Consumer Expenditure Elasticity and Value of Household Food Waste: A Case Study in Kurunegala District

G.D.S. Thilakarathna

Department of Agricultural Economics and Business Management, University of Peradeniya, Sri Lanka

dinushit@agri.pdn.ac.lk

Abstract

Household food waste is driven by consumer habits and behaviour, varying with demographic, social, and economic factors. This study aims to determine whether household food waste is a luxury good and identify how demographic and socioeconomic factors affect household food waste. A Quadratic Almost Ideal Demand System (QUAIDS) model was used, augmented with demographic, socioeconomic, and expenditure controls. Data from 195 respondents via an online survey in the Kurunegala district (October 2022) covered food habits and waste. Food categories included rice, cereals, pulses, fruits, vegetables, meat, fish, dairy, eggs, and miscellaneous foods. The value of Household food waste was estimated using a proxy value derived from multiplying waste amounts by monthly grocery expenditures. The demand system estimation showed that all food waste categories were normal goods. Rice, cereals, pulses, fruits, vegetables, and miscellaneous foods were necessity goods, while meat, fish, dairy, and eggs were luxury goods. Expenditure share on household food waste varies with residence area and income level, and most households practice waste management and have positive attitudes toward minimizing waste.

Keywords: Household food waste, Almost ideal demand system, QUAIDS, Expenditure elasticity

I. INTRODUCTION

According to estimates, nearly one-third of the food produced worldwide is wasted. In Sri Lanka and other developing nations, food loss and waste play a crucial role in reducing hunger, raising incomes, and strengthening food security. When crops are produced, harvested, and processed, there is a loss of food, both in terms of quantity and quality. Developing nations are more likely to experience this. Food loss includes food waste, which is the act of discarding edible food at the consumer and retail levels. Food waste is particularly prevalent in industrialized nations, where it accounts for more than 40% of all food losses and waste at the retail and household levels (FAO, 2015).

Household Food waste (FW) means all edible food and beverages grown at home or purchased from outside but discarded at home, because of spoilage or with an expired date. Usually after a meal at home, edible food and beverages are thrown out as FW. Bones, shells, peels, curry leaves like un-edible parts and any food or beverages that are eaten away from home are not included as household FW. That represents a major component of all food waste. Typical household features are more or less likely to influence food waste. One food waste for one household may not be food waste for another household, it depends on a broad range of categories. It varies on a wide range of cultural, social, and economic factors. There is a personal dimension linked to socio-demographic factors, knowledge about food waste, and personal beliefs which are also influenced by cultural context and social norms (Gjerris and Gaiani, 2013).

Quantifying the amount of food waste during each step of the food supply chain significantly reduces food waste. But quantifying the amount of household food waste is QUAIDS-specified, not easy due to the lack of standard methodologies. Therefore, this is a problem with the reduction of household waste. Current consumer FW research concurs with the food categories that are most often wasted at home. Vegetables, fruits, and bread are the top wasted products, even though prevalence among these categories depends much on the household's dietary preferences. Limited information about inedible parts of food discarded at the household level is available. Because most studies focused on avoidable FW (Vargas-Lopez et al., 2022).

Demand estimation describes changes in consumer behavior concerning the price of the

ISBN 978-955-627-028-0

product, consumer income, or any other factors that affect or impact demand. One of the most popular consumer demand measures is the income or expenditure elasticity in classical microeconomic theory. During this study, expenditure elasticity is used to determine whether household FW is a luxury good or not. That means changes in consumer behavior related to the diverse types of food waste of main food categories concerning monthly expenditure on each food category. Our approach contributes to the relevant literature by supplying a first attempt to quantify FW within households in the Kurunegala district. Moreover, by evaluating and studying household FW value and consumer responsiveness, we provide proxy value for FW at the household level. The definition of demand-side perspectives allows us to place FW in the context of elasticities and estimate its total expenditure changes, the value of waste produced, and price changes (Vargas-Lopez et al., 2022).

An almost ideal demand (AIDS) system is used to evaluate demand analysis related to household food waste. The flexible functional form of the property of the AIDS cost function shows that the demand functions are obtained from its first-order approximation to any set of demand functions acquired from utility-maximizing behavior. The set of demand equations is used to obtain values for parameters (Deaton and Muellbauer, 1980). The Quadratic Almost Ideal Demand System (QUAIDS) model is an extended form of the AIDS model, and it is developed by Banks, Blundell, and Lewbel (1997) and the introduction of demographics described in Poi (2012).

