IRTA
RECERCA I TECNOLOGIA
AGROALIMENTÀRIES

Moving ahead from food-related behaviours: an alternative approach to understand household food waste generation

Raquel Diaz-Ruiz[a*], Montserrat Costa-Font[b], José M. Gil[a],

a) Center for Agro-Food Economy and Development (CRED-UPC-IRTA), Spain
(raquel.diaz.ruiz@upc.edu)

b) Land Economy, Environment and Society Research Group. Scotland's Rural College (SRUC). United Kingdom

Raquel Diaz-Ruiz: raquel.diaz.ruiz@upc.edu
Jose M. Gil: chema.gil@upc.edu
Center for Agro-Food Economy and Development
Address: Edifici ESAB Parc Mediterrani de la Tecnologia
C/Esteve Terrades, 8 08860-Castelldefels, Barcelona, Spain

Montserrat Costa-Font: montse.costafont@sruc.ac.uk

Land Economy, Environment and Society Research Group
Scotland's Rural College (SRUC)
Address: King's Buildings, West Mains Road, Edinburgh EH9 3JG, United Kingdom
Corresponding author: Raquel Díaz-Ruiz email: raquel.diaz.ruiz@upc.edu

Word count: 8236

Abstract

Food waste prevention is a hot topic on the policy agenda. According to available data, urgent measures need to be undertaken to significantly reduce the current generation of food waste. However, it is important to thoroughly understand consumers' behaviour to define measures that will lead to a long-lasting change in the situation. The aim of the present work is to analyse consumer food waste behaviour by means of a model that brings together food-related and waste management variables. To do so, a survey was given to 418 consumers of the metropolitan area of Barcelona. Results show that food waste is directly influenced by purchasing discipline, waste prevention habits and materialism values and indirectly influenced by environmental values. This highlights the importance of addressing the problem from different perspectives and emphasizes the importance of considering this problem as a transversal element for policy makers. We suggest that household food waste prevention and reduction needs to be included as a key element in different policy areas.

Highlights

- Food waste conceptual model incorporating food-related, waste management and consumers' values.
- Waste prevention, purchasing discipline and materialistic values are direct predictors of food waste behaviour.
- Partial least squares (PLS-SEM) validated the consumers' food waste generation model.

Keywords: food waste, consumer behaviour, structural equation models, waste prevention

1. Introduction

The Food and Agricultural Organization of the United Nations (FAO), among other institutions, reported that global limitations on food availability would exist in the upcoming years up to 2050, which, combined with current food waste, results in an unethical and unsustainable world-feeding situation. Food waste is an environmental, economic, social and food security problem (Kosseva, 2013; Stuart, 2009) that urgently needs to be addressed. The United Nations advocates for it within its Sustainable Development Goals. In particular, goal 12.3 states that "By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" (United Nations, 2015). In Europe, reducing food waste is a key area of the circular economy package (European Comission, 2017).

Some work has been done to quantify food waste. FAO's report in 2011 exposed that one-third of all food produced for human consumption is lost or wasted every year (Gustavsson et al., 2011). In Europe and North America, this equals up to 300 kg of food per capita and year along the food supply chain. Moreover, published data revealed that about 50% of the total amount of food is wasted downstream, mainly at the household level (Bio Intelligence Service, 2010; Gustavsson et al., 2011; Katajajuuri et al., 2014; Stenmarck et al., 2016). The most recent study focused on EU-28 reports that 92 kg of food are discarded per person and year at households where approximately 60% of its volume is edible (Stenmarck et al., 2016).

Although food waste occurs along the whole supply chain, consumer food waste has been reported to be a hot spot and has received special attention. Different studies have analysed consumers' behaviour, awareness and the causes of food waste in such countries as Greece (Abeliotis et al., 2014), Canada (Parizeau et al., 2015), Romania (Stefan et al., 2013), Denmark (Stancu et al., 2016), the United States (Neff et al., 2015; Qi and Roe, 2016), Italy (Principato et al., 2015; Setti et al., 2016), Singapore (Grandhi and Appaiah Singh, 2015) and New Zealand (Tucker and Farrelly,

2015). However, despite the increasing interest, the above studies use mainly food-related approaches, leaving waste-related approaches aside. Bearing in mind that the latter is the prevailing approach in food waste prevention campaigns, especially in Europe where food waste legislation is waste oriented (Lucifero, 2016), a more focused analysis on food waste prevention strategies it is necessary in order to identify individual's attitudes, values, behaviours and motivations towards wasting food. Moreover taking into account that food waste is an interdisciplinary issue, it has to be addressed from both waste and food-related perspectives (Kosseva, 2013; Langley et al., 2010). However, the magnitude of the influence of waste and food-related perspectives on consumer behaviour towards wasting food is unknown to date. The aim of the present work is to reach a better understanding of the factors that influence consumers' food waste generation in order to define prevention strategies at the household level and demonstrate that a multidimensional perspective should be undertaken to address the prevention.

Up to date, there has been little attention on the factors driving food waste considering different behavioural dimensions simultaneously. Most of the existing academic literature on food waste either examines a partial dimension or is focused on estimating the amount of food wasted. However, consumer's food waste behaviour is a complex phenomenon build as a result of the interaction of several behavioural aspects. The decision-making process that ends on the behaviour of wasting food is shaped by social, economic and personal factors and is the outcome of the interaction of decisions, values and engagements. One of our contributions to the literature is to design a behavioural framework towards household food waste bringing together the two of the main approaches that define the food waste debate nowadays: waste management and food habits. In addition, we include consumers' values as possible predictors and moderators to complete the model. In particular, we focused on an especially significant region of Europe: the metropolitan area of Barcelona. It is one of the most populated areas of Europe located along the Mediterranean coast, with a growing population accounting for more than 3.2 million people in 2015, and it occupies an area of approximately 636 km^2, 48% of which is urbanised (AMB, 2015).

This paper is organised as follows. The next section undertakes a literature review to justify why we hypothesise that a variety of actions and motivators could affect the food waste behaviour, arguing that it is not only a food-related issue but a waste management, an environmental concern and materialistic issue, too. This section summarizes the state of the art regarding food waste behaviour at the household level and develops a conceptual model that explains consumers' food waste behaviour. Section three explains the data and method of analysis. The fourth section of the paper

99   reports the main results of the study. Finally, the fifth section discusses the relevance of the results

100   for further research and to define strategies of prevention food waste generation.

101   ## 2. Theoretical framework: food waste behaviour

102   Previous literature demonstrate that food waste does not respond to a single behavioural dimension

103   but emerges from a wide variety of actions and motivators (Evans, 2011; Quested et al., 2013;

104   Secondi et al., 2015; Setti et al., 2016; UNEP, 2014). Due to its complexity, studies to date have

105   only considered partial analysis from diverse disciplines. Watson and Meah (2012) emphasize the

106   dichotomy between the necessity of safe and nutritious food and the desire to reduce food waste. In

107   that line, our theoretical framework advocates for a combined approach assembling current

108   evidences on the relevance of food and environmental behaviours as well as selected consumer

109   values to explain consumers' food waste generation. We aim at testing the power of food-related

110   attitudes, waste-management behaviours and selected values (environmentalism and materialism) to

111   explain consumers' food waste behaviours.

112   In this section, the paper first attempts to bring together the published evidence from different

113   studies and the distinct identified behaviours towards food waste and to develop a theoretical model

114   considering three main issues: (i) food-related behaviours, (ii) waste management behaviours and

115   (iii) consumers values. It is important to highlight that this research attempts to test that food waste

116   behaviours are not only the results of food related behaviours but of a combination of food

117   unrelated and related behaviours among other elements. Therefore, we did not focus on specific

118   prevention or values regarding food waste, but on general waste prevention habits that we argue

119   could be also related to the generation of food waste.

120   ### 2.1. Food-related habits

121   Household food waste can be considered a food-related behaviour. Some studies intend to

122   determine, by means of different analytical tools, the main causes of food waste generation. The

123   most frequently identified actions that can lead to food waste generation can be grouped in five

124   categories: food purchase, food storage, food preparation, food consumption and lifestyle related to

125   food. Consumers' attitudes, values, knowledge and behaviour towards food might have an effect on

126   the food waste generation (Kosseva, 2013; Parfitt et al., 2010; Principato et al., 2015). We have

127   identified three factors related to food habits: purchasing behaviour, price importance and dietary

128   importance as representatives of food importance towards food waste generation.

Some studies have found noticeable conceptual links between food waste and food preferences, such as nutrition and food safety (HLPE 2014), dietary conscientiousness (Parizeau et al., 2015), affection for food (Porpino et al., 2016), food preferences (Bio Intelligence Service, 2010; Canali et al., 2014), domestic routines and habits (Evans, 2011) or the social value of food (Mallinson et al., 2016). Indeed, in the Quested et al. (2011) study, people cited eating a healthy diet as an encouraging factor for reducing food waste.

In particular, certain purchasing habits may affect the subsequent household management of food, namely poor planning and shopping routines (Mallinson et al., 2016; Mondéjar-Jiménez et al., 2015; Parizeau et al., 2015; Setti et al., 2016; Stancu et al., 2016; Stefan et al., 2013; Tucker and Farrelly, 2015), excessive buying, (Göbel et al., 2012; Parfitt et al., 2010; Porpino et al., 2015; WRAP et al., 2007) or the symptom of the 'good provider', who is trying to have as much variety as possible for all the household members (Graham-Rowe et al., 2014; Visschers et al., 2016).
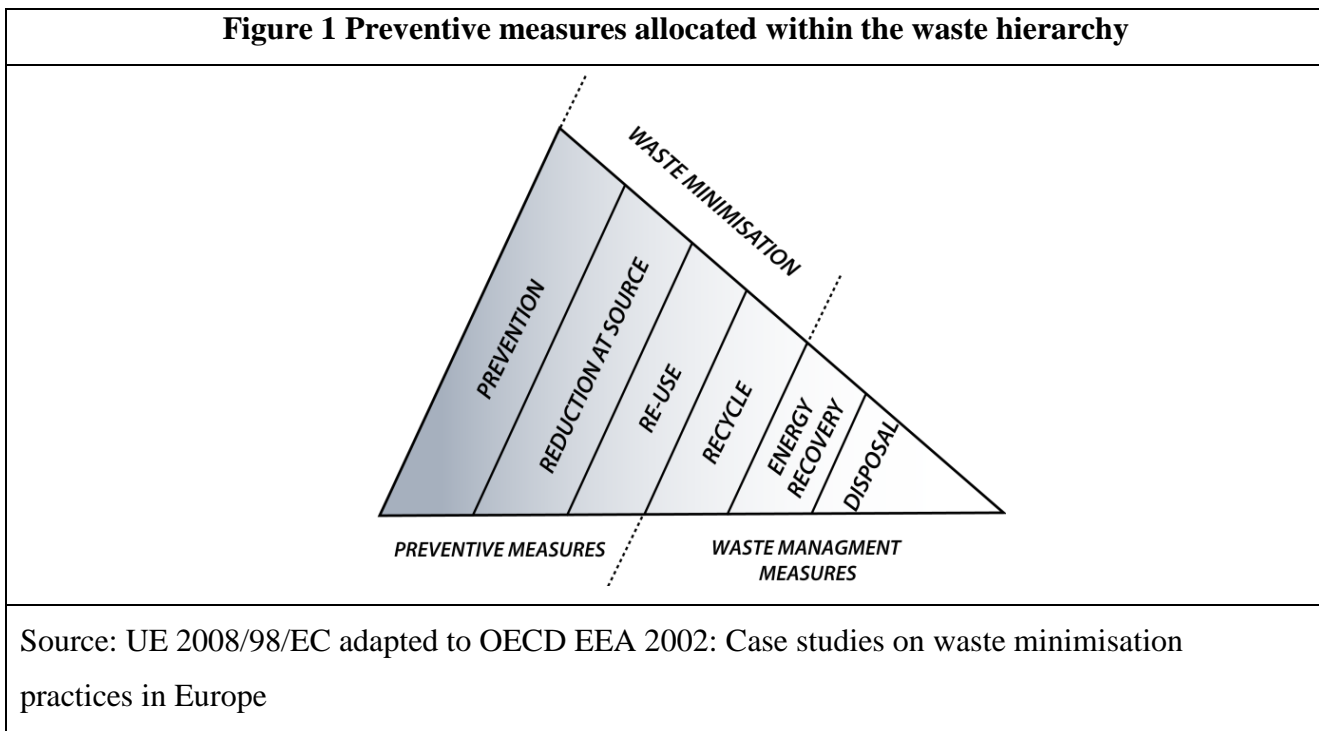
Moreover, food price is another element which could have an influence on consumers' food waste generation. This topic has not been studied in detail but some works suggested that marketing attractions such as promotions, also named offer temptation (2x1), can alter consumer's purchase discipline (Mondéjar-Jiménez et al., 2015; Parfitt et al., 2010; Quested et al., 2013; Setti et al., 2016). Moreover, consumer during diverse focus group in Europe pointed out food prices as a possible cause of food generation in the households (Geffen et al., 2016). Finally, Mallinson et al., (2016) described how a group of consumers who reveled higher levels of food cause were more influenced by promotions and were less price-conscious. However, besides these studies, little is known on the relationship between food price importance and food waste generation.

According to the aforementioned studies, we synthesize all food-related causes in three main variables, diet importance, price importance and purchasing discipline. The first three hypotheses are outlined:

- H1: Consumers who reveal a higher concern about the importance of their diet are expected to waste less food.
- H2: The importance that consumers place to food price is expected to have an influence on consumers' food waste (the effect negative or positive cannot be pre/established form the available literature)
- H3: Consumers who reveal a more disciplined purchasing behaviour are expected to waste less food.
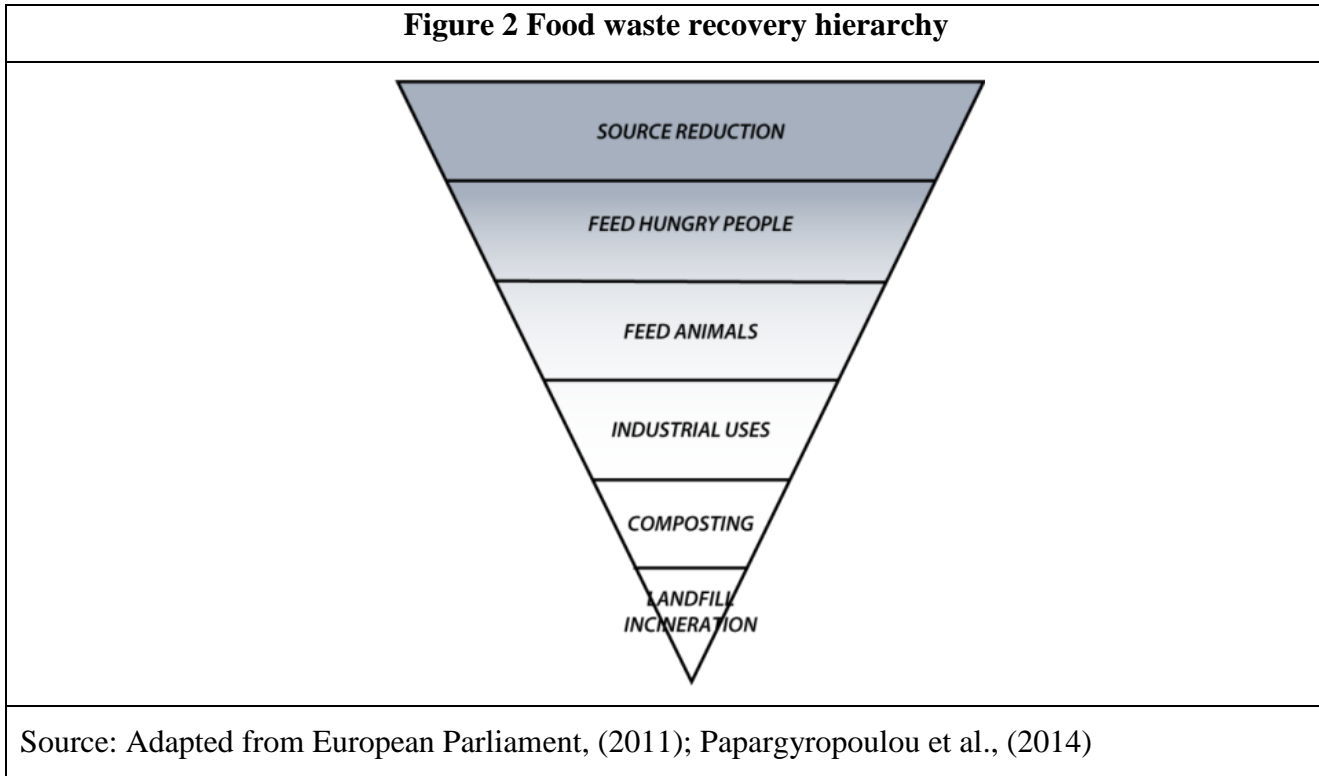
2.2. Waste management

161   Despite the lack of specific studies on food waste behaviours connected with other waste-related

162   activities, some food waste prevention campaigns have emerged from these specific sectors.

