Journal of Cleaner Production 379 (2022) 134636

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Household food waste disposal behaviour is driven by perceived personal benefits, recycling habits and ability to compost

Trang Thi Thu Nguyen [a,b,*], Lenka Malek [a], Wendy J. Umberger [a,b], Patrick J. O'Connor [a]

[a] Centre for Global Food and Resources, School of Economics and Public Policy, The University of Adelaide, 10 Pulteney St, Adelaide, South Australia, 5005, Australia
[b] Fight Food Waste Cooperative Research Centre, Wine Innovation Central Building Level 1, Waite Campus, Urrbrae, South Australia, 5064, Australia

ARTICLE INFO

Handling Editor: Kathleen Aviso

Keywords:
Proportional data
Fmlogit
Organic waste diversion
Home composting
Kerbside collection
Food waste hierarchy

ABSTRACT

Households are responsible for a large proportion of total food waste and are an important focal point for addressing food waste disposal issues. Determinants of household food waste minimisation behaviour have been previously explored; however, little is known about the determinants of household food waste disposal behaviour. Several food waste disposal options are available to households, depending on context, with some disposal practices being more sustainable than others. This study applies the food waste hierarchy to household food waste disposal behaviour and identifies three sustainable food waste disposal behaviours (sorting food waste into the green organics bin, reusing food waste for animal feed, and home composting); and three unsustainable behaviours (disposing of food waste in the general waste bin, the recycling bin, and/or the sink). Using data from a survey of 1027 respondents, a fractional multinomial logit model is used to analyse the associations between explanatory variables and sustainable versus unsustainable household food waste disposal behaviour. Having a kitchen caddy is associated with increased sustainable food waste disposal behaviour (higher proportion of food waste diverted to the green bin and composted). Key factors that drive households' use of kerbside green organics bins are perceived personal costs and benefits, and recycling habits. Importantly, environmental self-identity is positively associated with home composting practices. Factors associated with a higher proportion of food waste disposed of in the general waste bin (unsustainable behaviour) include stronger perceived inconvenience of using the green bin, living in a unit, and having a higher household income. Findings from this study can provide insight into interventions to promote more sustainable household food waste disposal practices.

1. Introduction

One-third of food produced globally is either lost or wasted along the supply chain (FAO, 2011), including at the household level. Households are responsible for a substantial proportion of food waste (FW), especially in developed countries (Parfitt et al., 2010). For example, in Australia, 32% of FW generated each year is from households, and 73% (or 1.8 million tons) of this is sent to landfill (Van Biene et al., 2021), adding environmental impacts including through increased greenhouse gas emissions (FAO, 2014).

Minimising household FW receives considerable attention due to the significant economic, social, and environmental costs imposed on current and future generations. However, sending FW to landfill also contributes to these costs. FW minimisation strategies that aim to reduce FW can lower the economic loss for households and the adverse social and environmental effects (Parizeau et al., 2015; Quested et al., 2013). However, even with minimisation strategies, some FW disposal remains to be managed (Ladele et al., 2021).

There is a growing literature on the determinants of household FW generation (Boulet et al., 2021; Roodhuyzen et al., 2017; Schanes et al., 2018), providing understanding of food wasting or minimising behaviour for behavioural change interventions aiming to reduce household FW (Aschemann-Witzel et al., 2019; Borg et al., 2022). However, less is known about the determinants of household FW disposal behaviour (Ladele et al., 2021; Wu et al., 2019). Generally, several FW disposal options are available to households. Some disposal practices are more environmentally, socially, and economically sustainable than others. However, no known previous research has examined behaviour with

Abbreviations: FW, food waste.

* Corresponding author. Centre for Global Food and Resources, School of Economics and Public Policy, The University of Adelaide, 10 Pulteney St, Adelaide, South Australia, 5005, Australia.
E-mail address: trang.nguyen@adelaide.edu.au (T.T.T. Nguyen).

https://doi.org/10.1016/j.jclepro.2022.134636
Received 16 June 2022; Received in revised form 6 October 2022; Accepted 7 October 2022
Available online 18 October 2022

respect to the range of possible disposal options available to households. Such an analysis can provide practical knowledge on factors that can promote sustainable household FW disposal practices, therefore, reducing the volume of FW sent to landfill.

The present study aims to increase understanding of where households dispose of their FW, and what factors are associated with 'sustainable' FW disposal behaviour (i.e. diverting household FW from landfill). A survey of 1030 households in Adelaide, South Australia (SA), was designed to ascertain participating households' FW disposal behaviour and to understand the factors that may help explain sustainable household FW disposal behaviour. The FW hierarchy was used to identify households which exhibited 'sustainable' FW disposal behaviour (i.e. sorting into the green organics bin,[1] reusing FW for animal feed,[2] and home composting/worm farming[3]); and 'unsustainable' FW disposal behaviours (i.e. discarding into the general waste bin,[4] the recycling bin,[5] or sink/others) (Papargyropoulou et al., 2014).

Adelaide, SA provides a unique context for studying sustainable FW disposal behaviour because all households in Adelaide have access to at least one sustainable disposal option – organic kerbside collection has been available to all households in the study area since 2011 (Zero Waste, 2015).

2. Conceptual framework and hypotheses

2.1. The FW hierarchy for household FW

The FW hierarchy (Fig. 1) considers the three dimensions of sustainability (environmental, economic, and social), and offers a holistic approach to addressing FW (Papargyropoulou et al., 2014). Prevention of avoidable household FW is considered to be the most preferred option. The second-most preferred option includes the distribution of surplus food, that is nutritious and safe for human consumption, to groups affected by poverty; otherwise, it can be fed to animals. The third group of solutions presents several options for recycling such as anaerobic digestion and composting, etc. The least preferred and least sustainable option is disposing of FW in landfill.

We apply the FW hierarchy framework to household FW at the point of disposal. At this point, prevention solutions are exhausted and food surplus becomes FW that needs to be disposed of sustainably, meaning away from landfill. The sustainable FW disposal options for household FW that are recommended by the hierarchy include animal feed, and nutrient recovery (e.g. anaerobic digestion, composting, land application). Thus, in the present study, 'sustainable' household FW behaviours include reusing FW to feed animals, recycling FW via home composting/worm farming, and sorting FW into the green bin. Meanwhile, 'unsustainable' household FW behaviour includes discarding FW into the rubbish bin, recycling bin, and the sink and others.

2.2. Predictors of sustainable FW behaviour

There is not yet a model that explains household food waste disposal behaviour. Based on a comprehensive review of relevant literature, the following factors were considered to influence households' sustainable FW behaviours: psychological factors, behavioural and situational factors, and socio-demographic and household characteristics. These factors were investigated as determinants of FW disposal behaviour in the present study, with hypotheses formulated based on relevant literature, and presented in the following sections.

2.2.1. Psychological factors

Food waste minimisation behaviour can be influenced by various psychological factors, including attitudes, perceptions, and emotions (Russell et al., 2017; Schanes et al., 2018). For example, FW reduction is more likely among individuals who believe it is 'wrong or bad' to waste food (Visschers et al., 2016), and who feel 'guilty' when throwing food away (Quested et al., 2013). Individuals who feel 'obliged' to not waste food or think that minimising FW is doing 'the right thing' are also more likely to reduce FW (Graham-Rowe et al., 2014).

