compositional analyses and analysis of survey information from the Department for Environment, Food and Rural Affairs. This data was re-weighted to account for the change in number and size of premises, number of pupils served by school catering, etc.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Vujić et al. 2022)	Serbia	Belgrade	Four municipalities across Belgrade were chosen based on different income level and housing type (based on the split of individual households and apartment blocks). Data was gathered through combination of direct measurement methods and questionnaires. A database of businesses/enterprises in Serbia was used to identify the types and distribution of Food Service in the selected municipalities. The sample included 6 hotels/accommodations, 15 restaurants and fast-food services, and 2 schools and kindergartens. Those businesses were given bags for separating daily their generated food waste, and the total mass of food waste generated was measured daily for seven days by separating it from other wastes and weighing. A separate estimate of other commercial outlets – which appear to be a mixture of Food Service and Retail wastes–- was estimated but is not included here. This amounted to 30% of the total food waste. Results are from the sample projected to the whole of Belgrade for Hotels, Restaurants and Fast food, and Schools and Kindergartens. Waste was sorted into six categories. Data was normalized based on number of employees. The share of edible and inedible parts is presented for each business type grouped by size (number of employees), although the interpretation of inedible parts may include edible parts that were expired and "can't anymore be consumed by humans."

Retail datapoints

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(JICA 2010)	Kenya	Nairobi	Across retail and out-of-home consumption, 90 locations had their waste analysed for a period of seven days, preceded by a one-day test measurement, which was excluded from the analysis. The figure is a sum of Shop and Market, which are measured separately. The original study scales this by the number of institutions in Nairobi.
(Jereme et al. 2013)	Malaysia		Table 1 cites the Ministry of Housing and Local Government (2011), estimating food waste generation by source. This was not findable by the bibliography nor through a direct internet search. As a result, we cannot have high confidence in the estimate.
(Love Food Hate Waste NZ 2020)	New Zealand		This summary document refers to a University of Otago Master's student having conducted waste audits at three supermarket chains. It also presents the final destinations of retail waste, which has been used to adjust the waste figure. The share going to Animal Feed, Donation and Protein Reprocessing has been removed from the waste figure.
(Tiarcenter 2019)	Russian Federation		The paper cites what is assumed to be a waste composition analysis by the Higher School of Economics (which was not found when searched for) and data from Rosstat. In addition, the shares of waste at each stage are calculations based on data from the Russian Agriculture Ministry (2017). The estimate provides a total food waste estimate as well as the amount of waste at each stage of the chain; these have been combined to form sector-specific estimates. The inability to trace the original source data and the lack of transparency on the calculations means that we cannot have high confidence in this estimate.
(SAGO 2019)	Saudi Arabia		This study forms the Saudi waste Baseline, conducted by Saudi Grains Organisation (SAGO). For Retail, over 7,000 samples across 19 product groups were taken. It is unclear from how many retailers samples were taken. Wholesale is not disaggregated from Retail so is included. Samples were taken across 13 regions in Saudi Arabia. The value taken is the share of total waste attributed to "Distribution." Additional information and images to supplement the main study can be found at *https://www.macs-g20.org/fileadmin/macs/Activities/2020_FLW_WS/4_Session_3_FW_at_HH_level_small.pdf*.
(Eurostat 2023)	Belgium		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Bulgaria		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Czechia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Denmark		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Germany		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Estonia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

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(Eurostat 2023)	Ireland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Greece		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Spain		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	France		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Croatia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Italy		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Cyprus		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," and the Eurostat metadata includes explanation that it is modelled from statistical data of companies and production value of select main sectors.
(Eurostat 2023)	Latvia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Lithuania		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Luxembourg		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Hungary		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Malta		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Netherlands		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Austria		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Poland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Portugal		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Slovenia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Slovakia		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(Eurostat 2023)	Finland		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/ scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Eurostat 2023)	Sweden		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints. Flagged by Eurostat as being "estimated," but it is unclear in what way.
