

Business Analysis and Intelligence

FOOD WASTE ESTIMATION: A GLOBAL PERSPECTIVE

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1. Introduction

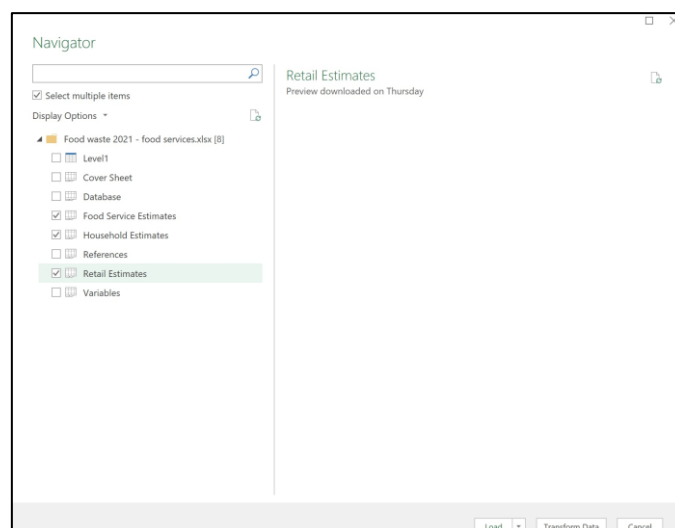
This report presents a comprehensive analysis of food waste across 215 countries worldwide, based on data from 2021. It focuses on sectors such as householders, food services, and retail. While many countries lack robust data on food waste, a smaller number maintain detailed records with high confidence in the data.

Countries as China, India are the highest contributors to food waste, while Slovenia, and Austria registered lower levels of waste. Regarding specific sectors, household estimates account for the largest share of food waste, largely due to a lack of information and awareness among the consumers.

This analysis aims to contribute to the ongoing discourse on food waste, equipping stakeholders with evidence-based insights for strategic decision-making, policy development, and encouraging sustainable consumption highlighting the issue as a global challenge.

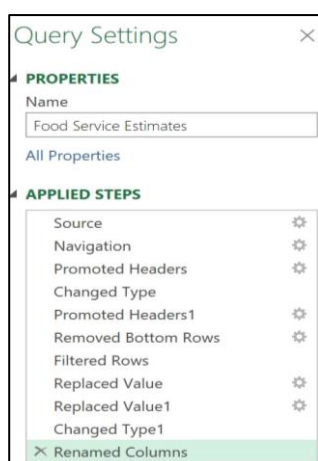
2. Data Wrangling

To prepare the dataset for analysis, I used Excell Power Query to clean the raw data. The first step is opening a new workbook in Excell, accessing Power Query and get data from Excel workbook (*UNEP Food Waste Index Report 2021*). From the data, I selected multiple items that is relevant for this analysis, including Food service estimate, Household estimate, and Retail estimate, then transform data as shown in *Screenshot 1*.

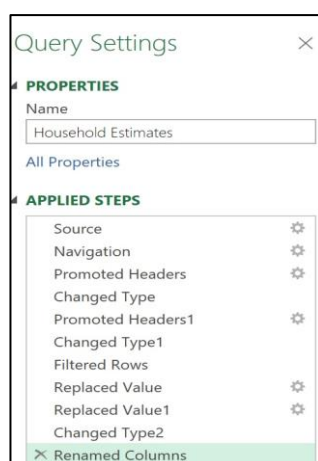


Screenshot 1. Selected Multiple items

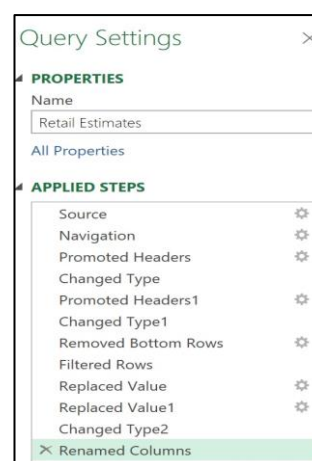
Into the dataset, I standardised the headers of the columns and replaced values * to 0 to avoid any blank spaces (this keeping the data consistent and makes it easier to analyse). I removed 3 rows from the bottoms and filtered information from columns that is irrelevant. This process I repeated for the 3 items (Food service, Household and Retail). I checked for any duplicates values, but I didn't find any duplicates as shown in the *Screenshots 2,3 and 4*.