163   Regulation of food waste could be characterized as recent and unspecific, even though there are

164   some documents that highlight the urgent need for its reduction. The Waste Framework Directive

165   (WFD-2008/98/EC) (EU, 2008) clearly defines a waste hierarchy (see Fig. 1) and sets a clear waste

166   prevention procedure as a priority. Within the Waste Framework Directive, the distinction between

167   prevention and minimisation could be misunderstood. Therefore, Figure 1 allocates within the waste

168   hierarchy the different preventive measures that encompass prevention, reduction and re-use and

169   waste management measures from recycling to disposal.

Figure 1 Preventive measures allocated within the waste hierarchy

Source: UE 2008/98/EC adapted to OECD EEA 2002: Case studies on waste minimisation practices in Europe

170

171   In this sense, to tackle food waste, it is important to differentiate between recycling and prevention

172   concepts. Evidence from the UK indicates that among all strategies to prevent waste, the prevention

173   of food waste is the one with the greatest potential (Cox et al., 2010). There is a specific food waste

174   hierarchy (see Fig. 2) that transposes the hierarchy preferences to food management (European

175   Parliament, 2011; Papargyropoulou et al., 2014).The hierarchy transposes the meanings of

176   prevention, recycling and discarding to food. Thus, first it would be necessary to prevent the

177   generation of food waste. Second, if waste could occur, food should be diverted to humans

178   beforehand. Thirdly, if food cannot be reached by human consumption, it might be used to feed

179   animals by conversion of food surplus into feeding. Next, any other industrial uses are proposed

180   such us generation of energy, bio-energy, etc. And the last two levels of food waste recovery

181   hierarchy are food composting and finally landfilling.

Figure 2 Food waste recovery hierarchy

Source: Adapted from European Parliament, (2011); Papargyropoulou et al., (2014)

182

183   There is a common tendency to relate waste reduction with recycling, although they are not the

184   same concepts. Some examples of waste prevention are the reduction of the amount of plastic

185   employed while shopping such as plastic bags or plastic packaging, repairing objects before buying

186   new ones, re using glass jars, etc. Recycling actions are more commonly known such as recycling

187   plastics, paper, etc. There is a debate in the scientific literature about the relationship between

188   prevention and recycling behaviours. Some authors consider them to be related (Cox et al., 2010)

189   and only the most environmentally encouraged or committed recyclers also act to prevent waste. By

190   contrast, others suggest that waste prevention behaviours are poorly or even negatively correlated

191   with recycling (Barr, 2007; Cecere et al., 2014; Tonglet et al., 2004b). These studies argue that

192   recycling may become a reason for decreasing the effort to reduce waste. Moreover a recent

193   publication found that the positive feelings of recycling can lead to using more quantity of the

194   material needed (Sun and Trudel, 2016). Variables that influence prevention and recycling are

195   diverse. Some authors, such as Barr, (2007); Refsgaard and Magnussen, (2009); Tonglet et al.,

196   (2004a); Zorpas and Lasaridi, (2013) suggested that recycling behaviour is influenced primarily by

197   opportunities, facilities and knowledge and, secondly, by not being deterred by issues of physically

198   recycling (e.g. time, space, inconvenience). Meanwhile, the factors that influence waste prevention

199   that are most cited in the literature are: universalism values and moral motivations, self-

200   responsibility to act, self-efficacy, cost, social norms, habits, strong environmental values and

201   knowledge about environmental politics (see Barr, 2007; Cox et al., 2010; Tonglet et al., 2004b).

202   As noted by previous authors the predictors of both are totally different and are quite diverse.

203   Therefore, we considered both behaviours to be distinguished.

204   Studies like Barr (2007) and Tonglet et al. (2004b) covered the issue of prevention and recycling

205   behaviour in a global scope, without focusing on one single act as in wasting food. More recently,

206   some studies have analysed the influence of food waste disposal, such as the use of the bio-waste

207   container, as an explanatory variable of food waste awareness and behaviour (Tucker and Farrelly,

208   2015; Visschers et al., 2016).

209   In the present work, we characterized food waste behaviour as a specific waste management

210   behaviour (Cecere et al. 2014). Prevention and recycling have different consequences, and we want

211   to find out to what extend food waste is influenced by prevention and recycling behaviours.

212   Thus, the following two hypotheses are considered:

213   - H4: Consumers who reveal more positive prevention behaviour are expected to reveal lower
214   food waste generation.
215   - H5: Consumers who reveal more positive recycling behaviour are expected to reveal lower
216   food waste generation.

217

218   *2.3. Consumers' values*

219   Individuals' environmental concern may be an important indicator impacting food waste behaviour.

220   In fact, recent studies have shown consumers' environmental awareness about food waste

221   consequences (Neff et al., 2015; Principato et al., 2015). In particular, Cecere et al. (2014) indicate

222   a positive effect of Green Attitude on the perceived production of food waste using the

223   Eurobarometer Report of 2011[1] data. Other studies directly link environmental awareness to

224   positive environmental behaviours and waste minimisation (Barr, 2007; Kilbourne and Pickett,

225   2008; Tonglet et al., 2004a). Taking into consideration the relevance of individual environmental

226   values on the formation of specific waste prevention behaviours we propose the following

227   hypotheses to analyse its indirect and direct effect on food waste behaviour:

---

[1] Flash Eurobarometer 316. Attitudes of Europeans Towards Resource Efficiency

228   • H6: Consumers who reveal a high environmental concern are expected to demonstrate more

229   positive waste prevention behaviour.

230   • H7: Consumers who reveal a high environmental concern are expected to demonstrate

231   positive recycling behaviour.

232   • H8: Consumers who reveal a high environmental concern are expected to report less food

233   waste generation

234   Finally, consumption habits in general could also influence food waste as mentioned by Parfitt et al.

235   (2010) and WRAP (2007). We include in the model materialism values as a proxy of consumerism.

236   Materialism understood as a value that attaches importance to material possessions and the pursuit

237   of personal wealth (Richins, 2004). The relationship between materialistic values, environmental

238   awareness and behaviour has been clearly established by previous literature. For instance, Hurst et

239   al., (2013) estimated by means of a meta-analysis the correlation between materialism and

240   environmental awareness, and between materialism and environmental behaviour. They noticed that

241   materialism was negatively and equally related with both environmental awareness and

242   environmental behaviours. Also, materialistic values were found to be negatively related to

243   environmental beliefs, and these beliefs influence environmental awareness and environmental

244   responsible behaviour (Kilbourne and Pickett 2008). Based on this evidence, we propose the final

245   hypotheses for the model that states that:

246   • H9: Individuals' materialistic values have a negative influence on individuals' environmental

247   awareness

248   • H10: Individuals' materialistic values have a negative influence on individuals' food waste
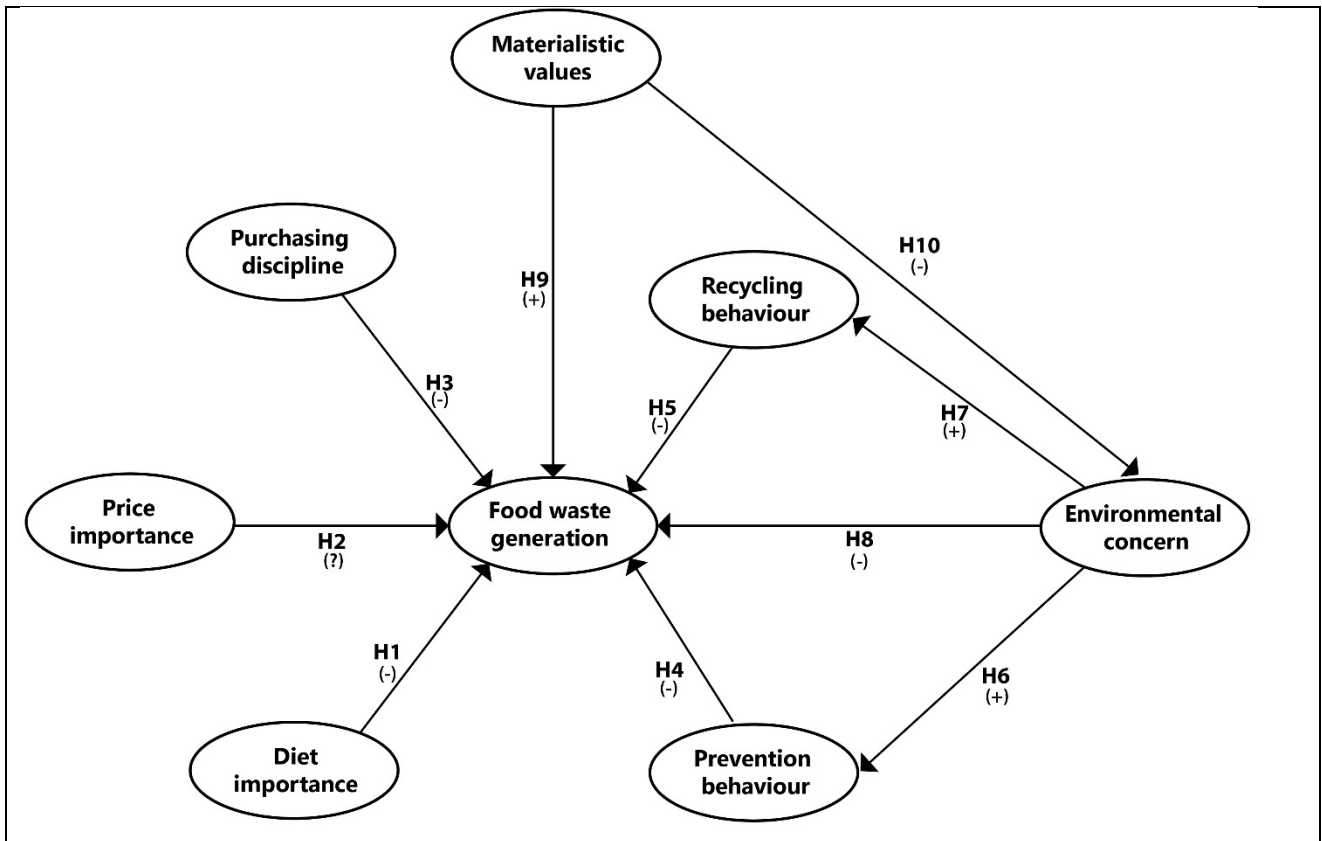
249   behaviour.

250   A theoretical food-waste-values behaviour framework model has been defined (see Fig. 3) by taking

251   into account all the considerations shown above. This model draws some paths of the decision-

252   making process that consumers undertake when defining their food waste behaviour.

253

254

255

Figure 3 Theoretical framework of food waste predictors

9

256

3. Material and methods

3.1.The sample

259 We drew our sample from a survey conducted in the metropolitan area of Barcelona (Spain) in
260 autumn 2013. We focused on the subset of consumers who were responsible for cooking or food
261 purchase in their households. We distributed the survey on paper and online through different social
262 media platforms and emails. We finally collected 418 responses. Individuals' characteristics are
263 presented in Table 1 such as gender, age, area of residence, education, income and children in
264 charge (see Table 1). Regarding to the implementation method, the questionnaire was, in most of
265 the cases, self-administrated with available assistance in the case it was required (especially old
266 people needed assistance for reading and understanding how to answer). The survey duration was of
267 about 10 minutes. Both pencil-surveys and online form had the same format and order.

268

269

270

10

272 **Table 1 Sample description**

	Frequency	*% of the sample*
Gender		
Male	172	41.1
Female	246	58.9
Age >18		
18-34	179	42.8
35-49	110	26.3
50-64	102	24.4
More than 65	28	6.5
Studies		
Basics	84	20.1
Medium/superior	119	28.5
Graduate	211	50.5
Dk/na	4	1
Working status		
Employee	263	62.9
Entrepreneur	36	8.6
Pensioner	40	9.6
Unemployed	71	17.0
Dk/na	8	1.9
Housing structure		
Unipersonal	45	10.8
Couple	106	25.4
Family	234	56.0
Sharing apartment	33	7.9
Children under 16 at home		
None	292	69.9
1	69	16.5
2	37	8.9
3 or more	1	1
Dk/na	16	3.8

273

274 3.2.Survey and measures

275 The questionnaire included 44 questions to build the hypothesized model. A seven-point Likert

276 scale was employed for all questions. Questions scales were in many cases adapted from validated

277 scales such as environmentalism (Dunlap et al., 2000), materialism (Kilbourne and Pickett, 2008;

278 Richins, 2004) and waste recycling and waste prevention (Barr, 2007), the remaining scales were

279 designed by the authors based on previous experience. The final model was formed by 24 indicators

280 due to model specifications explained below. Table 2 summarizes the characteristics of all latent

281 variables and indicators included in the model. It can be observed that the model includes three

constructs to capture food-related behaviours: purchasing discipline defined by two items, price importance formed by one item and finally importance of diet measured by three indicators. Two four-items constructs were considered for waste-related behaviour, recycling and prevention. Next, two dimensions represented consumer's values on materialism, which included four items, and second environmental concern with two items. Finally, food waste generation included six items.

The survey had a short introduction[2] asking consumers participation on a food survey. Then, all Agree-Disagree questions (purchasing disciplines, price importance, diet importance, materialism values and environmental concern) were randomly presented, next waste-related questions randomly ordered and finally food waste assessment. Food waste questions were placed at end to avoid interaction between food waste questions and other behaviours under analysis. It has a specific explanation to clarify participants' responses "*Following you should think on the amount of food that you have thrown away that otherwise could have been eaten during the past month. Everything which cannot be eaten such as potatoes peels, bones, etc. are not included. You may think on the food that is thrown away through the trash bin, the organic bin, the compost or what you give to your pet.*" Both online and paper survey had the same structure.

3.3. Analytical procedures

To test relationships among non-observed variables (latent variables) one may opt to use structural equation modelling (SEM) which is a second-generation type of modelling (Fornell and Larcker, 1981; Hair et al., 2014; Kline, 2011). There are two types of SEM, the covariance-based SEM (CBSEM) and the variance based (PLS-SEM). The former is applied to confirm or reject solid theories by estimating the covariance matrix of the data. The latter, is primarily applied in exploratory research to develop new or on early stages theories looking into the variance in the dependent variables (Hair et al., 2014). PLS intends to test how the theory fits the data, the fit of the model in PLS-SEM test the discrepancy between the observed values and the values predicted by the model in question. The objective of PLS is to maximize the variance explained rather than the fit. Due to the novelty approach of combining waste-related, food-related and values-related as a predictors of food waste, we used PLS-SEM to validate the hypotheses formulated above.