(Eurostat 2023)	Norway		Reported to Eurostat (indicator env_wasfw). Common methodologies required are defined by Commission-delegated decision (EU) 2019/1597, which is consistent with the Food Waste Index (in Retail settings, it allows direct measurement, mass balance, waste composition analysis and counting/scanning). Quality assurance is the responsibility of both Member States and Eurostat. Eurostat declared that overall, the "data are of good quality." However, at the time of writing, information on specific methodologies, sample sizes, etc. to determine specific estimates were not available. As a result, all Eurostat data are presented as a separate confidence classification that represents alignment of the overall dataset, although there remain uncertainties about specific datapoints.
(UNEP 2023)	Japan		Food-related businesses generating more than 100 tonnes of food waste per year are required to report quantities generated to the national government in accordance with the Food Recycling Law. For businesses producing less than 100 tonnes, the amount if separately estimated by multiplying the results of a sampling survey by the growth rate of waste generated by those businesses reporting 100 tonnes or more. Questionnaire surveys are used for those submitting reports to understand the share of edible parts. The amount of food waste is calculated for each of nine subsectors in the Retail industry. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection.
(We Team, Consumer Goods Forum and GS1 Argentina 2021)	Argentina		Detailed data is provide from retailers on sales and wastage of 16 food categories. Data was collected from supermarkets representing 41% of the total market share. The data was projected over the remaining market share to estimate the entire sector nationwide. The results are presented as total tonnage waste, as a share of total sales, total tonnages wasted and financial value. The report also includes breakdowns of waste into the 16 product categories, total waste by region and waste by cause. More recent data on food waste in some supermarkets is available via an online dashboard and accompanying reports, but this data only covers particular retail subsectors and does not scale estimates to the remainder of the country. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(U.S. EPA 2023)	United States of America		Data taken from studies conducted on food waste in specific sectors (state, municipal governments, industry groups, academics, etc.) that are correlated to facility-specific characteristics. This develops equations expressing generation factors, which are scaled up by applying national, sector-specific statistics. Multiple estimates are formed per sector, from which an average is taken. No new literature was identified for the 2019 estimates, so sectors retained the same generation factors as in the 2018 "wasted food report," and key changes will be in national statistics for each sector. Totals taken from Table 3, then adjusted to remove the shares going to "non-waste" destinations. They discuss limitations of data associated with using existing generation factors, with inaccuracies for certain destination such as food sent down the drain. Data reported here was reported to UNEP as part of the SDG 12.3.1(b) pilot data collection.
(Brancoli et al. 2022)	Brazil	São Paulo	Waste generated by the stalls of four street markets (total of 156 stalls) in São Paulo was swept and bagged by the municipality. The waste was later collected and transported to a site where it was sorted into 27 waste categories and weighed. Waste was collected on one day per street market.
(Beretta and Hellweg 2019)	Switzerland		Combines data from multiple sources: Baier and Deller (2014) for retailers, then extrapolated based on supermarket and discounter sales and population changes. This estimate combined with separate modelling by Beretta et al. (2017) based on confidential write-off rate data and supermarket shares. Figure 26 splits "retail trade" and "trade" (wholesale), which are aggregated in some other figures. Only the retail trade (detailhandel) is included here. The report only presents "avoidable" waste; approximate "unavoidable" waste was supplied from personal communication with authors.
(Bontinck, Grant and Lifecycles 2021)	Australia		This is a mass balance model of the whole Australian food supply chain, building on and adjusting the 2019 baseline study. A total of 169 sources were used throughout the whole supply chain analysis, including industry data, government data, scientific publications and official statistical data. For retail, this was updated from the 2019 report based on information from audits conducted for Sustainability Victoria.
