wrap

SYNTHESIS OF HOUSEHOLD FOOD WASTE COMPOSITIONAL DATA 2018

This report describes analysis of compositional data and WasteDataFlow information to produce estimates of food in local authority collected waste streams from UK homes in 2018.

About WRAP

WRAP is not-for-profit, working with governments, businesses and citizens to create a world in which we use resources sustainably. Our experts generate the evidence-based solutions we need to protect the environment, build stronger economies and support more sustainable societies. Our impact spans the entire lifecycle of the food we eat, the clothes we wear and the products we buy, from production to consumption and beyond.

This report describes analysis of compositional data and WasteDataFlow information to produce estimates of food in local authority collected waste streams from UK homes in 2018.

Document reference:

WRAP, 2020, Banbury, Synthesis of Household Food Waste Compositional Data 2018

Adapted from the 2014/15 report authored by: Eric Bridgwater (Eunomia) and Tom Quested (WRAP)

Adapted by: Rosy Scholes and Eric Bridgwater (Eunomia)

Front cover photography: Examples of food waste (WRAP)

Executive summary

Background and aim

A key objective for WRAP is to support and enable efforts to reduce the quantity and environmental impact of household food waste across the UK, working in partnership with a wide range of organisations including local authorities (LAs), grocery retailers, food manufacturers and community groups. It is therefore necessary to quantify household food waste in order to track progress and to understand the impact of work to date. WRAP's most recent published estimates relate to waste produced in 2014 and 2015. These estimates were originally published in 2016[1] but restated in 2018[2], along with results from 2007 and 2010, to align more closely with the Food Loss and Waste Accounting and Reporting Standard (FLWS)[3]. The restated results reclassified food waste as wasted food and inedible parts, rather than avoidable, possibly avoidable and unavoidable. Also, food fed to animals was no longer classified as household food waste. These changes lowered the amount of total UK household food waste in 2015, from 7.3 million tonnes to 7.1 million tonnes.

The aim of the current project was to produce estimates of food waste[4] collected by (or on behalf of) LAs from UK homes in 2018 using the most recent data available. Food waste collected from households by LAs – whether for recycling, or as part of the residual waste stream – makes up around two-thirds of the total food thrown away by households, with the remaining one-third going down the drain, home composted or fed to animals.

Method

2018 UK estimates are presented in this report, which have been calculated using the same methodology as for previous UK estimates, and are therefore comparable. 2017 estimates have also been produced and are included in this report; these can be directly compared with the previous 2014 and 2015 estimates but are not directly comparable with the 2017 results despite using the same methodology, due to overlapping datasets for the 2017 and 2018 estimates presented here. The main comparison presented in this report refers to changes from 2015 to 2018.

Estimates were also produced for England, Scotland, and Northern Ireland, as well as for London. In addition, the proportion of total food waste captured for recycling by collections targeting this material was also calculated.

Data from waste composition studies was collated and analysed alongside the most recent data about LA household waste collections available from WasteDataFlow, in order to arrive at estimates of LA-collected household food waste in the UK.

For the purposes of this project, LA-collected household food waste was assumed to include food in the following household waste streams:

---

[1] *WRAP (2016) Synthesis of Food Waste Compositional Data 2014-15, http://www.wrap.org.uk/content/household-food-waste-uk-2015-0*
[2] *WRAP (2018) Household food waste: restated data for 2007-2015, p.106*
[3] *Food Loss and Waste Reporting Standard*
[4] *Within this report, 'food' is used as a shorthand for 'food and drink'.*

- Kerbside residual: (i.e. 'general' waste).
- Kerbside collections targeting food waste: collections of either separate food waste or mixed garden and food waste.
- Kerbside dry recycling: food waste contamination of kerbside dry recycling collections from households.
- Household Waste Recycling Centre (HWRC) residual waste.

Kerbside residual is the most important waste stream to consider in relation to calculating household food waste arisings estimates, since the great majority of household food waste is collected via this route. Data on food waste arisings in kerbside residual was obtained for 82 LAs across the UK (out of a total of 385) for the 2018 estimates. Studies were obtained for all LAs in Northern Ireland. The LAs with compositional studies were reasonably representative of the UK and the sample was stratified by presence of collections targeting food waste and by population density, to account for differences between the sample and the population of LAs.

An additional stratified method was used to produce an alternative UK estimate. This meant the sample was stratified by nation, as well as by whether food waste was targeted or not and population density. There are some advantages to this approach, as it takes account of different food waste policies, and potentially different food waste disposal behaviour, between the nations. One disadvantage, however, is the lack of available data for Wales for 2018, meaning that the time range for studies was altered and studies for Wales from 2015 were used. This Wales estimate was used in the new, stratified by nation method. As such, the estimates cannot be compared to previous estimates and should be treated with caution.

Results

The estimated amount of household food waste collected by LAs in the UK in 2018 was 4.58 million tonnes. This is equivalent to 165.0 kg per household or 69.0 kg per person (Table 1).

Table 1: Estimates of household food waste collected by local authorities in the UK, 2018, tonnes

Waste stream	Food waste arisings		
	Tonnes	Kg/hh/year	Kg/person/year
Kerbside residual	3,642,000	131.0	54.8
Kerbside collections targeting food waste	777,000	28.0	11.7
Kerbside dry recycling (contamination)	89,000	3.2	1.3
HWRC residual	77,000	2.8	1.2
Total	4,585,000	165.0	69.0
95% confidence interval	*110,000*	*4.0*	*1.7*

The vast majority of this food waste (3.64 million tonnes; 79% of the total) was found in the kerbside residual waste stream, with most of the rest (0.78 million tonnes; 17% of the total) in kerbside collections targeting food waste. The proportion of all food waste that is found in the kerbside residual stream has fallen five percentage points from 2015, when 84% was in this stream. The proportion in targeted kerbside collections rose slightly, from 15% to 17%. The proportions in dry recycling and HWRC residual waste remained relatively constant.

Synthesis of Household Food Waste Compositional Data 2018

Looking at only waste collected at the kerbside (in residual or targeted collections), for the UK as a whole, total household food waste arisings in 2018 were less than in 2015. The 2018 estimate is 159.0kg per household and 66.5kg per person in each year, compared to 173.3kg per household and 73.1kg per person per year in 2015.

Figure 1 shows the amount of food waste per person calculated in previous studies, from 2007 until 2018. Since 2007 there has been an overall reduction, with the majority of the reduction occurring between 2007 and 2010. Since 2012, there is no evidence of a significant further reduction until 2015 to 2018, where there is a statistically significant 7% reduction in tonnages. There was a reduction of 18% in food waste tonnages between 2007 and 2012, followed by a 4% decrease between 2012 and 2018, though this latter increase was not statistically significant (at the 95% confidence level). Likewise, there was a reduction of 26% in food waste arisings per household between 2007 and 2012, followed by an 8% decrease between 2012 and 2018, with the increase (in terms of arisings per household) being statistically significant. Likewise, in respect of food waste arisings per capita (as presented in Figure 1), arisings decreased between 2007 and 2012 by 26%, and between 2012 and 2018 by 8%, with the reductions being statistically significant in both cases. The per capita food waste arisings decrease between 2012 and 2018 occurred from 2015 to 2018, with a reduction of 9% that was statistically significant.

Figure 1: Estimated arisings of local authority collected household food waste in the UK, 2007 to 2018, kg/person/yr

Food waste (kg per person per year)
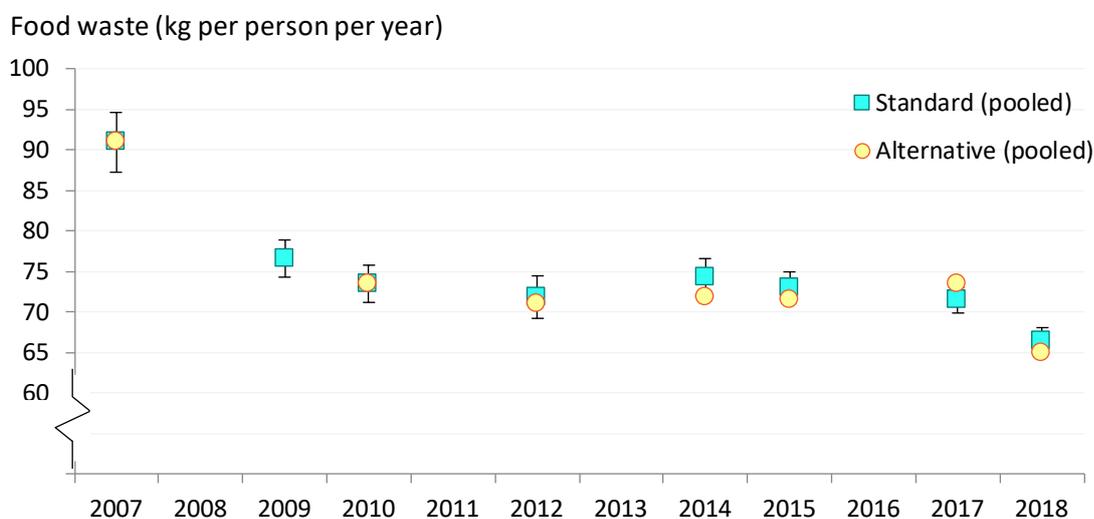
Results include food waste in kerbside residual and collections targeting food waste for treatment, but exclude minor waste streams (HWRC residual and contamination of dry recycling).

Nation-level estimates were also calculated. Minor waste streams (HWRC residual and contamination of dry recycling) are not included in the nation-level estimates since insufficient studies area available to support meaningful comparisons between the nations. The average amount of household kerbside food waste per household for England was higher than the UK estimate, at 167.5 kg/hh/year, compared to the UK average of 159.0 kg/hh/yr (excluding minor streams). The estimates for Northern Ireland (133.6 kg) and Scotland (138.3 kg) were lower than the UK average. The average for London was 163.0 kg/hh/year, slightly lower than the central estimate for England, but not showing statistical significance at the 95% confidence level.

Synthesis of Household Food Waste Compositional Data 2018

The capture rate – the proportion of LA-collected household food waste found in collections targeting food waste – increased between 2007 and 2018 from around 2% to 17% (see Figure 2). However, this means that the proportion of food waste in collections targeting food waste in 2017 was still relatively low, with the vast majority – 83% – being found in the residual waste streams, and a small amount (2%) as contamination of dry recycling.

Figure 2: Comparison of UK capture rates of household food waste over time, 2007 to 2018

Household food waste capture rate (%)

Contents

Glossary

- **'Alternative' estimates** - an alternative methodology to the 'Standard' methodology (see below) used for producing household food waste estimates. The 'alternative' methodology determines the total food waste in both the residual and targeted streams for each LA for which kerbside residual WCA data is available, before scaling this to the population; see section 2.4.
- **Capture rate** – the amount of household food waste captured in kerbside collections targeting food waste as a percentage of all household food waste (see section 2.4).
- **Defra** – Department for Environment, Food and Rural Affairs.
- **HH** – household.
- **HWRC** – Household Waste Recycling Centre (also known as a civic amenity site).
- **LA** – Local authority.
- **LA collected household food waste** – food waste found in the following waste streams: Kerbside residual: (i.e. 'general' waste collected from the households); Kerbside collections targeting food waste, which includes collections from households of either separate food waste or mixed garden and food waste; Kerbside dry recycling (food waste contamination of kerbside dry recycling collections from households); HWRC residual waste.
- **'Pooled' estimates** – estimates of food waste that combine waste-compositional information from a 24-month period around the 'target' year. The main advantage of the pooled estimates is that they use a relatively large number of studies, reducing the uncertainty around each estimate c.f. 'single-year' estimates.
- **'Single-year' estimates** – estimates of food waste that only use waste-compositional information from the 'target' year. These are used as a check for the 'pooled' estimates.
- **'Standard' estimates** – the main methodology used for producing household food waste estimates. Food waste in the kerbside residual stream is calculated for each LA for which a kerbside residual WCA data is available and scaled to the population; this is then added to total food waste targeted for collection; see section 2.4.
- **WCA** – waste compositional analysis, usually carried out on a specific waste stream (i.e. kerbside residual) within a particular LA. In properly conducted WCAs, waste is collected from a representative sample of households in the LA and the material is sorted into different categories, weighed and recorded.
- **WDF** – WasteDataFlow, a reporting system for waste collected by local authorities in the UK (http://www.wastedataflow.org/).
- **WRAP** – Waste and Resources Action Programme.