PLS technique is gaining adepts due to its flexibility in comparing theory and real data, soft distributional assumptions, its exploratory and prediction-oriented nature, its compatibility with

---

[2] Good morning/good afternoon. My name is Raquel Diaz, I am student from the Polytechnic University of Catalonia. We are doing an investigation about food in the metropolitan area. We guarantee complete anonymity of your responses. It would take you around 10 minutes. Could you please collaborate with the study? We appreciate your participation:

model complexity and its ease of model interpretation among other. PLS can estimate a model with a large number of latent variables and indicators with small sample sizes (Chin et al., 2008). As noted by Akter et al., (2017), PLS-SEM has been used to analyse more latent variables and including more indicators per model on average than in the CBSEM. In their systematic review, they found that CBSEM accounted for 4.4. latent variables and 14 indicators, whereas PLS 8.12 latent variables and 27.42 indicators were included. PLS also gives the flexibility to include one-single item latent variables, it has no a restriction of at least three-items per latent as in CBSEM.

To assess the validity of the model, a two-stage analytical procedure is used. First, the assessment of the measurement model to evaluate the correctness of the latent variables and indicators. And, secondly the structural model relationships and predictive power. Contrary to the CB-SEM, where the two stages are consecutive, the PLS-SEM uses the complete model with the relationships between latent variables from the beginning.

Smart PLS (v.3.2.6.) (Ringle et al., 2015) was used to deduce the model. In the following section all the stages and validation statistics are explained in detailed.
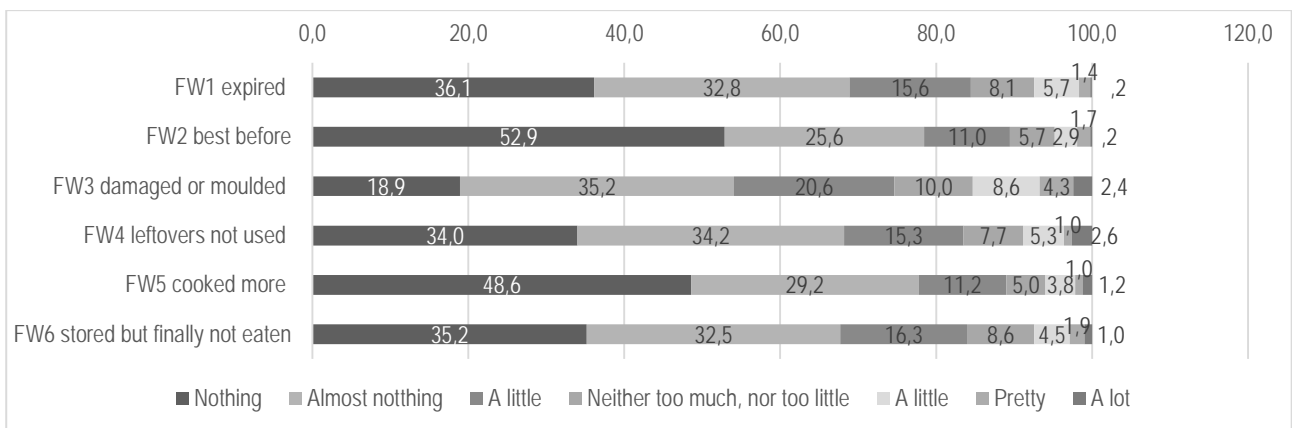
4. Results

4.1. Descriptive results

The first part of this section provides some descriptive results of the different constructs considered in the model. Table 2 summarizes the characteristics of the indicators included in the model, reporting the statements, its mean and standard deviation (SD) as well as the frequency of response distribution within the 7-point Likert scale. These responses have been grouped in three levels: negative from 1-3, neutral 4 and positive form 5-7. We tested the normality of all indicators by means of the Saphiro-Wilk test confirming the non-normal distribution (p-value =0.000) of all observed variables.

Regarding to food related behaviours, respondents revealed to have a disciplined attitude during shopping. In fact, 60.3 % declared they 'buy only what they need' and they 'do a shopping list' (67.2%). Consuming cheap food is important for almost half of the sample (52.2%) and diet seemed to be important in their food choices. Above the 70% of the sample showed interest in eating food 'rich in vitamins' (74.2%), 'low fat food' (70.8%) and 'food free of potential hazardous ingredients' (80.4%).

340 Regarding to waste recycling and prevention habits, the sample affirmed to have a very high
341 recycling and prevention behaviour. For instance, 82% of the households do recycle glass, this
342 percentage decreased to 80%, 70% and 60% in the case of domestic packaging, paper and organic
343 waste, respectively. In terms of waste prevention, both reusing and reduction were included on the
344 survey. The most frequent reusing activity, that 82.3% of respondents declared to do often or
345 always, was trying to repair things before buying new items as well as reusing paper. On reduction
346 activities the most frequent one was using their own shopping bag.

347 With respect to values, respondents reported low materialism values and high environmental
348 concern. Indeed, they most likely tend to disagree on being happier buying more things or acquiring
349 possessions as a sign of achieving. Furthermore, 75% of the sample do not agree on admiring
350 people who own expensive homes, cars and clothes. However, almost half of the sample admits that
351 they would be happier if they owned certain things they don't. As regards environmental concern, a
352 high percentage of respondents agree that if things continue on their present course, we will soon
353 experience a major ecological catastrophe (76.8%). We do not observe the same consensus on the
354 statement 'The so-called "ecological crisis" facing humankind has been greatly exaggerated' where
355 the opinion is more divided and only half of the sample do not agree with it.

356 Concerning food waste generation, most of participants claimed to generate very little food waste
357 (see Fig. 4). The question included the most common situations in where food can be thrown away.
358 The situation with higher mean (2.8 out of 7) is when food has been damaged or moulded.

Figure 4 Food waste behaviour results per situation

14

Table 2 Latent variables and indicators description

		Mean	SD	Distribution within 7-point Likert scale (%)		
				1-3	4	5-7
Purchasing discipline (PUR)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
PUR1	I usually buy only the things I need	4.8	1.7	25.6	14.1	60.3
PUR2	I do a shopping list with what I need when I go shopping	5.1	2.0	22.0	10.8	67.2
Price importance (PI)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
PRI1	It is important to me that food I consume is cheap	4.4	1.7	27.3	20.6	52.2
Diet importance (DIET)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
DIET1	Eating food rich in vitamins is important to me	5.5	1.4	8.6	17.2	74.2
DIET2	Eating low fat food is important to me	5.2	1.6	13.4	15.8	70.8
DIET3	Eating food free of potential hazardous ingredients such as pesticides is important to me	5.8	1.7	12.4	7.2	80.4
Recycling behaviour (REC)	*Could you please indicate how often do you the following? (1 Never - 7 always)*					
REC1	I recycle glass	5.9	1.9	12.4	5.0	82.5
REC2	I recycle paper	5.6	2.0	17.0	7.2	75.8
REC3	I recycle domestic packaging	5.8	1.9	13.2	6.0	80.9
REC4	I recycle organic waste	4.7	2.3	29.7	10.5	59.8
Prevention behaviour (PREV)	*Could you please indicate how often do you the following? (1 Never - 7 always)*					
RED1	I use my own bag when going shopping, rather than one provided by the shop	5.8	1.6	10.0	7.7	82.3
RED2	I buy products that can be used again, rather than disposable items	4.8	1.6	17.2	23.0	59.8
REU1	I try to repair things before buying new items	5.6	1.4	6.7	11.0	82.3
REU2	I reuse paper	5.3	1.9	16.7	9.6	73.7
Materialism values (MAT)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
MAT1	My life would be better if I owned certain things I don't have	4.3	1.9	30.1	20.6	49.3
MAT2	I'd be happier if I could afford to buy more things	3.2	1.8	56.2	18.4	25.4
MAT3	I admire people who own expensive homes, cars and clothes	2.3	1.7	75.6	14.4	10.0
MAT4	Some of the most important achievements in life include acquiring possessions	3.4	1.8	52.6	18.4	28.9
Environmental concern (ENV)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
ENV1	The so-called "ecological crisis" facing humankind has been greatly exaggerated (R)	4.8	1.9	24.9	16.5	58.6
ENV2	If things continue on their present course, we will soon experience a major ecological catastrophe	5.5	1.5	11.2	12.0	76.8
Food waste generation (FW)	*The amount of food I have thrown away in a recent week because …(1 Nothing - 7 A lot)*					
FW1	it has expired is …	2.2	1.3	84.4	8.1	7.4
FW2	it has passed the best before date is...	1.9	1.2	89.5	5.7	4.8
FW3	it has been damaged or moulded such as stale bread, etc. is … (stored in the fridge or cupboards)	2.8	1.5	74.6	10.0	15.3
FW4	I have leftovers and I have not used them for another meal is ...	2.3	1.4	83.5	7.7	8.9
FW5	I cooked more than I needed and I have not used it for another meal is….	1.9	1.3	89.0	5.0	6.0
FW6	I had stored from previous meals but finally I have not eaten is...	2.2	1.3	84.0	8.6	7.4

4.2. Measurement model evaluation

The measurement model was validated following the recommendations of (Hair et al., 2014). There are three main stages to do so: the assessment of item reliability, the convergent validity and the discriminant validity. The model consisted on 26 observed variables (OV) forming eight latent variables (LV). The OV excluded from the model did not accomplish the requirements.

4.2.1. Item reliability

According to the results showed in Table 3, all latent variables' composite reliability (CR) values are above 0.7 which indicates good internal consistency reliability (Fornell and Larcker, 1981). We opted to rely only on the composite reliability as a measure of the internal consistency, to the detriment of the Cronbach's alpha. Cronbach's alpha tends to underestimate the internal consistency and is sensitive to the number of items involved as well as to the sample measure (Hair et al., 2014; Xu et al., 2016). In our case, we have a wide range of LV items composition (a single-item, two items LV, etc.), that can affect the results of the statistic. Therefore, we decided to dismiss Cronbach's alpha criterion from our analysis.

4.2.2. Convergent validity

Convergent validity, which explains the positive correlation of a measure with alternative measures of the same construct, was tested by means of the average variance extracted (AVE). To do so, we first analyse the outer loadings of every indicator and second, we assessed the AVE's values for the LV. All indicators outer loadings are statistically significant as it is shown in Table 3, see t-values (the common used critical values for two-tailed test are 1.96 with 5% of significant level). In addition, most of the outer loadings are above 0.7 which means that the variance shared between the construct and the indicator is larger than the measurement error variance. There are seven outer loadings bellow that rule of thumb, however they are above 0.5. As pointed out by, Hair et al., (2014) citing Hulland, (1999) in social sciences when new scales are developed it is frequent to obtain lower outer loadings. Moreover, we have implemented the outer loading relevance testing for indicators with an outer loading below 0.7. Since the deletion of the outer loading below 0.7 has not increased the AVE and CR we decide to keep those indicators in the model. For a single-item construct (Price importance), the AVE is not an appropriate measure as the outer loading is fixed at 1.00. All of AVE are above 0.5, which indicates that the construct explains more than half of the variance of its indicators and therefore satisfies the criteria of convergent validity (Fornell and Larcker, 1981).

Table 3 Reliability measurements

	outer loading	t-statistic outer loading	Composite Reliability	Average Variance Extracted (AVE)
Purchasing discipline (PUR)			0.774	0.631
PUR1	0.818	11.056		
PUR2	0.770	8.779		
Price importance (PI)			1.000	1.000
PRI1	1.000			
Diet importance (DIET)			0.783	0.548
DIET1	0.757	4.835		
DIET2	0.803	6.356		
DIET3	0.653	4.512		
Recycling behaviour (REC)			0.936	0.786
REC1	0.916	61.966		
REC2	0.915	72.756		
REC3	0.943	101.263		
REC4	0.761	24.994		
Prevention behaviour (PREV)			0.807	0.512
RED1	0.664	12.243		
RED2	0.726	17.624		
REU1	0.720	14.021		
REU2	0.749	17.922		
Materialism values (MAT)			0.814	0.531
MAT1	0.594	6.693		
MAT2	0.849	25.824		
MAT3	0.851	24.844		
MAT4	0.572	5.719		
Environmental concern (ENV)			0.723	0.589
ENV1	0.960	13.417		
ENV2	0.506	2.459		
Food waste generation (FW)			0.888	0.572
FW1	0.641	10.379		
FW2	0.693	12.444		
FW3	0.749	19.696		
FW4	0.811	31.439		
FW5	0.807	21.314		
FW6	0.818	24.361		

397

4.2.3. Discriminant validity

As shown in Table 5, the discriminant validity is satisfied. We examine cross loadings of the indicators to asses to what extend every LV is different from the others, say they are measuring different things. We applied the Fornell-Larcker criterion where we compare the square root of the AVE values (in bold in the diagonal) with the latent variable correlation (off-diagonal).

We tested the possibility of having the prevention behavior break up in two dimensions measured by different constructs as proposed by Barr (2007) in the original scale. However, we detected problems of discriminant validity between them. Thus, both reusing and reducing behaviours have

been considered under the same latent variable called prevention[3]. The higher correlation found

between every pair of LV was between recycling behaviour and prevention behaviour (r=0.539).

Table 5 Fornell-Larcker test of discriminant validity

	DIET	ENV	FW	MAT	PRE	PI	PUR	REC
DIET	**0.740**							
ENV	0.076	**0.767**						
FW	-0.144	-0.048	**0.756**					
MAT	-0.120	-0.151	0.248	**0.729**				
PRE	0.306	0.236	-0.382	-0.293	**0.715**			
PI	0.160	-0.085	0.067	0.210	-0.028	**1.000**		
PUR	0.275	0.029	-0.253	-0.157	0.336	0.096	**0.794**	
REC	0.183	0.170	-0.287	-0.288	0.539	-0.026	0.290	**0.887**

Diagonals in bold represent the square root of each construct's AVE. Off-diagonals are the latent variable correlations.

4.3. Structural model evaluation

Once we have established the reliability and validity of the constructs we proceed to examine the

structural model which estimates hypothesized paths between exogenous and endogenous latent

constructs. It was evaluated by collinearity assessment, path significance, coefficient of

determination and the predictive accuracy.

The first step is to assess structural model for collinearity issues. In the proposed model there were

no presence of co-linearity in the structural model since all Variance Inflation Factors are below the

critical value of 5 (Hair et al., 2014).

PLS is a non-parametric technique. Thus, the bootstrapping procedure needs to be applied to obtain

the significance of the paths. A 5000 sub-samples bootstrapping was applied to compute the

empirical t values of the relationships in the model. Table 6 shows the path coefficients of all

hypotheses and its t-values with the associated p-value.   From the results, we can support

hypotheses 4, 9 and 3.   That is, there is a significant and negative association between waste

---

[3] A factor analysis was employed to decide if reusing   and reducing behaviours can be included in a common factor. A

principal component analysis was conducted on the 8 items with oblique rotation (direct oblim). The Kaiser-Meyer-

Okin measure verified the sampling adequacy for the analysis, KMO = 0.851. Two factors have eigenvalues over

Kaiser's criterion of 1 and in combination explained 65.6% of the variance. The pattern matrix after rotation reveals two

factors representing recycling and prevention. As regards of reduction and reusing variables it is confirmed that they are

not statistically different dimensions.

prevention and food waste (path coeff. = -0.272, t-value = 4.493), a significant and positive association between materialism values and food waste (path coeff. =0.124, t-value 2.504) and finally a significant and negative association between purchasing discipline and food waste. On the contrary, hypotheses 1, 2, 5 and 8 cannot be supported. Non-significant results were found for the negative and direct association between diet importance and food waste (path coeff. = -0.011, t-value=0.216), the direct and positive association between price importance and food waste (path coeff. = 0.049, t-value=1.011), the direct and negative association between recycling behaviour and food waste (path coeff. = -0.075, t-value=1.205) and finally the direst and positive association between environmental concern and food waste (path coeff. = 0.056, t-value=1.023). With regard to other model paths, we can observe a significant relation between materialism values and environmental concern (path coeff. = -0.151, t-value=2.339) supporting hypothesis 10. Finally, environmental concern was significantly, directly and positively linked with both prevention behaviour (path coeff. = 0.236, t-value=4.383) hypothesis 6 and recycling behaviour (path coeff. = 0.170, t-value=3.229) hypothesis 7. All in all, six out of ten hypotheses were supported. Figure 5 presents a summary of the measurement and structural model.