(Leket Israel 2022)	Israel		This study involved a combination of some measurement and other data into a flow model: "A comprehensive value chain model for various food production and consumption stages was designed to assess food waste and the potential for food rescue in Israel. The model is based on a bottom-up approach, and includes analysis of data relevant to agricultural production, import, export, industry, distribution and a sample of consumption patterns of 50 different types of food." [...] "For each type of food, the volume of input and output was measured in terms of gross agricultural product and loss rate for every stage of the value chain in the food production, distribution and consumption process." [...] "This data is indicative and intended to serve as the basis for public debate, and for further research and study."
(JICA 2013b)	Zimbabwe	Chitungwiza	This report includes a waste amount survey, in which waste from three samples were taken from each establishment type (including Corner shops, Supermarkets, Markets) each day during a survey period of five days. Out of 45 intended samples, 43 were successfully taken. For the waste composition analysis, one sample per establishment type was taken each day for five days.
(Garduño et al. 2023)	Mexico	Baja California Sur	The authors distributed questionnaire surveys to actors across the food chain, based on statistical records of businesses, in an attempt to be representative of the various establishment types. Perceptions of wastage rates by specific product groups at specific business types were gathered. These were then used as waste factors for those products/business types, and scaled by relevant business data to get an estimate for the sector. The study involved 50 surveys across wholesale and retail businesses. Authors highlight that it is limited by being built on the perceptions of the stakeholders, and that they struggled to engage supermarkets.

SOURCE	COUNTRY	STUDY AREA	DESCRIPTION
(Gooch et al. 2019)	Canada		The study uses data from Canadian Industry statistics to inform the number of food retailers across the country. It includes 204 responses from Retail (based on a total of 618 responses across the whole value chain, of which 33% from Retail, in Appendix 2 section 3.3). Around 43% of respondents collected and gave data in the Retail sector. As part of a whole-chain Mass Balance model, the % loss factors on a product level were used to inform estimates of food waste. Table G (Appendix 1) shows the summary loss factors for each stage in the supply chain. Results were subsequently tested and validated through interviews. Note: the "scope" (Figure C, Appendix 2) suggests that food sent to animal feed and biomaterial processing was included; these have been manually removed based on the utilization of food loss and waste destinations across the value chain, as reported in Figure 3-9. These % shares were read from the graph (using computer software) so may be imprecise. Due to possible issues with self-reported loss rates (acknowledged in the paper) and differences in scope, this is assigned "medium confidence."
(Xue et al. 2021)	China		The paper considers food loss and waste across the entire food system. For Retail, questionnaires and interviews were held with 108 retailers, based on a stratified sampling method. It also included data on pre-consumer waste rates for specific products from 107 publications. The tonnes of food waste per sector was taken from the supplementary information for Figure 2c. The average population for 2014-18 is used to derive kilogram per capita estimates. These were combined in a mass-balance model. Only edible food waste is considered.
(Devine et al. 2023)	United Kingdom of Great Britain and Northern Ireland		Data were provided by Retail signatories to Courtauld 2030, which cover more than 95% of the food retail sector (by sales). This was scaled up based on market coverage.
(Vujić et al. 2022)	Serbia	Belgrade	Four municipalities across Belgrade were chosen based on different income levels and housing types (based on the split of individual households and apartment blocks). Data was gathered through a combination of direct measurement methods and questionnaires. A database of businesses/ enterprises in Serbia was used to identify the types and distribution of Retail businesses in the selected municipalities. The sample included three "Retail sale in non-specialized stores" and three "Retail sale in specialized stores." Those businesses were given bags for separating daily generated food waste. The total mass of food waste generated was measured daily for a period of seven days by separating it from other wastes and weighing. A separate estimate of other commercial outlets – which appear to be a mixture of Food Service and Retail wastes – was estimated but is not included here. Waste was sorted into six categories. Data was normalized based on the number of employees. It includes estimates of edible and inedible wastes, although the interpretation of inedible parts may include edible parts that were expired and "can't anymore be consumed by humans."

Annex 3: Table of household estimates

This table is repeated in the Appendix, where tables of estimates for food service and retail can also be found.