Screenshots 2. Query Setting Food Service



Screenshots 3. Query Setting Household



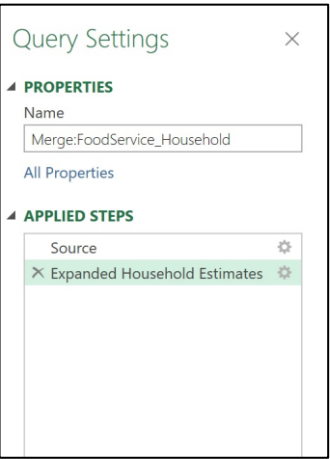
Screenshots 4. Query Setting Retail

To have a clear and easy to understand analysis, I merged all 3 items into a single Excell sheet. First step, I was to create a new sheet named "All sectors estimate". I merged the Household estimate data with the Food service estimate using the common column "M49 Code", establishing an online connection. Then, I merged the resulting dataset "Merge: Foodservice estimate/Household estimate with the Retail estimate, again using the common column "M49

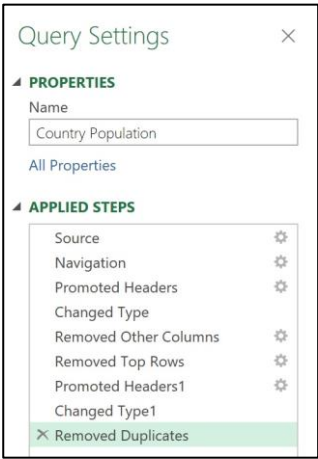
Code”. After completing the merge, saved the final combined dataset in the “All sectors estimate” sheet as shown in *Screenshot 5*. This approach consolidates all data into a single location, simplifying further analysis.

To enhance my analysis, I checked the original file to identify additional relevant data and found the column “Country_Population_Millions”. I created a new sheet titled “Country Population”, imported the data into the Power Query Editor, and selected the columns “Country”, “M49 Code”, and “Country_Population_Millions”, as shown in *Screenshot 5*.

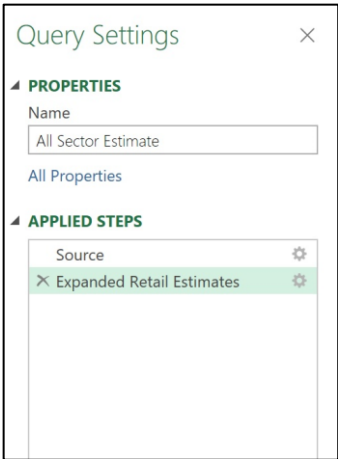
Next, I merged the “Country Population” data with the “All Sectors Estimate” sheet using the column “M49 Code” and created a final sheet named “Data”, as shown in *Screenshot 6*.



Screenshots 4. Query Setting Merge



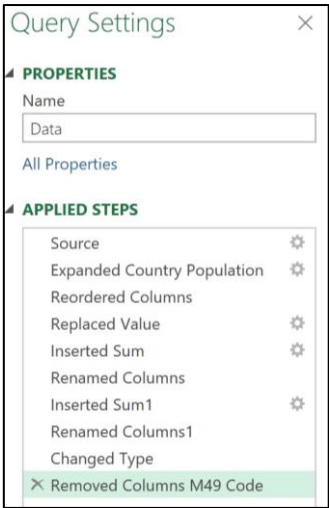
Screenshots 5. Query Setting Country P.



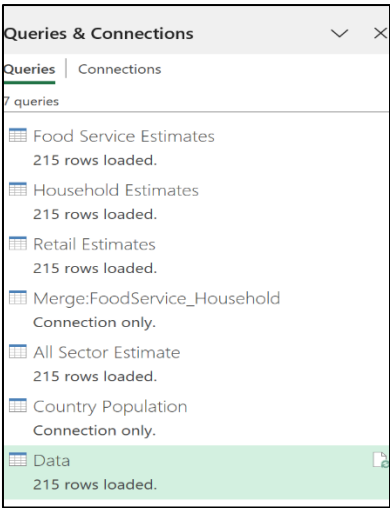
Screenshots 6. Query Setting All Sector

In the “Data” sheet, I added two new columns named “Sum All Sector (tonnes /year), is a summary of food waste from food service, household, retail sectors. And the column “Sum All Sector (kg/capita/year), is a summary of food waste from the same sectors as shown in Screenshot 3.