Similarly, sorting FW is more likely among individuals who feel a personal responsibility to do so (Knickmeyer, 2020). This suggests that certain types of intangible personal benefits can motivate households to engage in pro-environmental behaviours such as sorting FW. Further, Lusk and Ellison (2017) suggest that FW disposal decisions, like any other decisions, should be viewed in terms of costs and benefits. Therefore, we hypothesise ***H1:*** *Households that perceive personal benefits from sorting FW into the green bin are more likely to perform sustainable FW disposal behaviours and are less likely to perform unsustainable FW disposal behaviours.*

In contrast, inconvenience is a personal cost often associated with sorting waste and has been shown to significantly drive household recycling behaviour. 'Inconvenience' often refers to aspects related to sorting and storing FW, such as the time and effort needed (Barr et al., 2003; Miafodzyeva and Brandt, 2013); uncleanliness; insufficient storage space; and the accessibility and ease of use of a recycling system (Lee et al., 2017; Zhang et al., 2016). Based on this, we hypothesise ***H2:*** *Households that perceive a higher degree of inconvenience and the sense that sorting FW is out of their personal control are less likely to perform sustainable FW disposal behaviours and more likely to perform unsustainable FW disposal behaviours.*

Environmental concerns have often been ranked behind other household concerns when it comes to minimising FW (Neff et al., 2015; Quested et al., 2013). Studies report mixed findings regarding associations between environmental concerns and FW generation (Chen, 2019; Diaz-Ruiz et al., 2018; Elimelech et al., 2019). Overall, environmental self-identity has been found to be a better predictor of pro-environmental behaviours than environmental concerns (Whitmarsh and O'Neill, 2010). For example, people who perceived themselves as recyclers, were more likely to recycle (Mannetti et al., 2004). Therefore, we included environmental self-identity as an indicator of environmental attitudes, rather than an environmental concern score. To our knowledge, ours is the first study to include environmental self-identity as a predictor in a model explaining food waste behaviour. We hypothesise ***H3:*** *Households that have a higher environmental self-identity score are more likely to perform sustainable FW disposal behaviours and less likely to perform unsustainable FW disposal behaviours.*

2.2.2. Waste recycling habits and situational factors

Waste sorting behaviour differs from waste minimisation and is more similar to general recycling behaviour. When households recycle one material, they may also recycle other materials as they have the habits of recycling and the learning curve is relatively small for them (Tonglet et al., 2004). Thus, we hypothesise ***H4:*** *Households with the habits of recycling non-organic materials (i.e. glass, cardboard, rigid plastics) are more likely to perform sustainable FW disposal behaviours and less likely to perform unsustainable FW disposal behaviours.*

Existing literature emphasises that access to the necessary equipment and infrastructure is an essential factor for sorting FW (e.g. having a dedicated FW collection kit installed in the household's kitchen (Bernstad, 2014)). Moreover, it can trigger recycling behaviour even if

[1] The green-lid bin that is used to collect food organics and garden organics (FOGO) waste by kerbside collection. Hereafter using the 'green bin' interchangeably.

[2] These include feeding to pets, other animals that are raised by households such as chicken, and wild animals such as birds.

[3] Composting that takes place autonomously at households. This includes compost bin or worm farm.

[4] The bin that is used to collect rubbish that cannot be recycled by kerbside collection. They are red-lid or blue-lid bins depend on different local governments. Here after using with the 'rubbish bin' interchangeably.

[5] The yellow-lid bin that is used to collect recyclable non-organic materials.

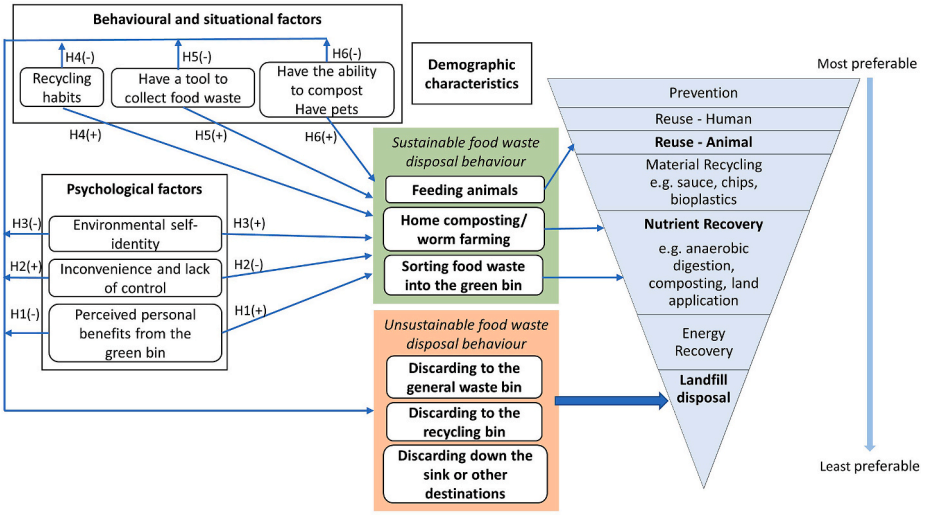

Fig. 1. Conceptual framework and hypotheses (H1 – H6).

households don't have pro-recycling attitudes (Bernstad et al., 2013). We, therefore, hypothesise ***H5:*** *Households with a tool to collect FW in the kitchen (e.g. kitchen caddy) are more likely to perform sustainable FW disposal behaviours and are less likely to perform unsustainable FW disposal behaviours.*

Situational factors are also critical predictors of pro-environmental behaviour (Knickmeyer, 2020; Li et al., 2019). Thus, we hypothesise ***H6:*** *Households with the required conditions (i.e. can make and use compost or have pets) to engage in sustainable practices (e.g. home composting and animal feed) are more likely to perform sustainable FW disposal behaviours and less likely to perform unsustainable FW disposal behaviours.*

2.2.3. Socio-demographic and household characteristics

Several socio-demographic characteristics were included in our model to explain households' FW disposal behaviour. The following characteristics were included in the analyses based on previous research showing associations with FW behaviour: gender (Koivupuro et al., 2012), age (Karunasena et al., 2021), education level (Qi and Roe, 2016), household size (Ananda et al., 2021) household income, housing type, and presence of children in the household (Aschemann-Witzel et al., 2019).

3. Material and methods

3.1. Participants

A cross-sectional online survey of households in metropolitan Adelaide, SA, was conducted during April and May 2021 to understand subjective household behaviour and attitudes towards FW and various food-related issues. Participants were eligible if they were aged 18 years or over and lived in metropolitan Adelaide. A market research company (PureProfile) programmed and administered the survey. Quotas were set for gender and age to obtain a sample that closely matched the gender and age distribution of the general Australian population. Ethics approval for the study was provided by the University of Adelaide Human Research Ethics Committee (H-2020-242).

3.2. Questionnaire

The questionnaire obtained measures of participants' household FW volume and disposal methods. It also assessed topics including concerns, attitudes, and beliefs regarding FW; food purchase, consumption, and storage behaviours; and socio-demographic and household characteristics.

3.2.1. Measuring household FW behaviour

The survey instrument was designed to assess household FW behaviour after conducting a thorough review of the relevant literature and gaining insight on household behaviour through four focus group discussions. Survey instruments designed to have respondents 'self-report' either their individual or their household FW are the most common method for collecting data on household FW and behavioural drivers of waste disposal (Ponis et al., 2017; van der Werf et al., 2020). Although self-reported measures of household FW may under-estimate the actual level of FW (Hebrok and Boks, 2017) – e.g. due to inaccurate recall (Xue et al., 2017) – this method was determined to be suitable for our study due to the relatively low respondent burden (van Herpen et al., 2019). The method allowed understanding of the use of both sustainable and unsustainable FW behaviour among a large sample of households, and incorporation of behavioural determinants such as household routines, beliefs, and attitudes, which have been found to be important factors influencing FW behaviours (Boulet et al., 2021; Elimelech et al., 2018; Roodhuyzen et al., 2017). Direct measurements (e.g. physical waste surveys) are not conducive for combining with behavioural determinants with such a large sample (Elimelech et al., 2018).