REGION	M49 CODE	COUNTRY	HOUSEHOLD ESTIMATE (KG/CAPITA/YEAR)	HOUSEHOLD ESTIMATE (TONNES/YEAR)	CONFIDENCE IN ESTIMATE
Australia and New Zealand	36	Australia	98	2 559 065	High confidence
Australia and New Zealand	554	New Zealand	61	316 590	High confidence
Central Asia	398	Kazakhstan	88	1 708 990	Very low confidence
Central Asia	417	Kyrgyzstan	86	568 288	Very low confidence
Central Asia	762	Tajikistan	86	852 861	Very low confidence
Central Asia	795	Turkmenistan	88	566 433	Very low confidence
Central Asia	860	Uzbekistan	86	2 968 299	Very low confidence
Eastern Asia	156	China	76	108 667 369	Medium confidence
Eastern Asia	344	China, Hong Kong SAR	101	759 923	Medium confidence
Eastern Asia	446	China Macao SAR	76	53 016	Low confidence
Eastern Asia	408	Democratic People's Republic of Korea	81	2 104 855	Low confidence
Eastern Asia	392	Japan	60	7 398 006	High confidence
Eastern Asia	496	Mongolia	18	60 364	Medium confidence
Eastern Asia	410	Republic of Korea	95	4 921 086	Medium confidence
Eastern Europe	112	Belarus	71	674 104	Low confidence
Eastern Europe	100	Bulgaria	26	176 280	Eurostat
Eastern Europe	203	Czechia	69	723 810	Eurostat
Eastern Europe	348	Hungary	66	658 020	Eurostat
Eastern Europe	616	Poland	60	2 391 600	Eurostat
Eastern Europe	498	Republic of Moldova	71	231 061	Low confidence
Eastern Europe	642	Romania	67	1 323 991	Low confidence
Eastern Europe	643	Russian Federation	33	4 829 772	Medium confidence
Eastern Europe	703	Slovakia	65	366 600	Eurostat
Eastern Europe	804	Ukraine	69	2 758 037	Low confidence
Latin America and the Caribbean	660	Anguilla	95	1 892	Very low confidence
Latin America and the Caribbean	28	Antigua and Barbuda	88	7 922	Low confidence
Latin America and the Caribbean	32	Argentina	91	4 156 798	Low confidence
Latin America and the Caribbean	533	Aruba	88	9 682	Low confidence
Latin America and the Caribbean	44	Bahamas	88	36 089	Low confidence
Latin America and the Caribbean	52	Barbados	88	24 646	Low confidence
Latin America and the Caribbean	84	Belize	53	21 596	Medium confidence
Latin America and the Caribbean	68	Bolivia (Plurinational State of)	90	1 101 625	Low confidence
Latin America and the Caribbean	535	Bonaire, St. Eustatius & Saba	95	2 838	Very low confidence

REGION	M49 CODE	COUNTRY	HOUSEHOLD ESTIMATE (KG/CAPITA/YEAR)	HOUSEHOLD ESTIMATE (TONNES/YEAR)	CONFIDENCE IN ESTIMATE
Latin America and the Caribbean	76	Brazil	94	20 289 630	Medium confidence
Latin America and the Caribbean	92	British Virgin Islands	88	2 641	Low confidence
Latin America and the Caribbean	136	Cayman Islands	88	6 162	Low confidence
Latin America and the Caribbean	152	Chile	88	1 725 226	Low confidence
Latin America and the Caribbean	170	Colombia	70	3 653 302	Medium confidence
Latin America and the Caribbean	188	Costa Rica	91	473 131	Low confidence
Latin America and the Caribbean	192	Cuba	91	1 023 900	Low confidence
Latin America and the Caribbean	531	Curaçao	88	16 724	Low confidence
Latin America and the Caribbean	212	Dominica	91	6 394	Low confidence
Latin America and the Caribbean	214	Dominican Republic	160	1 799 544	Medium confidence