In the end, I removed the column “M49 Code” that I don’t need for the analysis. The previous steps involved standardising the dataset through the following transformations and records could be found in Screenshot 8.



Screenshot 7. Query Setting Data



Screenshot 8. Power Query and Connections

3. Exploratory Data Analysis (EDA) & Results interpretation*

3.1 Classification of Variables

In Table 1 presents the finalised 14 variables in the dataset, I excluded some redundant variables, which may not aid the analysis and added variables for special analysis purpose.

Table 1. Classification of variables

Variable	Data Type	Levels of Measurement
Region	Categorical	Qualitative/Nominal
Country	Categorical	Qualitative/Nominal
Country_Population_Millions	Numerical	Quantitative/Ratio
Food service estimate (kg/capita/year)	Numerical	Quantitative/Ratio
Food service estimate (tonnes/year)	Numerical	Quantitative/Ratio
Confidence in estimate	Categorical	Qualitative/Interval
Household estimate (kg/capita/year)	Numerical	Quantitative/Ratio
Household estimate (tonnes/year)	Numerical	Quantitative/Ratio
Confidence in estimate.1	Categorical	Qualitative/Interval
Retail estimate (kg/capita/year)	Numerical	Quantitative/Ratio
Retail estimate (tonnes/year)	Numerical	Quantitative/Ratio
Confidence in estimate.2	Categorical	Qualitative/Interval
Sum All Sector (tonnes/year)	Numerical	Quantitative/Ratio
Sum All Sector (kg/capita/year)	Numerical	Quantitative/Ratio

3.2 Descriptive Statics and Univariate Analysis

This dataset covers data of global food waste from 2021. As shown in Table 2. On average, food waste is around 126 million kg per capita, closely align with the median of 123 million kg per capita, which indicates a relatively balanced distribution. The most frequently occurring value (mode) is 146 million kg per capita. However, the data reveals substantial variation, with a difference of 199 million kg per capita between the lowest and highest food waste, highlighting significant disparities. The Positive skewness of 2 and a kurtosis of 9 suggest the presence of outliers on the higher end, which elevate the mean above the median.

Table 2. Descriptive Static

<i>Sum All Sector (kg/capita/year)</i>	
Mean	126
Standard Error	2
Median	123
Mode	146
Standard Deviation	22
Sample Variance	485
Kurtosis	9
Skewness	2
Range	199
Minimum	61
Maximum	260
Sum	27107
Count	215

4. Interpreting results and Revising Business Questions*



Figure 1. Top 5 Countries Food waste global 2021

I revisited and refined the business questions from my previous assessment (Assessment 1), to better align them with my exploratory data analysis (EDA). The primary question I aim to address is: *Which country wasted the most food in 2021?* Through the visual analysis as show in *Figure 1*, I observed that China recorded the highest total food waste in tonnes globally, while Nigeria had the highest food waste per capita in kilograms. These findings provide valuable insights into the distribution and scale of food waste across different regions.