Shorthand used in this report for previous reports in this area:
- **The 2014/15 study**: *Synthesis of Food Waste Compositional Data 2014 & 2015* http://www.wrap.org.uk/content/household-food-waste-uk-2015-0
- **The 2012 study**: *Synthesis of Food Waste Compositional Data 2012* http://www.wrap.org.uk/sites/files/wrap/hhfdw-synthesis-food-waste-composition-data.pdf

- **The 2010 study**: *Synthesis of Food Waste Compositional Data 2010*
  www.wrap.org.uk/sites/files/wrap/Synthesis%20of%20Food%20Waste%20Compositional%20Data%202010%20FINAL.pdf

Acknowledgements

1.0 Introduction

1.1 Background

A key objective for WRAP is to support and enable efforts to reduce the quantity and environmental impact of household food[5] waste across the UK, working in partnership with a wide range of organisations including local authorities (LAs), grocery retailers and food manufacturers and community groups. It is therefore necessary to quantify household food waste in order to track progress and to understand the impact of work to date. Prior to this report, the most recent estimates for household food waste published by WRAP were for 2015, published in 2016[6] and amended in 2018[7].

The aim of this project was to produce estimates of food waste collected by (or on behalf of) LAs from UK homes using the most recent data available. These results were compared to estimates from previous years. Estimates were also produced for England, Northern Ireland and Scotland, as well as for London. In addition, the capture rate (the proportion of food waste captured by collections that target this material) was also calculated.

2018 UK estimates are presented in this report which use the same methodology as for previous UK estimates, and are therefore comparable. These results have been compared with estimates from previous years.

Within this report, the definition of food waste used in this study can be found in section 1.2, the methodology is explained in section 2.0 and the results are set out in section 2.0. The results are based on data from WasteDataFlow (WDF) – the UK's repository for data relating to waste collected by LAs – and waste compositional analyses (WCAs) conducted by individual LAs, waste authorities and other bodies.

The approach used in this project is similar to the study Synthesis of Food Waste Compositional Data 2014-15[8] (hereafter referred to as 'The 2014/15 study'), which produced estimates of food waste collected by LAs from UK households for 2014 and 2015. That project was based on the *Synthesis of Food Waste Compositional Data 2012*[9] (hereafter referred to as 'The 2012 study') which was in turn based on the *Synthesis of Food Waste Compositional Data 2010*[10] (hereafter referred to as 'The 2010 study'), which performed the same exercise for 2010. The 2014/15 study was amended in 2018. The restated results reclassified food as wasted food and inedible parts, rather than avoidable, possibly avoidable and unavoidable. Also, food fed to animals was no longer classified as household food waste. These changes lowered the amount of total UK household hood waste in 2015, from 7.3 million tonnes to 7.1 million tonnes.

---

[5] *Within this report, 'food' is used as a shorthand for 'food and drink'*
[6] *http://www.wrap.org.uk/content/household-food-and-drink-waste-uk-2012*
[7] WRAP (2018) Household food waste: restated data for 2007-2015, p.106
[8] WRAP (2016): *http://www.wrap.org.uk/hhfw2015*
[9] *http://www.wrap.org.uk/sites/files/wrap/hhfdw-synthesis-food-waste-composition-data.pdf*
[10] *www.wrap.org.uk/sites/files/wrap/Synthesis%20of%20Food%20Waste%20Compositional%20Data%202010%20FINAL.pdf*

The 2018 estimates – and previous estimates – combine information from a range of years around a 'reference' year: these are referred to in the report as 'pooled' estimates. The main advantage of the pooled estimates is that they each use a relatively large number of studies, thus reducing the uncertainty in each estimate.

1.2 Definition of 'Local Authority Collected Household Food Waste'

LA collected household food waste was classified, for the purposes of this study, as the food waste found within the following streams:

- **Kerbside residual:** (i.e. 'general' waste collected from households).
- **Kerbside collections targeting food waste:** this includes collections from households of either separate food waste or mixed garden and food waste. This collected material is subject to two main treatment processes: in-vessel composting and anaerobic digestion. For brevity, this waste stream is hereafter referred to as 'collections targeting food waste'.
- **Kerbside dry recycling:** food waste contamination of kerbside dry recycling collections from households.
- **Household Waste Recycling Centre (HWRC) residual waste**.

Negligible quantities of food waste collected for treatment were reported for HWRCs in the UK and this stream has therefore excluded from this study.

The 2012 study made a separate estimate of food waste arisings in street sweepings (91,000 tonnes in the UK in 2012).[11] Due to lack of recent waste compositional data for street sweepings, an updated estimate was not produced in the 2014/15 study; for the same reason, no new estimate has been produced for this study.

Excluding food waste in street sweepings from the estimate of household food waste also reflects Defra guidance that classifies street sweepings as "household waste" but not "waste from households".[12] This reflects an assumption that the food waste found in street sweepings was relatively unlikely to have come from food that had entered a household.

Some previous studies of LA-collected food waste included an estimate of food waste arising in fines (small particulate material) in residual waste streams. As in the 2014/15 study, no estimate of food waste in fines is provided in this study due to a lack of robust data. To allow robust comparisons over time, retrospective adjustments were made to the historic data in the 2014/15 study to remove the contribution from fines. Therefore, figures produced in the 2014/15 study will be used as a point of comparison.

---

[11] *Synthesis of Food Waste Compositional Data 2012, WRAP 2013, Section 4.4.*
[12] *2013/14 National Statistics on Local Authority Collected Waste Management in England, Methodological Summary, Defra,*
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/388983/mwb_201314_stats
Methodology_summary.pdf

The estimates in this report quantify food waste found in the above waste streams. This includes both edible material (e.g. bread, the flesh of fruit, meat) and inedible material associated with food (e.g. eggshells, citrus peel, meat bones). This approach is consistent with the definitional framework for food waste developed by the European-funded FUSIONS project[13] and the *Food Loss and Waste Standard* developed by the World Resources Institute.[14] This is also consistent with previous estimates of food waste produced by WRAP, which included 'avoidable', 'possibly avoidable' and 'unavoidable' food waste. An estimate for the split between these fractions is provided in the 2014/15 study.[15]

[13] *http://www.eu-fusions.org/*
[14] *Food Loss and Waste Reporting Standard*
[15] *WRAP (2018) Household food waste: restated data for 2007-2015, p.106*

2.0 Methodology

2.1 Introduction

This section describes the methodology used in this study to quantify food waste collected by (or on behalf of) LAs from UK homes in 2018. This methodology is similar to that used in previous synthesis studies (e.g. the 2010, 2012 and 2014/15 studies).

It should be noted that an additional stratified method was used to produce a further UK estimate, presented in Section3.4. This meant the sample was stratified by nation, as well as by whether food waste was targeted or not and population density. There are some advantages to this approach, as it takes account of different food waste policies, and potentially different food waste disposal behaviour, between the nations. One disadvantage, however, is the lack of available data for Wales for 2018, meaning that the time range for studies was altered and studies for Wales from 2015 were used. This Wales estimate was used in the new, stratified by nation method. As such, the estimates cannot be compared to previous estimates and should be treated with caution.

Data was collated from a range of WCAs that had been commissioned by different LAs. Many LAs in the UK commission studies to examine the waste they collect or that is collected on their behalf by waste contractors. These compositional studies classify the waste into different materials, typically using between 40 and 70 categories depending on the detail required and the amount of waste to be sorted. Food waste is generally one of these categories and is often further subdivided: e.g. home compostable / non- home-compostable; packaged / non-packaged; edible / inedible. These studies typically collect and sort the waste from 135-250 households, though some studies with smaller samples (as low as 50 households) were included in the 2018 estimates, in order to maximise the sample of compositional datasets.

This WCA data was analysed alongside information from WDF, the national database that holds data on waste collected by local authorities. LAs provide this information to the organisations overseeing WDF and, once checked, the data is published and can be used in research (such as these 'syntheses'). The information WDF contains regarding the total weight of material collected within each waste stream can negate the need for all waste streams to be sampled in WCAs. For instance, LAs with separate food waste collections will usually record the amount in the correct category in WDF and therefore do not need further measurement to determine the quantity of food in this waste stream.

However, WDF does not give a breakdown of the type of materials present in the residual waste stream(s). To obtain an estimate of the amount of food in each residual stream, the percentage of food waste in a stream (as measured by the LA WCAs) needs to be applied to the total weight of that residual waste stream. This section and the related appendices describe how these two sources of data were combined and the reasons for the methodological choices made.

2.2 Compositional Datasets Included in the New Pooled Estimates

As discussed in section 2.1, the new estimates presented here are pooled estimates for 2018. This section discusses the compositional datasets included for these estimates.

2.2.1 Collation of Compositional Datasets

During the course of this project, organisations and companies commissioning and undertaking waste compositional analyses were contacted to obtain data. Data was provided by a wide range of contractors and LAs.

2.2.2 Selection Criteria

Selection Criteria – 2018 Pooled Estimates
The target period for the 2018 pooled estimates was for the calendar year 2018. Two selection criteria were used to determine whether to include each available dataset:

- **The date of the fieldwork.** For the pooled estimate, studies undertaken between April 2017 and February 2019 were included. There is a trade-off between the number of studies included and getting studies as close to the target timespan as possible.
- **Whether samples were reasonably representative of the socio-demographic profile of the relevant LA.** WCAs that included some form of socio-demographic stratification[16] were included. This criterion was met by all the datasets collated for the 2018 pooled estimates.

As there was only one kerbside residual WCAs for Wales which fell into the required date range for this study, to create a separate nation estimate for Wales data from the Resource Futures study carried out in 2015 was used, in which kerbside residual from all 22 local authorities was surveyed. By expanding the date range for Wales, full coverage of all local authorities in the nation were obtained. There were some changes in kerbside collection schemes in Welsh local authorities between 2015 and 2018, but they were generally minor (i.e. three authorities switched from fortnightly to three-weekly residual collections). Almost all local authorities already had a separate food waste collection in 2015. However, it is noted that using 2015 composition data is a weakness in the approach (though better than using just one WCA from 2018). As such, the estimate is not comparable with other estimates within this report, or with Wales estimates in other reports. These data sets were **not** included in the main UK estimate (i.e. when not stratified by nation).

---

[16] *Examples included MOSAIC run by Experian and the Output Area Classification run by the UK Office for National Statistics (ONS). The latter classifies 41 census variables into a 3-tier classification of 7, 21 and 52 groups.*

For the UK estimates that were stratified by nation (a new calculation method introduced in this report), it was necessary to produce estimates for Wales to contribute to this estimate, and this did include the 2015 WCAs for Wales.

Inclusion of Single-phase Waste Compositional Analyses
The current study used data from two types of WCA:

- single-phase, where fieldwork is conducted over a single time period; and
- multi-phase waste, where studies were conducted over two or more different time periods to account for possible seasonal variation.

This is a similar approach to the three previous studies, but contrasts with the compositional estimates for 2007 produced from the *Defra WR0119* study,[17] which (due to having a large number of datasets available) only included multi-phase WCAs for kerbside compositional datasets.