Table 6 Significance analysis of the structural model

Hypotheses	Path	Path coefficient	t-value	p-value
H1	DIET→FW	-0.011	0.216	0.829
H2	PI→FW	0.049	1.011	0.312
H3	PUR→FW	-0.124	2.539	0.011
H4	PRE→FW	-0.272	4.450	0.000
H5	REC→FW	-0.075	1.205	0.228
H6	ENV→PRE	0.236	4.383	0.000
H7	ENV→REC	0.170	3.229	0.001
H8	ENV→FW	0.056	1.023	0.307
H9	MAT→FW	0.124	2.398	0.017
H10	MAT→ENV	-0.151	2.339	0.019

Finally, the overall potential explanatory power of food waste generation in the model equals 19.0% ($R2=0.190$), which is similar to the values found in previous studies analysing waste prevention behaviour (Barr, 2007; Stancu et al., 2016). Low coefficient of determination values as 0.20 can be considered high in the consumer behaviour discipline (Hair et al., 2011; Henseler et al., 2009). All coefficient of determination R^2 values of the latent constructs are shown in Table 7. The power in predicting the rest of exogenous LV is weak, below 6.8% of the variance explained. Yet, by examining the predictive accuracy of the endogenous constructs by means of Stone-Geisser's Q2
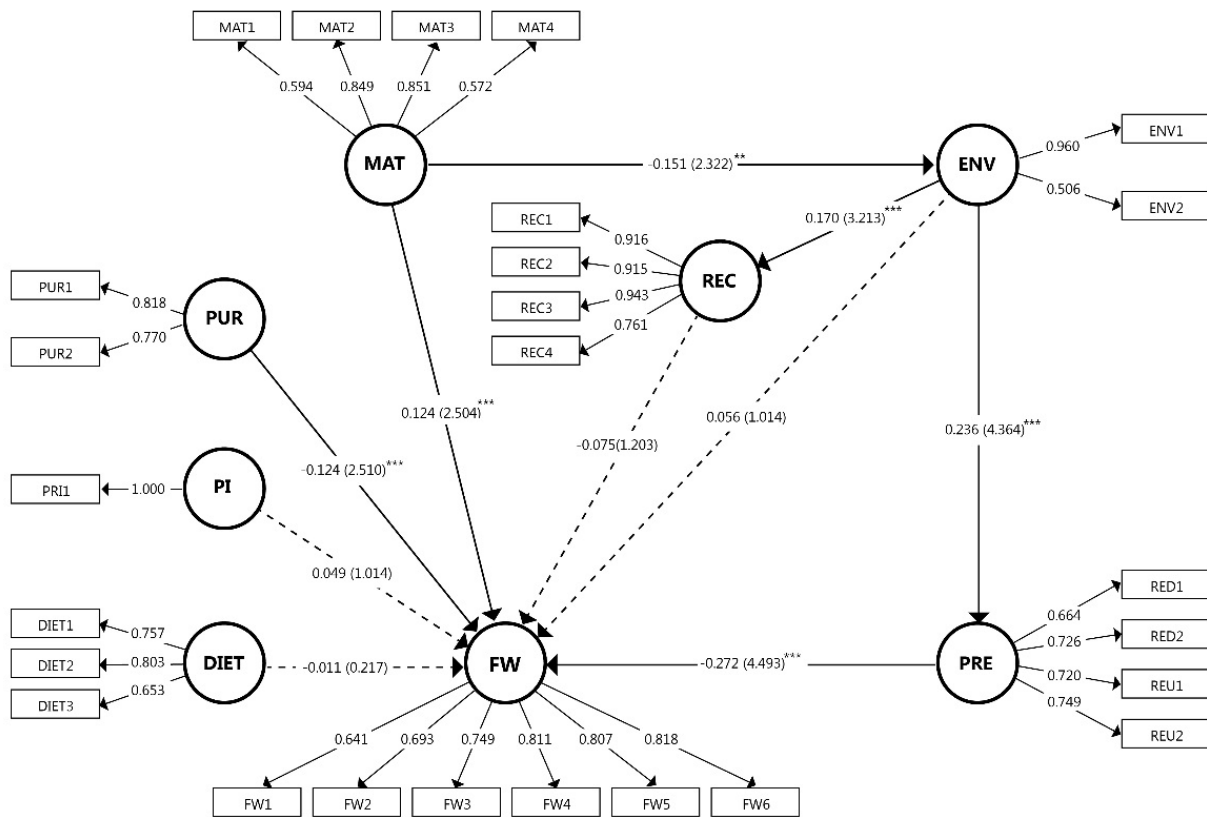
447 value we confirmed the predictive relevance of every endogenous construct in the model

448 (Environment concern = 0.008, Food waste = 0.090, Prevention = 0.025 and Recycling = 0.020). To

449 assess the Q^2 values a blindfolding procedure needs to be applied (see Hair et al., (2014)for details).

450 Values larger than zero indicate a satisfactory predictive relevance. Finally, environmental concern

451 has a significant indirect effect towards food waste through recycling and prevention (0.077, p-

452 value = 0.001).

453 **Table 7 Coefficient of determination and predictive relevance of endogenous latent variables**

	R²	Q²
Environmental concern (ENV)	0.023	0.008
Food waste generation (FW)	0.190	0.090
Prevention behaviour (PREV)	0.056	0.025
Recycling behaviour (REC)	0.029	0.020

454

455

457 **Figure 5 Measurement and structural model to predict consumer food waste behaviour**

458

20

5. Discussion and conclusions

Over the past decade, many public institutions such as FAO, UN, the European commission or USDA among others together with NGOs and further stakeholders have alerted the society about the increasing amount of food being produced but not eaten. Some reports intended to quantify the amount of food lost or wasted within the different stages of the food chain reaching the conclusion that households are important points to be assessed due to the big amount of waste that they generate. In order to reduce household food waste a better understanding of the reasons that build consumers food waste behaviour is needed. Up to now a big part of the food waste literature is focused on the analysis of consumers' food attitudes to explain food waste behaviours. However, we argue that the environmental dimensions of consumers' actions together with consumer values can also play an important role in that behavioural process. To do that we developed a model that combine food-related and waste-related behaviours together with environmental and materialism values to explain household food waste behaviours.

It is the first time, to our knowledge, that food-related and waste-related behaviours and environmental and materialism values are used in the same model to predict food waste generation. To do the analysis we employed PLS-SEM, classified as soft modelling techniques where the exploratory nature of the models prevails to the confirmatory one. The results obtained from our model confirmed our hypothesis that food waste behaviour is a complex issue that needs to be analysed with an integrative approach. Overall, the main results of the present study suggest that consumers' purchasing discipline, waste prevention behaviours and materialism values are useful direct predictors of food waste behaviour. Specifically, high and committed waste prevention behaviour influences to declare low food waste generation. Also, a disciplined purchasing behaviour – namely doing a shopping list or buying only what it is needed - also predicts lower food waste generation. Finally, the higher the materialistic values a consumer has the higher the amount of food waste he/she declares to generate. Moreover, we want to highlight that all three factors resulted equally important to predict food waste. In addition of the direct predictors indirect relations have also been identified. This is the case of environmentalism concern, that indirectly influence food waste perceived behaviour through waste prevention. Finally, we cannot assure that recycling behaviour, price and diet importance have an influence on food waste behaviour.

5.1. Research implications

We contribute to the literature supporting previous research mentioned in section 2 and developing a new angle for the understanding of household food waste generation. New variables considered

21

491   are consumers' purchasing discipline, price importance and diet importance. We are aware that

492   recent studies demonstrated that other food factors such as date labelling knowledge and preference,

493   planning, marketing sale attractions or leftovers management are also important to undertint the

494   formation of consumers' food waste behaviour. Therefore, we suggest a further analysis must be

495   performed consider all those factors together

496   Another contribution refers to the recognition of a relation between high environmental concern and

497   positive recycling behaviour contrary to previous work Barr (2007); Refsgaard and Magnussen

498   (2009); Tonglet et al. (2004a) who noticed that individuals' recycling behaviour is not conditioned

499   by their environmental values and does not determine their waste behaviour. With our results, we

500   cannot ensure that recycling has a predictive effect on food waste generation. It is interesting to

501   highlight that our model reveals a lack of differentiation between two dimensions of waste

502   prevention behaviour that have been considered in other works as conceptually different. Waste

503   reducing and prevention have been jointly treated in this study for three main reasons. First, Barr,

504   (2007), in his seminal paper, already indicated that both variables are very similar in people's mind.

505   Second, previous research carried out in Catalonia (Díaz-Ruiz et al., 2015) corroborated this idea.

506   Third, a discriminant analysis validated it. For future studies, it would worth it keep them separate it

507   in order to evaluate the evolution through time. Moreover, other regions from Europe with other

508   waste management background might have different outcomes.

509   This paper also contributes to the literature by relating materialism with environmentalism concern

510   and with a specific environmental behaviour as food waste generation. The relationship between

511   materialism and environmentalism is negative and significant confirming evidences from Hurst et

512   al.,(2013) meta-analysis and Kilbourne and Pickett's (2008). We also tested in the same model, as

513   recommended by Hurst et al., (2013), a direct relationship between environmentalism values and

514   food waste generation. The relationship was positive and with almost the same intensity than

515   towards environmental concern. These relationships are important, significant and negative,

516   supporting Hurt et al. Moreover our model also supports the studies that relate consumerism culture

517   life with food waste (Parfitt et al., 2010; WRAP et al., 2007; WRAP and Quested, 2009).

518   Finally, it is important to take into account that consumer behaviour is measured on a self-report

519   basis. As seen in Figure 6, people tend to answer that they do not generate food waste, or only a

520   little. Interestingly, results coincide with the answer about the amount of food wasted   in the

521   Eurobarometer Flash EB Series 316 (European Commission, 2011), in which 71% of respondents

522   believe they throw away less than 15% (is the answer with the lowest percentage) of the food they

523   buy. In addition, in the latest version of Euro Barometer Flash EB Series 388 (European

22

Commission, 2014), people tend to say that they generate less food waste than in 2011. It seems that this is a general trend in consumer food waste self-reporting. In Neff et al., (2015) 73% of the sample reported that they discarded less than the average American, or, in Mondéjar-Jiménez et al., (2015), more than 75% of both groups in Italy and Spain reported that they waste none or up to 15% of the food (the second category available) that they purchased. The lack of official and cross-sectional data makes it difficult to evaluate if the estimations of consumers are correct. There is a debate on the literature between the positive and negative effects of self-reporting. On the one hand, Kormos and Gifford (2014) argue that there is a great variance (79%) between the objective behaviour and the self-reported, which remains unexplained. And, on the other hand, Milfont (2009) advocates the lack of empirical studies testing the effect of social desirability on self-reported environmental attitudes and ecological behaviour. We suggest testing different typologies of consumer food waste self-reporting and comparing those tests with real data for future studies. Improving the dependent variable variance will improve the predictive power of the models.

We encourage researchers to include variables from both perspectives, food and waste management to analyse consumers' food waste behaviour and to deepen in other cultural values such as materialism. Statistical modelling and consumers' studies have their limitations on the number of constructs we can capture from a single sample – such as the length of surveys, the cost of collecting data or the statistical performance of multiple hypotheses at the same time. However, there is a wide literature contributing to fill the gaps and improve the models. Our aim with this study was two-fold contributing to the academic literature and providing evidences to policy makers to better address food waste prevention. On the former we acknowledge the need for further empirical evidence and we encourage other researcher to include the variables proposed in the present model to their future studies, prioritizing waste prevention, shopping discipline and materialism values.

5.2. Policy implications

Given the urgency of the situation, structural changes need to be done to achieve significant reductions of food waste as indicated by the United Nations' SDGs. To do so, we encourage policymakers to treat the issue using a multiple dimension strategy, and involving as much expertise as possible to embrace the whole complexity of the food waste conundrum. Using this type of approach behavioural changes may be reached and last over time moving consumer to construct a more sustainable society.

555 We want to highlight the relevance of the prevention behaviour for food waste reduction. We

556 perceive that prevention behaviour is a complex issue very often confused with recycling

557 behaviours. Nevertheless, to prevent is not the same as to recycle, and the food waste prevention

558 campaigns should address the first in order to reduce waste generation. In addition, European

559 environmental legislation (UE 2008/98/EC) recommends to perform prevention actions as the first

560 option in the hierarchy to manage waste, as shown in Figure 1, but to date it does not receive

561 sufficient attention. As cited by the House of Lords (2014) according to FareShare[4]: 'at the

562 moment, we have a waste hierarchy that is completely out of kilter with the economic hierarchy that

563 sits alongside it'. It could create the temptation to prioritize energy recovery over redistribution or

564 prevention. Researchers and policy institutions should be able to facilitate the first stages of the

565 food waste prevention pyramid (see Fig. 3) by providing evidence and promoting certain

566 regulations to encourage food waste prevention. Campaigners might be careful not to confuse

567 consumers with the concepts of recycling, sorting or composting with prevention and not generation

568 of waste. Sorting organic waste or composting at home could be seen as a way of being more

569 concerned about food waste, but research on this specific topic is needed to find out the effect of

570 food sorting.

571 In Europe, food waste prevention emerged from waste sectors. As Lucifero (2016) pointed out food

572 waste definition in Europe is more environmentally oriented and especially waste oriented. This fact

573 could influence food waste prevention initiatives, but our research encourages policymakers to pay

574 greater attention to food-related variables on food waste prevention campaigns. Notwithstanding,

575 simplifying it to mere tips on food management could be counterproductive. The results of our

576 survey and a previous one in the same region (Díaz-Ruiz et al., 2015) revealed high self-evaluations

577 in purchasing discipline, for example, making a shopping list, organizing the fridge or developing

578 cooking skills. Indeed, changing prevention behaviours is not as easy as influencing recycling

579 behaviours, as demonstrated in different studies to date. Prevention behaviours are influenced by a

580 set of actions and values distant from materialistic or direct economic issues. Furthermore, food

581 waste prevention, in particular, could be even more complex than other behaviours, such as energy

582 efficiency in households. As explained by Quested et al. (2013), turning off the lights has a direct

583 consequence, seen by the user (reducing the light bill, for instance), that food waste reduction does

584 not have. Food waste consequences happen outside of home and could be diverse: economic, social

585 and environmental among others. We finally recommend including the discussion of current

586 consumerism lifestyle into the debate. And to include values-based campaigns in the food waste

---

[4] http://www.fareshare.org.uk/

587 prevention agenda as previously proposed by other authors in the environmental field (Hurst et al.,

588 2013). This could be translated in proposing less resources consuming lifestyles, more frugality

589 related to decrease materialism values of individuals.

590 ### 5.3. Final remark

591 To achieve the goal of reducing global food waste, special attention needs to be paid to individual

592 households. It is necessary to understand consumers' behaviour and attitudes towards food waste

593 generation and prevention. Since wasting food is caused by multiple factors, this paper proposes a

594 model to encourage both researchers and policymakers to broaden the perspectives and combine a

595 diversity of approaches to depict factors influencing the generation of food waste. And eventually,

596 more appropriate and effective solutions will be designed.

602 **References**

603 Abeliotis, K., Lasaridi, K., Chroni, C., 2014. Attitudes and behaviour of Greek households
604   regarding food waste prevention. Waste Manag. Res. 32, 237–40.
605   doi:10.1177/0734242X14521681

606 Akter, S., Fosso Wamba, S., Dewan, S., 2017. Why PLS-SEM is suitable for complex modelling?
607   An empirical illustration in big data analytics quality. Prod. Plan. Control 28, 1011–1021.
608   doi:10.1080/09537287.2016.1267411

609 AMB, 2012. Àrea metropolitana - URL http://www.amb.cat/s/home.html (accessed 7.21.14).

610 Barr, S., 2007. Factors Influencing Environmental Attitudes and Behaviors: A U.K. Case Study of
611   Household Waste Management, Environment and Behavior. doi:10.1177/0013916505283421

612 Bio Intelligence Service, 2010. Preparatory Study on Food Waste Across EU 27.
613   doi:10.2779/85947

614 Canali, M., Östergre, K., Amani, P., 2014. Drivers of current food waste generation , threats of
615   future increase and opportunities for reduction. Bologna.