To manage some of the limitations of self-reported FW behaviour, we incorporated several key features into the design of the questionnaire. Throughout the survey, we provided access to a definition of FW. Respondents were shown lists of eleven types of solid FW and three types of liquid waste (Appendix 1). They were asked to indicate (by selecting 'yes' or 'no') whether their household produced each type of FW and the total volume of FW that was produced by their household in a typical week. Photos of measurement units (Fig. S2) and illustrations of different volumes (Fig. S1) were shown in the online survey to assist respondents in determining FW volume. Measurement unit options (i.e. a 7-L kitchen caddy and a 4-L ice-cream container for solid FW; a 1-L bottle for liquid waste) were provided to allow respondents to choose their preferred way of quantifying the volume of FW produced. After specifying their total volume of household FW, respondents were asked to report how they disposed of FW by using a pie graph to indicate the percent (proportion) of their household FW that was sorted or discarded into different destinations. The destinations included 1) general waste bin, 2) green organics bin, 3) recycling bin, 4) compost/worm farm, 5) feeding animals, and 6) sink and others. These proportions summed to 100% which is the total FW amount that households reported producing during a typical week. The question design was informed by similar weighting questions in survey based studies by Malek and Umberger (2021).

Feedback was collected from 26 participants in four focus groups and

100 respondents in an online pilot test and used to improve the design of the questionnaire. For example, the survey asked respondents to indicate the percentage of their total FW volume that was sent to each destination because focus group participants suggested that percentages were easier for them to self-report.

3.2.2. Attitudes, perceptions, and emotions towards sustainable FW disposal behaviour

In the absence of a universally accepted scale for measuring attitudes, perceptions and emotions related to sustainable FW disposal behaviour, eight items or statements from the existing literature were included in the survey (Graham-Rowe et al., 2014; Russell et al., 2017). Respondents were asked to indicate using a 7-point Likert scale (where 1 = strongly disagree and 7 = strongly agree) the extent they agreed with statements related to what influenced them or would influence them to put FW into the green organics bin (Table 2).

3.2.3. Environmental self-identity

Respondents' environmental self-identity was assessed on a 7-point Likert scale (where 1 = strongly disagree and 7 = strongly agree) using three items drawn from Whitmarsh and O'Neill (2010): 'Acting environmentally friendly is an important part of who I am', 'I am the type of person who acts in an environmentally friendly way', and 'I see myself as an environmentally friendly person'.

3.2.4. Recycling habits

To assess recycling habits, respondents were asked to indicate using a 7-point Likert scale how frequently (never' = 1 to 'always' = 7) they perform the following three behaviours: 1) sort and recycle glass bottles, 2) sort and recycle paper/cardboard, and 3) sort and recycle rigid plastic packaging (e.g. milk bottles, yoghurt containers, fruit punnets).

3.3. Data analyses

Data analysis consisted of two key steps. First, an exploratory factor analysis was used to reduce a pool of eight attitudinal items, into two factors: 'Personal benefits' (3 items) and 'Inconvenience and lack of control' (5 items; Table 2). The results of the factor analysis are shown in Table S1. Reliability analysis was applied to these two newly formed constructs and two other constructs drawn from previous studies, including 'Environmental self-identity' and 'Recycling habits' to assess the internal consistency of each construct. The Cronbach's alpha values for these variables ranged from 0.68 to 0.93 (Table 2), indicating reasonable to excellent internal consistency (Taber, 2018). Average scores were calculated for each of the four constructs (Table 2). We tested for multicollinearity of all explanatory variables by calculating the variance inflation factor (VIF). All VIF values were below 2, indicating no multicollinearity in the model.

Table 2
Summary statistics of key independent variables (n = 1030).

Items per index variables	Mean (SD)	Min	Max
Perceived personal benefits of sorting FW to the green bin (Cronbach's α = 0.68)	*5.36 (1.13)*	*1*	*7*
Putting FW into the green bin is the right thing to do			
I feel good when I sort and dispose of FW correctly into the green bin			
By using the green bin for FW, my rubbish bin stays cleaner and does not need to be taken out as frequently			
Inconvenience and lack of control in using the green bin (Cronbach's α = 0.82)	*3.40 (1.37)*	*1*	*7*
I do not have sufficient information regarding FW going into the green bin			
It is expensive to buy supplies (e.g. compostable bags, kitchen caddy, etc.) to sort into the green bin			
I do not want to deal with the smell and the mess of food when sorting FW			
It takes too much time and effort to sort FW into the green bin			
I have no control over FW as other people in the house are the ones disposing FW			
Environmental self-identity (Cronbach's α = 0.93)	*5.25 (1.17)*	*1*	*7*
Acting environmentally friendly is an important part of who I am			
I am the type of person who acts in an environmentally friendly way			
I see myself as an environmentally friendly person			
Recycling habit (Cronbach's α = 0.81)	*6.20 (1.11)*	*1*	*7*
Sort and recycle glass bottles			
Sort and recycle paper/cardboard			
Sort and recycle rigid plastic packaging (e.g. milk bottles)			

Note: All items were assessed on 7-point Likert scales; higher values correspond to stronger agreement with the statement or higher frequency of recycling habit. FW=Food waste.

Step 2 involved estimation of a fractional multinomial logit (fmlogit) model using the Stata fmlogit package developed by Buis (2008). It is a multivariate generalisation of the fractional logit model following Papke and Wooldridge (1996). The fmlogit model is estimated by maximising the log-likelihood function of a regular multinomial logit using the proportions as dependent variables and using robust standard errors, which can measure shares of outcomes or multiple proportions (Mullahy, 2015). It models a set of dependent variables that each must range between 0 and 1 and must always add up to 1 for each observation (Buis, 2008).

In the present study, our model aims to understand the relationship between attitudinal, behavioural, and contextual factors and the

Table 1
Summary statistics of socio-demographic and household characteristics (n = 1030).

Variable	Definition	Mean (SD)	Min	Max
Women	1 = Women; 0 = Otherwise	0.50 (0.50)	0	1
Age	Years old	46.45 (16.95)	18	92
University educated	1 = University education; 0 = Otherwise	0.36 (0.48)	0	1
Household income[a]	Thousands of AUD per year	85.23 (52.53)	12.25	222.30
Share of life in Australia	Number of years living in Australia over age (years)	0.52 (0.32)	0.03	1
Live in a unit	1 = Yes; 0 = No	0.13 (0.34)	0	1
Household residents	Number of residents living in the household	2.79 (1.31)	1	10
Have children younger than five years old	1 = Yes; 0 = No	0.13 (0.33)	0	1
Have a kitchen caddy	1 = Yes; 0 = No	0.56 (0.50)	0	1
Ability to compost	1 = Have the ability to make compost, and use the compost generated; 0 = Otherwise	0.57 (0.49)	0	1
Have pets	1 = Yes; 0 = No	0.65 (0.48)	0	1

Note.
[a] Household income is a semi-continuous variable.

proportion of FW sorted to sustainable and unsustainable destinations. The proportional values indicating the percent of household FW disposed of in the six destinations sum to 1 and are the six dependent variables used in the analysis (Table 3). The values are negatively correlated and range between 0 and 1 inclusively, and thus, meet the requirements for an fmlogit model. Robust standard errors were used in the model estimation to, in-part, control for heteroskedasticity (Papke and Wooldridge, 1996).

4. Results and discussion

4.1. Respondent characteristics and their FW disposal practices

A total of 1030 respondents completed the survey. Socio-demographic and household characteristics of participants are shown in Table 1. On average, 50% of the respondents were female, the average age was 47 years, and 36% were university-educated. Seventy-eight per cent of respondents were born in Australia. Almost two-thirds of households had at least one pet (65%). Overall, the gender, age distribution and tertiary education attainment of the study sample matched that of the general Australian adult population, within 5% (Australian Bureau of Statistic, 2021).

Three households reported having no solid FW, therefore, 1027 observations were included in further analyses. Table 3 shows the average proportion of total FW disposed of in each destination for all included households. The largest proportion of FW was disposed of in the rubbish bin (36%), followed by the green bin (32%), the recycling bin (12%), the compost bin (10%), animal feed (6%), and sink and others (4%). Our findings are consistent with Reynolds et al. (2014)'s estimate that Australian households dispose of 20% of their FW through informal routes, including home composting, feeding to pets and sewer disposal. This also highlights the substantial amount of FW that cannot be captured through auditing of formal waste management systems (i.e. kerbside waste collection) (Reynolds et al., 2014).