The inclusion of only multi-phase studies for the *Defra WR0119* study was intended to control for seasonal variation in arisings of various components in the kerbside stream. For the 2010 study, an assessment was made of seasonal variations in food waste through analysing separate phase data from multi-phase studies used in the *Defra WR0119* study. This assessment concluded that although some seasonal variation was apparent in food waste arisings in kerbside waste, this was relatively minor. The use of single phase WCAs is therefore unlikely to introduce a significant weakness into the estimates.

Use of Individual Waste Compositional Analysis Phases
For the current study, multi-phase WCAs were split into their individual phases. The most important advantage of this approach was that it increased the number of data points for producing UK estimates, thus increasing the effective sample size in the analysis.

The published 2010 study did not split multi-phase data into constituent phases in this manner, and did not give greater weighting to the more comprehensive multi-phase waste compositional analyses, which would have provided a better reflection of the quality of information contributed by such WCAs to the sampled dataset, in comparison to single-phase studies.[18] The procedure of splitting multi-phase studies into constituent single phases for the current study overcame this problem and effectively provided greater weighting to multi-phase studies. However, this approach meant that the dataset for the current study included studies that sampled households in the same areas (i.e. from the same collection rounds, although not necessarily exactly the same households). Given that some households may have been sampled more than once, this could have led to a small degree of non-independence between phases, resulting in estimates of precision that are slightly optimistic (e.g. the width of the calculated confidence intervals could be a slight underestimate).

---

[17] *http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15133*
[18] *In contrast to the previously published results for 2010, the 2010 results presented in this report do have multi-phase waste compositional analyses split into their constituent phases. For a discussion of the differences in methodology, see section 2.7.*

However, it was considered that the advantages of using a greater number of data points through splitting multi-phase datasets outweighed the disadvantages. The splitting of multi-phase WCAs into single-phase data also provided more flexibility in selecting WCA data within the time frame of the study. Furthermore, splitting multi-phase datasets had only a small effect on the 2012 results. Therefore, the approach of splitting multi-phase datasets was applied for the 2014/15 and the current 2018 estimates.

2.2.3 Number of Compositional Datasets

The number of compositional datasets for each separate estimate, as well as for the UK pooled estimate, are as shown in Table 2.

Table 2: Number of compositional analyses for each nation and in the pooled UK estimate

Waste stream	Number of WCAs
England	100
London	*8*
Wales	1 *(45)*[19]
Scotland	6
Northern Ireland	22
Total – pooled UK estimate	129

2.2.4 Coverage of Compositional Datasets in the Current Study

The coverage of the WCAs collated was assessed against a number of factors, listed below:

- Nation within the UK;
- Region within England;
- Socio-economic factors (e.g. deprivation level);
- Rurality factors (e.g. population density);
- Presence and type of collection targeting food waste;
- Frequency of residual collection; and
- Season / month fieldwork waste undertaken.

For each of these factors, coverage was assessed in terms of how representative the LAs with usable WCA data (i.e. the sample) were compared to all LAs in the UK (i.e. the population). If there was a substantial mismatch between the sample and the population, further analysis was conducted to assess whether this mismatch was materially important – i.e. if there was evidence that the amount of food waste varies according to that factor. If

[19] One study used in the pooled UK estimate from 2018 data, 45 studies from 2015 used in the Wales only estimate found in Appendix 1.0

there was, then weighting of the sample was undertaken to adjust for this mismatch and reduce the bias in the results.

For example, in previous works the presence of a collection targeting food waste was associated with a lower percentage of food waste in the kerbside residual stream – a predictable impact of food waste being diverted from the residual waste stream. Therefore, it was important to adjust for any mismatch in the presence of collections targeting food waste between the sample and the population. In contrast, there was little evidence that the percentage of kerbside residual waste stream that is food waste varied with, for example, deprivation, and therefore a mismatch in the deprivation coverage between the population and the sample did not need to be adjusted for via weighting.

The conclusion was that – similar to previous studies – stratification by presence of collections targeting food waste was important. Unlike other studies, however, the present study found that population density significantly affected the results and coverage was not good enough. Consequently, weighting was also introduced for population density. This is outlined in more detail in Appendix A.2.0.

2.2.5 Food Packaging in Waste Compositional Analysis Data

During this study, it was found that different contractors undertaking WCAs were handling food found in packaging in different ways. For example, in some situations 'packaged food' was a separate sub-category found within the 'food' category, resulting in a small amount of packaging being recorded as 'food' in these studies. In other situations, packaged food was separated out into food (recorded under the 'food' category) and packaging (recorded under the appropriate material).

Previous work by WRAP[20] has shown that a minority of food waste is found in packaging – in 2012, 810,000 tonnes out of a total of 4.7 million tonnes collected by LAs; i.e. 17%. Packaging is usually much less dense than the food it contains, and the degree to which packaging recorded as food can influence the results is relatively small. Nevertheless, it is important to try and minimise any potential biases. For this reason, the sorting protocols of contractors were obtained to understand how food packaging had been recorded. We concluded that the effects relating to including a sorting category of packaged food were not significant in the regression models and consequently no changes were made to the methodology for this study. However, this issue should be monitored closely in future studies of this nature.

2.2.6 Checking Data Points

WCAs with high or low levels of food waste – i.e. towards the top and bottom end of the distributions as assessed by kg / household / week or by percentage of the residual stream – were checked to determine whether there had been an error at some point in the

---

[20] *Household Food and Drink Waste in the UK 2012, WRAP 2013: http://www.wrap.org.uk/content/household-food-and-drink- waste-uk-2012*

measurement or data processing. No such errors were found and therefore no data points were excluded.

2.3 WasteDataFlow (WDF) Time Period Used for Analysis

For the current study, the most recent 12 months (available at the time of the analyses) of data from WasteDataFlow was used. In this instance, calendar year 2018 data was available for England and Wales, but only calendar year 2017 for Scotland and Northern Ireland, and thus this data was used. The WasteDataFlow periods used in previous studies is documented in section 2.7.

2.4 Standard Method for Calculating Household Food Waste

The 2010 to 2018 studies used two methods for calculating UK household food waste arisings, a 'standard' method and an 'alternative' method, with the standard method being that used to produce the final estimates. The same approach has been applied for the 2018 estimates in this report.

The alternative method was also applied, in order to understand how the choice of calculation method impacts on the results. The alternative method is described in detail in the 2014/15 report. The key difference is that the alternative method determines the total food waste in both the residual and targeted streams for each LA before scaling this to the population.

The sum of food waste arisings across the four household waste streams (detailed below) was calculated to arrive at an estimate of UK arisings of LA collected household food waste.

The main aspects of the standard method are described below, organised by waste stream.

2.4.1 Standard Method: Kerbside Residual

The weight of food waste in the kerbside residual waste stream was determined by taking the percentage of kerbside residual waste that is food from each of the WCAs. From this information, an average percentage was calculated and multiplied by the amount of kerbside residual waste collected in the UK.

Within this study, two developments have been made to the method to improve its accuracy:

- Stratification by nation. WCAs for each nation were processed separately and subsequent analysis was done by nation. The total tonnes in each nation were them summed to produce the national figure.
- The weighted stratification of population density, due to the fact that population density came out as statistically significant in an analysis of factors affecting food waste arisings (see Appendices A.1.0 and A.3.0 for more information on the stratification approach). Consideration was given to stratifying for other factors, but either there was no significant relationship with the percentage of residual waste that was food, the sample was representative, or the effect on the results was minimal.

Within previous studies, a number of developments to the method had also been made to improve its accuracy and these have been applied to this study:

- The stratification of the sample and population according to whether LAs have any collections targeting food waste (same as the 2014-15 report);
- Adjustment to account for different yields of collections targeting food waste between the sample and the population (as for the 2014-15 report); and
- Disaggregation of multi-phase studies (see section 1.2.2).

A further refinement in the current estimates is stratification by population density. In order to stratify by population density, each study in the sample was grouped into a population density quartile, established from UK-wide data. The average percentage of food waste in each quartile and in each stratum was then calculated from studies from LAs within that stratum. The average percentages for each quartile were then weighted equally to give a total average for each stratum weighted by population density. The two strata are:

- LAs that have kerbside collections targeting food waste (e.g. separate food-waste collections, mixed food and garden collections); and
- LAs that do not have kerbside collections targeting food waste.

These strata were analysed separately for each nation.

For each stratum, the average percentage of food waste was then multiplied by the amount of residual waste for all LAs in the stratum (irrespective of whether they had a WCA). This gave a total of food waste in the kerbside residual waste stream for each stratum and each nation. These totals were then added to obtain an estimate for the whole of the UK.

In the past, a number of slightly different methods were used in the standard method to scale information from the sample of LAs to the whole of the UK for the kerbside residual stream.

The stratification by population density for the 2018 estimates does not impact comparability with previous estimates, since the earlier estimates did not have significant issues regarding the coverage of sample authorities by population density. The stratification by population density for the 2018 estimates adjusts for inconsistent coverage by population density of the sample available for 2018, and this adjustment ensures that the 2018 estimates are comparable with earlier estimates.

The stratification by nation included in the 2018 estimates does not produce results that are directly comparable to earlier estimates (which did not stratify by nation). However, the main estimates stated in the 2018 report do not stratify by nation (and instead treat the UK as one nation), and these estimates are comparable with previous estimates. The main estimates are presented in the Executive Summary and Section 3.1. The stratified by nation results (not directly comparable with previous estimates) are presented separately in Section 3.4.

2.4.2 Standard Method: Kerbside Collections Targeting Food Waste

This section describes the method used to estimate the amount of food waste collected at kerbside for each LA.

Data sources
The process primarily used WasteDataFlow (WDF) and information collated by WRAP on waste collections systems used by LAs.

Kerbside organics tonnages were taken from Question 10 of WDF. Tonnages were presented by LA for each organic material stream. LAs report tonnages quarterly, except for Scotland where tonnages are reported annually.

The following WDF categories are relevant:

- **Waste food only:** this category is straightforward as the vast majority is food waste, and it is also an important indicator of the presence of separate food waste collections. A small amount of the material collected as food waste consists of contamination. It was stated in the previous study that contamination had been accounted for, but upon inspection of the values it was apparent that this was not the case. To be able to compare studies like-for-like, no adjustment for contamination has been made in this study. It should be noted, however, that this results in a slight overestimation of the tonnage of food waste.
- **Mixed garden and food waste**: this category is less easily dealt with as the proportion of food waste in this material cannot be determined directly from the WDF tonnages. For most LAs, the amount of food waste in this mixed stream was calculated either from the number of households served or from the total waste collected from this waste stream.
- **Other compostable waste**: this category is highly uncertain as it could consist of garden waste, food waste, cardboard or mixed food and garden wastes. For authorities reporting tonnages in this category, reference has been made to data supplied by WRAP on kerbside organics recycling scheme types for LAs.

WRAP scheme data was used to cross check the WDF tonnages. The most recent scheme data (for financial year 2017/18) was used for separate food collections and garden waste collections (which also includes mixed garden and food waste collections).

2.4.3 Standard Method: Kerbside Dry Recycling

A similar procedure to that applied to kerbside residual was carried out for kerbside dry recycling: where compositional data identified food waste contamination in kerbside dry recycling, this was used to arrive at an average percentage of the dry recycling waste stream that was food. This average percentage was multiplied by the total amount of dry recycling collected in the UK to arrive at an estimate of food waste in kerbside dry recycling. This waste stream makes a minor contribution to the total amount of food waste from households. The LAs were not stratified for this waste stream due to the small number of studies available.

It should be noted that in this study, only single stream comingled WCA was available for this study. As this collection type is prone to higher rates of contamination than other dry recycling collection types, the average arising of food waste in contamination from the compiled WCAs was applied to that portion of kerbside recycling collected comingled, identified from scheme data for all UK local authorities for the financial year 2017/18 and WDF tonnages. No recent data was available food waste arising as contamination in separately collected kerbside dry recycling, and therefore a lower nominal figure, derived from an assessment of data from previous national food waste estimates (of 1% food waste contamination, around half the level found in comingled recycling) was applied to the separately collected portion of dry recycling.