According to the AIDS model's Quadratic Almost Ideal Demand System (QUAIDS), expenditure elasticity for each FW of each food category is estimated. Based on the elasticity value of each home food waste of a chosen food category, it is determined whether a household produces luxury food waste. A luxury good is one for which demand grows more than proportionally as income rises in economics. The desire for luxury items is known to be highly income elastic. In other words, consumers will increasingly purchase luxury commodities as their income increases. Due to its extreme sensitivity to economic difficulties, consumer expenditure on luxury items is frequently influenced by the state of the economy. Consumer patterns, however, frequently support the economy as well. Materials and Methods

II. MATERIALS AND METHODS

A. Description of data collection

The primary data for this study were collected through a self-administered online questionnaire conducted in the Kurunegala district. The Kurunegala district was selected due to its well-defined city planning and the clear demarcation of rural, semi-urban, and urban residential areas, which allowed for a comprehensive analysis of income level differences across these regions. The research design adopted a cross-sectional time horizon.

B. Sampling Method

This study employed a random sampling method to select participants from the Kurunegala district. The district's diverse residential areas, including urban, semi-urban, and rural regions, provided a comprehensive representation of varying income levels and household behaviors. Respondents were recruited through social media platforms such as Facebook, LinkedIn, and Twitter, ensuring broad accessibility.

The data collection process was executed through an online survey. The questionnaire, crafted using established scales adapted from previous literature, was initially prepared in English and then translated into Sinhala to ensure accessibility for all respondents. A back-translation process was employed to verify the accuracy of the translation, ensuring that all respondents could understand and accurately complete the survey. To ensure the reliability and validity of the questionnaire, it underwent a pre-testing phase. Feedback from this phase was utilized to refine the questionnaire, enhancing its clarity and understandability. The final sample consisted of 195 respondents, who provided detailed information on their household's socio-demographic characteristics, food expenditure, food-wasting behavior, and waste management practices.

Data collection occurred in October 2022, with respondents from the Kurunegala district recruited via social networks such as Facebook, LinkedIn, and Twitter. The questionnaire comprised four main sections: 1. Household Socio-Demographic Information, 2. Food Expenditure Information, 3.

Food-Wasting Behavior, and 4. Waste Management Practices and Attitudes. The final section delved into the waste management practices adopted by households and their attitudes towards reducing food waste.

Respondents were instructed to provide answers reflecting their household's behavior and practices. The questionnaire targeted ten specific food categories:

- Rice
- Other cereals
- Pulses
- Fruits
- Vegetables
- Meat (beef, chicken, and pork products)
- Fish and shellfish
- Dairy products (milk, yogurt, etc.)
- Eggs
- Miscellaneous food

Prices for each food category were obtained from the different markets located in respondents' areas. Respondents were asked to report their monthly expenditure on each food category and the corresponding percentage of food waste. This comprehensive data collection approach enabled a detailed analysis of household food waste patterns and behaviors.

C. Method of Data Analysis

1) Model Specification

In their influential work, Deaton and Muellbauer developed the Almost-Ideal Demand System (AIDS) to analyze consumer spending patterns. Banks et al. later refined this model by incorporating a quadratic term in log expenditure, addressing the limitations of the original log-linear specification, which did not fully capture consumer behavior for certain goods. This enhanced model is referred to as the Quadratic Almost-Ideal Demand System (QUAIDS). Banks et al. demonstrated that AIDS is a special case of QUAIDS, with the quadratic specification offering a more general and flexible framework.

For our analysis of food waste, we consider both the AIDS model by Deaton and Muellbauer and the QUAIDS model by Banks et al. However, the results presented in the following sections focus exclusively on the QUAIDS specification. The demand function, as originally defined by Deaton and Muellbauer, takes the following form:

$$\omega_i = \alpha_i + \sum_j^k \gamma_{ij} \log p_j + \beta_i \log\left(\frac{m}{a(p)}\right)$$

Where α_i γ_{ij} and β_i are vectors of parameters, w_i is the expenditure share for good i, m is the total expenditure, the price index a(p) is defined as:

$$\log a(p) = a_0 + \Sigma_k a_k \log_{p_k} + \frac{1}{2}\Sigma_j \Sigma_k \gamma_{k_j} \log_{p_k} \log p_j$$