Latin America and the Caribbean	218	Ecuador	96	1 727 535	Medium confidence
Latin America and the Caribbean	222	El Salvador	91	579 084	Low confidence
Latin America and the Caribbean	238	Falkland Islands (Malvinas)	95	-	Very low confidence
Latin America and the Caribbean	254	French Guiana	95	28 375	Very low confidence
Latin America and the Caribbean	308	Grenada	91	11 874	Low confidence
Latin America and the Caribbean	312	Guadeloupe	95	37 834	Very low confidence
Latin America and the Caribbean	320	Guatemala	91	1 629 472	Low confidence
Latin America and the Caribbean	328	Guyana	88	71 298	Low confidence
Latin America and the Caribbean	332	Haiti	90	1 044 831	Low confidence
Latin America and the Caribbean	340	Honduras	90	940 257	Low confidence
Latin America and the Caribbean	388	Jamaica	86	243 364	High confidence
Latin America and the Caribbean	474	Martinique	95	34 996	Very low confidence
Latin America and the Caribbean	484	Mexico	105	13 368 447	Medium confidence
Latin America and the Caribbean	500	Montserrat	95	-	Very low confidence
Latin America and the Caribbean	558	Nicaragua	90	626 538	Low confidence
Latin America and the Caribbean	591	Panama	101	445 347	Medium confidence
Latin America and the Caribbean	600	Paraguay	91	619 272	Low confidence

REGION	M49 CODE	COUNTRY	HOUSEHOLD ESTIMATE (KG/CAPITA/YEAR)	HOUSEHOLD ESTIMATE (TONNES/YEAR)	CONFIDENCE IN ESTIMATE
Latin America and the Caribbean	604	Peru	88	2 983 735	Medium confidence
Latin America and the Caribbean	630	Puerto Rico	88	286 071	Low confidence
Latin America and the Caribbean	652	Saint Barthélemy	95	946	Very low confidence
Latin America and the Caribbean	659	Saint Kitts and Nevis	88	4 401	Low confidence
Latin America and the Caribbean	662	Saint Lucia	91	16 441	Low confidence
Latin America and the Caribbean	663	Saint Martin (French part)	88	2 641	Low confidence
Latin America and the Caribbean	670	Saint Vincent & Grenadines	91	9 134	Low confidence
Latin America and the Caribbean	534	Sint Maarten (Dutch part)	88	3 521	Low confidence
Latin America and the Caribbean	740	Suriname	91	56 630	Low confidence
Latin America and the Caribbean	780	Trinidad and Tobago	88	134 673	Low confidence
Latin America and the Caribbean	796	Turks and Caicos Islands	88	4 401	Low confidence
Latin America and the Caribbean	850	United States Virgin Islands	88	8 802	Low confidence
Latin America and the Caribbean	858	Uruguay	88	301 034	Low confidence
Latin America and the Caribbean	862	Venezuela	93	2 626 859	Medium confidence
Melanesia	242	Fiji	90	83 945	Very low confidence
Melanesia	540	New Caledonia	87	25 215	Very low confidence
Melanesia	598	Papua New Guinea	89	903 213	Very low confidence
Melanesia	90	Solomon Islands	43	31 242	Medium confidence
Melanesia	548	Vanuatu	141	46 687	Medium confidence
Micronesia	316	Guam	60	10 173	Very low confidence
Micronesia	296	Kiribati	62	8 056	Very low confidence
Micronesia	584	Marshall Islands	63	2 526	Very low confidence
Micronesia	583	Micronesia (Fed. States of)	38	4 205	Medium confidence