2.4.4 Standard Method: HWRC Residual

A similar procedure to that applied to kerbside residual and kerbside dry recycling was applied to arrive at an estimate of UK arisings of food waste in HWRC residual. Again, this waste stream makes only a small contribution to the total amount of food waste from households. The LAs were not stratified for this waste stream due to the small number of studies available.

The proportion of food waste arising in HWRC residual waste increased from 1% to 3% between 2014/15 and 2017 but, fell back to 2% in 2018. Contamination in dry recycling remained roughly the same at 2%. The difference in HWRC arisings could be due to sampling error, as only a relatively small number of WCAs fed into the previous and current estimates for food waste in HWRC residual waste. HWRC residual waste tonnages did not change significantly between 2015 and 2018.

2.5 Household and Population Data

Household and population counts were used to express the amount of food waste in terms of arisings per household and per person.

The number of households does not affect the total tonnage for the standard, pooled estimates presented in this report, although it does affect the tonnage per household as well as some of the other estimates produced, such as those derived using the alternative method.

For the 2018 pooled estimates, the ONS 2016-based household projections[21] for local authorities and higher administrative areas in England were used to scale up the number of households for each nation within the UK from the 2015 estimates.

Population counts for all nations and periods were taken from the ONS population estimates time series dataset (which provides mid-year estimates for 2018).

In the waste industry, results are often presented as waste per household (e.g. kg per household per week) as the household is the unit from which waste collection is measured. This is how results have been presented in previous synthesis reports. However, the number of people per household can vary over time and between different areas (e.g. between UK nations). As the amount of food waste has previously been shown to vary with the number of people in the household (i.e. more food waste in larger households),[22] the results are also presented per person in this report. Additional analysis of existing datasets suggests that expressing the amount of food waste generated per person removes some of the variation found in the figures for arisings per household, implying that comparisons made on a per person basis are more robust than using per household data. Use of per person figures also brings reporting more closely in line with other food waste measurement initiatives.[23]

2.6 Confidence Intervals

Confidence intervals were calculated for the main estimates in the report. These measure the uncertainties arising from sampling errors: i.e. errors resulting from the limitations of the sample of LAs, and (for each WCA) from only a sample of houses being included (typically 135-250). For each waste stream where sampling forms part of the estimation process (kerbside residual, kerbside dry recycling and HWRC residual), the variation in the percentage of that waste stream that is food was used to construct the confidence interval. For collections that target food waste, the estimates for the amount of food waste they capture were assumed to be without sampling error, as all the information was derived from WDF (i.e. a census of all LAs).

For the kerbside residual stream, the confidence intervals were calculated for each stratum (LAs with collections targeting food waste and LAs without such collections). These two confidence intervals were then combined to give an overall confidence interval for kerbside residual stream. The confidence interval for all the waste streams was then combined to give an overall estimate of confidence, quoted at the 95% confidence level.[24]

[21] *https://www.ons.gov.uk/releases/2016basedhouseholdprojectionsinengland*
[22] *Household Food and Drink Waste in the UK 2012, WRAP 2013: http://www.wrap.org.uk/content/household-food-and-drink- waste-uk-2012*
[23] *E.g. Estimates of European food waste levels, FUSIONS, 2016: http://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf*

[24] Combining confidence intervals in this way assumes that the estimates and their uncertainties are independent. Where waste compositional analyses have measured waste in multiple streams within the same LA, there may be some correlation between the uncertainties calculated, but the effect on the overall confidence intervals (which are dominated by the kerbside residual waste stream) is likely to be small.

These confidence intervals omit contributions from systematic errors, which are usually difficult to quantify and / or combine with random sampling errors. Systematic errors may stem from a number of sources including:

- whether the LAs with WCAs were representative of all UK LAs;
- the factors used in calculating the amount of food waste in mixed garden and food waste; and
- the time of year at which WCA were undertaken.

Where two estimates were compared (e.g. between nations within the UK), t-tests were used to assess whether the differences were significant.

2.7 Interpretation of Trends in Food Waste Arisings

Over recent years, there have been a number of studies to estimate the amount of LA-collected food waste from UK households. The 2014-15 report included estimates from 2010, 2012, 2014 and 2015, using the most recent methodology so that results are comparable, including with this study.[25] Comparisons are also made with the 2007 estimate, even though some small methodological differences exist. Given the scale of change between 2007 and 2010, these small differences are unlikely to change the conclusions relating to these years.

Due to the nine-month bleed period for WCAs included, there are overlapping datasets for 2017 and 2018. As such, the two are not wholly comparable and trends will be inferred from 2015 to 2018.

Table 3 summarises key data used for current and historic estimates. This includes which periods of WasteDataFlow were used, the fieldwork dates for WCAs, and how many LAs were covered by these WCAs.

---

[25] On revision, the UK estimate for 2012 was revised upwards by 3,000 tonnes (less than 0.1%). For 2010, the UK estimate was revised upwards by 142,000 (c. 3%).

Table 3: Comparison of key features of national household food waste estimates for different target periods

Target period for estimates	2007	2010	2012	2014	2015	2017	2018
Nations from which compositional studies were included	England	England, Wales, Scotland, Northern Ireland	England, Wales, Scotland	England, Wales, Scotland	England, Wales, Scotland, Northern Ireland	England, Scotland, Northern Ireland	England, Scotland, Northern Ireland
Time period of WDF data	UK: Jan2007 to Dec 2007	UK: Oct 2009 to Sept 2010	England: Oct 2011 to Sept 2012; Wales and Northern Ireland: April 2011 to Mar 2012; Scotland: Jan to Dec 2011	England and Wales: Oct 2013 to Sept 2014; Northern Ireland: Jan 2014 to Dec 2014; Scotland: Jan 2013 to Dec2013	England and Wales: Oct 2014 to Sept 2015; Northern Ireland: Apr 2014 to Mar 2015; Scot: Jan 2014 to Dec 2014	Calendar year 2017	Calendar year 2017 (2018 for England)
Time period of compositional data	February 2005 to September 2008	January 2009 to April 2011	February 2011 to March 2013, though excluding any studies carried out in 2011 that had been included in the 2010 estimates	April 2013 to March 2015	April 2014 to March 2016	April 2016 to September 2018	April 2018 to Feb 2019
No. of LAs from which kerbside residual compositional data included	120	87	63	87	116	124	82
Organisation commissioning the 'synthesis' study	Main study = Defra (additional calculations performed for WRAP)	WRAP	WRAP	WRAP		WRAP	WRAP
Link	http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15133	www.wrap.org.uk/sites/files/wrap/Synthesis%20of%20Food%20Waste%20Compositional%20Data%202010%20FINAL.pdf	http://www.wrap.org.uk/sites/files/wrap/hhfdw-synthesis-food-waste-composition-data.pdf	http://www.wrap.org.uk/content/household-food-waste-uk-2015-0		*This report*	

3.0 Results

This section of presents the overall results of the study. Section 3.1 presents an estimate of LA-collected household food waste arisings for the UK for 2018, including a comparison with previous estimates. Trends over time are presented in section 3.2. Estimates for England, Northern Ireland, Scotland and London are included in section 3.3. The estimates presented in this section are standard, pooled estimates, as described in section 1.1.

A new estimate for the whole UK is presented in section 3.4, where the dataset has been stratified by nation. This is the method that is likely to be used in WRAPs reporting taken forwards; however, this method includes 2015 WCA data for Wales, as there was insufficient WCA data for the relevant time period.

Capture rates for household food waste arisings are included in section 3.5.

3.1 UK Arisings in 2018 (not stratified by nation)

These estimates use the same methodology as previous UK arisings estimates and are therefore comparable with previous estimates. This method does not stratify by nation (in contrast to the estimates presented in section 2.3.

Table 4 shows estimates for household food waste collected by LAs in the UK in 2018. Food waste arisings expressed in terms of kg per household per year and kg per person per year are shown in Table 5.

Total food waste collected from UK households by LAs in 2018 is estimated at 4.58 million tonnes. This is equivalent to 165.0 kg per household or 69.0 kg per person. The 95% confidence interval is ±0.1 million tonnes, ±1.7 kg per person or ±2.4%.

As in previous estimates (presented in the 2014-15 report), the vast majority of this food waste (3.64 million tonnes; 79% of the total) was found in the kerbside residual waste stream, with most of the rest (0.78 million tonnes; 17% of the total) in kerbside collections targeting food waste (see Figure 1). Estimated food waste arisings at HWRCs fell between 2017 and 2018 from 3% to 2%; meanwhile contamination in dry recycling remained at 2%.

Table 4: Estimates of household food waste collected by local authorities in the UK 2018, tonnes

Waste stream	Tonnes of FW	95% Confidence interval
Kerbside residual	3,642,000	±110,000
Kerbside collections targeting food waste	777,000	N/A
Kerbside dry recycling (contamination)	89,000	±2,000
HWRC residual	77,000	±4,000
TOTAL	4,585,000	±110,000

Table 5: Estimates of household food waste collected by local authorities in the UK 2018, kg per household and kg per person

Waste Stream	Kg/hh/yr		Kg/person/yr	
	Food waste arisings	95% Confidence Interval	Food waste arisings	95% Confidence Interval
Kerbside residual	131.0	±3.9	54.8	±1.7
Kerbside collections targeting food waste	28.0	N/A	11.7	N/A
Kerbside dry recycling (contamination)	3.2	±0.05	1.3	±0.02
HWRC residual	2.8	±0.1	1.2	±0.05
TOTAL	165.0	±4.0	69.0	±1.7

Figure 3: Household food waste collected by local authorities in the UK 2018, by waste stream
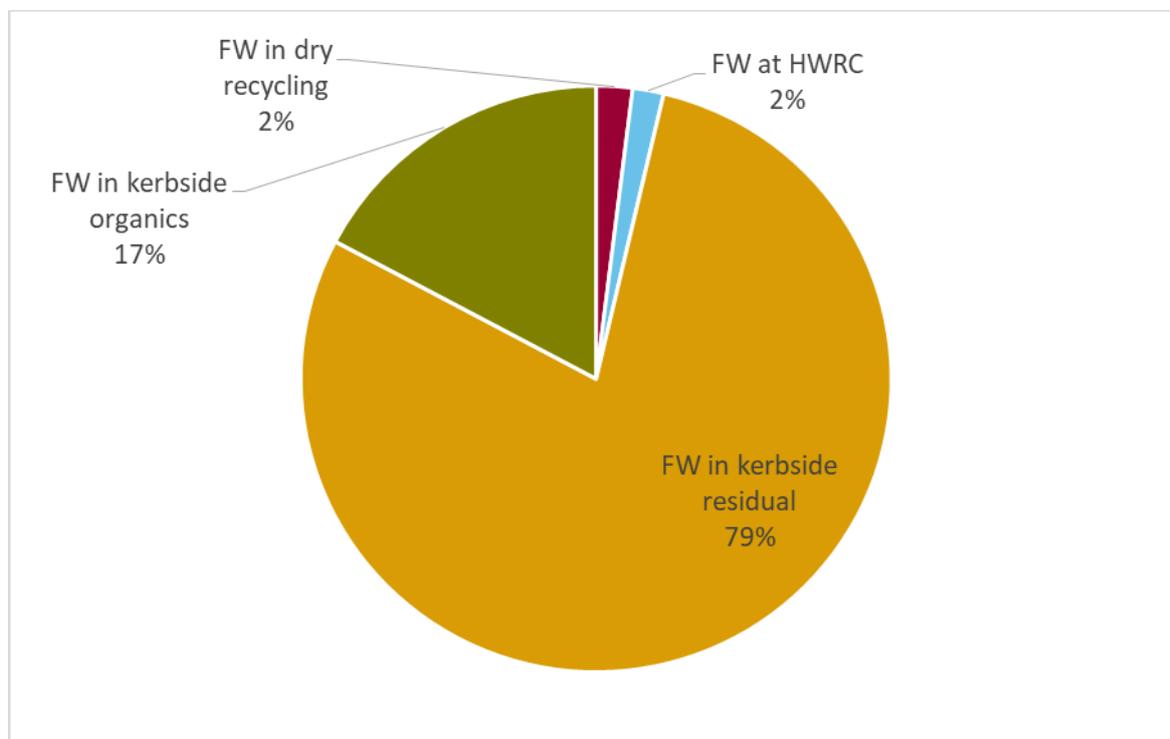
3.2 UK Trends in LA Collected Household Food Waste

For the purposes of comparing household food waste arisings for different periods, only food waste in kerbside residual and collections targeting food waste for treatment has been reported, as this represents the vast majority of food waste arisings and estimates for the other (minor) streams are relatively uncertain due to a lack of data.