616 Cecere, G., Mancinelli, S., Mazzanti, M., 2014. Waste prevention and social preferences: the role of
617   intrinsic and extrinsic motivations. Ecol. Econ. 107, 163–176.
618   doi:10.1016/j.ecolecon.2014.07.007

619 Chin, W.W., Peterson, R.A., Brown, S.P., 2008. Structural Equation Modeling in Marketing: Some
620   Practical Reminders. J. Mark. Theory Pract. 16, 287–298. doi:10.2753/MTP1069-6679160402

621 Cox, J., Giorgi, S., Sharp, V., Strange, K., Wilson, D.C., Blakey, N., 2010. Household waste
622   prevention--a review of evidence. Waste Manag. Res. 28, 193–219.
623   doi:10.1177/0734242X10361506

624 Díaz-Ruiz, R., Costa-Font, M., Gil, J.M., 2015a. A social perspective on food waste: to what extent
625   consumers are aware of their own food waste, in: Escajedo San-Epifanio, L., De Renobales
626   Scheifler, M. (Eds.), Envisioning a Future without Food Waste and Food Poverty. Wageningen
627   Academic Publishers, pp. 157–164. doi:doi:10.3920/978-90-8686-820-9_18

628 Dunlap, R.E., Van Liere, K.D., Mertig, A.G., Jones, R.E., 2000. New Trends in Measuring
629   Environmental Attitudes: Measuring Endorsement of the New Ecological Paradigm: A
630   Revised NEP Scale. J. Soc. Issues 56, 425–442. doi:10.1111/0022-4537.00176

631 EU, 2008. DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE
632   COUNCIL of 19 November 2008 Directives on waste and repealing certain. European
633   Parliament, European Union.

634 European Comission, 2017. Communication from the commission to the european parliament, the
635   council, the european economic and social committee and the committee of the regions.
636   Closing the loop - An EU action plan for the Circular Economy COM/2015/0614 final.

637 European Commission, 2011. Flash Eurobarometer Series 316, Attitudes of Europeans towards
638   resource efficiency Analytical report Attitudes of Europeans towards resource efficiency.

639 European Commission, 2014. Flash Eurobarometer 388 (Attitudes of Europeans Towards Waste
640   Management and Resource Efficiency). doi:10.2779/14825

641 European Parliament, 2011. Report in how to avoif food wastage: strategies for a more efficient
642   foos chain in the EU (2011/2175(INI)) Committee on Agriculture and Rural Development
643   Rapporteur: Slavatore Caronna.

644 Evans, D., 2011. Blaming the consumer – once again: the social and material contexts of everyday

645   food waste practices in some English households. Crit. Public Health 21, 429–440.

646   doi:10.1080/09581596.2011.608797

647   Fornell, C., Larcker, D.F., 1981. Evaluating Structural Equation Models with Unobservable

648   Variables and Measurement Error. J. Mark. Res. 18, 39. doi:10.2307/3151312

649   Geffen, L. van, Sijtsema, S.J., Újhelyi, K., Eisenhauer, P., Diedrich, A.-C., Brumbauer, T., Díaz-

650   Ruiz, R., López-i-Gelats, F., Reinoso Botsho, D., Winter, M. van H., Herpen, E. van, 2016.

651   National , Qualitative insight on Household & Catering Food Waste. Wageningen, Netherlands

652   Wageningen Univ. Econ. Res. 193.

653   Göbel, C., Teitscheid, P., Ritter, G., 2012. Reducing Food Waste - Identification of causes and

654   courses of action in North. Müntser.

655   Graham-Rowe, E., Jessop, D.C., Sparks, P., 2014. Identifying motivations and barriers to

656   minimising household food waste. Resour. Conserv. Recycl. 84, 15–23.

657   doi:10.1016/j.resconrec.2013.12.005

658   Grandhi, B., Appaiah Singh, J., 2015. What a Waste! A Study of Food Wastage Behavior in

659   Singapore. J. Food Prod. Mark. 22, 1–16. doi:10.1080/10454446.2014.885863

660   Gustavsson, J., Cedeberg, C., Sonesson, U., Otterdijk, R. van, Meybeck, A., 2011. Global food

661   losses and food waste - Extent, causes and prevention. Rome.

662   Hair, J.F., Ringle, C.M., Sarstedt, M., 2011. PLS-SEM: Indeed a Silver Bullet. J. Mark. Theory

663   Pract. 19, 139–152. doi:10.2753/MTP1069-6679190202

664   Hair, J.F.J., Hult, G.T.M., Ringle, C., Sarstedt, M., 2014. A Primer on Partial Least Squares

665   Structural Equation Modeling (PLS-SEM), Long Range Planning.

666   doi:10.1016/j.lrp.2013.01.002

667   Henseler, J., Ringle, C.M., Sinkovics, R.R., 2009. The use of Partial Least Squares Path Modeling

668   in International Marketing. Adv. Int. Mark. 20, 277–319. doi:10.1016/0167-8116(92)90003-4

669   HLPE, 2014. Food losses and waste in the context of sustainable food systems. A Rep. by High

670   Lev. Panel Expert. Food Secur. Nutr. Comm. World Food Secur. Rome 2014.

671   House of Lords, 2014. Counting the cost of food waste: EU food waste prevention. House of Lords,

672   European Union Committee, 10th Report of Session 2013–14.

673 Hurst, M., Dittmar, H., Bond, R., Kasser, T., 2013. The relationship between materialistic values
674   and environmental attitudes and behaviors: A meta-analysis. J. Environ. Psychol. 36, 257–269.
675   doi:10.1016/j.jenvp.2013.09.003

676 Katajajuuri, J.-M., Silvennoinen, K., Hartikainen, H., Heikkilä, L., Reinikainen, A., 2014. Food
677   waste in the Finnish food chain. J. Clean. Prod. 73, 322–329.
678   doi:10.1016/j.jclepro.2013.12.057

679 Kilbourne, W., Pickett, G., 2008. How materialism affects environmental beliefs, concern, and
680   environmentally responsible behavior. J. Bus. Res. 61, 885–893.
681   doi:10.1016/j.jbusres.2007.09.016

682 Kline, R.B., 2011. Principles and practice of structural equation modeling, Methodology in the
683   social sciences. doi:10.1038/156278a0

684 Kormos, C., Gifford, R., 2014. The validity of self-report measures of proenvironmental behavior:
685   Ameta-analytic review. J. Environ. Psychol. 40, 359–371. doi:10.1016/j.jenvp.2014.09.003

686 Kosseva, M.R., 2013. Introduction: Causes and Challenges of Food Wastage, in: Food Industry
687   Wastes. Assessment and Recuperation of Commodities. Elsevier, pp. xv–xxiv.
688   doi:10.1016/B978-0-12-391921-2.00019-6

689 Langley, J., Yoxall, A., Heppell, G., Rodriguez, E.M., Bradbury, S., Lewis, R., Luxmoore, J.,
690   Hodzic, A., Rowson, J., 2010. Food for thought?--A UK pilot study testing a methodology for
691   compositional domestic food waste analysis. Waste Manag. Res. 28, 220–227.
692   doi:10.1177/0734242X08095348

693 Lucifero, N., 2016. Food Loss and Waste in the EU Law between Sustainability of Well-being and
694   the Implications on Food System and on Environment. Agric. Agric. Sci. Procedia 8, 282–289.
695   doi:10.1016/j.aaspro.2016.02.022

696 Mallinson, L.J., Russell, J.M., Barker, M.E., 2016. Attitudes and behaviour towards convenience
697   food and food waste in the United Kingdom. Appetite 103, 17–28.
698   doi:10.1016/j.appet.2016.03.017

699 Milfont, T.L., 2009. The effects of social desirability on self-reported environmental attitudes and
700   ecological behaviour. Environmentalist 29, 263–269. doi:10.1007/s10669-008-9192-2

701 Mondéjar-Jiménez, J.A., Ferrari, G., Secondi, L., Principato, L., 2015. From the table to waste: An

exploratory study on behaviour towards food waste of Spanish and Italian youths. J. Clean. Prod. 138, 8–18. doi:10.1016/j.jclepro.2016.06.018

Neff, R. a., Spiker, M.L., Truant, P.L., 2015. Wasted Food: U.S. Consumers' Reported Awareness, Attitudes, and Behaviors. PLoS One 10, e0127881. doi:10.1371/journal.pone.0127881

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

Parfitt, J., Barthel, M., Macnaughton, S., 2010. Food waste within food supply chains: quantification and potential for change to 2050. Philos. Trans. R. Soc. Lond. B. Biol. Sci. 365, 3065–81. doi:10.1098/rstb.2010.0126

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

Porpino, G., Parente, J., Wansink, B., 2015. Food waste paradox: antecedents of food disposal in low income households. Int. J. Consum. Stud. 39, 619–629. doi:10.1111/ijcs.12207

Porpino, G., Wansink, B., Parente, J.G., 2016. Wasted Positive Intentions: The Role of Affection and Abundance on Household Food Waste. J. Food Prod. Mark. 4446, Forthcoming. doi:10.1080/10454446.2015.1121433

Principato, L., Secondi, L., Pratesi, C.A., 2015. Reducing food waste: an investigation on the behaviour of Italian youths. Br. Food J. 117, 731–748. doi:10.1108/BFJ-10-2013-0314

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, 1–19. doi: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. doi:10.1016/j.resconrec.2013.04.011

Quested, T.E., Parry, A.D., Easteal, S., Swannell, R., 2011. Food and drink waste from households in the UK. Nutr. Bull. 36, 460–467. doi:10.1111/j.1467-3010.2011.01924.x

Refsgaard, K., Magnussen, K., 2009. Household behaviour and attitudes with respect to recycling

731   food waste--experiences from focus groups. J. Environ. Manage. 90, 760–71.

732   doi:10.1016/j.jenvman.2008.01.018

733   Richins, M.L., 2004. The Material Values Scale: Measurement Properties and Development of a

734   Short Form. J. Consum. Res. doi:10.1086/383436

735   Ringle, C., Wende, S., Becker, J., 2015. Ringle, Christian M., Wende, Sven, & Becker, Jan-

736   Michael. (2015). SmartPLS 3. Bönningstedt: SmartPLS. Retrieved from

737   http://www.smartpls.com. Retrieved from.

738   Secondi, L., Principato, L., Laureti, T., 2015. Household food waste behaviour in EU-27 countries:

739   A multilevel analysis. Food Policy 56, 25–40. doi:10.1016/j.foodpol.2015.07.007

740   Setti, M., Falasconi, L., Segrè, A., Cusano, I., Vittuari, M., 2016. Italian consumers' income and

741   food waste behavior. Br. Food J. Iss Br. Food J. Br. Food J. Br. Food J. 118, 1731–1746.

742   doi:10.1108/02656710210415703

743   Stancu, V., Haugaard, P., Lähteenmäki, L., 2016. Determinants of consumer food waste behaviour:

744   Two routes to food waste. Appetite 96, 7–17. doi:10.1016/j.appet.2015.08.025

745   Stefan, V., van Herpen, E., Tudoran, A.A., Lähteenmäki, L., L??hteenm??ki, L., 2013. Avoiding

746   food waste by Romanian consumers: The importance of planning and shopping routines. Food

747   Qual. Prefer. 28, 375–381. doi:10.1016/j.foodqual.2012.11.001

748   Stenmarck, Å., Jensen, C., Quested, T., Moates, G., 2016. Estimates of European food waste levels.

749   Stuart, T., 2009. Waste: Uncovering the Global Food Scandal. Penguin books, London.

750   Sun, M., Trudel, R., 2016. The Effect of Recycling versus Trashing on Consumption: Theory and

751   Experimental Evidence. J. Mark. Res. doi:10.1509/jmr.15.0574

752   Tonglet, M., Phillips, P.S., Bates, M.P., 2004a. Determining the drivers for householder pro-

753   environmental behaviour: Waste minimisation compared to recycling. Resour. Conserv.

754   Recycl. 42, 27–48. doi:10.1016/j.resconrec.2004.02.001

755   Tonglet, M., Phillips, P.S., Read, A.D., 2004b. Using the Theory of Planned Behaviour to

756   investigate the determinants of recycling behaviour: A case study from Brixworth, UK.

757   Resour. Conserv. Recycl. 41, 191–214. doi:10.1016/j.resconrec.2003.11.001

758   Tucker, C. a., Farrelly, T., 2015. Household food waste: the implications of consumer choice in

759   food from purchase to disposal. Local Environ. 21, 682–706.

760   doi:10.1080/13549839.2015.1015972

761   UNEP, 2014. Prevention and reduction of food and drink waste in businesses and households -

762   Guidance for governments, local authorities, businesses and other organisations, Version 1.0.

763   Visschers, V.H.M.M., Wickli, N., Siegrist, M., 2016. Sorting out food waste behaviour: A survey

764   on the motivators and barriers of self-reported amounts of food waste in households. J.

765   Environ. Psychol. 45, 66–78. doi:10.1016/j.jenvp.2015.11.007

766   Watson, M., Meah, A., 2012. Food, Waste And Safety: Negotiating Conflicting Social Anxieties

767   Into The Practices Of Domestic Provisioning. Sociol. Rev. 60, 102–120. doi:10.1111/1467-

768   954X.12040

769   WRAP, Programme, R., Waste, F., Report, F., WRAP, 2007. Food Behaviour Consumer Research :

770   Quantitative Phase.

771   WRAP, Quested, T., 2009. Household Food and Drink Waste in the UK A report containing

772   quantification of the amount and types of household.

773   Xu, D.Y., Lin, Z.Y., Gordon, M.P.R., Robinson, N.K.L., Harder, M.K., 2016. Perceived key

774   elements of a successful residential food waste sorting program in urban apartments:

775   stakeholder views. J. Clean. Prod. 134, 362–370. doi:10.1016/j.jclepro.2015.12.107

776   Zorpas, A.A., Lasaridi, K., 2013. Measuring waste prevention. Waste Manag. 33, 1047–56.

777   doi:10.1016/j.wasman.2012.12.017

778

779

1 **Moving ahead from food-related behaviours: an alternative approach to understand**
2 **household food waste generation**

3 Raquel Diaz-Ruiz[a*], Montserrat Costa-Font[b], José M. Gil[a],

4   a) Center for Agro-Food Economy and Development (CRED-UPC-IRTA), Spain
5 (raquel.diaz.ruiz@upc.edu)

6   b) Land Economy, Environment and Society Research Group. Scotland's Rural College
7 (SRUC). United Kingdom
8

9 Raquel Diaz-Ruiz: raquel.diaz.ruiz@upc.edu
10 Jose M. Gil: chema.gil@upc.edu
11 Center for Agro-Food Economy and Development
12 Address: Edifici ESAB Parc Mediterrani de la Tecnologia
13 C/Esteve Terrades, 8 08860-Castelldefels, Barcelona, Spain
14

15 Montserrat Costa-Font: montse.costafont@sruc.ac.uk

16 Land Economy, Environment and Society Research Group
17 Scotland's Rural College (SRUC)
18 Address: King's Buildings, West Mains Road, Edinburgh EH9 3JG, United Kingdom
19 Corresponding author: Raquel Díaz-Ruiz email: raquel.diaz.ruiz@upc.edu
20

22 **Abstract**

23 Food waste prevention is a hot topic on the policy agenda. According to available data, urgent

24 measures need to be undertaken to significantly reduce the current generation of food waste.

25 However, it is important to thoroughly understand consumers' behaviour to define measures that

26 will lead to a long-lasting change in the situation. The aim of the present work is to analyse

27 consumer food waste behaviour by means of a model that brings together food-related and waste

28 management variables. To do so, a survey was given to 418 consumers of the metropolitan area of

29 Barcelona. Results show that food waste is directly influenced by purchasing discipline, waste

30 prevention habits and materialism values and indirectly influenced by environmental values. This

31 highlights the importance of addressing the problem from different perspectives and emphasizes the

32 importance of considering this problem as a transversal element for policy makers. We suggest that

33 household food waste prevention and reduction needs to be included as a key element in different

34 policy areas.