Micronesia	520	Nauru	60	598	Very low confidence
Micronesia	580	Northern Mariana Islands	60	2 992	Very low confidence
Micronesia	585	Palau	63	1 263	Very low confidence
Northern Africa	12	Algeria	113	5 057 909	Very low confidence
Northern Africa	818	Egypt	163	18 085 437	Medium confidence
Northern Africa	434	Libya	84	572 937	Medium confidence
Northern Africa	504	Morocco	113	4 219 805	Very low confidence
Northern Africa	729	Sudan	116	5 414 527	Very low confidence

REGION	M49 CODE	COUNTRY	HOUSEHOLD ESTIMATE (KG/CAPITA/YEAR)	HOUSEHOLD ESTIMATE (TONNES/YEAR)	CONFIDENCE IN ESTIMATE
Northern Africa	788	Tunisia	172	2 121 810	Medium confidence
Northern Africa	732	Western Sahara	140	80 958	Very low confidence
Northern America	60	Bermuda	79	4 718	Very low confidence
Northern America	124	Canada	79	3 019 925	High confidence
Northern America	304	Greenland	79	4 718	Very low confidence
Northern America	666	Saint Pierre and Miquelon	76	758	Very low confidence
Northern America	840	United States of America	73	24 716 539	High confidence
Northern Europe	208	Denmark	79	464 520	Eurostat
Northern Europe	233	Estonia	61	81 130	Eurostat
Northern Europe	234	Faroe Islands	75	3 768	Low confidence
Northern Europe	246	Finland	53	293 620	Eurostat
Northern Europe	352	Iceland	75	27 886	Low confidence
Northern Europe	372	Ireland	48	240 960	Eurostat
Northern Europe	833	Isle of Man	75	6 029	Low confidence
Northern Europe	428	Latvia	82	151 700	Eurostat
Northern Europe	440	Lithuania	86	236 500	Eurostat
Northern Europe	578	Norway	78	423 540	Eurostat
Northern Europe	752	Sweden	61	643 550	Eurostat
Northern Europe	826	United Kingdom	76	5 097 005	High confidence
Polynesia	16	American Samoa	81	3 258	Very low confidence
Polynesia	184	Cook Islands	86	1 724	Very low confidence
Polynesia	258	French Polynesia	81	25 252	Very low confidence
Polynesia	570	Niue	86	-	Very low confidence
Polynesia	882	Samoa	86	18 857	Very low confidence
Polynesia	772	Tokelau	86	-	Very low confidence
Polynesia	776	Tonga	88	9 690	Very low confidence
Polynesia	798	Tuvalu	88	881	Very low confidence
Polynesia	876	Wallis and Futuna Islands	86	862	Very low confidence
South-eastern Asia	96	Brunei Darussalam	76	34 109	Low confidence
South-eastern Asia	116	Cambodia	85	1 419 831	Medium confidence
South-eastern Asia	360	Indonesia	53	14 728 364	Medium confidence
South-eastern Asia	418	Lao People's Dem. Rep.	89	673 831	Medium confidence
South-eastern Asia	458	Malaysia	81	2 754 808	Medium confidence
South-eastern Asia	104	Myanmar	78	4 221 946	Low confidence
South-eastern Asia	608	Philippines	26	2 954 580	Medium confidence
South-eastern Asia	702	Singapore	68	409 182	Medium confidence
South-eastern Asia	764	Thailand	86	6 180 468	Medium confidence

REGION	M49 CODE	COUNTRY	HOUSEHOLD ESTIMATE (KG/ CAPITA/YEAR)	HOUSEHOLD ESTIMATE (TONNES/ YEAR)	CONFIDENCE IN ESTIMATE
South-eastern Asia	626	Timor-Leste	78	104 419	Low confidence
South-eastern Asia	704	Viet Nam	72	7 079 811	Medium confidence
Southern Asia	4	Afghanistan	127	5 229 654	Medium confidence
Southern Asia	50	Bangladesh	82	14 101 956	Medium confidence