Figure 4 shows total household food waste arisings, in tonnes, from the current and previous studies, while Figure 5 shows the same estimates, expressed as kg per person, in a given year. These estimates use the standard pooled method; the 95% confidence interval for each estimate is also provided. The data used in the figures is shown numerically in Table 6 and Table 7.

The results show that there was a statistically significant reduction of 338,000 tonnes in the amount of food waste collected from UK households by LAs between 2015 and 2018. In terms of food waste per person, the reduction was 6.5 kg/hh/yr. This impact is largely unexplained but stems from a reduction in the amount of food waste estimated in residual collections.

There was a reduction of 22 percentage points in food waste tonnages between 2007 and 2012 (statistically significant at the 95% confidence level), followed by a 3 percentage point decrease between 2012 and 2018 (not statistically significant at the 95% confidence level). There was an increase in food waste tonnages between 2012 and 2015 of 4 percentage points (not statistically significant), although there has been a decrease in food waste tonnages between 2015 and 2018 of 7 percentage points, which is statistically significant at the 95% confidence level.

There was a reduction in food waste arisings per household of 26 percentage points between 2007 and 2012 (statistically significant at the 95% confidence level), followed by a 7 percentage

point decrease between 2012 and 2018 (also statistically significant at the 95% confidence level; the corresponding comparison in terms of tonnages is not statistically significant for 2012 and 2018, due to growth in number of households nationally between these two periods). There was an increase in food waste arisings per household between 2012 and 2015 of 1 percentage point (not statistically significant), although there has been a decrease in food waste arisings per household between 2015 and 2018 of 8 percentage points, which is statistically significant at the 95% confidence level.

It should be noted that there are some small differences between the method used to calculate the 2007 estimate and that used for subsequent estimates (2010-2018). These are discussed in section 1.7. The effect of these differences on the results is thought to be small, and unlikely to impact upon the validity of the above conclusion.

Figure 4: Estimated arising of local authority collected household food waste in the UK 2007 to 2018, million tonnes (±95% confidence interval)[26]
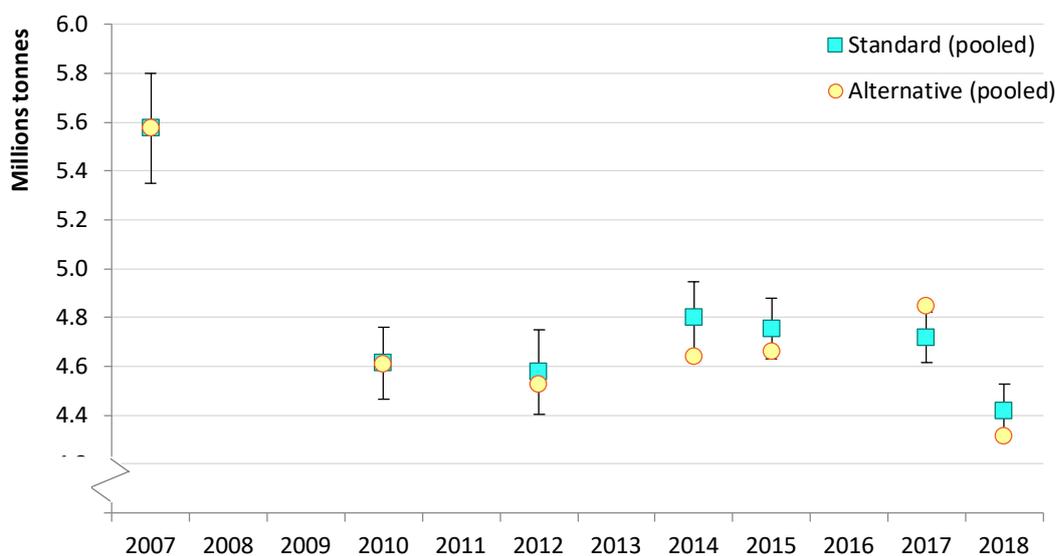
Results cover food waste in kerbside residual and collections targeting food waste for treatment, but exclude minor waste streams (HWRC residual and contamination of dry recycling).

---

[26] *In the 2012 synthesis study, a pooled estimate for 2009 was reported. Due to the practical limitations within the current project, it was not possible to apply the most recent improvements in the methodology to this year; it has therefore not been reported here.*

Table 6: Estimated local authority collected household food waste in the UK 2007 to 2018, thousand tonnes

Waste stream	2007	2010	2012	2014	2015	2017	2018
Food waste in kerbside residual	5,488	4,322	4,040	4,198	4,117	3,975	3,642
Food waste in kerbside collections targeting food waste	88	293	537	602	639	746	777
Total food waste (kerbside residual plus collections targeting food waste)	5,577	4,615	4,577	4,799	4,756	4,721	4,419
95% confidence interval	±225	±147	±171	±148	±125	±102	**±110**

Figure 5: Estimated arising of local authority collected household food waste in the UK 2007 to 2018, kg per person (±95% confidence interval)

Results cover food waste in kerbside residual and collections targeting food waste for treatment, but exclude minor waste streams (HWRC residual and contamination of dry recycling).
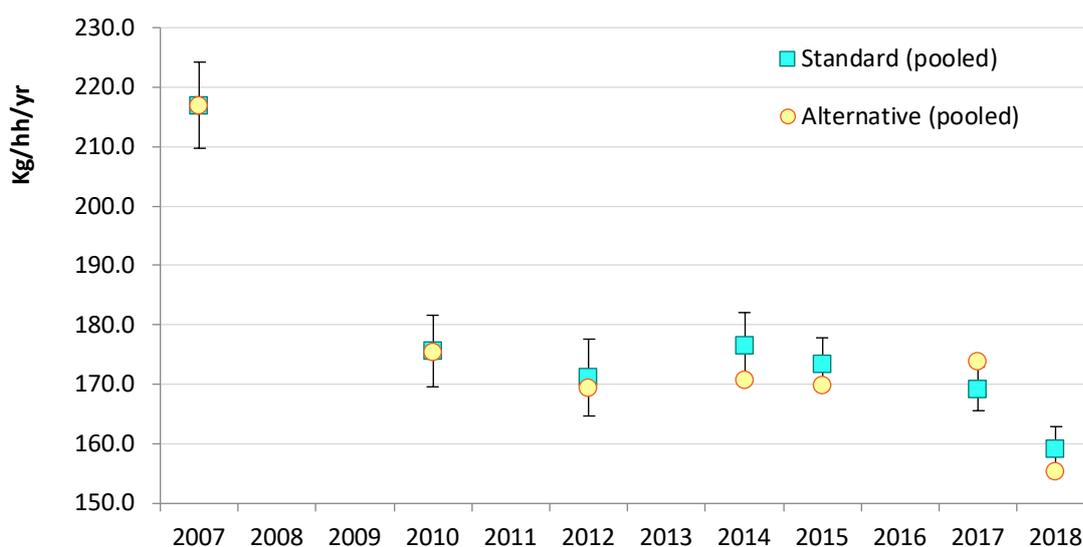
Table 7: Estimated local authority collected household food waste in the UK 2007 to 2018, kg per person

Waste stream	2007	2010	2012	2014	2015	2017	2018
Food waste in kerbside residual	89.5	68.9	63.4	65.0	63.2	60.2	54.8
Food waste in kerbside collections targeting food waste	1.4	4.7	8.4	9.3	9.8	11.3	11.7
Total food waste (kerbside residual plus collections targeting food waste)	90.9	73.5	71.9	74.3	73.1	71.5	66.5
95% confidence interval	±3.7	±2.3	±2.7	±2.3	±1.9	±1.5	±3.9

As noted earlier in this section, most food waste is found in the residual waste stream. The amount of food waste in this waste stream is the product of the total amount of waste (of all materials) in the residual stream and the percentage (based on analysis of WCAs) that is estimated to be food. The trends in these two components are presented below.

The average percentage of the residual waste stream that was food waste in 2018 was 27.2% for those LAs that targeted food waste and 35.6% for those that did not. The overall average was 30.1%. This represents a new low in the average percentage, which has varied slightly since 2007, with a high of 35% in 2007 and a previous low of 32% in 2012 (Figure 6). The percentage for LAs targeting food waste was generally lower, but followed a similar pattern, ranging from 28.5% - 31%. For those LAs without collections targeting food waste, the pattern was similar, although consistently higher, with levels ranging from 34% to 38%.

% of kerbside residual waste that is food
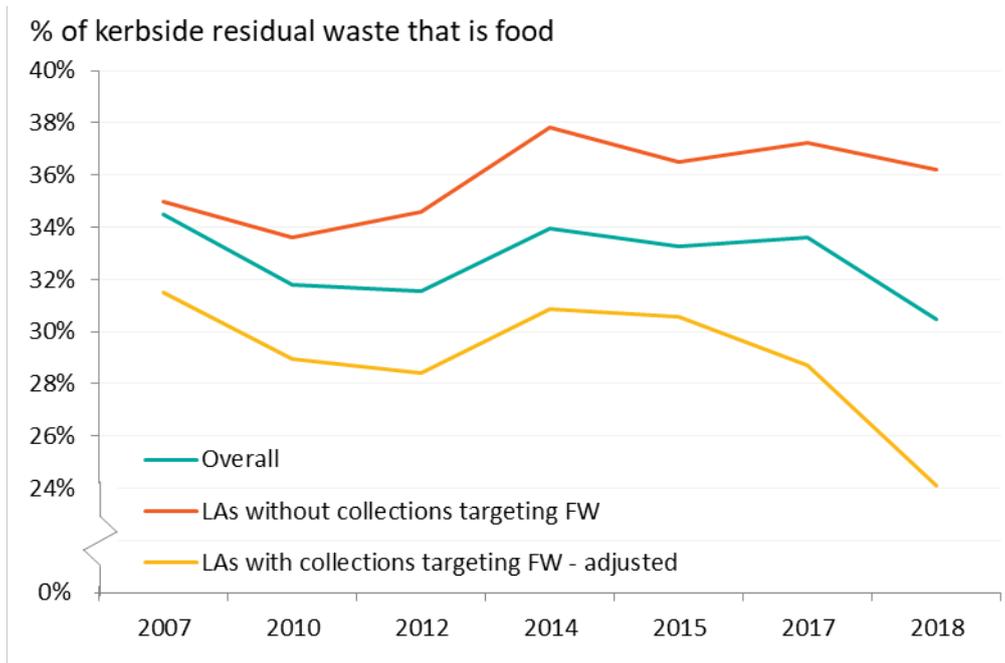
The percentage of residual waste that is food has decreased significantly for LAs that have collections targeting food waste. The percentage of residual that is food for LAs without targeted collections has also decreased.

The amount of residual waste collected from UK households has also consistently decreased (Figure 7), despite an increase in population. This decrease was less prominent from 2015 to 2018.