35

Highlights

- Food waste conceptual model incorporating food-related, waste management and consumers' values.
- Waste prevention, purchasing discipline and materialistic values are direct predictors of food waste behaviour.
- Partial least squares (PLS-SEM) validated the consumers' food waste generation model.

Keywords: food waste, consumer behaviour, structural equation models, waste prevention

1. Introduction

The Food and Agricultural Organization of the United Nations (FAO), among other institutions, reported that global limitations on food availability would exist in the upcoming years up to 2050, which, combined with current food waste, results in an unethical and unsustainable world-feeding situation. Food waste is an environmental, economic, social and food security problem (Kosseva, 2013; Stuart, 2009) that urgently needs to be addressed. The United Nations advocates for it within its Sustainable Development Goals. In particular, goal 12.3 states that "By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" (United Nations, 2015). In Europe, reducing food waste is a key area of the circular economy package (European Comission, 2017).

Some work has been done to quantify food waste. FAO's report in 2011 exposed that one-third of all food produced for human consumption is lost or wasted every year (Gustavsson et al., 2011). In Europe and North America, this equals up to 300 kg of food per capita and year along the food supply chain. Moreover, published data revealed that about 50% of the total amount of food is wasted downstream, mainly at the household level (Bio Intelligence Service, 2010; Gustavsson et al., 2011; Katajajuuri et al., 2014; Stenmarck et al., 2016). The most recent study focused on EU-28 reports that 92 kg of food are discarded per person and year at households where approximately 60% of its volume is edible (Stenmarck et al., 2016).

Although food waste occurs along the whole supply chain, consumer food waste has been reported to be a hot spot and has received special attention. Different studies have analysed consumers' behaviour, awareness and the causes of food waste in such countries as Greece (Abeliotis et al., 2014), Canada (Parizeau et al., 2015), Romania (Stefan et al., 2013), Denmark (Stancu et al., 2016), the United States (Neff et al., 2015; Qi and Roe, 2016), Italy (Principato et al., 2015; Setti et al., 2016), Singapore (Grandhi and Appaiah Singh, 2015) and New Zealand (Tucker and Farrelly,

67   2015). However, despite the increasing interest, the above studies use mainly food-related

68   approaches, leaving waste-related approaches aside. Bearing in mind that the latter is the prevailing

69   approach in food waste prevention campaigns, especially in Europe where food waste legislation is

70   waste oriented (Lucifero, 2016), a more focused analysis on food waste prevention strategies it is

71   necessary in order to identify individual's attitudes, values, behaviours and motivations towards

72   wasting food. Moreover taking into account that food waste is an interdisciplinary issue, it has to be

73   addressed from both waste and food-related perspectives (Kosseva, 2013; Langley et al., 2010).

74   However, the magnitude of the influence of waste and food-related perspectives on consumer

75   behaviour towards wasting food is unknown to date. The aim of the present work is to reach a better

76   understanding of the factors that influence consumers' food waste generation in order to define

77   prevention strategies at the household level and demonstrate that a multidimensional perspective

78   should be undertaken to address the prevention.

79   Up to date, there has been little attention on the factors driving food waste considering different

80   behavioural dimensions simultaneously. Most of the existing academic literature on food waste

81   either examines a partial dimension or is focused on estimating the amount of food wasted.

82   However, consumer's food waste behaviour is a complex phenomenon build as a result of the

83   interaction of several behavioural aspects. The decision-making process that ends on the behaviour

84   of wasting food is shaped by social, economic and personal factors and is the outcome of the

85   interaction of decisions, values and engagements. One of our contributions to the literature is to

86   design a behavioural framework towards household food waste bringing together the two of the

87   main approaches that define the food waste debate nowadays: waste management and food habits.

88   In addition, we include consumers' values as possible predictors and moderators to complete the

89   model. In particular, we focused on an especially significant region of Europe: the metropolitan area

90   of Barcelona. It is one of the most populated areas of Europe located along the Mediterranean coast,

91   with a growing population accounting for more than 3.2 million people in 2015, and it occupies an

92   area of approximately 636 km^2, 48% of which is urbanised (AMB, 2015).

93   This paper is organised as follows. The next section undertakes a literature review to justify why we

94   hypothesise that a variety of actions and motivators could affect the food waste behaviour, arguing

95   that it is not only a food-related issue but a waste management, an environmental concern and

96   materialistic issue, too. This section summarizes the state of the art regarding food waste behaviour

97   at the household level and develops a conceptual model that explains consumers' food waste

98   behaviour. Section three explains the data and method of analysis. The fourth section of the paper

99   reports the main results of the study. Finally, the fifth section discusses the relevance of the results

100 for further research and to define strategies of prevention food waste generation.

101 ## 2.   Theoretical framework: food waste behaviour

102 Previous literature demonstrate that food waste does not respond to a single behavioural dimension

103 but emerges from a wide variety of actions and motivators (Evans, 2011; Quested et al., 2013;

104 Secondi et al., 2015; Setti et al., 2016; UNEP, 2014). Due to its complexity, studies to date have

105 only considered partial analysis from diverse disciplines. Watson and Meah (2012) emphasize the

106 dichotomy between the necessity of safe and nutritious food and the desire to reduce food waste. In

107 that line, our theoretical framework advocates for a combined approach assembling current

108 evidences on the relevance of food and environmental behaviours as well as selected consumer

109 values to explain consumers' food waste generation. We aim at testing the power of food-related

110 attitudes, waste-management behaviours and selected values (environmentalism and materialism) to

111 explain consumers' food waste behaviours.

112 In this section, the paper first attempts to bring together the published evidence from different

113 studies and the distinct identified behaviours towards food waste and to develop a theoretical model

114 considering three main issues: (i) food-related behaviours, (ii) waste management behaviours and

115 (iii) consumers values. It is important to highlight that this research attempts to test that food waste

116 behaviours are not only the results of food related behaviours but of a combination of food

117 unrelated and related behaviours among other elements. Therefore, we did not focus on specific

118 prevention or values regarding food waste, but on general waste prevention habits that we argue

119 could be also related to the generation of food waste.

120 ### 2.1. Food-related habits

121 Household food waste can be considered a food-related behaviour. Some studies intend to

122 determine, by means of different analytical tools, the main causes of food waste generation. The

123 most frequently identified actions that can lead to food waste generation can be grouped in five

124 categories: food purchase, food storage, food preparation, food consumption and lifestyle related to

125 food. Consumers' attitudes, values, knowledge and behaviour towards food might have an effect on

126 the food waste generation (Kosseva, 2013; Parfitt et al., 2010; Principato et al., 2015). We have

127 identified three factors related to food habits: purchasing behaviour, price importance and dietary

128 importance as representatives of food importance towards food waste generation.

129 Some studies have found noticeable conceptual links between food waste and food preferences,

130 such as nutrition and food safety (HLPE 2014), dietary conscientiousness (Parizeau et al., 2015),

131 affection for food (Porpino et al., 2016), food preferences (Bio Intelligence Service, 2010; Canali et

132 al., 2014), domestic routines and habits (Evans, 2011) or the social value of food (Mallinson et al.,

133 2016). Indeed, in the Quested et al. (2011) study, people cited eating a healthy diet as an

134 encouraging factor for reducing food waste.

135 In particular, certain purchasing habits may affect the subsequent household management of food,

136 namely poor planning and shopping routines (Mallinson et al., 2016; Mondéjar-Jiménez et al.,

137 2015; Parizeau et al., 2015; Setti et al., 2016; Stancu et al., 2016; Stefan et al., 2013; Tucker and

138 Farrelly, 2015), excessive buying, (Göbel et al., 2012; Parfitt et al., 2010; Porpino et al., 2015;

139 WRAP et al., 2007) or the symptom of the 'good provider', who is trying to have as much variety

140 as possible for all the household members (Graham-Rowe et al., 2014; Visschers et al., 2016).
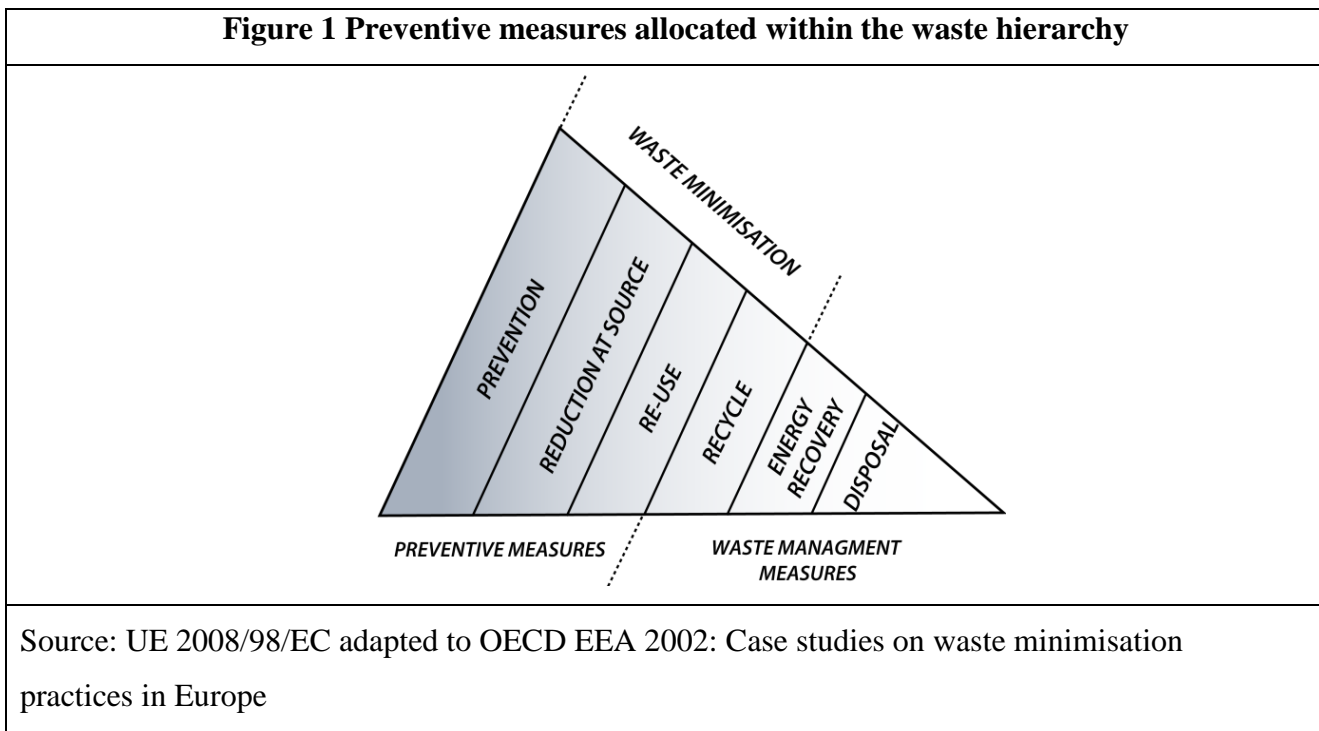
141 Moreover, food price is another element which could have an influence on consumers' food waste

142 generation. This topic has not been studied in detail but some works suggested that marketing

143 attractions such as promotions, also named offer temptation (2x1), can alter consumer's purchase

144 discipline (Mondéjar-Jiménez et al., 2015; Parfitt et al., 2010; Quested et al., 2013; Setti et al.,

145 2016). Moreover, consumer during diverse focus group in Europe pointed out food prices as a

146 possible cause of food generation in the households (Geffen et al., 2016). Finally, Mallinson et al.,

147 (2016) described how a group of consumers who reveled higher levels of food cause were more

148 influenced by promotions and were less price-conscious. However, besides these studies, little is

149 known on the relationship between food price importance and food waste generation.

150 According to the aforementioned studies, we synthesize all food-related causes in three main

151 variables, diet importance, price importance and purchasing discipline. The first three hypotheses

152 are outlined:

- H1: Consumers who reveal a higher concern about the importance of their diet are expected
  to waste less food.
- H2: The importance that consumers place to food price is expected to have an influence on
  consumers' food waste (the effect negative or positive cannot be pre/established form the
  available literature)
- H3: Consumers who reveal a more disciplined purchasing behaviour are expected to waste
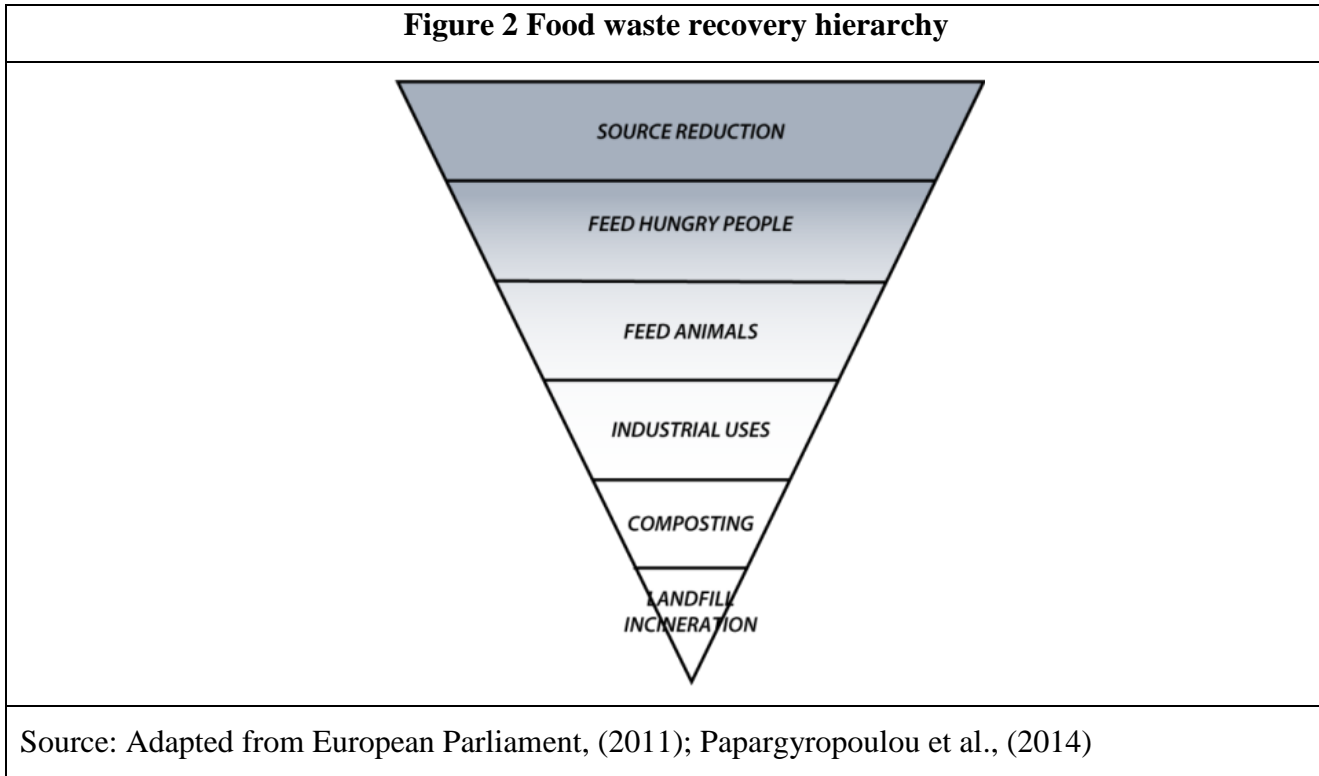 less food.

2.2. Waste management

161   Despite the lack of specific studies on food waste behaviours connected with other waste-related
162   activities, some food waste prevention campaigns have emerged from these specific sectors.
163   Regulation of food waste could be characterized as recent and unspecific, even though there are
164   some documents that highlight the urgent need for its reduction. The Waste Framework Directive
165   (WFD-2008/98/EC) (EU, 2008) clearly defines a waste hierarchy (see Fig. 1) and sets a clear waste
166   prevention procedure as a priority. Within the Waste Framework Directive, the distinction between
167   prevention and minimisation could be misunderstood. Therefore, Figure 1 allocates within the waste
168   hierarchy the different preventive measures that encompass prevention, reduction and re-use and
169   waste management measures from recycling to disposal.