4.2. Factors associated with 'sustainable' FW disposal behaviour

The following sections summarise and discuss the key results of the fmlogit analysis. The average marginal effects from the fmlogit model estimation are presented in Table 4.

4.2.1. Psychological factors

4.2.1.1. Perceived personal benefits. As shown in Table 4, each one-point increase in perceived personal benefit score is associated with a 7.2% increase in the share of FW sorted sustainably into the green bin and a 5.5% reduction in the share of FW disposed of unsustainably in the rubbish bin. These results partially support ***H1***.

Interestingly, our findings show that perceiving personal benefits from use of the green bin is associated with a 2.0% lower share of FW sorted into home compost/worm farm, which is also a sustainable disposal option. This is consistent with previous studies which found residents prefer to use the green bin over a backyard composter (Ladele et al., 2021; Tucker et al., 2003). Wonneck and Hobson (2017) found home composting decreased when kerbside green organics bins were introduced to households. As home composting requires knowledge about composting, space and a use (e.g. garden) for the output (Edgerton et al., 2009), these findings suggest that the green bin may be the option requiring less effort to do 'the right thing'.

Two of the three statements in the 'personal benefits' index variable relate to intangible benefits, i.e. feeling good and feeling morally right when sorting FW correctly. Therefore, information campaigns that trigger positive emotions as well as communicate the tangible benefits of disposing of food may help encourage sustainable FW disposal behaviour.

Table 3
Dependent variables, proportions of total household FW discarded in different destinations (n = 1027).

Dependent variables	Mean	SD	Min	Max
Rubbish bin	0.363	0.339	0	1
Green organics bin	0.323	0.361	0	1
Recycling bin	0.115	0.169	0	1
Home composting	0.101	0.238	0	1
Animal feed	0.059	0.144	0	1
Sink and other	0.039	0.082	0	0.7

4.2.1.2. Perceived inconvenience and lack of personal control. Perceived inconvenience and lack of personal control scores are negatively associated with two of the sustainable behaviours (i.e. green bin and home composting) and positively associated with all three unsustainable behaviours. Thus, these findings support our hypothesis, ***H2***. Specifically, each one-point increase in perception score, indicating a stronger belief that sorting FW is inconvenient and out of personal control, is associated with a 6.8% lower proportion of FW sorted into the green bin and a 1.5% lower proportion of FW composted at home. In contrast, each one-point increase in perception score is associated with 6.3%, 0.8% and 0.9% higher proportion of FW disposed of unsustainably through the rubbish bin, recycling bin, and sink and others, respectively.

Our inconvenience factor reflects perceptions including insufficient information about what can go in the green bin, the cost of buying equipment and supplies (e.g. kitchen caddy and liners) for sorting and storing of FW, and the time and effort required to sort and store FW. This suggests that households face several potential barriers when sorting FW. First, households may have insufficient information regarding appropriate/sustainable disposal destinations for different types of waste, which is often a barrier to recycling (Knickmeyer, 2020) and composting (Wu et al. (2019). Similar to recyclable materials that are often categorised as 'trash' after being used and distorted (e.g. paper after it has been cut, torn, or crumpled) (Trudel et al., 2015), rotten FW can be perceived as trash that cannot be reused or recycled and may therefore go directly to the rubbish bin. Second, studies have shown hygiene issues are barriers to household participation in kerbside recycling programs (Lee et al., 2017). For example, due to the degradable nature of FW, storing FW can create undesirable odours and can be untidy. Third, the time and effort needed for sorting FW is a barrier to engaging in sustainable disposal behaviour, with Wu et al. (2019) also finding that time pressure is one of the main reasons why individuals fail to use their green kerbside composting carts. Lastly, cost of necessary equipment can be a barrier. Previous studies have found that financial factors (e.g. saving money) are often ranked above altruistic motivations (e.g. environmental and social concerns) as determinants of FW minimisation (Quested et al., 2013). Structural modifications and provision of subsidised or free products such as kitchen pails and composting resources have been identified as possible strategies to address financial concerns of households regarding sorting FW (Boonrod et al., 2015; Sewak et al., 2021). Thus, different incentives from local governments (e.g. council rate discounts) for households to sort their FW correctly, could potentially result in more FW sorted sustainably; and could be investigated in future research.

Additionally, our findings suggest that interventions that reduce the time and effort required by households to sort FW sustainably and that address households' knowledge and information gaps are important. As for the lack of knowledge about FW sorting, specific and tailored information provision programs, rather than those that raise general awareness, are important for addressing behavioural change (Bernstad et al., 2013; Roe et al., 2022). Miafodzyeva and Brandt (2013) suggested that increasing awareness and knowledge about 'concrete' information (e.g. how and what to recycle) is more effective at influencing recycling behaviour than increasing 'abstract' knowledge (e.g. measures of general recycling information).

Table 4
Average marginal effects for fractional multinomial logit modelling of household FW disposal (n = 1027).

Variable	Sustainable FW behaviours						Unsustainable FW behaviours					
	Green bin		Compost		Animal feed		General waste bin		Recycling bin		Sink and other	
Perceive benefits from sorting FW	0.072***	(0.009)	−0.020***	(0.006)	−0.003	(0.004)	−0.055***	(0.009)	0.003	(0.005)	0.003	(0.004)
Perceive sorting FW as inconvenient and out of personal control	−0.068***	(0.007)	−0.015***	(0.005)	0.004	(0.003)	0.063***	(0.006)	0.008*	(0.004)	0.009***	(0.002)
Environmental self-identity	−0.042***	(0.010)	0.031***	(0.007)	0.005	(0.005)	0.002	(0.009)	0.003	(0.006)	0.002	(0.002)
Have a kitchen caddy	0.164***	(0.021)	0.032**	(0.015)	0.016	(0.010)	−0.200***	(0.020)	−0.007	(0.011)	−0.005	(0.005)
Recycling habit	0.027***	(0.010)	0.000	(0.008)	−0.002	(0.004)	−0.005	(0.009)	−0.015**	(0.006)	−0.006***	(0.002)
Have the ability to compost	−0.136***	(0.019)	0.146***	(0.011)	0.029***	(0.008)	−0.034**	(0.017)	−0.013	(0.011)	0.009	(0.005)
Have pets	−0.011	(0.020)	0.001	(0.015)	0.068***	(0.007)	−0.054***	(0.019)	−0.007	(0.012)	0.002	(0.006)
Female	−0.016	(0.018)	−0.012	(0.013)	0.014	(0.009)	0.016	(0.017)	−0.006	(0.011)	0.003	(0.005)
Age	0.000	(0.001)	0.002***	(0.000)	0.001**	(0.000)	−0.002***	(0.001)	0.000	(0.000)	−0.001***	(0.000)
University educated	0.043**	(0.020)	0.007	(0.015)	0.001	(0.010)	−0.022	(0.019)	−0.021*	(0.013)	−0.008	(0.005)
Share life in Australia	0.038	(0.038)	0.068**	(0.027)	0.045**	(0.018)	−0.074**	(0.033)	−0.063***	(0.018)	−0.014	(0.009)
Household size	−0.010	(0.008)	0.013**	(0.005)	0.003	(0.003)	−0.009	(0.007)	0.002	(0.004)	0.000	(0.002)
Live in a unit	−0.083***	(0.027)	0.010	(0.021)	−0.001	(0.011)	0.054**	(0.025)	0.004	(0.015)	0.016*	(0.008)
Have a child younger than five years old	0.019	(0.029)	−0.037**	(0.018)	0.021	(0.015)	−0.005	(0.023)	−0.001	(0.017)	0.003	(0.007)
Household income	3.7E-08	(1.8E-07)	−2.3E-07	(1.5E-07)	−5.9E-08	(9.4E-08)	4.4E-07***	(1.7E-07)	−1.7E-07	(1.2E-07)	−1.7E-08	(4.9E-08)
Number of observations	1027											
Wald χ^2	1028.09											
Log pseudolikelihood	−1295.56											
Prob > χ^2	0.000											

Note: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1; Robust standard errors in brackets; FW=Food waste.