Southern Asia	64	Bhutan	19	15 072	High confidence
Southern Asia	356	India	55	78 192 338	Medium confidence
Southern Asia	364	Iran (Islamic Republic of)	93	8 208 360	Low confidence
Southern Asia	462	Maldives	207	107 877	Medium confidence
Southern Asia	524	Nepal	93	2 831 907	Low confidence
Southern Asia	586	Pakistan	130	30 754 726	Medium confidence
Southern Asia	144	Sri Lanka	76	1 656 148	Medium confidence
Southern Europe	8	Albania	86	243 657	Low confidence
Southern Europe	20	Andorra	82	6 598	Low confidence
Southern Europe	70	Bosnia and Herzegovina	86	277 117	Low confidence
Southern Europe	191	Croatia	53	213 590	Eurostat
Southern Europe	292	Gibraltar	82	2 474	Low confidence
Southern Europe	300	Greece	87	903 930	Eurostat
Southern Europe	336	Holy See	83	-	Very low confidence
Southern Europe	380	Italy	107	6 317 280	Eurostat
Southern Europe	470	Malta	92	48 760	Eurostat
Southern Europe	499	Montenegro	86	54 051	Low confidence
Southern Europe	807	North Macedonia	86	179 311	Low confidence
Southern Europe	620	Portugal	124	1 273 480	Eurostat
Southern Europe	674	San Marino	82	2 474	Low confidence
Southern Europe	688	Serbia	108	780 482	Medium confidence
Southern Europe	705	Slovenia	36	76 320	Eurostat
Southern Europe	724	Spain	61	2 895 272	Eurostat
Sub-Saharan Africa	24	Angola	89	3 171 950	Low confidence
Sub-Saharan Africa	204	Benin	89	1 189 816	Low confidence
Sub-Saharan Africa	72	Botswana	50	132 594	Medium confidence
Sub-Saharan Africa	854	Burkina Faso	92	2 085 610	Low confidence
Sub-Saharan Africa	108	Burundi	92	1 185 863	Low confidence
Sub-Saharan Africa	132	Cabo Verde	89	52 584	Low confidence
Sub-Saharan Africa	120	Cameroon	89	2 487 472	Low confidence
Sub-Saharan Africa	140	Central African Republic	92	513 353	Low confidence
Sub-Saharan Africa	148	Chad	92	1 630 217	Low confidence
Sub-Saharan Africa	174	Comoros	89	74 865	Low confidence
Sub-Saharan Africa	178	Congo	89	532 075	Low confidence
Sub-Saharan Africa	384	Côte d'Ivoire	89	2 509 753	Low confidence
Sub-Saharan Africa	180	Dem. Rep. of the Congo	62	6 147 778	Medium confidence
Sub-Saharan Africa	262	Djibouti	89	99 820	Low confidence
Sub-Saharan Africa	226	Equatorial Guinea	90	150 824	Low confidence

REGION	M49 CODE	COUNTRY	HOUSEHOLD ESTIMATE (KG/ CAPITA/YEAR)	HOUSEHOLD ESTIMATE (TONNES/ YEAR)	CONFIDENCE IN ESTIMATE
Sub-Saharan Africa	232	Eritrea	92	338 555	Low confidence
Sub-Saharan Africa	748	Eswatini	89	106 950	Low confidence
Sub-Saharan Africa	231	Ethiopia	69	8 543 382	Medium confidence
Sub-Saharan Africa	266	Gabon	90	215 849	Low confidence
Sub-Saharan Africa	270	Gambia	92	249 316	Low confidence
Sub-Saharan Africa	288	Ghana	84	2 812 571	High confidence
Sub-Saharan Africa	324	Guinea	89	1 235 269	Low confidence
Sub-Saharan Africa	624	Guinea-Bissau	92	194 117	Low confidence
Sub-Saharan Africa	404	Kenya	81	4 351 168	Medium confidence
Sub-Saharan Africa	426	Lesotho	89	205 878	Low confidence
Sub-Saharan Africa	430	Liberia	92	487 593	Low confidence
Sub-Saharan Africa	450	Madagascar	92	2 724 081	Low confidence
Sub-Saharan Africa	454	Malawi	92	1 877 693	Low confidence