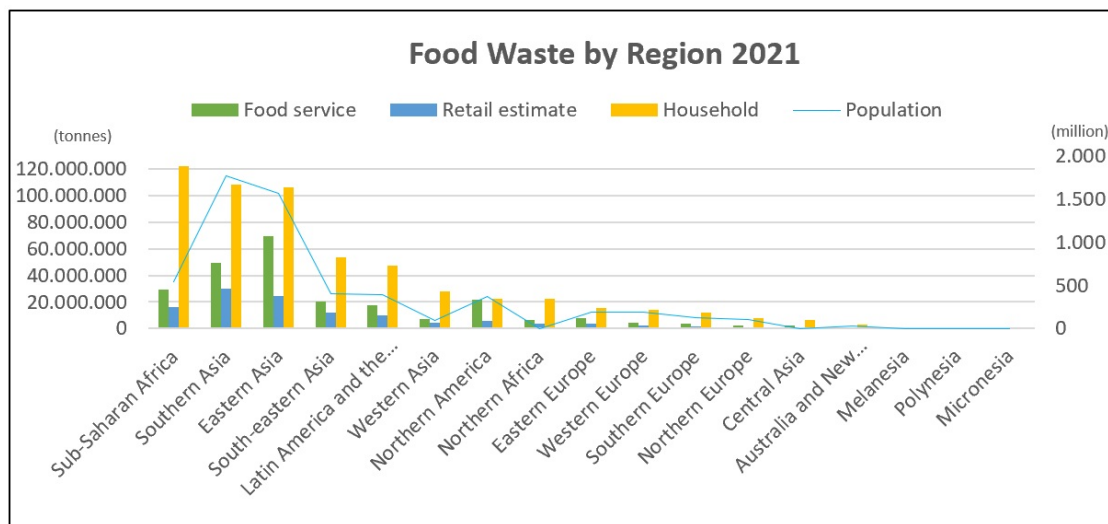


Figure 2. Food waste by Region 2021

To answer the questions *Which Region wasted the most food per tonnes in 2021?* In the *Figure 2*, the highlights that Sub-Saharan Africa, followed by Southern Asia, and Eastern Asia, are the regions with the highest food waste across all sectors.

Which Sector generated the most food waste per tonnes in 2021. I observed that the household sector accounts for the largest share of food waste globally, followed by the food service sector,

with the retail sector contributing the least. These findings underscore the significant role of households in global food waste patterns.

In *Table 3*, presents an analysis using a heat map scale to visualize food waste levels by region. Regions such as Sub-Saharan Africa, Southern Asia, and Eastern Asia are highlighted in red, indicating the highest levels of food waste per tonnes by Sector. In contrast, Regions like Micronesia, Polynesia, Melanesia, Australia and New Zealand, Central Asia, and Northern Europe are shown in green, reflecting lower levels of food waste in 2021.

It is important to note that some sectors lacked complete population data, and rows were assigned a value of “0” to maintain consistency throughout the analysis.

Table 3. Food waste by Sector and Population

Region	Food service	Retail estimate	Household	Population
Sub-Saharan Africa	29.629.195	16.409.032	121.812.970	543
Southern Asia	49.071.377	30.001.266	108.284.874	1.767
Eastern Asia	69.563.642	24.731.615	106.361.282	1.561
South-eastern Asia	20.268.579	12.354.867	53.339.806	399
Latin America and the Caribbean	17.820.858	10.027.493	47.216.702	389
Western Asia	7.488.048	4.678.768	27.899.721	95
Northern America	21.894.490	5.632.124	22.307.056	366
Northern Africa	6.668.671	3.772.398	22.114.942	0
Eastern Europe	7.940.571	4.074.097	15.155.126	193
Western Europe	4.590.247	2.658.755	14.242.534	195
Southern Europe	3.733.505	1.377.269	11.970.150	129
Northern Europe	2.022.285	835.582	8.029.320	100
Central Asia	2.024.174	1.145.054	6.346.507	0
Australia and New Zealand	668.646	253.171	2.854.879	30
Melanesia	301.291	169.969	976.664	0
Polynesia	17.330	9.342	49.878	0
Micronesia	14.500	7.784	45.445	0
Grand Total	243.717.410	118.138.588	569.007.856	5.768,9

The absence of data estimates for some countries presents a global challenge in achieving accurate food waste measurement. The collected data includes a column indicating the confidence level of the estimates. As shown in *Figure 4,5 and 6*, I analysed the distribution of countries based on the confidence levels of their data.