4.2.1.3. Environmental self-identity. Environmental self-identity is significantly and positively associated with a higher proportion of sustainable FW disposal. Each one-point increase in environmental self-identity score is associated with a 4.2% reduction in the share of household FW sorted into the green bin and a 3.1% increase in the share of household FW composted. This result partially supports ***H3***, as it appears that environmental self-identity is associated with sustainable FW disposal behaviour (specifically, home composting). Further, this finding reveals that home composting is generally preferred over the green bin when environmental self-identity is considered.

Previous empirical studies reported mixed findings about the relationship between environmental concern and FW behaviour (Chen, 2019; Diaz-Ruiz et al., 2018; Elimelech et al., 2019). Our results suggest that when environmental concerns become part of an individual's self-identity, environmentally friendly behaviours/actions may become part of an individual's lifestyle (i.e. as a means of reinforcing self-identity). Insight on the predictive value of environmental self-identity could also have some policy implications. For example, this behaviour could be strengthened by reminding individuals of their pro-environmental attitudes and by helping them understand the connection between FW and its positive avoided impact on the environment when disposed of into a sustainable waste stream (Van der Werff et al., 2014).

4.2.2. Waste-related behaviours

4.2.2.1. Recycling habits. Table 4 shows households that more frequently recycle their non-organic materials (e.g. glass, cardboard) disposed of a statistically higher proportion of their FW in the green bin (each one-point increase in recycling frequency score is associated with an additional 2.7% of household FW sorted to the green bin), and a smaller proportion to unsustainable disposal streams. The results also show that people who more frequently recycle their inorganic waste dispose of a smaller proportion of their FW to unsustainable disposal streams, specifically into their recycling bin and down the sink (each one-point increase in recycling frequency score is associated with a 1.5% and 0.6% decrease in FW sorted to the recycling bin and down the sink, respectively). These findings suggest that ***H4*** is supported.

Our results differ to those of Diaz-Ruiz et al. (2018) who did not find a significant association between non-organic recycling and FW minimisation behaviour; however, Tonglet et al. (2004) found that previous recycling experience positively influences recycling behaviour. This suggests 1) FW prevention and FW sorting are distinct behaviours, and 2) sorting recyclables and sorting FW can be related and given that the non-organic recycling stream has been around longer, insight about the successes and failures of engaging residents in non-organic recycling could potentially be applied to organic recycling.

While on average the households in our sample almost always recycle non-organic materials (Table 2), they sort less than one-half of their FW sustainably. This suggests that the sorting of FW is not yet as habitual among households as is the recycling of non-organic materials. Future studies could explore how a stronger connection between the two streams (non-organic and organic recycling) and promoting the value of FW as a recyclable material could impact FW sorting behaviour.

4.2.2.2. A tool to collect FW in the kitchen. The presence of a kitchen caddy (or a similar tool) in the kitchen was associated with a significantly higher share of household FW channelled into sustainable streams (an additional 16.4% and 3.2% of FW sorted in the green bin and compost, respectively), and a lower proportion of FW disposed of in unsustainable streams (a 20.0% reduction in FW disposed of in the rubbish bin). These findings support ***H5***. Interestingly, of all the predictor variables included in the model, the presence of a kitchen caddy was associated with the largest reduction in unsustainable sorting behaviour.

These results are in line with Bernstad (2014), who found an increase in both the source-separation ratio and the amount of separately collected FW in households that received sorting equipment. Bernstad

(2014) proposed that this outcome could be an effect of improved convenience and creation/enforcement of a social norm (i.e. the presence of a kitchen caddy gave residents the impression that all households in the area were sorting FW and it was "natural" and "normal").

Several Australian councils have been implementing the provision of a free or subsidised kit that includes a small (approximately 7 L) kitchen caddy and a roll of certified compostable bags. This kit can be collected at the council office, local library, or in a few cases, delivered to the household (GISA, 2021). Although our results show that access to this equipment can encourage a larger proportion of FW to be sorted sustainably, only 56% of surveyed respondents reported having access to a kitchen caddy (Table 1), and only 22% obtained their caddy from their council. In 2020, an estimated one in five households in metropolitan Adelaide had a kitchen caddy (GISA, 2021). This may be because most councils require residents to collect them, which can be inconvenient and may result in limited/unequal distribution to residents. Or it could be because households are not aware of the opportunity. Therefore, more work is needed to help determine how to promote and deliver the caddies to residents more effectively. This could help to scale-up this intervention, which has the potential to have a considerable impact on the FW sorting behaviour of households.

4.2.3. Situational factors

Households that have the ability to make and use compost were found to sort a significantly higher proportion of their FW into compost/worm farms (an additional 14.6%) and animal feed (an additional 2.9%), and sort a lower share of their FW into the green bin (reduction of 13.6%) and the rubbish bin (reduction of 3.4%). Further, pet ownership results in 6.8% more FW fed to animals and 5.4% less FW discarded into the rubbish bin. These findings support ***H6***.

Notably, a relatively small share of FW was recycled either by being composted or being fed to animals (10% and 6% of total FW, respectively; see Table 3) – despite these two options being ranked in the FW hierarchy as more sustainable options compared to the rubbish bin. Australians also rated home/backyard composting as the most preferred policy to divert FW from the landfill (Benyam et al., 2018). This suggests that these sustainable options may not have gained sufficient attention and that ways to increase the accessibility of these streams could be investigated further in future research. For example, Benyam et al. (2018) suggested an important factor for successful implementation of a home composting program includes understanding composting as physically easy to do and that it brings many beneficial outcomes (e.g. creation of natural fertiliser, save money from buying manufactured fertilisers).

4.2.4. Socio-demographic and household characteristics

Several socio-demographic characteristics were controlled for in the analysis, some of which were found to have a significant effect on FW sorting behaviour (Table 4). These findings can be useful in designing future interventions/information campaigns to target those individuals and households that have more FW but are less likely to engage in sustainable FW sorting and disposal practices.

Having a university degree was associated with relatively more FW sorted into the green bin. While previous research also found that more educated individuals tended to waste more food (Qi and Roe, 2016), education was positively associated with recycling behaviour in nine of 15 previous studies (Miafodzyeva and Brandt, 2013).

Living in a unit was significantly associated with less household FW sorted into the green bin and more FW disposed of in the general waste bin. Previous studies have also found that households residing in non-detached dwellings such as a unit or an apartment, are less likely to sort both organic and non-organic waste compared to households in detached dwellings (Ladele et al., 2021; Miafodzyeva and Brandt, 2013). Miafodzyeva and Brandt (2013) suggested that a possible reason for this may be the lack of space available for waste sorting equipment (e.g. bins, kitchen caddies). Knickmeyer (2020) provided a thorough review of the primary social factors influencing waste sorting behaviour and concluded that waste management systems should be tailored to meet the needs of households living in different types of buildings in urban and high-density areas.

Home composting was positively associated with age, a higher proportion of life lived in Australia, and household size, and negatively associated with having a child younger than five years old. Our findings are consistent with Wu et al. (2019) who reported that older people are more likely to use home composting while young adults did not use composting carts due to perceived lack of time. This may be explained as older people having low inconvenience costs while young people tend to incur high inconvenience costs (Lee et al., 2017).

Higher income households were shown to sort a higher proportion of their FW into the general waste bin. This is concerning as other studies have reported a positive relationship between FW volume and levels of affluence (Aschemann-Witzel et al., 2019). Therefore, managing FW may become a greater issue as the affluence of households in developing economies increases.

4.3. Research implications

The results are applicable to countries or jurisdictions where it is more economical to collect food organic waste than it is to send it to landfill. This means the proportion of FW in the residential general waste bin is relatively high and the costs of landfilling become significant and unsustainable compared to collecting, transferring and recycling the FW (Pearce, 1976). For example, countries or cities where FW is reported to comprise approximately one-half of municipal solid waste include Denmark (Edjabou et al., 2016); Israel (Elimelech et al., 2018); Shanghai, China (Wang et al., 2021).