Figure 7: Trend in kerbside residual waste from UK households

Approx. kerbside residual waste from UK households (million tonnes)
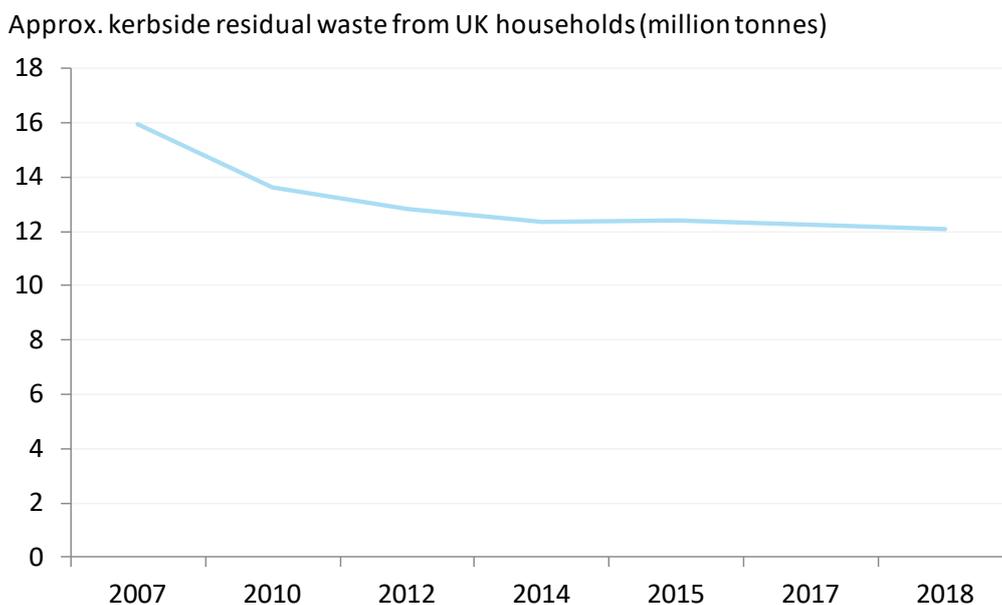
3.3 Arisings by Nation and London

There were a sufficient number of waste compositional studies to calculate separate estimates of household food waste for Scotland, Northern Ireland, England and London. These estimates include nation-level (or city-level) food waste in kerbside residual and food waste collected at the kerbside for treatment. For the minor waste streams (HWRC residual and contamination of dry recycling), a lack of WCAs meant that these were not able to be calculated at nation level.

A separate estimate has been calculated for Wales in Appendix A.1.0. As outlined in the methodology, this uses compositional data from 2015 and therefore should not be compared to other nations or previous estimates. It has, however, been necessary to include in the UK estimates that stratify by nation (see Section 2.3).

The estimates shown below include only food waste in kerbside residual and food waste collected at the kerbside through collections that target food waste. It is important to note that methodological issues may have influenced these national results to a small degree. In particular, the latter half of Appendix A1.1 contains discussion of some of the uncertainties associated with these estimates.

3.3.1 Arisings in England

Estimated arisings of LA collected household food waste in England in 2018 are shown in Table 8, in terms of tonnes, kg per household and kg per year. This estimate is based on 100 phases of waste compositional data, from65 different local authorities.

Table 8: Estimated arising of local authority collected household food waste in England, 2018

Waste Stream	Thousand tonnes	Kg/hh/yr	Kg/person/ yr
Food waste in kerbside residual	3,328	143.3	59.5
Food waste in kerbside collections targeting food waste	557	24.0	10.0
Total food waste (kerbside residual plus collections targeting food waste)	3,885	167.3	69.4
95% confidence interval	±105	±4.5	±1.9

The 2018 estimates have been compared (in terms of kg / person / year) with estimates for England for 2009, 2015 and 2017, calculated for the 2015 and 2017 studies using the same method. The amount of food waste in these two streams was lower in 2018 (69.4 (±1.9)

kg/person/year) compared with 2015 (72.4 (±2.4) kg / person / year). This decrease is statistically significant.

Table 9: Estimated arising of food waste in residual and collections targeting food waste in England in 2009, 2015, 2017 and 2018 (kg / person / year)

Waste Stream	2009	2015	2017	2018
Food waste in kerbside residual	68.1	63.7	65.3	59.5
Food waste in kerbside collections targeting food waste	3.5	8.6	9.5	10.0
Total food waste (kerbside residual plus collections targeting food waste)	71.6	72.4	74.8	69.4
95% confidence interval	±4.0	±2.4	±1.7	±1.9

A large proportion of LAs in England do not target food waste, and this allows for a comparison of total food waste arisings at the kerbside between LAs that target food waste and those that do not. English authorities that target food waste were found to have arisings of 155 **± 9** kg/hh/yr, some 20kg lower than authorities that did not target food waste (174 **± 7** kg/hh/yr). This difference is almost statistically significant at the 95% confidence level

3.3.2 Arisings in Scotland

Estimated arisings of LA-collected household food waste for Scotland in 2017 are shown in Table 10 using the standard method.[27] This estimate is based on 6 phases of waste compositional data from 5 local authorities in Scotland.

[27] *The headline figures for Scotland here are calculated using the alternative method, whereas figures for other nations and regions are presented using the standard method and so it is not always appropriate to compare them directly. Comparison can be made between the standard estimate for Scotland (2014) and other estimates also calculated using the standard method. However, for the 2009 estimate for Scotland (using the alternative method) and the trend in Scotland between 2009, 2014 and 2017 (also using the alternative method), comparison should be made only to estimates for other nations that are also calculated using the alternative method. Such data for the UK can be found in the previous 2014/15 study. More discussion of this is found in the report by Zero Waste Scotland:* Household food and drink waste in Scotland 2014, ZWS (2016).

Table 10: Estimated arising of local authority collected household food waste in Scotland 2017 (using the standard method)

Waste Stream	Thousand Tonnes	Kg/hh/yr	Kg/person/yr
Food waste in kerbside residual	263	105.7	48.3
Food waste in kerbside collections targeting food waste	81	32.6	14.9
Total food waste (kerbside residual plus collections targeting food waste)	343	138.3	63.1
95% confidence interval	±45	±18.1	±8.3

As described in the 2017 report and in section 1.4, the result for Scotland in 2009 using the standard method was not robust due to a lack of data in one of the two strata. This is similar to the 2018 result, with only one sample from an authority not targeting food waste at the kerbside. For this reason, the results produced using the alternative method have also been presented, both for 2018 (Table 11) and as a comparison with 2009, 2014 and 2017 (Table 12). The difference between the standard and alternative method central estimate in 2018 was 18,100 tonnes or 5.0%; however, it should be noted they are not statistically significant.

These two different Scotland estimates for 2018 did not differ from the per person estimates for the rest of the UK to a statistically significant degree. This indicates that levels of household food waste in Scotland are broadly similar to those found across the rest of the UK.

Table 11: Estimated arising of local authority collected household food waste in Scotland 2018 (using the alternative method)

Waste Stream	Thousand Tonnes	Kg/hh/yr	Kg/person/yr
Total food waste (kerbside residual plus collections targeting food waste)	386	155.5	71.0
95% confidence interval	±30	±12.2	±5.6

Table 12 makes a comparison between Scotland's 2018 figures and those for 2009, 2014 and 2017 using the alternative method. The differences in central estimates are not statistically significant at the 95% confidence level. The apparent reduction between central estimates in Scotland would be greater if the standard method (used in the other UK nations and regions) was applied, though it would still not be statistically significant.

Table 12: Estimated arising of food waste in residual and collections targeting food waste in Scotland in 2009, 2014, 2017 and 2018 (kg / person / year) using the alternative method

Waste Stream	2009	2014	2017	2018
Total food waste (kerbside residual plus collections targeting food waste)	75.1	70.8	70.7	71.0
95% confidence interval	±7.1	±6.5	±10.2	±5.6

3.3.3 Arisings in Northern Ireland

Estimated arisings of LA-collected household food waste for Northern Ireland in 2018 are shown in Table 12. The average amount of food waste per person generated (52.1 ± 4.8 kg per person) is statistically significantly lower (at the 95% confidence level) than for England (69.4 ± 1.9 kg per person). This estimate is based on 22 phases of waste compositional data from all 11 local authorities in Northern Ireland.

As all of the Northern Ireland studies were carried out by one contractor that did not carry out studies elsewhere in the UK, it is difficult to determine whether there is a 'contractor effect' caused by methodological differences, or if the arisings are genuinely lower. LAs in Northern Ireland provide food waste collections across all households, and it is plausible that this could be having an impact on residents' awareness of the food that they are throwing out. However, Wales and Scotland also have near-universal coverage for household food waste collections without achieving the same 'prevention effect', so this factor on its own does not adequately explanation Northern Ireland's lower arisings.

The arisings figures for Northern Ireland are therefore somewhat puzzling. 2018 is the first time in the programme of household food waste estimates that this issue has arisen, since waste composition analyses have not been available in Northern Ireland for previous estimates. It is therefore impossible to assess whether the arisings figures have changed significantly over time, or whether food waste arisings in Northern Ireland are consistently low.

Table 13: Estimated arising of local authority collected household food waste in Northern Ireland, 2018

Waste Stream	Thousand tonnes	Kg/hh/yr	Kg/person/yr
Food waste in kerbside residual	78.7	107.3	41.8
Food waste in kerbside collections targeting food waste	19.3	26.3	10.3
Total food waste (kerbside residual plus collections targeting food waste)	98.0	133.6	52.1
95% confidence interval	±9.0	±12.4	±4.8

3.3.4 Arisings in London

Estimated arisings of LA-collected household food waste for London in 2018 are shown in Table 14. The amount of food waste collected by LAs in London was estimated to be 572 thousand tonnes (±72 thousand tonnes at the 95% confidence level), equivalent to 64.2 (±8.1) kg per person per year.

Comparing the estimated arisings for London in 2015 and 2017 it appears that the amount of food waste per person has increased considerably, and then decreased in 2018 (see Table 15). This is highly likely due to sampling error, given the relatively small number of WCAs available to produce estimates for London in all periods (in comparison to the number available for England or the UK). There could be genuinely different food waste arisings in London compared to the rest of the country, which could be related to changing lifestyle and consumption patterns in the capital. However, due to the variation in results over the periods for which data is available and the concerns about possible sampling error, conclusions should not be drawn on this issue from the findings presented here.

Table 14: Estimated arising of local authority collected household food waste in London 2018

Waste Stream	Thousand Tonnes	Kg/hh/yr	Kg/person/yr
Food waste in kerbside residual	461	132.4	51.8
Food waste in kerbside collections targeting food waste	111	31.7	12.5
Total food waste (kerbside residual plus collections targeting food waste)	572	162.9	64.2
95% confidence interval	±72	±20.7	±8.1

Table 15: Estimated arising of food waste in residual and collections targeting food waste in London in 2015, 2017 and 2018 (kg per person)

Waste Stream	2015	2017	2018
Food waste in kerbside residual	65.0	87.1	51.8
Food waste in kerbside collections targeting food waste	10.0	11.8	12.5
Total food waste (kerbside residual plus collections targeting food waste)	75.0	98.9	64.2
95% confidence interval	±5.3	±6.6	±8.1

3.4 UK estimates (stratified by nation)

The UK wide estimates stratified by nation are presented in this section. The UK estimates stratified by nation are not comparable to previous estimates.

The nation stratified estimates rely on producing separate estimates for each UK nation and then adding these together to arrive at a UK total. There are some advantages to this approach, as it takes account of different food waste policies, and potentially different food waste disposal behaviour, between the nations. One disadvantage, however, is that coverage of waste compositional analyses (WCAs) in Wales in 2018 is very poor, and therefore WCAs from 2015 (for which period WCA coverage in Wales was excellent) were included and analysed alongside 2018 reported WasteDataFlow tonnages for Wales. As most of the WCAs for the Wales estimates do

not match with the 2018 period, the Wales estimates are not comparable with other separate nation estimates presented in this report. This introduces a degree of uncertainty to the nation stratified estimates.