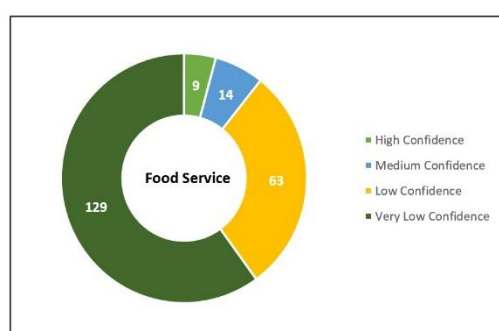


Figure 4. Confidence estimate by Food Service

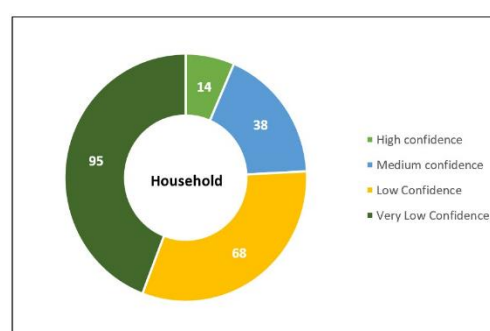


Figure 5. Confidence estimates by Household

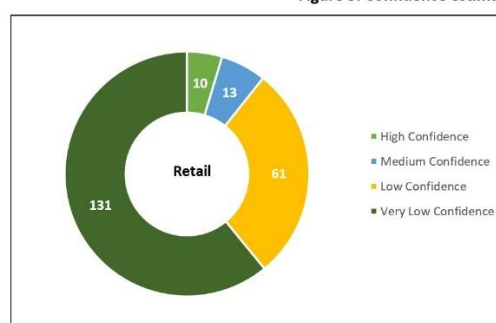


Figure 6. Confidence estimates by Retail

Figure 4,5 and 6 reveals significant disparities in data confidence levels across countries and sector. Specifically, 9 countries reported high-confidence data for overall food waste, while 129 countries registered very low confidence. Similarly, in the household sector, 14 countries had high-confidence data, compared to 95 countries with very low confidence. In retail sector, only 10 countries recorded high confidence data, whereas 131 countries fell into the very low confidence category.

As shown in Table 4, the countries with high confidence in each sector serve as reference points to extrapolate data for neighbouring countries. While these extrapolated figures are not exact estimates, they provide useful approximations to better understand regional food waste patterns.

Table 4. Countries with high confidence food waste estimates by sector

Household	Food Service	Retail
Australia	Australia	Australia
Austria	Austria	Austria
Canada	China	Denmark
Denmark	Denmark	Germany
Germany	Estonia	Italy
Ghana	Germany	New Zealand
Malta	Sweden	Saudi Arabia
Netherland	United Kingdom	Sweden
New Zealand	United States	United Kingdom
Norway		United States
Saudi Arabia		
Sweden		
United Kingdom		
United States		

In *Figure 7*, provides an overview of food waste in tonnes on a global scale, highlighting marked differences. This visualisation emphasizes the varying levels of food waste across countries and regions, offering valuable context for targeted interventions.