Alternatively, the quadratic model proposed by Banks et al. [31] describes the indirect utility function as follows:

$$\ln V(p,m) = \left[\left\{\frac{\ln m - \ln a(p)}{b(p)}\right\}^{-1} + \lambda(p)\right]^{-1}$$

Where ln a(p) denotes the transcendental logarithm function:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{k} \alpha_i \ln p_i + \left(\frac{1}{2}\right)\sum_{i=1}^{k}\sum_{j=1}^{k} \gamma_{ij} \ln p_i \ln p_k$$

Where p_i represents the price of good i for i=1… k. Additionally, in the indirect utility function, b(p) serves as the Cobb-Douglas price aggregator:

$$\mathrm{b(p)} = \prod_{i=1}^{k} p_i^{\beta^i}$$

and

$$\lambda(\mathrm{p}) = \sum_{i=1}^{k} \lambda_i \ln p_i$$

To adhere to economic theory, it is required to impose or test the conditions of aggregation, homogeneity, and symmetry, which leads to the following implications:

$$\sum_{i=1}^{k} \alpha i = 1 \qquad \sum_{i=1}^{k} \beta i = 1 \qquad \sum_{i=1}^{k} \gamma ij = 0$$
$$0 \qquad \gamma ij = \gamma$$

2) Elasticity

Since the estimated parameters themselves are not the main focus of our analysis, they are not

ISBN 978-955-627-028-0

presented in the subsequent sections. Instead, we concentrate on discussing the estimated expenditure and uncompensated price elasticities, which provide the economic insights we aim to explore. The expenditure elasticities are calculated using the following equations:

$$\mu_i = 1 + \frac{1}{\omega_i}\left[\beta_i + \eta_i' z + \left(\frac{2\lambda_i}{b(p)c(p,z)}\right)\ln\frac{m}{m_0(z)a(p)}\right]$$

3) Interpretation and Insights

By analyzing the estimated elasticity values, we can derive insights into household food waste patterns:

Expenditure Elasticity**:** Indicates whether a good is considered a necessity (Ei<1) or a luxury (Ei>1). This helps in understanding how changes in total expenditure influence the demand for different goods, thereby shedding light on the economic behaviour underlying food consumption and waste patterns. This analysis contributes to economic theory and promotes sustainable consumption practices.

III. RESULTS

A. Descriptive results

The demographic distribution of the respondents shows that the majority, 39% (n=76), reside in urban areas. A further 37.4% (n=73) live in rural areas, and 23.6% (n=46) are from semi-urban areas. Among the surveyed households, 84.6% (n=165) of the household heads are aged between 56 and 70 years, indicating a significant representation of older individuals in leadership positions within these households. This demographic factor likely influences household decision-making processes. The survey also revealed that households with four members are the most common, constituting 41.1% (n=80) of the sample. Households with five members represent 21.0%, reflecting diversity in household sizes within the region (Table 01).

Table 01: Demographic characteristics

Demographic characters	Value (%)	Std. Err.	Obs.
Age of HH head (% of respondents)			
Below 20 years	2.1	0.01	04
25-40 years	21.0	0.29	41
41-55 years	31.3	0.03	61
56-70 years	43.1	0.03	84
Above 71 years	2.5	0.01	05
Household head Male (% of respondents)	84.6	0.02	165
Household size (% of respondents)			
1	2.1	0.01	04
2	10.3	0.02	20
3	13.3	0.02	26
4	41.1	0.03	80
5	21	0.02	41
6	8.2	0.01	16
7	1.5	0.00	03
8	1.5	0.00	03
9	1.0	0.00	02
Residence area (% of respondents)			
Rural	37.4	0.03	73
Semi-urban	23.6	0.03	46
Urban	39.0	0.03	76

Participants were asked about their monthly expenditure on groceries, which averaged 43,305.62 LKR per household (SD = 20937.51). In terms of food waste, the average monthly expenditure was 2,604.40 LKR per household (SD = 2,054.05). This indicates considerable variability in household spending on both groceries and food waste (Table 02). Monthly household incomes were categorized into three groups: low income (≤35,000 LKR), middle income (35,000 LKR - 100,000 LKR), and high income (>100,000 LKR). Analysis revealed that 39% of respondents are in the high-income category, indicating a significant presence of economically affluent individuals. Additionally, 38% belong to middle-income households, suggesting a substantial middle-class presence, while 23% are categorized as low-income, highlighting economic challenges faced by a portion of the population. Examining the food purchasing habits, the highest food waste expenditure was reported by individuals who purchase raw food daily. Following this, those who buy raw food 3-5 days per week also exhibited high food waste expenditure. Households purchasing raw food monthly had lower food waste expenditure, with the lowest observed among those who buy raw food monthly. Food safety practices were also assessed. Among the 195 respondents, 93% consistently check the expiration dates when purchasing food, 5% do so sometimes, and 2% do not consider expiration dates at all. Furthermore, 83.59% (n=163) of respondents regularly freeze fruits and vegetables to minimize waste, while 16.41% (n=32) do not engage in this practice.