On the other hand, for the non-nation stratified estimates, there is also a degree of uncertainty, as account is not taken of unrepresentative coverage of WCAs by nation. In the case of the 2018 non-nation stratified estimates (comparable to previous UK estimates), there is excellent coverage of Northern Ireland, and consequently WCAs from Northern Ireland are overrepresented.

Table 16 shows estimates for household food waste collected by LAs in the UK in 2018 for the nation stratified method. Food waste arisings expressed in terms of kg per household per year and kg per person per year are shown in Table 17.

Total food waste collected from UK households by LAs in 2018 is estimated at 4.6 million tonnes for the stratified method. This is equivalent to 167 kg per household or 70 kg per person. The 95% confidence interval was ±1.30 million tonnes, ±5.28 kg per person or ±3.14%.

The vast majority of this food waste (3.69 million tonnes; 80% of the total) was found in the kerbside residual waste stream, with most of the rest (0.78 million tonnes; 17% of the total) in kerbside collections targeting food waste.

Table 16: Estimates of household food waste collected by local authorities in the UK 2018 using the stratified by nation method, tonnes

Waste Stream	Tonnes of FW	Confidence interval
Kerbside residual	3,774,000	±105,000
Kerbside collections targeting food waste	777,000	N/A
Kerbside dry recycling (contamination)	89,000	±2,000
HWRC residual	77,000	±5,000
TOTAL	4,717,000	±105,000

Table 17: Estimates of household food waste collected by local authorities in the UK 2018 using the stratified by nation method, kg per household and kg per person

Waste Stream	kg per household in 2018		kg per person in 2018	
	Food waste arisings	95% Confidence Interval	Food waste arisings	95% Confidence Interval
Kerbside residual	135.8	±4.5	56.8	±1.9
Kerbside collections targeting food waste	28.0	N/A	11.7	N/A
Kerbside dry recycling (contamination)	3.2	±0.1	1.3	±0.02
HWRC residual	2.8	±0.2	1.2	±0.1
TOTAL	169.7	±4.5	71.0	±1.9

The results of the nation stratified estimate are compared with the non-nation stratified estimate in Table 1819. As shown, the total tonnes for the stratified by nation estimate is slightly higher than for the non-stratified estimate, however not significantly.

Table 18: Comparison of total tonnes and kg/person/year for the stratified by nation and non-stratified by nation estimates

|	Total tonnes		Kg/person/year	
	Non-stratified	Stratified	Non-stratified	Stratified
Total UK	4,585,000	4,716,000	69.0	71.0
95% confidence interval	±110,000	±105,000	±1.7	±1.9

3.5 Capture Rates for Food Waste

The capture rate – the percentage of total household food waste that is captured in kerbside (KS) collections targeting food waste – has been calculated using the formula below:

$$\text{Capture rate} = \frac{\text{FW in kerbside collections targeting FW}}{\text{FW in KS residual + FW in KS targeted collections + FW in KS dry recycling (contamination) + FW in HWRC residual}}$$

The UK capture rate was calculated based on the UK estimate not stratified by nation, so that it could be compared to previous studies. The capture rate was found to be 16.9% ± 0.4%[28] for 2018 – 777,000 tonnes in targeted collections out of a total of 4,484,000 tonnes. The capture rate reflects the position across the UK, including LAs that provide collections targeting food waste and those that do not.

Figure 6 illustrates the increase in capture rates over recent years: in 2007, the capture rate was a mere 1.6% (±0.1%), making the 2018 result more than a tenfold increase across the eleven-year period. A large part of this change is related to the increased coverage of collections targeting food waste during this period, as well as educational campaigns. However, the rate of increase since 2012 appears to have slowed, perhaps reflecting financial constraints on local authorities that have tended to limit their capacity to offer new services unless they offer substantial financial benefits.

Figure 8: Trend in UK capture rates of household food waste (±95% confidence interval)

---
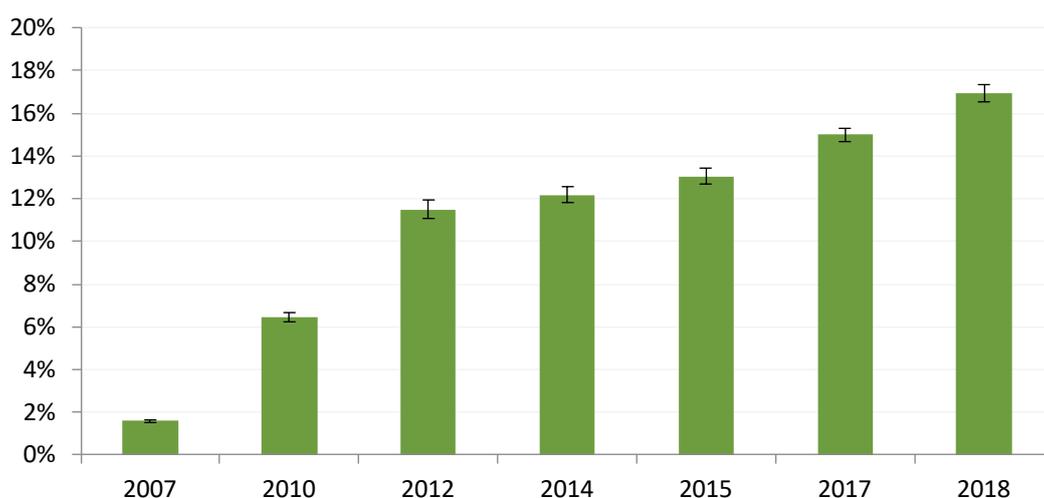
[28] *95% confidence interval includes contribution from sampling error, and assumes no sampling error in FW in collections targeting food waste as this information is derived from WasteDataFlow.*

4.0 Conclusions

For the UK, the per capita food waste arisings show the first statistically significant fall since the 2007-2012 period between 2015 and 2018.

There was a reduction of 22 percentage points in food waste tonnages between 2007 and 2012 (statistically significant at the 95% confidence level), followed by a 3 percentage point decrease between 2012 and 2018 (not statistically significant at the 95% confidence level). There was an increase in food waste tonnages between 2012 and 2015 of 4 percentage points (not statistically significant), although there has been a decrease in food waste tonnages between 2015 and 2018 of 7 percentage points, which is statistically significant at the 95% confidence level.

There was a reduction in food waste arisings per household of 26 percentage points between 2007 and 2012 (statistically significant at the 95% confidence level), followed by a 7 percentage point decrease between 2012 and 2018 (also statistically significant at the 95% confidence level; the corresponding comparison in terms of tonnages is not statistically significant for 2012 and 2018, due to growth in number of households nationally between these two periods). There was an increase in food waste arisings per household between 2012 and 2015 of 1 percentage point (not statistically significant), although there has been a decrease in food waste arisings per household between 2015 and 2018 of 8 percentage points, which is statistically significant at the 95% confidence level. The 2018 estimate for the average amount of household food waste per person for England was not significantly different from that for the UK as a whole. However, Northern Ireland has lower food waste arisings per household than England, with this result being statistically significant. It has not been possible to determine if this reflects a real difference in behaviour or is (partly or wholly) due to a 'contractor effect': all studies in Northern Ireland were carried out by one contractor who hadn't carried out any WCAs elsewhere in the UK, and whose methodology might have differed from those of other contractors.

Comparing the estimated arisings for London in 2015 and 2017 it appears that the amount of food waste per person has increased considerably, and then decreased in 2018 (see Table 15). This is highly likely due to sampling error, given the relatively small number of WCAs available to produce estimates for London in all periods (in comparison to the number available for England or the UK). There could be genuinely different food waste arisings in London compared to the rest of the country, which could be related to changing lifestyle and consumption patterns in the capital. However, due to the variation in results over the periods for which data is available and the concerns about possible sampling error, conclusions should not be drawn on this issue from the findings presented here.

The capture rate – the proportion of LA-collected household food waste found in collections targeting food waste – increased between 2015 and 2018 from around 13% to 17%. However, this means that the proportion of food waste collected in targeted collections in 2018 was still relatively low, with the vast majority – 83% – being found in the residual waste streams (or, to a far lesser degree, in contamination of dry recycling or at the HWRC).

In LAs that have separate food waste collections, the average capture rate was less than one-third (30.1%), with the remainder still going into the residual waste – clearly showing that there is still

great potential to increase the use of these collections where they are present. The UK-wide capture rate has improved by four percentage points between 2015 and 2018.

A.1.0 Wales 2018 Estimates

The Wales estimates are included here as they feed into the stratified by nation estimate (see Section 3.4.

A.1.1 Estimated Arisings of Household Food Waste

Estimated arisings of LA-collected household food waste for Wales in 2018 are shown in Table 1920. The average amount of food waste per person generated in Wales in 2018 (71.3kg per person) was apparently significantly higher (statistically significant at the 95% level) than for England (67.9 ± 1.9 kg per person). However, with just one sample it was not possible to determine confidence intervals for the Welsh sample, and so it is difficult to determine if this is truly statistically different. The amount of food in collections targeting food waste was much higher than the rest of the UK, with 38.1 kg per person collected in 2018, 53% of the total food waste collected from the kerbside. This reflects the fact that all local authorities in Wales have collections targeting food waste that cover almost all households; it is likely that educational programmes and communications regarding food waste in Wales have also had an impact.

Table 19: Estimated arising of local authority collected household food waste in Wales 2018

Waste Stream	Thousand Tonnes	Kg/hh/yr	Kg/person/yr
Food waste in kerbside residual	104	77.0	33.2
Food waste in kerbside collections targeting food waste	120	88.3	38.1
Total food waste (kerbside residual plus collections targeting food waste)	224	165.3	71.3
95% confidence interval	N/A	N/A	N/A

The previous 2015 study estimated that the total food waste arisings in Wales were 66.2 ± 1.6 kg per person. The estimate for 2018 is 7.7% higher than for 2015, a difference which appears to be statistically significant. However, that 2015 compositional studies were used for the 2018 estimate, so this increase results solely from the tonnage of waste reported in WasteDataFlow and does not reflect any actual change in behaviour relating to food waste. The error associated with using 2015 compositions rather than more recent compositional analyses has not been quantified. Comparisons for 2009, 2015, 2017 and 2018 results are shown in Table 20.

Table 20: Estimated arising of food waste in residual and collections targeting food waste in Wales in 2009, 2015, 2017 and 2018 (kg per person)

Waste Stream	2009	2015	2017	2018
Food waste in kerbside residual	68.0	34.6	32.8	33.2
Food waste in kerbside collections targeting food waste	7.3	31.6	36.9	38.1
Total food waste (kerbside residual plus collections targeting food waste)	75.4	66.2	69.7	71.3
95% confidence interval	±3.7	±1.6	±1.6	N/A

A.2.0 Regression Analysis

Multiple regression analysis was carried out on 2017 data (as part of a project for WRAP to produce national compositional estimates for municipal waste in the UK) using the statistical analysis software 'R' to determine the influences that different factors have on the amount of household food waste produced between local authorities (LAs).

Multiple regression analysis is a type of predictive analysis that attempts to explain the variation in a key variable (the dependent variable – in this case the amount of household food waste produced in a LA) by identifying potentially explanatory factors (the independent variables – e.g. deprivation, whether food waste is targeted or not etc.), and looking at the relationship between the variables.

A multiple regression analysis was carried out to determine which independent variables are important to the analysis in the main body of the report. It looks to identify any independent variables that are particularly significant; if the proportion of cases in the sample is not representative of the wider UK population in respect of a particular independent variable, the results may be skewed. If it was determined that the sample was not representative of the UK population, weighting or stratification could be introduced to make the results representative and minimise biases.

Regression analyses were carried out on two dependent variables, to correspond with the standard and alternative methods of calculating food waste arisings. The dependent variables were:

- The percentage of food waste arisings in the residual waste stream; and
- The combined amount of food waste in the residual waste stream and in collections targeting food waste per household, quantified as kg/hh/yr.