Figure 1 Preventive measures allocated within the waste hierarchy

Source: UE 2008/98/EC adapted to OECD EEA 2002: Case studies on waste minimisation
practices in Europe

170

171   In this sense, to tackle food waste, it is important to differentiate between recycling and prevention
172   concepts. Evidence from the UK indicates that among all strategies to prevent waste, the prevention
173   of food waste is the one with the greatest potential (Cox et al., 2010). There is a specific food waste
174   hierarchy (see Fig. 2) that transposes the hierarchy preferences to food management (European
175   Parliament, 2011; Papargyropoulou et al., 2014).The hierarchy transposes the meanings of
176   prevention, recycling and discarding to food. Thus, first it would be necessary to prevent the
177   generation of food waste. Second, if waste could occur, food should be diverted to humans
178   beforehand. Thirdly, if food cannot be reached by human consumption, it might be used to feed

179 animals by conversion of food surplus into feeding. Next, any other industrial uses are proposed

180 such us generation of energy, bio-energy, etc. And the last two levels of food waste recovery

181 hierarchy are food composting and finally landfilling.

Figure 2 Food waste recovery hierarchy

Source: Adapted from European Parliament, (2011); Papargyropoulou et al., (2014)

182

183 There is a common tendency to relate waste reduction with recycling, although they are not the

184 same concepts. Some examples of waste prevention are the reduction of the amount of plastic

185 employed while shopping such as plastic bags or plastic packaging, repairing objects before buying

186 new ones, re using glass jars, etc. Recycling actions are more commonly known such as recycling

187 plastics, paper, etc. There is a debate in the scientific literature about the relationship between

188 prevention and recycling behaviours. Some authors consider them to be related (Cox et al., 2010)

189 and only the most environmentally encouraged or committed recyclers also act to prevent waste. By

190 contrast, others suggest that waste prevention behaviours are poorly or even negatively correlated

191 with recycling (Barr, 2007; Cecere et al., 2014; Tonglet et al., 2004b). These studies argue that

192 recycling may become a reason for decreasing the effort to reduce waste. Moreover a recent

193 publication found that the positive feelings of recycling can lead to using more quantity of the

194 material needed (Sun and Trudel, 2016). Variables that influence prevention and recycling are

195 diverse. Some authors, such as Barr, (2007); Refsgaard and Magnussen, (2009); Tonglet et al.,

196 (2004a); Zorpas and Lasaridi, (2013) suggested that recycling behaviour is influenced primarily by

197 opportunities, facilities and knowledge and, secondly, by not being deterred by issues of physically

198 recycling (e.g. time, space, inconvenience). Meanwhile, the factors that influence waste prevention

199 that are most cited in the literature are: universalism values and moral motivations, self-

200 responsibility to act, self-efficacy, cost, social norms, habits, strong environmental values and

201 knowledge about environmental politics (see Barr, 2007; Cox et al., 2010; Tonglet et al., 2004b).

202 As noted by previous authors the predictors of both are totally different and are quite diverse.

203 Therefore, we considered both behaviours to be distinguished.

204 Studies like Barr (2007) and Tonglet et al. (2004b) covered the issue of prevention and recycling

205 behaviour in a global scope, without focusing on one single act as in wasting food. More recently,

206 some studies have analysed the influence of food waste disposal, such as the use of the bio-waste

207 container, as an explanatory variable of food waste awareness and behaviour (Tucker and Farrelly,

208 2015; Visschers et al., 2016).

209 In the present work, we characterized food waste behaviour as a specific waste management

210 behaviour (Cecere et al. 2014). Prevention and recycling have different consequences, and we want

211 to find out to what extend food waste is influenced by prevention and recycling behaviours.

212 Thus, the following two hypotheses are considered:

213 • H4: Consumers who reveal more positive prevention behaviour are expected to reveal lower
214   food waste generation.

215 • H5: Consumers who reveal more positive recycling behaviour are expected to reveal lower
216   food waste generation.

217

218 *2.3. Consumers' values*

219 Individuals' environmental concern may be an important indicator impacting food waste behaviour.

220 In fact, recent studies have shown consumers' environmental awareness about food waste

221 consequences (Neff et al., 2015; Principato et al., 2015). In particular, Cecere et al. (2014) indicate

222 a positive effect of Green Attitude on the perceived production of food waste using the

223 Eurobarometer Report of 2011[1] data. Other studies directly link environmental awareness to

224 positive environmental behaviours and waste minimisation (Barr, 2007; Kilbourne and Pickett,

225 2008; Tonglet et al., 2004a). Taking into consideration the relevance of individual environmental

226 values on the formation of specific waste prevention behaviours we propose the following

227 hypotheses to analyse its indirect and direct effect on food waste behaviour:

---

[1] Flash Eurobarometer 316. Attitudes of Europeans Towards Resource Efficiency

228   • H6: Consumers who reveal a high environmental concern are expected to demonstrate more

229   positive waste prevention behaviour.

230   • H7: Consumers who reveal a high environmental concern are expected to demonstrate

231   positive recycling behaviour.

232   • H8: Consumers who reveal a high environmental concern are expected to report less food

233   waste generation

234 Finally, consumption habits in general could also influence food waste as mentioned by Parfitt et al.

235 (2010) and WRAP (2007). We include in the model materialism values as a proxy of consumerism.

236 Materialism understood as a value that attaches importance to material possessions and the pursuit

237 of personal wealth (Richins, 2004). The relationship between materialistic values, environmental

238 awareness and behaviour has been clearly established by previous literature. For instance, Hurst et

239 al., (2013) estimated by means of a meta-analysis the correlation between materialism and

240 environmental awareness, and between materialism and environmental behaviour. They noticed that

241 materialism was negatively and equally related with both environmental awareness and

242 environmental behaviours. Also, materialistic values were found to be negatively related to

243 environmental beliefs, and these beliefs influence environmental awareness and environmental

244 responsible behaviour (Kilbourne and Pickett 2008). Based on this evidence, we propose the final

245 hypotheses for the model that states that:

246   • H9: Individuals' materialistic values have a negative influence on individuals' environmental

247   awareness

248   • H10: Individuals' materialistic values have a negative influence on individuals' food waste
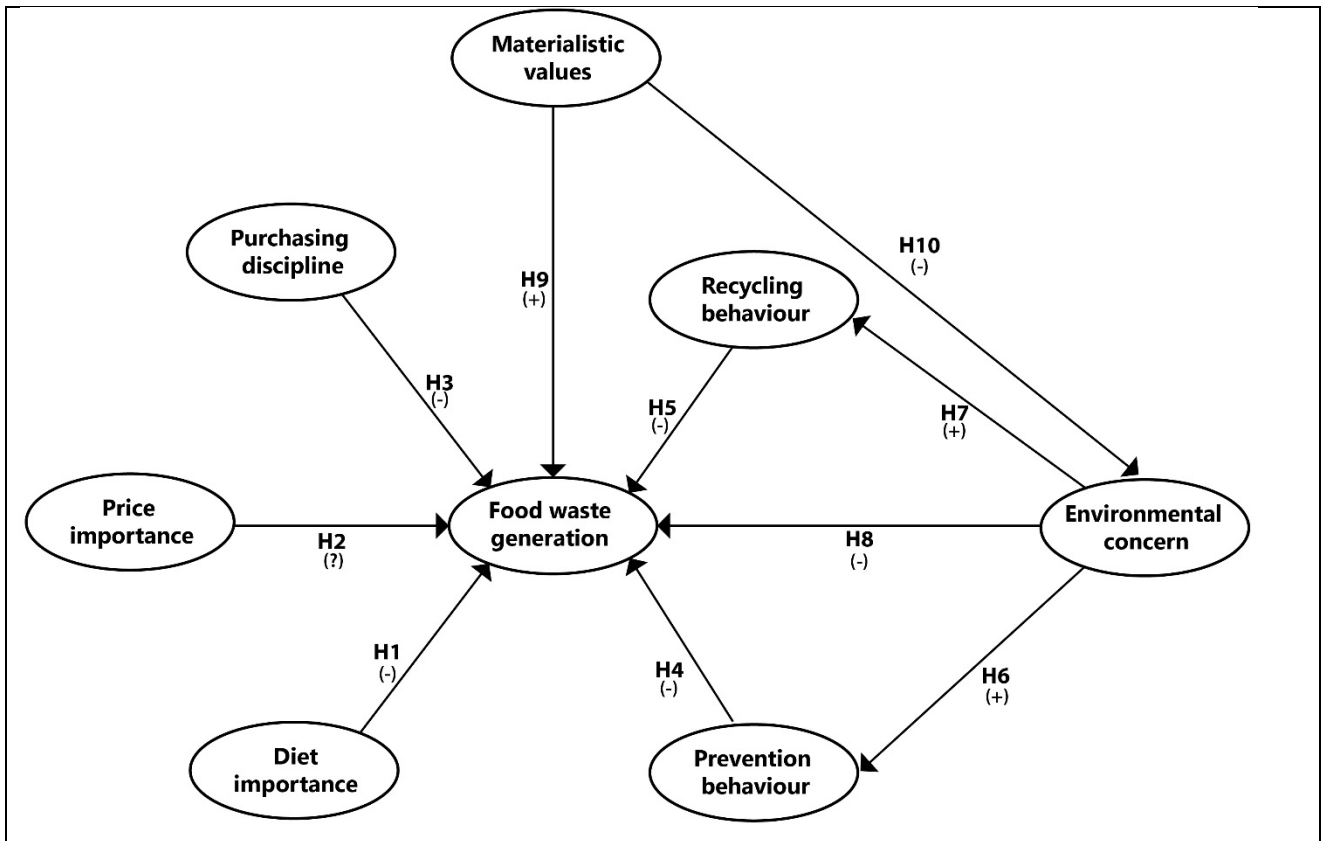
249   behaviour.

250 A theoretical food-waste-values behaviour framework model has been defined (see Fig. 3) by taking

251 into account all the considerations shown above. This model draws some paths of the decision-

252 making process that consumers undertake when defining their food waste behaviour.

253

254

255

Figure 3 Theoretical framework of food waste predictors

256

3. Material and methods

3.1. The sample

259 We drew our sample from a survey conducted in the metropolitan area of Barcelona (Spain) in
260 autumn 2013. We focused on the subset of consumers who were responsible for cooking or food
261 purchase in their households. We distributed the survey on paper and online through different social
262 media platforms and emails. We finally collected 418 responses. Individuals' characteristics are
263 presented in Table 1 such as gender, age, area of residence, education, income and children in
264 charge (see Table 1). Regarding to the implementation method, the questionnaire was, in most of
265 the cases, self-administrated with available assistance in the case it was required (especially old
266 people needed assistance for reading and understanding how to answer). The survey duration was of
267 about 10 minutes. Both pencil-surveys and online form had the same format and order.

268

269

270

271

Table 1 Sample description

	Frequency	*% of the sample*
Gender		
Male	172	41.1
Female	246	58.9
Age >18		
18-34	179	42.8
35-49	110	26.3
50-64	102	24.4
More than 65	28	6.5
Studies		
Basics	84	20.1
Medium/superior	119	28.5
Graduate	211	50.5
Dk/na	4	1
Working status		
Employee	263	62.9
Entrepreneur	36	8.6
Pensioner	40	9.6
Unemployed	71	17.0
Dk/na	8	1.9
Housing structure		
Unipersonal	45	10.8
Couple	106	25.4
Family	234	56.0
Sharing apartment	33	7.9
Children under 16 at home		
None	292	69.9
1	69	16.5
2	37	8.9
3 or more	1	1
Dk/na	16	3.8

273

274 **3.2. Survey and measures**

275 The questionnaire included 44 questions to build the hypothesized model. A seven-point Likert

276 scale was employed for all questions. Questions scales were in many cases adapted from validated

277 scales such as environmentalism (Dunlap et al., 2000), materialism (Kilbourne and Pickett, 2008;

278 Richins, 2004) and waste recycling and waste prevention (Barr, 2007), the remaining scales were

279 designed by the authors based on previous experience. The final model was formed by 24 indicators

280 due to model specifications explained below. Table 2 summarizes the characteristics of all latent

281 variables and indicators included in the model. It can be observed that the model includes three

11

282   constructs to capture food-related behaviours: purchasing discipline defined by two items, price

283   importance formed by one item and finally importance of diet measured by three indicators. Two

284   four-items constructs were considered for waste-related behaviour, recycling and prevention. Next,

285   two dimensions represented consumer's values on materialism, which included four items, and

286   second environmental concern with two items. Finally, food waste generation included six items.

287   The survey had a short introduction[2] asking consumers participation on a food survey. Then, all

288   Agree-Disagree questions (purchasing disciplines, price importance, diet importance, materialism

289   values and environmental concern) were randomly presented, next waste-related questions

290   randomly ordered and finally food waste assessment. Food waste questions were placed at end to

291   avoid interaction between food waste questions and other behaviours under analysis. It has a

292   specific explanation to clarify participants' responses "*Following you should think on the amount of*

293   *food that you have thrown away that otherwise could have been eaten during the past month.*

294   *Everything which cannot be eaten such as potatoes peels, bones, etc. are not included. You may*

295   *think on the food that is thrown away through the trash bin, the organic bin, the compost or what*

296   *you give to your pet.*" Both online and paper survey had the same structure.

3.3. Analytical procedures

298   To test relationships among non-observed variables (latent variables) one may opt to use structural

299   equation modelling (SEM) which is a second-generation type of modelling (Fornell and Larcker,

300   1981; Hair et al., 2014; Kline, 2011). There are two types of SEM, the covariance-based SEM

301   (CBSEM) and the variance based (PLS-SEM). The former is applied to confirm or reject solid

302   theories by estimating the covariance matrix of the data. The latter, is primarily applied in

303   exploratory research to develop new or on early stages theories looking into the variance in the

304   dependent variables (Hair et al., 2014). PLS intends to test how the theory fits the data, the fit of the

305   model in PLS-SEM test the discrepancy between the observed values and the values predicted by

306   the model in question. The objective of PLS is to maximize the variance explained rather than the

307   fit. Due to the novelty approach of combining waste-related, food-related and values-related as a

308   predictors of food waste, we used PLS-SEM to validate the hypotheses formulated above.

309   PLS technique is gaining adepts due to its flexibility in comparing theory and real data, soft

310   distributional assumptions, its exploratory and prediction-oriented nature, its compatibility with

---

[2] Good morning/good afternoon. My name is Raquel Diaz, I am student from the Polytechnic University of Catalonia. We are doing an investigation about food in the metropolitan area. We guarantee complete anonymity of your responses. It would take you around 10 minutes. Could you please collaborate with the study? We appreciate your participation:

311 model complexity and its ease of model interpretation among other. PLS can estimate a model with
312 a large number of latent variables and indicators with small sample sizes (Chin et al., 2008). As
313 noted by Akter et al., (2017), PLS-SEM has been used to analyse more latent variables and
314 including more indicators per model on average than in the CBSEM. In their systematic review,
315 they found that CBSEM accounted for 4.4. latent variables and 14 indicators, whereas PLS 8.12
316 latent variables and 27.42 indicators were included. PLS also gives the flexibility to include one-
317 single item latent variables, it has no a restriction of at least three-items per latent as in CBSEM.
318 To assess the validity of the model, a two-stage analytical procedure is used. First, the assessment
319 of the measurement model to evaluate the correctness of the latent variables and indicators. And,
320 secondly the structural model relationships and predictive power. Contrary to the CB-SEM, where
321 the two stages are consecutive, the PLS-SEM uses the complete model with the relationships
322 between latent variables from the beginning.

323 Smart PLS (v.3.2.6.) (Ringle et al., 2015) was used to deduce the model. In the following section
324 all the stages and validation statistics are explained in detailed.