Sub-Saharan Africa	466	Mali	92	2 078 251	Low confidence
Sub-Saharan Africa	478	Mauritania	89	422 451	Low confidence
Sub-Saharan Africa	480	Mauritius	90	117 408	Low confidence
Sub-Saharan Africa	175	Mayotte	93	30 536	Very low confidence
Sub-Saharan Africa	508	Mozambique	92	3 033 197	Low confidence
Sub-Saharan Africa	516	Namibia	90	232 106	Low confidence
Sub-Saharan Africa	562	Niger	92	2 411 286	Low confidence
Sub-Saharan Africa	566	Nigeria	113	24 791 826	Medium confidence
Sub-Saharan Africa	638	Réunion	93	89 759	Very low confidence
Sub-Saharan Africa	646	Rwanda	141	1 937 761	Medium confidence
Sub-Saharan Africa	654	Saint Helena	93	925	Very low confidence
Sub-Saharan Africa	678	Sao Tome and Principe	89	20 499	Low confidence
Sub-Saharan Africa	686	Senegal	77	1 328 487	Medium confidence
Sub-Saharan Africa	690	Seychelles	183	20 089	Medium confidence
Sub-Saharan Africa	694	Sierra Leone	92	792 109	Low confidence
Sub-Saharan Africa	706	Somalia	92	1 619 177	Low confidence
Sub-Saharan Africa	710	South Africa	47	2 819 981	Medium confidence
Sub-Saharan Africa	728	South Sudan	92	1 003 706	Low confidence
Sub-Saharan Africa	768	Togo	92	814 188	Low confidence
Sub-Saharan Africa	800	Uganda	110	5 209 076	Medium confidence
Sub-Saharan Africa	834	United Rep. of Tanzania	152	9 960 496	Medium confidence
Sub-Saharan Africa	894	Zambia	78	1 559 958	Medium confidence
Sub-Saharan Africa	716	Zimbabwe	48	791 249	Medium confidence
Western Asia	51	Armenia	102	283 222	Low confidence
Western Asia	31	Azerbaijan	102	1 055 462	Low confidence
Western Asia	48	Bahrain	132	193 612	Medium confidence
Western Asia	196	Cyprus	71	88 750	Eurostat
Western Asia	268	Georgia	101	377 643	Medium confidence
Western Asia	368	Iraq	143	6 378 198	Medium confidence
Western Asia	376	Israel	97	874 433	Medium confidence

REGION	M49 CODE	COUNTRY	HOUSEHOLD ESTIMATE (KG/CAPITA/YEAR)	HOUSEHOLD ESTIMATE (TONNES/YEAR)	CONFIDENCE IN ESTIMATE
Western Asia	400	Jordan	101	1 136 788	Low confidence
Western Asia	414	Kuwait	99	420 861	Low confidence
Western Asia	422	Lebanon	128	701 828	Medium confidence
Western Asia	512	Oman	99	451 415	Low confidence
Western Asia	634	Qatar	93	250 830	High confidence
Western Asia	682	Saudi Arabia	105	3 818 681	High confidence
Western Asia	275	State of Palestine	102	534 863	Low confidence
Western Asia	760	Syrian Arab Republic	172	3 798 032	Medium confidence
Western Asia	792	Türkiye	102	8 694 318	Low confidence
Western Asia	784	United Arab Emirates	99	930 427	Low confidence
Western Asia	887	Yemen	104	3 490 097	Low confidence
Western Europe	40	Austria	83	742 020	Eurostat
Western Europe	56	Belgium	71	827 860	Eurostat
Western Europe	250	France	61	3 942 430	Eurostat
Western Europe	276	Germany	78	6 502 860	Eurostat
Western Europe	438	Liechtenstein	81	3 235	Low confidence
Western Europe	442	Luxembourg	91	59 150	Eurostat
Western Europe	492	Monaco	81	3 235	Low confidence
Western Europe	528	Netherlands	59	1 036 040	Eurostat
Western Europe	756	Switzerland	119	1 041 879	Medium confidence

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