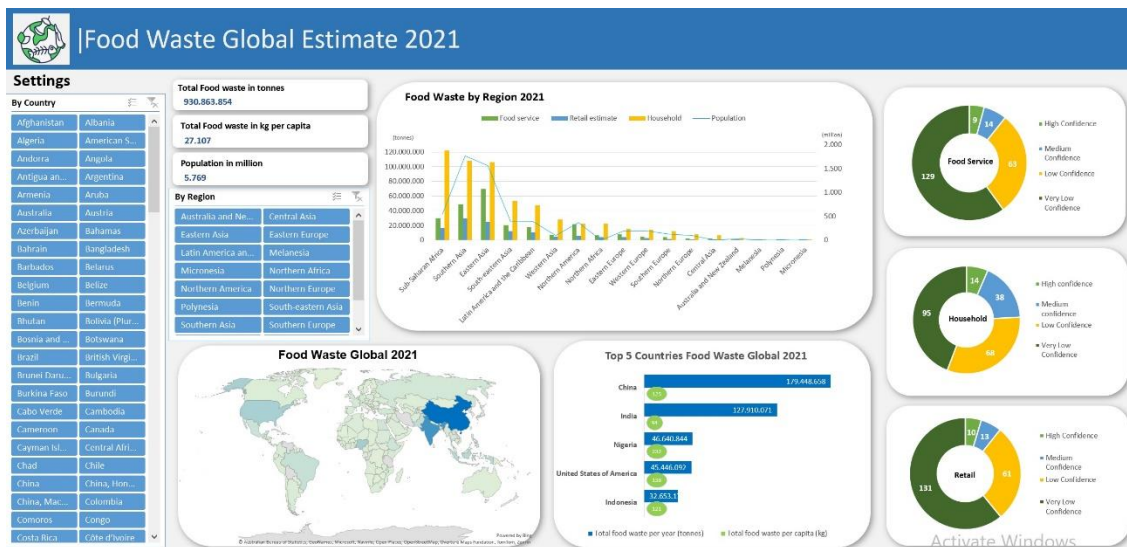


Figure 7. Food Waste Global 2021

5. Data Story

This data analysis is a valuable resource for Government and Regulatory bodies, Public-Private Partnerships (PPP), Waste Management and Recycling Companies, and Nonprofits and NGOs involved in organizational planning and resource allocation. As well as Universities or Research Institutions studying food waste trends. It also supports Investors and startups in making strategic decisions about business locations. Furthermore, it benefits Food Manufacturers, Farmers, Supply Chain Companies, Retailers, Restaurants, and Food Services by helping to reduce economic losses and improve process efficiency. Additionally, it offers Consumer insights into food waste patterns, empowering them to adopt more sustainable consumption habits and reduce their environmental footprint.

6. Data Dashboard



Screenshot 8. 2021 Global Food Waste Estimates Dynamics Dashboard

This Dashboard provides insights into global food waste data through a variety of visualisations, including Pie Charts, Choropleth Map, and Bar Chart. It features two interactive slicers, enabling users to filter the data by Country and Region for a more targeted geographical analysis.

7. Insights/Recommendations

Based on the analysis, in the table below are insights and recommendations for stakeholders in food waste global.

Stakeholder	Insights	Recommendations
Consumers	Households are major food waste contributors, emphasizing the need for individual action.	Promote awareness campaigns, portion control tools, and food-sharing apps.
Government and Regulatory Bodies	Data reveals discrepancies in food waste across regions and sectors, pointing to opportunities for policy intervention.	Implement regulations, incentivize food donation, and standardize waste tracking.
Waste Management and Recycling Companies	Food waste is often improperly disposed of.	Enhance collection efficiency and promote composting and recycling.
Startup Companies	Technology can target sectors with significant waste.	Develop waste-tracking solutions, food-sharing platforms, and smart storage apps.
Investors	Food waste reduction offers investment potential.	Fund waste reduction technologies and food redistribution startups.
Nonprofits and NGOs	Surplus food can address food insecurity.	Establish redistribution programs and collaborate with businesses.
Farmers	Overproduction and spoilage lead to waste.	Improve crop planning and partner with food banks.
Environmental Organizations	Food waste impacts climate and resource use.	Advocate for sustainable practices and raise awareness of food waste's environmental impact.
Public-Private Partnerships (PPP)	Collaborations reduce food waste effectively.	Support and promote the alliance between the public and private sectors with countries not yet associated.
Universities and Research Institutions	Data gaps need further study.	Conduct research on waste reduction and collaborate on innovative solutions.
Food Manufacturing	Processing inefficiencies cause waste.	Optimize production processes and reduce surplus.
Retailers	Unsold inventory contributes to waste.	Improve inventory management and donate unsold goods.
Restaurants and Food Service	Overproduction and portion control issues.	Adopt portion control and repurpose surplus food.
Supply Chain Companies	Inefficiencies in transport lead to spoilage.	Invest in cold chain technologies and optimize logistics.
Food Packaging	Packaging extends shelf life.	Develop sustainable packaging to reduce spoilage.
Social media	Public awareness is crucial for behaviour change.	Share data and success stories to engage audiences in food waste reduction.

8. References

1. UNEP (United Nations Environment Programme). (2024, March 27), *Food Waste Index Report 2024*. UN Environment Programme, (pp 22-193).
<https://wedocs.unep.org/handle/20.500.11822/45230>
2. UNEP (United Nations Environment Programme). (2021, March 4), *Food Waste Index Report 2021*, UN Environment Programme, Database.
<https://wedocs.unep.org/bitstream/handle/20.500.11822/35355/FWD.xlsx>