The impact of COVID-19 and the economic crisis on food waste behaviors was also examined. None of the respondents reported an increase in household food waste due to these conditions.

ISBN 978-955-627-028-0

Conversely, 63.59% (n=124) indicated a reduction in food waste during this period, while 36.41% (n=71) reported no change in their household food waste practices. These findings provide valuable insights into the demographic and economic factors influencing household food waste and the practices employed to manage and reduce waste within the study population.

B. QUAIDS Estimation Findings

Rice emerges as the dominant category with the highest expenditure share among all households. Vegetables also exhibit a substantial expenditure share across all household food waste (FW) categories. In low-income households, higher expenditure shares are observed for rice, other cereals, pulses, fruits, and miscellaneous FW, with lower shares for meat, fish, eggs, and dairy products compared to high-income households. Conversely, high-income households show elevated expenditure shares for meat, fish, eggs, and dairy products, alongside lower shares for rice, cereals, pulses, fruits, and miscellaneous FW.

Urban households exhibit higher expenditure shares for vegetables, meat, fish, eggs, and dairy products, while displaying lower shares for rice, cereals, pulses, fruits, and miscellaneous FW. In contrast, rural households have elevated expenditure shares for rice, cereals, pulses, fruits, and miscellaneous FW, with lower shares for vegetables, meat, fish, eggs, and dairy products. The following table summarizes the QUAIDS estimation results along with their significance levels:

Semi-urban households show the highest expenditure shares on rice waste and miscellaneous FW (Table 03).

Table 03: Expenditure shares on household food waste

Food category	Elasticity	Standard error	Significance level
Rice	0.942	0.061	***
Other cereals	0.928	0.104	**
Pulses	0.805	0.156	*
Fruits	0.712	0.082	**
Vegetables	1.001	0.069	***
Meat	1.658	0.082	***
Fish	1.312	0.116	**
Dairy products	1.297	0.125	**
Eggs	1.273	0.143	**
Miscellaneous foods	0.870	0.104	*

Elasticity values of Food Waste

The QUAIDS model was used to estimate expenditure elasticities for various household food waste categories. The results indicate that rice, cereals, pulses, fruits, and miscellaneous foods are considered necessities, with expenditure elasticity values below 1. Conversely, vegetables, meat, fish, dairy products, and eggs were classified as luxury goods, with elasticity values exceeding 1.

Table 02: Average monthly expenditure on food and FW at the household level

Expenditure share on FW	All households	Low-income	Middle-income	High-income	Rural	Semi-urban	Urban
Rice	0.250	0.257	0.227	0.210	0.258	0.260	0.237
Other kinds of cereals	0.059	0.075	0.065	0.047	0.083	0.064	0.031
Pulses	0.048	0.043	0.054	0.039	0.062	0.058	0.026
Fruits	0.153	0.229	0.164	0.130	0.198	0.178	0.095
Vegetables	0.198	0.153	0.175	0.238	0.148	0.187	0.253
Meat	0.090	0.034	0.068	0.129	0.048	0.059	0.150
Fish	0.044	0.016	0.037	0.057	0.044	0.030	0.052
Dairy products	0.023	0.004	0.019	0.031	0.018	0.016	0.032
Eggs	0.190	0.017	0.020	0.018	0.016	0/010	0.027
Miscellaneous food	0.114	0.170	0.120	0.099	0.122	0.133	0.095