The results are also applicable to waste management systems where other organic materials (e.g. biodegradable food packaging, coffee cups and cutlery) can be added into the organic stream. For example, many countries have banned or have pledged to ban single-use plastic in the near future, leading to increased production of biodegradable packaging materials (Dey et al., 2021; Rankin, 2019). This volume of compostable products can increase the need for an organic waste collection system.

South Australia provides an interesting example of a developed economy that provides its urban residents with access and the necessary infrastructure to improve their sustainable disposal behaviour. Our results suggest that when an organic management system is in place and available for all residents, more than one-half of household FW is still disposed of in the general waste bin. This is a message for countries that plan to implement an organic waste collection system to pay attention to promoting households' personal benefits and environmental impacts from the start when launching a new system.

4.4. Study strengths, limitations, and future research

To our knowledge, this is the first study to analyse how households use multiple FW disposal streams and the factors associated with sustainable disposal behaviours. Our study setting provided a unique context where all households had access to at least one sustainable disposal stream – the green organics bin which is part of the kerbside waste disposal system.

When interpreting the findings, it is important to take into consideration that the beliefs and attitudes reported are associated with the respondent alone, while the FW behaviour is associated with the collective household. Thus, the beliefs and attitudes of the surveyed respondents may differ from other household members and may not be consistent with the reported sorting behaviour of the household as a whole. Further, the study was conducted in metropolitan suburbs where all residents had access to a green organics bin and kerbside collection. The green waste collection system in our study area allowed disposal of both FW and organic garden waste; however, this disposal option may be different in other areas (e.g. other Australian local governments may

only accept garden waste in the kerbside collection).

It is worth noting that waste regime (i.e. relevant policies that local governments are implementing) is one of the key situational factors that directly influences household sorting behaviour (Jereme et al., 2018; Ladele et al., 2021). Policies which enforce sorting FW versus those that facilitate voluntary sorting of FW will result in different outcomes (Huang et al., 2014). For example, Shanghai's residual waste declined significantly when waste sorting became compulsory in 2019 (Wang et al., 2021). However, mandating waste sorting behaviour should be considered carefully as the outcomes will depend on complex political, social, and economic factors (Tilman and Sandhu, 1998).

Thus, the present research can provide a case study for future research into the role of local government policy in FW sorting behaviour. Future research can advance our work by exploring FW disposal behaviour in other regions or countries that have different waste management regimes to understand how local government policy can influence residents' waste disposal behaviour. Our findings indicate that several psychological factors, waste-related behaviours, and socio-demographic and household characteristics influence household FW disposal. However, these factors may vary between different households. Future research might, therefore, consider demographic, psychographic, or behavioural segmentation analysis to identify target groups for behavioural interventions. For example, non-detached dwellers (i.e. apartment residents) were found to have less sustainable FW disposal behaviour. This may be a result of complex factors such as lack of space, sharing bins with neighbours and their household characteristics. Future research might explore this association further to aid the design of interventions for this population group, which is likely to grow with urbanisation.

5. Conclusions

Several FW disposal practices can be used by households. The findings of this study provide a comprehensive understanding of households' varied FW sorting and disposal behaviours, which is critical to promoting sustainable practices (e.g. reusing for animal feed, home composting, and sorting into the green organics bin for kerbside collection) while avoiding unsustainable practices that lead to disposal in landfill. Our analysis shows that more household FW is discarded into the general waste bin than any other available disposal stream, including the green bin.

Overall, our results indicate the FW-related behavioural and contextual factors have the largest positive impact on households' sustainable sorting behaviours, such as having a tool to collect FW, recycling habits, or having the ability to make and use compost. Additionally, perceiving personal benefits of sorting FW to the green bin promotes the use of this sustainable disposal stream, and perceiving costs of inconvenience hinders this practice. However, compared to behavioural and contextual factors, these perceptions are less influential on sustainable sorting behaviours.

Our findings are expected to be of interest to local government and the waste management industry working on the circular economy. Overall, the findings can help to inform strategies for promoting sustainable FW disposal practices to divert FW from landfill.

Acknowledgements

The work has been supported by the Fight Food Waste Cooperative Research Centre whose activities are funded by the Australian Government's Cooperative Research Centre Program.

CRediT authorship contribution statement

Trang Thi Thu Nguyen: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Lenka Malek:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Wendy J. Umberger:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Patrick J. O'Connor:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2022.134636.

Appendix 1

List of different types of food waste that households may produce in a typical week.

Solid FOOD WASTE:	Yes	No
1. Fruit and vegetable scraps/peels/stems (e.g. potato peels, apple core)	☐	☐
2. Uneaten fruits and vegetables including fresh and frozen products (e.g. rotten fruits and vegetables)	☐	☐
3. Offcuts/bones/skins of meat and poultry (e.g. chicken bones and skins, pork fats)	☐	☐
4. Fish skeletons/offcuts, seafood shells and eggshells	☐	☐
5. Meat, fish, seafood (e.g. mince, fish fillet) and eggs	☐	☐
6. Hard dairy products (e.g. cheese, butter)	☐	☐
7. Soft dairy products (e.g. yogurt, sour cream)	☐	☐
8. Other inedible items or by-products of food and beverage preparation (e.g. tea bags, coffee grounds) and paper towels	☐	☐
9. Bread and cereals (e.g. bread, rice, pasta, couscous, breakfast cereals, pasta)	☐	☐
10. Mixed leftovers from cooked meals, chilled or frozen ready meals, takeaway/home delivered meals	☐	☐
11. Sugar, chocolate, confectionary, crisps and ice-cream	☐	☐
Liquid **FOOD WASTE**:	Yes	No
1. Cooking oils		
2. Non-alcoholic beverages (e.g. milk, juice, carbonated drinks, coffee)	☐	☐
3. Alcoholic beverages (e.g. wine, beer)	☐	☐

References

Ananda, J., Karunasena, G.G., Mitsis, A., Kansal, M., Pearson, D., 2021. Analysing behavioural and socio-demographic factors and practices influencing Australian household food waste. J. Clean. Prod. 306, 127280 https://doi.org/10.1016/j.jclepro.2021.127280.

Aschemann-Witzel, J., Gimenez, A., Ares, G., 2019. Household food waste in an emerging country and the reasons why: consumer's own accounts and how it differs for target groups. Resour. Conserv. Recycl. 145, 332–338. https://doi.org/10.1016/j.resconrec.2019.03.001.

Australian Bureau of Statistic, 2021. National, State and Territory Population. Sep 2020. Retrieved from. https://www.abs.gov.au/statistics/economy/finance/household-income-and-wealth-australia/latest-release.

Barr, S., Ford, N.J., Gilg, A.W., 2003. Attitudes towards recycling household waste in exeter, devon: quantitative and qualitative approaches. Local Environ. 8 (4), 407–421. https://doi.org/10.1080/13549830306667.

Benyam, A., Kinnear, S., Rolfe, J., 2018. Integrating community perspectives into domestic food waste prevention and diversion policies. Resour. Conserv. Recycl. 134, 174–183. https://doi.org/10.1016/j.resconrec.2018.03.019.

Bernstad, A., la Cour Jansen, J., Aspegren, A., 2013. Door-stepping as a strategy for improved food waste recycling behaviour – evaluation of a full-scale experiment. Resour. Conserv. Recycl. 73, 94–103. https://doi.org/10.1016/j.resconrec.2012.12.012.

Bernstad, A., 2014. Household food waste separation behavior and the importance of convenience. Waste Manage. (Tucson, Ariz.) 34 (7), 1317–1323. https://doi.org/10.1016/j.wasman.2014.03.013.