The regression for the first dependent variable informs the 'standard' method, as this approach uses the percentage of food waste arisings in the residual waste stream as the basis for calculations. The second dependent variable is useful for the 'alternative' method, as this method uses the combined amount of food waste in both the residual waste and targeted collections.

To correspond with the methodology used in the main analysis, and to maximise the sample size available, multi-phase waste composition analyses were split into constituent phases.

The independent variables tested in each of the following regression analyses were:

- Whether food waste is targeted for collection at the kerbside (i.e. separate food waste or mixed organics collections are provided);
- Level of deprivation (measured as a percentage of the population within the LA that belongs to Social Grade D or E);
- Population density (inhabitants per square km);
- Whether kerbside residual collections were fortnightly or weekly;
- Whether the LA is within England, Wales, Scotland or Northern Ireland;
- The contractor that carried out the analysis;

- The year in which the WCA was carried out; and
- The quarter of the year during which the WCA was carried out.

There may well be other variables that influence the amount of food waste, particularly whether food waste prevention campaigns have been run locally. However, data for each LA relating to such variables is very difficult to obtain and was not possible to do so for this study. Consequently, it was not possible to include these in the regression analyses.

To determine how closely the regression model fits, the coefficient of multiple determination, commonly known as the R^2 value, was examined. This is a measure of how closely the regression model fits the data; with a high R^2 value indicating that most variables have been identified and a low R^2 value indicating that there are still unidentified independent variables. Due to other variables that will inevitably influence the amount of food waste that are not included in this analysis, a relatively low R^2 value was expected.

An analysis of variance (ANOVA) test was carried out to analyse the significance of the variables in determining the regression model. This is an exploratory analysis and it is only important to determine whether they significantly influence the response variable, rather than exactly how they affect these variables. Thus, it was not important to present the model by level, as done in previous reports.

We have also not presented a parsimonious model, as done in previous reports, as in the context of this work this is not particularly informative. The process of model selection is used to create predictive models that are then used to make future predictions, which is not the case in this analysis. Interpreting p-values from parsimonious models in this context can be misleading.

A.2.1 Regression Results: Percentage of Kerbside Residual Which is Food Waste

This section presents the results and discussion relating to the regression models of the first dependent variable.

The results for the inclusive model are as shown in Table 212. The R^2 for this model is 0.388, which means that 38.8% of the variation within the dependent variable has been accounted for. This only accounts for a relatively small proportion of variation between LAs, however this is to be expected. The sample sizes for WCA in each of the LAs were relatively small, which would in itself make variations in the data. Where variations have arisen due to small sample sizes, we cannot explain this variation with regression models. This is therefore a limit on the maximum R^2 value that can be achieved through regression modelling.

Table 21: Inclusive regression model for percentage of kerbside residual that is food waste

	Estimate	Significance	95% CI lower bound	95% CI upper bound
(Intercept)	33.0%	<0.0005	0.2815	0.3784
Deprivation	16.7%	0.0251	0.0211	0.3133
Population density	0.0%	0.0091	0.0000	0.0000
Fortnightly	0.6%	0.6672	-0.0213	0.0332
FW targeted	-6.1%	<0.0005	-0.0818	-0.0400
2017	-2.8%	0.0116	-0.0498	-0.0064
2018	-4.3%	0.0484	-0.0852	-0.0003
Quarter 2	0.1%	0.9589	-0.0257	0.0270
Quarter 3	-0.1%	0.8835	-0.0216	0.0186
Quarter 4	2.2%	0.1068	-0.0048	0.0492

The data in Table 21 indicates there is a strong statistical significance associated with the correlation between the dependent variable and the level of deprivation and whether food waste is targeted or not. Population density and number of households in the LA also have a fairly significant effect. These findings informed the approach to the analysis for calculating the national estimates:

- Food waste targeted or not: the samples were stratified by whether food waste was targeted or not.
- Population density: in England the coverage of the sample was not representative, and so the sample was also stratified by population density. For Scotland, the sample was not representative, but very few or no samples were available for some of the population density strata and this was deemed to be inadequate to allow for stratification to be carried out. In Northern Ireland, the samples included all local authorities, and so full coverage by population density was included in the sample and no stratification was required.
- Deprivation level: in England the coverage of the sample was broadly representative, and it was deemed too complex to include stratification by deprivation, as well as the two above mentioned factors. For Scotland, the sample was not representative, but very few or no samples were available for some of the deprivation level strata and this was deemed to be inadequate to allow for stratification to be carried out. In Northern Ireland, the samples included all local authorities, and so full coverage by deprivation level was included in the sample and no stratification was required.

Incidentally, for the national composition estimates a similar analysis was carried out (correlation matrix investigating how different factors affect the arisings of different types of material in kerbside residual plus recycling), which led to a set of decisions on calculations used in that analysis that are consistent or analogous with those set out above. Please refer to *National Household Waste Composition 2017, Eunomia on behalf of WRAP, 2019*[29] for further information.

---

[29] WRAP website link required

Unlike previous studies, there was no statistically significant difference in percentage food waste in kerbside residual by quarter.

Figure 9: Distribution of percentage of residual stream that is food waste from sample studies
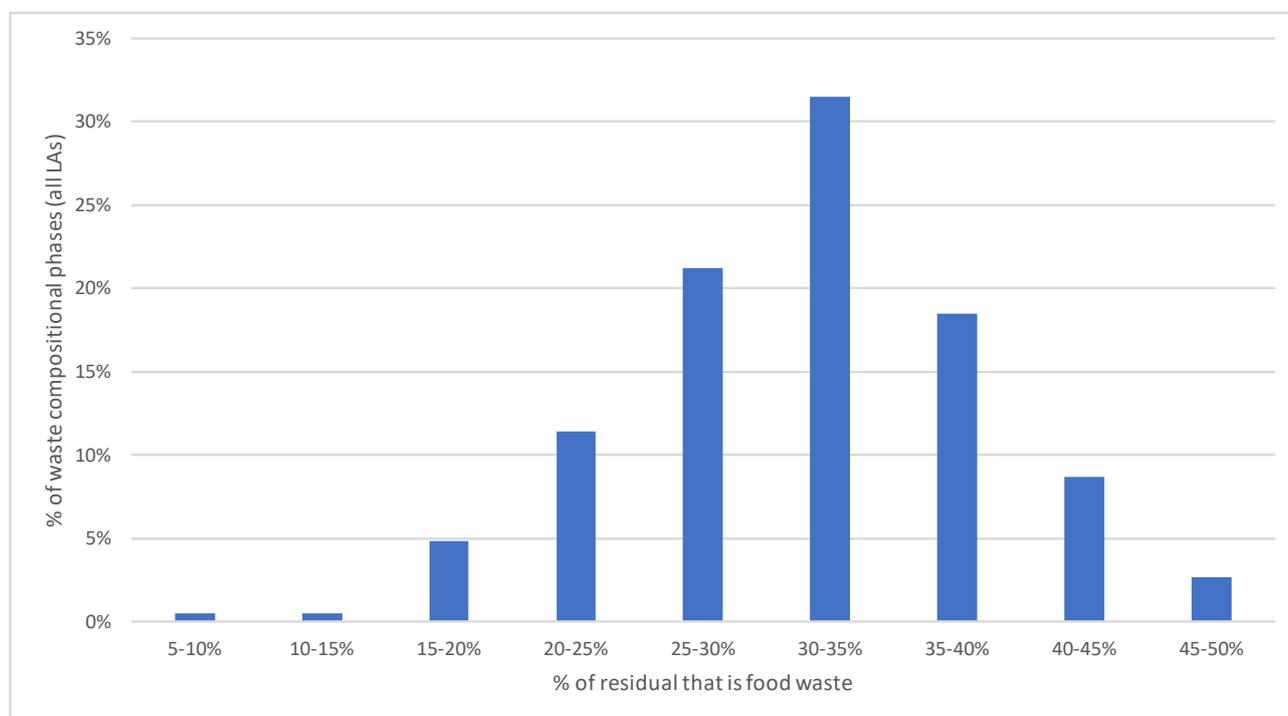
A.2.1.1 Contractor Effect

Another independent variable was explored in the regression modelling, relating to whether there were differences between contractors regarding the percentage of food waste arisings found in their WCAs. In the 2015 report, statistically significant differences were found between two groups of contractors in the regression modelling. In this study, however, no significant difference was found between contractors, with the possible exception of the contractor that had carried out studies solely in Northern Ireland. As this was not an independent variable, it is difficult to determine whether the effect was due to the nation or due to the contractor. Due to this uncertainty, it has not been accounted for quantitatively in the modelling.

It was thought previously that the difference could stem from the use of a subcategory within food waste of 'packaged food' – i.e. that a small element of packaging was being included in the percentage of food waste and increasing the estimate. However, it was found that this was unlikely to be the explanation – controlling for the inclusion of a 'packaged food' subcategory in the regression model did not eliminate the effect relating to the contractors.

It is possible that any contractor effect relates to differences in methodological approach. During the previous study, several discussions with the main contractors who contributed were carried out. However, these conversations did not yield evidence for any methodological differences that would impact on the findings of the study. It is interesting to note, however, that the differences found previously no longer seem to be present.

The above discussion underlines the importance of waste compositional analyses being performed using consistent methodologies. Zero Waste Scotland previously published some useful guidance aimed at achieving a higher level of consistency in waste composition methodologies[30].

A.2.2   Regression Results: Total Food Waste Arisings at the Kerbside (kg/hh/yr)

This section presents the results and discussion regarding the regression models of the second dependent variable, relating to the alternative method.

The results for the inclusive model are as shown in Table 22. The R^2 for this model is 0.422, which means that 42.2% of the variation within the dependent variable has been accounted for. As expected, this again only accounts for a relatively small proportion of variation between LAs.

There is a strong, statistically significant correlation between the dependent variable and number of households, population density, residual waste collection type, contractor and study year. As this is an exploratory analysis and the alternative method has not been used in the main body of the report for Wales, Northern Ireland and England, weighting and stratification have not been considered for these nations. As the alternative method has been used for Scotland, it was necessary to look at the coverage of these factors. Following the coverage assessment, it was indicated that stratification by deprivation would be preferable for Scotland as the sample was not representative; but very few or no samples were available for some the deprivation level strata and the data was deemed to be inadequate to allow for stratification to be carried out (see also appendix A.2.1).

---

[30] Guidance on the Methodology for Waste Composition Analysis, Zero Waste Scotland, 2015

Table 22: Inclusive regression model for total kerbside food waste arisings

	Estimate	Significance	95% CI lower bound	95% CI upper bound
(Intercept)	171.3295	<0.0005	144.9496	197.7094
Deprivation	129.7618	0.0015	50.2528	209.2708
Population density	0.0068	<0.0005	0.0037	0.0099
Fortnightly	-14.8353	0.0501	-29.6796	0.0090
FW targeted	-8.0444	0.1644	-19.4183	3.3294
2017	-23.0275	<0.0005	-34.8469	-11.2081
2018	-30.2170	0.0106	-53.3080	-7.1260
Quarter 2	-9.5018	0.1925	-23.8401	4.8365
Quarter 3	-1.2047	0.8279	-12.1276	9.7182
Quarter 4	8.1808	0.2734	-6.5188	22.8804

Overall, the regression model provides justification for the stratification approach adopted for the 'standard' method (§2.4), particularly in relation to the decision to only stratify the sample by whether or not food waste was targeted at the kerbside for treatment and weighting by population density.

WRAP's vision is a world in which resources are used sustainably.

Our mission is to accelerate the move to a sustainable resource-efficient economy through re-inventing how we design, produce and sell products; re-thinking how we use and consume products; and re-defining what is possible through re-use and recycling.

Find out more at **www.wrap.org.uk**

WRAP

wrap.org.uk
@WRAP_UK