***p < 0.01; **p < 0.05; *p < 0.1

ISBN 978-955-627-028-0

Table 04: Expenditure elasticity of household FW categories

FW categories	All households	Low-income	Middle-income	High-income	Rural	Semi-urban	Urban
Rice	0.942 (0.061)	1.070 (0.054)	0.958 (0.058)	0.825 (0.099)	1.008 (0.052)	1.006 (0.052)	0.831 (0.096)
Other cereal	0.928 (0.104)	1.197 (0.082)	0.985 (0.097)	0.607 (0.185)	1.075 (0.064)	1.075 (0.084)	0.371 (0.288)
Pulses	0.805 (0.156)	1.055 (0.123)	0.792 (0.148)	0.601 (0.267)	0.935 (0.104)	0.933 (0.112)	0.342 (0.413)
Fruits	0.712 (0.082)	0.564 (0.066)	0.662 (0.080)	0.892 (0.138)	0.653 (0.056)	0.641 (0.062)	0.903 (0.196)
Vegetables	1.001 (0.069)	1.057 (0.098)	1.032 (0.069)	0.975 (0.083)	1.055 (0.082)	1.029 (0.06)	0.975 (0.081)
Meat	1.658 (0.082)	2.468 (0.242)	1.645 (0.081)	1.555 (0.082)	2.085 (0.135)	1.876 (0.109)	1.473 (0.072)
Fish	1.312 (0.116)	1.479 (0.212)	1.339 (0.117)	1.250 (0.126)	1.292 (0.102)	1.425 (0.147)	1.286 (0.145)
Dairy products	1.297 (0.125)	1.442 (0.204)	1.310 (0.137)	1.249 (0.134)	1.348 (0.140)	1.404 (0.156)	1.237 (0.134)
Eggs	1.273 (0.143)	1.097 (0.224)	1.242 (0.110)	1.377 (0.212)	1.243 (0.152)	1.348 (0.236)	1.270 (0.147)
Miscellaneous	0.870 (0.104)	0.810 (0.094)	0.867 (0.095)	0.919 (0.173)	0.844 (0.086)	0.853 (0.079)	0.914 (0.186)

These findings suggest that households in the Kurunegala District tend to classify staple foods like rice and pulses as necessities, while luxury food items like meat and dairy products see higher food waste levels as income increases.

IV. DISCUSSION

Throughout this study, household food waste (FW) was estimated using a proxy value derived from multiplying waste amounts by monthly grocery expenditures. This approach introduced a total expenditure "proxy" in the QUAIDS model at the household level, providing a focused method for identifying meals that significantly contribute to the overall economic value of food waste.

Expenditure Share Analysis

The expenditure share analysis revealed that rice waste constituted the highest among household food waste categories across all households. This is particularly noteworthy in a sample where 98% of respondents were Sinhalese, as rice is a staple food in Sri Lankan households. Additionally, lower expenditure shares were identified for other cereals, pulses, meat, and fish, which might be influenced by elevated prices during an economic crisis, leading to reduced consumption of these categories. High-income households demonstrated higher expenditure shares on meat, fish, eggs, dairy products, and vegetables. This trend can be attributed to inflationary effects on food prices, causing lower spending by low-income households in these categories.

Residential Area-Based Analysis

The analysis based on residential areas revealed higher expenditure shares for rice, cereals, pulses, fruits, and miscellaneous food in rural areas. This reflects the agrarian nature of the Kurunegala district, a major rice-producing region. In contrast, urban households exhibited higher expenditure shares for vegetables, meat, fish, eggs, and dairy products, indicating different consumption patterns influenced by urban living conditions.

Expenditure Elasticity values

Expenditure elasticity values were calculated using the QUAIDS model, revealing positive values for all food categories and confirming them as normal goods. By distinguishing between necessity and luxury goods based on elasticity values, the study identified rice, cereals, pulses, fruits, and miscellaneous foods as necessities. Conversely, vegetable, meat, fish, dairy products, and egg waste were classified as luxury goods. Fruit waste, despite being perishable, was considered a necessity due to lower consumption levels in Sri Lanka. The study highlighted the perishability and cultural factors contributing to vegetable, meat, fish, dairy products, and egg waste being categorized as luxury goods. Rural

ISBN 978-955-627-028-0

areas exhibited higher wastage for all food categories except fruits and miscellaneous food, possibly due to factors such as limited space for disposal in urban areas and different separation habits in rural households. Urban households and those in high-income defiles allocated a higher percentage of their food budget to fruits, emphasizing higher expenditure elasticity for fruits in urban areas. Additionally, low-income households exhibited higher expenditure elasticity values for most categories except for fruit, dairy, eggs, and miscellaneous food, indicating higher consumption by wealthier individuals.