Boonrod, K., Towprayoon, S., Bonnet, S., Tripetchkul, S., 2015. Enhancing organic waste separation at the source behavior: a case study of the application of motivation mechanisms in communities in Thailand. Resour. Conserv. Recycl. 95, 77–90. https://doi.org/10.1016/j.resconrec.2014.12.002.

Borg, K., Boulet, M., Karunasena, G., Pearson, D., 2022. Segmenting households based on food waste behaviours and waste audit outcomes: introducing over Providers, under Planners and Considerate Planners. J. Clean. Prod. 351, 131589 https://doi.org/10.1016/j.jclepro.2022.131589.

Boulet, M., Hoek, A., Raven, R., 2021. The gaze of the gatekeeper: unpacking the multi-level influences and interactions of household food waste through a video elicitation study. Resour. Conserv. Recycl. 171, 105625 https://doi.org/10.1016/j.resconrec.2021.105625.

Buis, M.L., 2008. FMLOGIT: Stata Module Fitting a Fractional Multinomial Logit Model by Quasi Maximum Likelihood.

Chen, H.S., 2019. Environmental concerns and food consumption: what drives consumers' actions to reduce food waste? J. Int. Food Agribus. 31 (3), 273–292. https://doi.org/10.1080/08974438.2018.1520179.

Dey, A., Dhumal, C.V., Sengupta, P., Kumar, A., Pramanik, N.K., Alam, T., 2021. Challenges and possible solutions to mitigate the problems of single-use plastics used for packaging food items: a review. J. Food Sci. Technol. 58 (9), 3251–3269. https://doi.org/10.1007/s13197-020-04885-6.

Diaz-Ruiz, R., Costa-Font, M., Gil, J.M., 2018. Moving ahead from food-related behaviours: an alternative approach to understand household food waste generation. J. Clean. Prod. 172, 1140–1151. https://doi.org/10.1016/j.jclepro.2017.10.148.

Edgerton, E., McKechnie, J., Dunleavy, K., 2009. Behavioral determinants of household participation in a home composting scheme. Environ. Behav. 41 (2), 151–169 https://doi.org/10.1177%2F0013916507311900.

Edjabou, M.E., Petersen, C., Scheutz, C., Astrup, T.F., 2016. Food waste from Danish households: generation and composition. Waste Manage. (Tucson, Ariz.) 52, 256–268. https://doi.org/10.1016/j.wasman.2016.03.032.

Elimelech, E., Ayalon, O., Ert, E., 2018. What gets measured gets managed: a new method of measuring household food waste. Waste Manage. (Tucson, Ariz.) 76, 68–81. https://doi.org/10.1016/j.wasman.2018.03.031.

Elimelech, E., Ert, E., Ayalon, O., 2019. Exploring the drivers behind self-reported and measured food wastage. Sustainability 11 (20), 5677. https://doi.org/10.3390/su11205677.

FAO, 2011. Global Food Losses and Food Waste–Extent, Causes and Prevention. Retrieved from. https://www.fao.org/3/i2697e/i2697e.pdf.

FAO, 2014. Food Wastage Footprint: Full-Cost Accounting. Retrieved from. https://www.fao.org/3/i3991e/i3991e.pdf.

GISA, 2021. *Valuing our Food Waste: South Australia's Strategy to Reduce and Divert Household and Business Food Waste 2020-2025*. Green Industries SA. Government of South Australia Retrieved from. https://www.greenindustries.sa.gov.au/resources/valuing-our-food-waste.

Graham-Rowe, E., Jessop, D.C., Sparks, P., 2014. Identifying motivations and barriers to minimising household food waste. Resour. Conserv. Recycl. 84, 15–23. https://doi.org/10.1016/j.resconrec.2013.12.005.

Hebrok, M., Boks, C., 2017. Household food waste: drivers and potential intervention points for design – an extensive review. J. Clean. Prod. 151, 380–392. https://doi.org/10.1016/j.jclepro.2017.03.069.

Huang, W., Wang, J., Dai, X., Li, M., Harder, M.K., 2014. More than financial investment is needed: food waste recycling pilots in Shanghai, China. J. Clean. Prod. 67, 107–116. https://doi.org/10.1016/j.jclepro.2013.12.019.

Jereme, I.A., Siwar, C., Begum, R.A., Talib, B.A., Choy, E.A., 2018. Analysis of household food waste reduction towards sustainable food waste management in Malaysia. J. Solid Waste Technol. Manag. 44 (1), 86–96. https://doi.org/10.5276/JSWTM.2018.86.

Karunasena, G.G., Ananda, J., Pearson, D., 2021. Generational differences in food management skills and their impact on food waste in households. Resour. Conserv. Recycl. 175, 105890 https://doi.org/10.1016/j.resconrec.2021.105890.

Knickmeyer, D., 2020. Social factors influencing household waste separation: a literature review on good practices to improve the recycling performance of urban areas. J. Clean. Prod. 245, 118605 https://doi.org/10.1016/j.jclepro.2019.118605.

Koivupuro, H.-K., Hartikainen, H., Silvennoinen, K., Katajajuuri, J.-M., Heikintalo, N., Reinikainen, A., Jalkanen, L., 2012. Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households. Int. J. Consum. Stud. 36 (2), 183–191. https://doi.org/10.1111/j.1470-6431.2011.01080.x.

Ladele, O., Baxter, J., van der Werf, P., Gilliland, J.A., 2021. Familiarity breeds acceptance: predictors of residents' support for curbside food waste collection in a city with green bin and a city without. Waste Manage. (Tucson, Ariz.) 131, 258–267. https://doi.org/10.1016/j.wasman.2021.06.010.

Lee, M., Choi, H., Koo, Y., 2017. Inconvenience cost of waste disposal behavior in South Korea. Ecol. Econ. 140, 58–65. https://doi.org/10.1016/j.ecolecon.2017.04.031.

Li, D., Zhao, L., Ma, S., Shao, S., Zhang, L., 2019. What influences an individual's pro-environmental behavior? A literature review. Resour. Conserv. Recycl. 146, 28–34. https://doi.org/10.1016/j.resconrec.2019.03.024.

Lusk, J.L., Ellison, B., 2017. A note on modelling household food waste behaviour. Appl. Econ. Lett. 24 (16), 1199–1202. https://doi.org/10.1080/13504851.2016.1265070.

Malek, L., Umberger, W.J., 2021. Distinguishing meat reducers from unrestricted omnivores, vegetarians and vegans: a comprehensive comparison of Australian consumers. Food Qual. Prefer. 88, 104081 https://doi.org/10.1016/j.foodqual.2020.104081.

Mannetti, L., Pierro, A., Livi, S., 2004. Recycling: planned and self-expressive behaviour. J. Environ. Psychol. 24 (2), 227–236. https://psycnet.apa.org/doi/10.1016/j.jenvp.2004.01.002.

Miafodzyeva, S., Brandt, N., 2013. Recycling behaviour among householders: synthesizing determinants via a meta-analysis. Waste Biomass Valorizat 4 (2), 221–235. https://doi.org/10.1007/s12649-012-9144-4.

Mullahy, J., 2015. Multivariate fractional regression estimation of econometric share models. J. Econom. Methods 4 (1), 71–100. https://doi.org/10.1515/jem-2012-0006.

Neff, R.A., Spiker, M.L., Truant, P.L., 2015. Wasted food: U.S. Consumers' reported awareness, attitudes, and behaviors. PLoS One 10 (6), e0127881. https://doi.org/10.1371/journal.pone.0127881.

Papargyropoulou, E., Lozano, R., Steinberger, J.K., Wright, N., Ujang, Z.b., 2014. The food waste hierarchy as a framework for the management of food surplus and food waste. J. Clean. Prod. 76, 106–115. https://doi.org/10.1016/j.jclepro.2014.04.020.

Papke, L.E., Wooldridge, J.M., 1996. Econometric methods for fractional response variables with an application to 401(k) plan participation rates. J. Appl. Econom. 11 (6), 619–632. https://doi.org/10.1002/(SICI)1099-1255(199611)11:6<619::AID-JAE418>3.0.CO;2-1.