Food Waste Behavior

The study also considered food waste behavior, revealing that attitudes such as cooking skills and consciousness of expiration dates significantly influenced waste reduction. Moreover, responses indicated a reduction in household food waste during the COVID-19 period and the prevailing economic crisis. This finding aligns with similar observations in Mexico during the pandemic, underscoring the importance of individual and household-level factors in minimizing food waste during challenging economic conditions. These findings suggest a notable trend toward decreased household food waste among the surveyed population amidst the adversity of the COVID-19 pandemic and economic instability. This emphasizes the critical role of economic and cultural factors in shaping food waste patterns and highlights the potential for targeted interventions to reduce waste across different income levels and residential areas.

V. CONCLUSION

According to our findings, all categories of household food waste (FW) were classified as normal goods, as evidenced by positive elasticity values. Specifically, waste of rice, other cereals, pulses, fruits, and miscellaneous food items were identified as necessity goods, while waste of meat, fish, dairy products, eggs, and vegetables fell under luxury goods. The expenditure elasticity values of food waste varied across household income levels and residential areas. Notably, all FW categories exhibited higher expenditure elasticity values in rural areas, except for fruits. Low-income households generally showed higher expenditure elasticity values compared to other income groups, with exceptions noted for fruit, dairy products, and eggs. The study suggests that management practices, attitudes, and behaviors towards reducing household FW can be discerned from these observations.

VI. LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

The primary limitation of this study was the absence of directly collected food waste data. Instead, household food waste (FW) was estimated using a proxy value derived from multiplying waste amounts by monthly grocery expenditures. While maintaining food diaries would have provided more precise results, time constraints rendered this approach impractical. The study relied on an online survey, thus analyzing self-reported data. Such methods introduce potential measurement errors due to respondents providing inaccurate information or opting out of participation. Data collection occurred exclusively in October 2022, which may limit the generalizability of findings since household FW can fluctuate seasonally, such as during holidays like Christmas or New Year, impacting waste patterns. Furthermore, the rapidly changing economic conditions posed challenges in maintaining consistent food prices throughout the study period.

Future research should consider integrating food diaries with online surveys to enhance data accuracy and account for seasonal variations in household FW. Additionally, investigations should explore how expenditure on food, price dynamics, and demographic factors influence variations in FW at the household level.

VII. IMPLICATION

Based on the analysis results, household food waste (FW) categories were classified as luxury goods and necessity goods solely based on expenditure elasticity values, without considering price elasticity values. Future research endeavors should focus on determining price elasticity values within the household food category.

This study was conducted exclusively in one district of Sri Lanka, suggesting a need for broader geographical representation across all districts for comprehensive insights. The findings are crucial for identifying which goods are considered luxury or necessity in Sri Lankan households, pivotal for developing effective strategies to minimize FW at the household level.

ISBN 978-955-627-028-0

Understanding the dynamics of different FW categories across various income levels and expenditure patterns is essential for addressing household food waste effectively. Such insights are invaluable for policymakers and decision-makers seeking to implement targeted measures for FW reduction, particularly in the context of ongoing economic challenges.

Ultimately, this study provides vital information to ensure continuous fulfillment of food requirements amidst the current economic crisis, underscoring its relevance and potential impact on policy formulation and decision-making.

REFERENCES

Adesina, A & Zinnah, MM 1993, 'This document is discoverable and free to researchers across the globe due to the work of AgEcon Search. Help ensure our sustainability', *Journal of Gender, Agriculture and Food Security*, vol. 1, no. 3, pp. 1–22.

Ansah, IGK, Marfo, E & Donkoh, SA 2020, 'Food demand characteristics in Ghana: An application of the quadratic almost ideal demand systems', *Scientific African*, vol. 8, e00293, viewed 12 August 2022, https://doi.org/10.1016/j.sciaf.2020.e00293.

Barrera, EL & Hertel, T 2020, 'Global food waste across the income spectrum: Implications for food prices, production and resource use', *Food Policy*, February, 101874, viewed 12 August 2022, https://doi.org/10.1016/j.foodpol.2020.101874.

Deaton, A & Muellbauer, J 1980, 'An almost ideal demand system', *Neuroradiology*, vol. 41, no. 70(3), pp. 312–326.

FAO 2013, 'Food wastage footprint', *FAO*, viewed 3 September 2024, http://www.fao.org/publications.

Gjerris, M & Gaiani, S 2013, 'Household food waste in Nordic countries: Estimations and ethical implications', *Etikk i Praksis*, vol. 7, no. 1, pp. 6–23, viewed 13 August 2022, https://doi.org/10.5324/eip.v7i1.1786.

Gorter, HD, Drabik, D, Just, DR, Reynolds, C & Sethi, G 2020, 'Analyzing the economics of food loss and waste reductions in a food supply chain', *Food Policy*, August 2019, 101953, viewed 15 August 2022, https://doi.org/10.1016/j.foodpol.2020.101953.

Gostkowski, M 2018, 'Elasticity of consumer demand: Estimation using a quadratic almost ideal demand system', *Econometrics*, vol. 22, no. 1, pp. 68–78, viewed 15 August 2022, https://doi.org/10.15611/eada.2018.1.05.

Gustavsson, J, Cederberg, C, Sonesson, U, van Otterdijk, R & Meybeck, A 2011, *Global food losses and food waste*, FAO, Rome.

Halloran, A, Clement, J, Kornum, N, Bucatariu, C & Magid, J 2014, 'Addressing food waste reduction in Denmark', *Food Policy*, vol. 49, no. P1, pp. 294–301, viewed 15 August 2022, https://doi.org/10.1016/j.foodpol.2014.09.005.

Hamilton, SF & Richards, TJ 2019, 'Food policy and household food waste', *American Journal of Agricultural Economics*, vol. 101, no. 2, pp. 600–614, viewed 18 August 2022, https://doi.org/10.1093/ajae/aay109.

Banks, J, Blundell, R & Lewbel, A 1997, 'Quadratic Engel curve and consumer demand', *Review of Economics and Statistics*, vol. 79, no. 4, pp. 527–539, viewed 16 August 2022, http://links.jstor.org/sici?sici=0034-6535%28199711%2979%3A4%3C527%3AQECACD%3E2.0.CO%3B2-Z.

Landry, CE & Smith, TA 2019, 'Demand for household food waste', *Applied Economic Perspectives and Policy*, vol. 41, no. 1, pp. 20–36, viewed 16 August 2022, https://doi.org/10.1093/aepp/ppy037.

Nimanthika, LDM 2014, 'Assessing the demand for a healthy diet in Sri Lanka: The almost ideal demand', pp. 23–41.

Nirmali, SAN & Edirisinghe, JC 2015, 'Food demand elasticities, price changes and calorie availability of households in the Western Province of Sri Lanka', *Sri Lankan Journal of Agricultural Economics*, vol. 12, no. 0, pp. 15, viewed 18 August 2022, https://doi.org/10.4038/sjae.v12i0.4594.

Philippidis, G, Sartori, M, Ferrari, E & M'Barek, R 2019, 'Waste not, want not: A bio-economic impact assessment of household food waste reductions in the EU', *Resources, Conservation and Recycling*, vol. 146, December 2018, pp. 514–522, viewed 15 August 2022, https://doi.org/10.1016/j.resconrec.2019.04.016.

Poi, BP 2008, 'Demand-system estimation: Update', *Applied Economics*, vol. 4, pp. 554–556.

Schanes, K, Dobernig, K & Gözet, B 2018, 'Food waste matters: A systematic review of household food waste practices and their policy implications', *Journal of Cleaner Production*, vol. 182, pp. 978–991, viewed 16

August 2022, https://doi.org/10.1016/j.jclepro.2018.02.030.

Secondi, L, Principato, L & Laureti, T 2015, 'Household food waste behavior in EU-27 countries: A multilevel analysis', *Food Policy*, vol. 56, pp. 25–40, viewed 18 August 2022, https://doi.org/10.1016/j.foodpol.2015.07.007.

Vargas-Lopez, A, Cicatiello, C, Principato, L & Secondi, L 2022, 'Consumer expenditure, elasticity and value of food waste: A Quadratic Almost Ideal Demand System for evaluating changes in Mexico during COVID-19', *Socio-Economic Planning Sciences*, vol. 82, February, 101065, viewed 12 August 2022, https://doi.org/10.1016/j.seps.2021.101065.

Weerahewa, J 2012, 'An analysis of consumer demand for fruits in Sri Lanka', *Appetite*, October, viewed 15 August 2022, https://doi.org/10.1016/j.appet.2012.09.017.

Wikström, F, Williams, H, Trischler, J & Rowe, Z 2019, 'The importance of packaging functions for food waste of different products in households', *Sustainability (Switzerland)*, vol. 11, no.