Parfitt, J., Barthel, M., Macnaughton, S., 2010. Food waste within food supply chains: quantification and potential for change to 2050. Philos. Trans. R. Soc. 365 (1554), 3065–3081. https://doi.org/10.1098/rstb.2010.0126.

Parizeau, K., von Massow, M., Martin, R., 2015. Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. Waste Manage. (Tucson, Ariz.) 35, 207–217. https://doi.org/10.1016/j.wasman.2014.09.019.

Pearce, D., 1976. The economics of waste disposal in the UK. Resour. Pol. 2 (4), 247–255. https://doi.org/10.1016/0301-4207(76)90079-9.

Ponis, S.T., Papanikolaou, P.-A., Katimertzoglou, P., Ntalla, A.C., Xenos, K.I., 2017. Household food waste in Greece: a questionnaire survey. J. Clean. Prod. 149, 1268–1277. https://doi.org/10.1016/j.jclepro.2017.02.165.

Qi, D., Roe, B.E., 2016. Household food waste: multivariate regression and principal components analyses of awareness and attitudes among U.S. Consumers. PLoS One 11 (7), e0159250. https://doi.org/10.1371/journal.pone.0159250.

Quested, T.E., Marsh, E., Stunell, D., Parry, A.D., 2013. Spaghetti soup: the complex world of food waste behaviours. Resour. Conserv. Recycl. 79, 43–51. https://doi.org/10.1016/j.resconrec.2013.04.011.

Rankin, J., 2019. European Parliament Votes to Ban Single-Use Plastics. The Guardian. Retrieved from. https://www.theguardian.com/environment/2019/mar/27/the-last-straw-european-parliament-votes-to-ban-single-use-plastics.

Reynolds, C., Mavrakis, V., Davison, S., Høj, S.B., Vlaholias, E., Sharp, A., Thompson, K., Ward, P., Coveney, J., Piantadosi, J., Boland, J., Dawson, D., 2014. Estimating informal household food waste in developed countries: the case of Australia. Waste Manag. Res. 32 (12), 1254–1258. https://doi.org/10.1177/0734242X14549797.

Roe, B.E., Qi, D., Beyl, R.A., Neubig, K.E., Apolzan, J.W., Martin, C.K., 2022. A randomized controlled trial to address consumer food waste with a technology-aided tailored sustainability intervention. Resour. Conserv. Recycl. 179, 106121 https://doi.org/10.1016/j.resconrec.2021.106121.

Roodhuyzen, D., Luning, P., Fogliano, V., Steenbekkers, L., 2017. Putting together the puzzle of consumer food waste: towards an integral perspective. Trends Food Sci. Technol. 68, 37–50. https://doi.org/10.1016/j.tifs.2017.07.009.

Russell, S.V., Young, C.W., Unsworth, K.L., Robinson, C., 2017. Bringing habits and emotions into food waste behaviour. Resour. Conserv. Recycl. 125, 107–114. https://doi.org/10.1016/j.resconrec.2017.06.007.

Schanes, K., Dobernig, K., Gözet, B., 2018. Food waste matters - a systematic review of household food waste practices and their policy implications. J. Clean. Prod. 182, 978–991. https://doi.org/10.1016/j.jclepro.2018.02.030.

Sewak, A., Kim, J., Rundle-Thiele, S., Deshpande, S., 2021. Influencing household-level waste-sorting and composting behaviour: what works? A systematic review

(1995–2020) of waste management interventions. Waste Manag. Res. 39 (7), 892–909. https://doi.org/10.1177/0734242X20985608.
Taber, K.S., 2018. The use of Cronbach's alpha when developing and reporting research instruments in science education. Res. Sci. Educ. 48 (6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2.
Tilman, C., Sandhu, R., 1998. A model recycling program for Alabama. Resour. Conserv. Recycl. 24 (3), 183–190. https://doi.org/10.1016/S0921-3449(98)00042-1.
Tonglet, M., Phillips, P.S., Read, A.D., 2004. Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. Resour. Conserv. Recycl. 41 (3), 191–214. https://doi.org/10.1016/j.resconrec.2003.11.001.
Trudel, R., Argo, J.J., Meng, M.D., 2015. Trash or recycle? How product distortion leads to categorization error during disposal. Environ. Behav. 48 (7), 966–985. https://doi.org/10.1177/0013916515577635.
Tucker, P., Speirs, D., Fletcher, S.I., Edgerton, E., McKechnie, J., 2003. Factors affecting take-up of and drop-out from home composting schemes. Local Environ. 8 (3), 245–259. https://doi.org/10.1080/13549830306660.
Van Biene, M., Grant, T., Kneller, C., Reynolds, C., Forbes, H., Sheane, R., 2021. National food waste strategy feasibility study–final report. Retrieved from. https://www.fial.com.au/sharing-knowledge/food-waste.
van der Werf, P., Seabrook, J.A., Gilliland, J.A., 2020. Food for thought: comparing self-reported versus curbside measurements of household food wasting behavior and the predictive capacity of behavioral determinants. Waste Manage. (Tucson, Ariz.) 101, 18–27. https://doi.org/10.1016/j.wasman.2019.09.032.
Van der Werff, E., Steg, L., Keizer, K., 2014. I Am what I Am, by looking past the present: the influence of biospheric values and past behavior on environmental self-identity. Environ. Behav. 46 (5), 626–657. https://doi.org/10.1177/0013916512475209.
van Herpen, E., van der Lans, I.A., Holthuysen, N., Nijenhuis-de Vries, M., Quested, T.E., 2019. Comparing wasted apples and oranges: an assessment of methods to measure household food waste. Waste Manage. (Tucson, Ariz.) 88, 71–84. https://doi.org/10.1016/j.wasman.2019.03.013.
Visschers, V.H.M., Wickli, N., Siegrist, M., 2016. Sorting out food waste behaviour: a survey on the motivators and barriers of self-reported amounts of food waste in households. J. Environ. Psychol. 45, 66–78. https://doi.org/10.1016/j.jenvp.2015.11.007.
Wang, Y., Shi, Y., Zhou, J., Zhao, J., Maraseni, T., Qian, G., 2021. Implementation effect of municipal solid waste mandatory sorting policy in Shanghai. J. Environ. Manag. 298, 113512 https://doi.org/10.1016/j.jenvman.2021.113512.
Whitmarsh, L., O'Neill, S., 2010. Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. J. Environ. Psychol. 30 (3), 305–314. https://doi.org/10.1016/j.jenvp.2010.01.003.
Wonneck, L.A., Hobson, K., 2017. Practice-based spillover effects: evidence from Calgary's municipal food and yard waste recycling pilot. Can. Geogr. 61 (3), 415–427. https://doi.org/10.1111/cag.12391.
Wu, W.-N., Liu, L.-Y., Brough, C., 2019. No time for composting: subjective time pressure as a barrier to citizen engagement in curbside composting. Waste Manage. (Tucson, Ariz.) 91, 99–107. https://doi.org/10.1016/j.wasman.2019.04.057.
Xue, L., Liu, G., Parfitt, J., Liu, X., Van Herpen, E., Stenmarck, Å., O'Connor, C., Östergren, K., Cheng, S., 2017. Missing food, missing data? A critical review of global food losses and food waste data. Environ. Sci. Technol. 51 (12), 6618–6633. https://doi.org/10.1021/acs.est.7b00401.
Zero Waste, S.A., 2015. South Australia's Kerbside Three-Bin System Waste Report 2012-2013. Retrieved from. https://www.greenindustries.sa.gov.au/resources/south-australia's-kerbside-three-bin-system-waste-report-(2013).
Zhang, S., Zhang, M., Yu, X., Ren, H., 2016. What keeps Chinese from recycling: accessibility of recycling facilities and the behavior. Resour. Conserv. Recycl. 109, 176–186. https://doi.org/10.1016/j.resconrec.2016.02.008.