4. Results
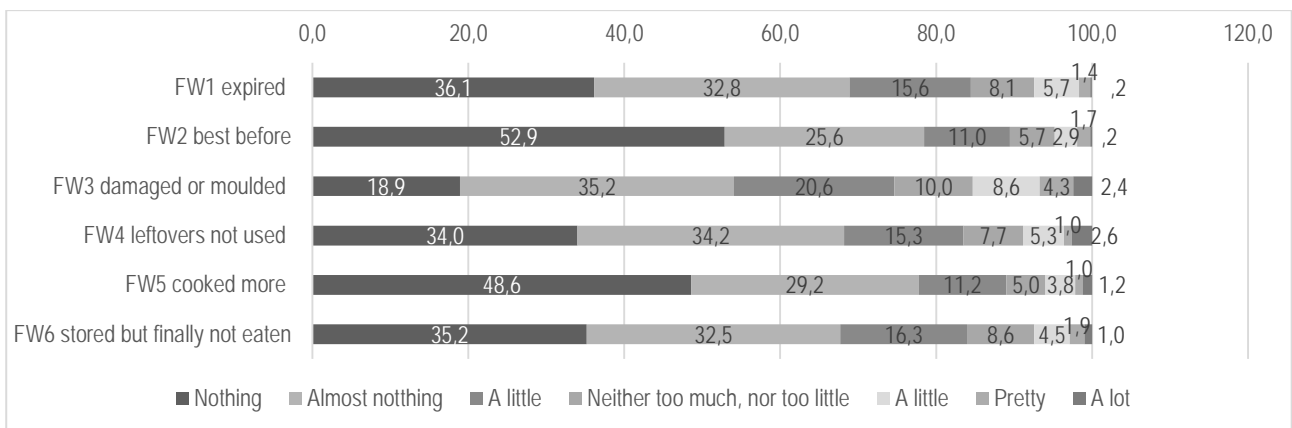
4.1. Descriptive results

327 The first part of this section provides some descriptive results of the different constructs considered
328 in the model. Table 2 summarizes the characteristics of the indicators included in the model,
329 reporting the statements, its mean and standard deviation (SD) as well as the frequency of response
330 distribution within the 7-point Likert scale. These responses have been grouped in three levels:
331 negative from 1-3, neutral 4 and positive form 5-7. We tested the normality of all indicators by
332 means of the Saphiro-Wilk test confirming the non-normal distribution (p-value =0.000) of all
333 observed variables.

334 Regarding to food related behaviours, respondents revealed to have a disciplined attitude during
335 shopping. In fact, 60.3 % declared they 'buy only what they need' and they 'do a shopping list'
336 (67.2%). Consuming cheap food is important for almost half of the sample (52.2%) and diet seemed
337 to be important in their food choices. Above the 70% of the sample showed interest in eating food
338 'rich in vitamins' (74.2%), 'low fat food' (70.8%) and 'food free of potential hazardous ingredients'
339 (80.4%).

Regarding to waste recycling and prevention habits, the sample affirmed to have a very high recycling and prevention behaviour. For instance, 82% of the households do recycle glass, this percentage decreased to 80%, 70% and 60% in the case of domestic packaging, paper and organic waste, respectively. In terms of waste prevention, both reusing and reduction were included on the survey. The most frequent reusing activity, that 82.3% of respondents declared to do often or always, was trying to repair things before buying new items as well as reusing paper. On reduction activities the most frequent one was using their own shopping bag.

With respect to values, respondents reported low materialism values and high environmental concern. Indeed, they most likely tend to disagree on being happier buying more things or acquiring possessions as a sign of achieving. Furthermore, 75% of the sample do not agree on admiring people who own expensive homes, cars and clothes. However, almost half of the sample admits that they would be happier if they owned certain things they don't. As regards environmental concern, a high percentage of respondents agree that if things continue on their present course, we will soon experience a major ecological catastrophe (76.8%). We do not observe the same consensus on the statement 'The so-called "ecological crisis" facing humankind has been greatly exaggerated' where the opinion is more divided and only half of the sample do not agree with it.

Concerning food waste generation, most of participants claimed to generate very little food waste (see Fig. 4). The question included the most common situations in where food can be thrown away. The situation with higher mean (2.8 out of 7) is when food has been damaged or moulded.

Figure 4 Food waste behaviour results per situation

Table 2 Latent variables and indicators description

		Mean	SD	Distribution within 7-point Likert scale (%)		
				1-3	4	5-7
Purchasing discipline (PUR)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
PUR1	I usually buy only the things I need	4.8	1.7	25.6	14.1	60.3
PUR2	I do a shopping list with what I need when I go shopping	5.1	2.0	22.0	10.8	67.2
Price importance (PI)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
PRI1	It is important to me that food I consume is cheap	4.4	1.7	27.3	20.6	52.2
Diet importance (DIET)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
DIET1	Eating food rich in vitamins is important to me	5.5	1.4	8.6	17.2	74.2
DIET2	Eating low fat food is important to me	5.2	1.6	13.4	15.8	70.8
DIET3	Eating food free of potential hazardous ingredients such as pesticides is important to me	5.8	1.7	12.4	7.2	80.4
Recycling behaviour (REC)	*Could you please indicate how often do you the following? (1 Never - 7 always)*					
REC1	I recycle glass	5.9	1.9	12.4	5.0	82.5
REC2	I recycle paper	5.6	2.0	17.0	7.2	75.8
REC3	I recycle domestic packaging	5.8	1.9	13.2	6.0	80.9
REC4	I recycle organic waste	4.7	2.3	29.7	10.5	59.8
Prevention behaviour (PREV)	*Could you please indicate how often do you the following? (1 Never - 7 always)*					
RED1	I use my own bag when going shopping, rather than one provided by the shop	5.8	1.6	10.0	7.7	82.3
RED2	I buy products that can be used again, rather than disposable items	4.8	1.6	17.2	23.0	59.8
REU1	I try to repair things before buying new items	5.6	1.4	6.7	11.0	82.3
REU2	I reuse paper	5.3	1.9	16.7	9.6	73.7
Materialism values (MAT)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
MAT1	My life would be better if I owned certain things I don't have	4.3	1.9	30.1	20.6	49.3
MAT2	I'd be happier if I could afford to buy more things	3.2	1.8	56.2	18.4	25.4
MAT3	I admire people who own expensive homes, cars and clothes	2.3	1.7	75.6	14.4	10.0
MAT4	Some of the most important achievements in life include acquiring possessions	3.4	1.8	52.6	18.4	28.9
Environmental concern (ENV)	*To what extend do you agree with the following statements (1 Totally disagree - 7 Totally agree)*					
ENV1	The so-called "ecological crisis" facing humankind has been greatly exaggerated (R)	4.8	1.9	24.9	16.5	58.6
ENV2	If things continue on their present course, we will soon experience a major ecological catastrophe	5.5	1.5	11.2	12.0	76.8
Food waste generation (FW)	*The amount of food I have thrown away in a recent week because …(1 Nothing - 7 A lot)*					
FW1	it has expired is …	2.2	1.3	84.4	8.1	7.4
FW2	it has passed the best before date is...	1.9	1.2	89.5	5.7	4.8
FW3	it has been damaged or moulded such as stale bread, etc. is … (stored in the fridge or cupboards)	2.8	1.5	74.6	10.0	15.3
FW4	I have leftovers and I have not used them for another meal is ...	2.3	1.4	83.5	7.7	8.9
FW5	I cooked more than I needed and I have not used it for another meal is….	1.9	1.3	89.0	5.0	6.0
FW6	I had stored from previous meals but finally I have not eaten is...	2.2	1.3	84.0	8.6	7.4

4.2. Measurement model evaluation

The measurement model was validated following the recommendations of (Hair et al., 2014). There are three main stages to do so: the assessment of item reliability, the convergent validity and the discriminant validity. The model consisted on 26 observed variables (OV) forming eight latent variables (LV). The OV excluded from the model did not accomplish the requirements.

4.2.1. Item reliability

According to the results showed in Table 3, all latent variables' composite reliability (CR) values are above 0.7 which indicates good internal consistency reliability (Fornell and Larcker, 1981). We opted to rely only on the composite reliability as a measure of the internal consistency, to the detriment of the Cronbach's alpha. Cronbach's alpha tends to underestimate the internal consistency and is sensitive to the number of items involved as well as to the sample measure (Hair et al., 2014; Xu et al., 2016). In our case, we have a wide range of LV items composition (a single-item, two items LV, etc.), that can affect the results of the statistic. Therefore, we decided to dismiss Cronbach's alpha criterion from our analysis.

4.2.2. Convergent validity

Convergent validity, which explains the positive correlation of a measure with alternative measures of the same construct, was tested by means of the average variance extracted (AVE). To do so, we first analyse the outer loadings of every indicator and second, we assessed the AVE's values for the LV. All indicators outer loadings are statistically significant as it is shown in Table 3, see t-values (the common used critical values for two-tailed test are 1.96 with 5% of significant level). In addition, most of the outer loadings are above 0.7 which means that the variance shared between the construct and the indicator is larger than the measurement error variance. There are seven outer loadings bellow that rule of thumb, however they are above 0.5. As pointed out by, Hair et al., (2014) citing Hulland, (1999) in social sciences when new scales are developed it is frequent to obtain lower outer loadings. Moreover, we have implemented the outer loading relevance testing for indicators with an outer loading below 0.7. Since the deletion of the outer loading below 0.7 has not increased the AVE and CR we decide to keep those indicators in the model. For a single-item construct (Price importance), the AVE is not an appropriate measure as the outer loading is fixed at 1.00. All of AVE are above 0.5, which indicates that the construct explains more than half of the variance of its indicators and therefore satisfies the criteria of convergent validity (Fornell and Larcker, 1981).

Table 3 Reliability measurements

	outer loading	t-statistic outer loading	Composite Reliability	Average Variance Extracted (AVE)
Purchasing discipline (PUR)			0.774	0.631
PUR1	0.818	11.056		
PUR2	0.770	8.779		
Price importance (PI)			1.000	1.000
PRI1	1.000			
Diet importance (DIET)			0.783	0.548
DIET1	0.757	4.835		
DIET2	0.803	6.356		
DIET3	0.653	4.512		
Recycling behaviour (REC)			0.936	0.786
REC1	0.916	61.966		
REC2	0.915	72.756		
REC3	0.943	101.263		
REC4	0.761	24.994		
Prevention behaviour (PREV)			0.807	0.512
RED1	0.664	12.243		
RED2	0.726	17.624		
REU1	0.720	14.021		
REU2	0.749	17.922		
Materialism values (MAT)			0.814	0.531
MAT1	0.594	6.693		
MAT2	0.849	25.824		
MAT3	0.851	24.844		
MAT4	0.572	5.719		
Environmental concern (ENV)			0.723	0.589
ENV1	0.960	13.417		
ENV2	0.506	2.459		
Food waste generation (FW)			0.888	0.572
FW1	0.641	10.379		
FW2	0.693	12.444		
FW3	0.749	19.696		
FW4	0.811	31.439		
FW5	0.807	21.314		
FW6	0.818	24.361		

397

4.2.3. Discriminant validity

399 As shown in Table 5, the discriminant validity is satisfied. We examine cross loadings of the

400 indicators to asses to what extend every LV is different from the others, say they are measuring

401 different things. We applied the Fornell-Larcker criterion where we compare the square root of the

402 AVE values (in bold in the diagonal) with the latent variable correlation (off-diagonal).

403 We tested the possibility of having the prevention behavior break up in two dimensions measured

404 by different constructs as proposed by Barr (2007) in the original scale. However, we detected

405 problems of discriminant validity between them. Thus, both reusing and reducing behaviours have

406 been considered under the same latent variable called prevention[3]. The higher correlation found

407 between every pair of LV was between recycling behaviour and prevention behaviour (r=0.539).

408 **Table 5 Fornell-Larcker test of discriminant validity**

	DIET	ENV	FW	MAT	PRE	PI	PUR	REC
DIET	**0.740**							
ENV	0.076	**0.767**						
FW	-0.144	-0.048	**0.756**					
MAT	-0.120	-0.151	0.248	**0.729**				
PRE	0.306	0.236	-0.382	-0.293	**0.715**			
PI	0.160	-0.085	0.067	0.210	-0.028	**1.000**		
PUR	0.275	0.029	-0.253	-0.157	0.336	0.096	**0.794**	
REC	0.183	0.170	-0.287	-0.288	0.539	-0.026	0.290	**0.887**

Diagonals in bold represent the square root of each construct's AVE. Off-diagonals are the latent variable correlations.

409

4.3. Structural model evaluation

411 Once we have established the reliability and validity of the constructs we proceed to examine the

412 structural model which estimates hypothesized paths between exogenous and endogenous latent

413 constructs. It was evaluated by collinearity assessment, path significance, coefficient of

414 determination and the predictive accuracy.

415 The first step is to assess structural model for collinearity issues. In the proposed model there were

416 no presence of co-linearity in the structural model since all Variance Inflation Factors are below the

417 critical value of 5 (Hair et al., 2014).

418 PLS is a non-parametric technique. Thus, the bootstrapping procedure needs to be applied to obtain

419 the significance of the paths. A 5000 sub-samples bootstrapping was applied to compute the

420 empirical t values of the relationships in the model. Table 6 shows the path coefficients of all

421 hypotheses and its t-values with the associated p-value. From the results, we can support

422 hypotheses 4, 9 and 3. That is, there is a significant and negative association between waste

---

[3] A factor analysis was employed to decide if reusing and reducing behaviours can be included in a common factor. A principal component analysis was conducted on the 8 items with oblique rotation (direct oblim). The Kaiser-Meyer-Okin measure verified the sampling adequacy for the analysis, KMO = 0.851. Two factors have eigenvalues over Kaiser's criterion of 1 and in combination explained 65.6% of the variance. The pattern matrix after rotation reveals two factors representing recycling and prevention. As regards of reduction and reusing variables it is confirmed that they are not statistically different dimensions.

prevention and food waste (path coeff. = -0.272, t-value = 4.493), a significant and positive association between materialism values and food waste (path coeff. =0.124, t-value 2.504) and finally a significant and negative association between purchasing discipline and food waste. On the contrary, hypotheses 1, 2, 5 and 8 cannot be supported. Non-significant results were found for the negative and direct association between diet importance and food waste (path coeff. = -0.011, t-value=0.216), the direct and positive association between price importance and food waste (path coeff. = 0.049, t-value=1.011), the direct and negative association between recycling behaviour and food waste (path coeff. = -0.075, t-value=1.205) and finally the direst and positive association between environmental concern and food waste (path coeff. = 0.056, t-value=1.023). With regard to other model paths, we can observe a significant relation between materialism values and environmental concern (path coeff. = -0.151, t-value=2.339) supporting hypothesis 10. Finally, environmental concern was significantly, directly and positively linked with both prevention behaviour (path coeff. = 0.236, t-value=4.383) hypothesis 6 and recycling behaviour (path coeff. = 0.170, t-value=3.229) hypothesis 7. All in all, six out of ten hypotheses were supported. Figure 5 presents a summary of the measurement and structural model.

Table 6 Significance analysis of the structural model

Hypotheses	Path	Path coefficient	t-value	p-value
H1	DIET→FW	-0.011	0.216	0.829
H2	PI→FW	0.049	1.011	0.312
H3	PUR→FW	-0.124	2.539	0.011
H4	PRE→FW	-0.272	4.450	0.000
H5	REC→FW	-0.075	1.205	0.228
H6	ENV→PRE	0.236	4.383	0.000
H7	ENV→REC	0.170	3.229	0.001
H8	ENV→FW	0.056	1.023	0.307
H9	MAT→FW	0.124	2.398	0.017
H10	MAT→ENV	-0.151	2.339	0.019

Finally, the overall potential explanatory power of food waste generation in the model equals 19.0% (R2=0.190), which is similar to the values found in previous studies analysing waste prevention behaviour (Barr, 2007; Stancu et al., 2016). Low coefficient of determination values as 0.20 can be considered high in the consumer behaviour discipline (Hair et al., 2011; Henseler et al., 2009). All coefficient of determination R^2 values of the latent constructs are shown in Table 7. The power in predicting the rest of exogenous LV is weak, below 6.8% of the variance explained. Yet, by examining the predictive accuracy of the endogenous constructs by means of Stone-Geisser's Q2
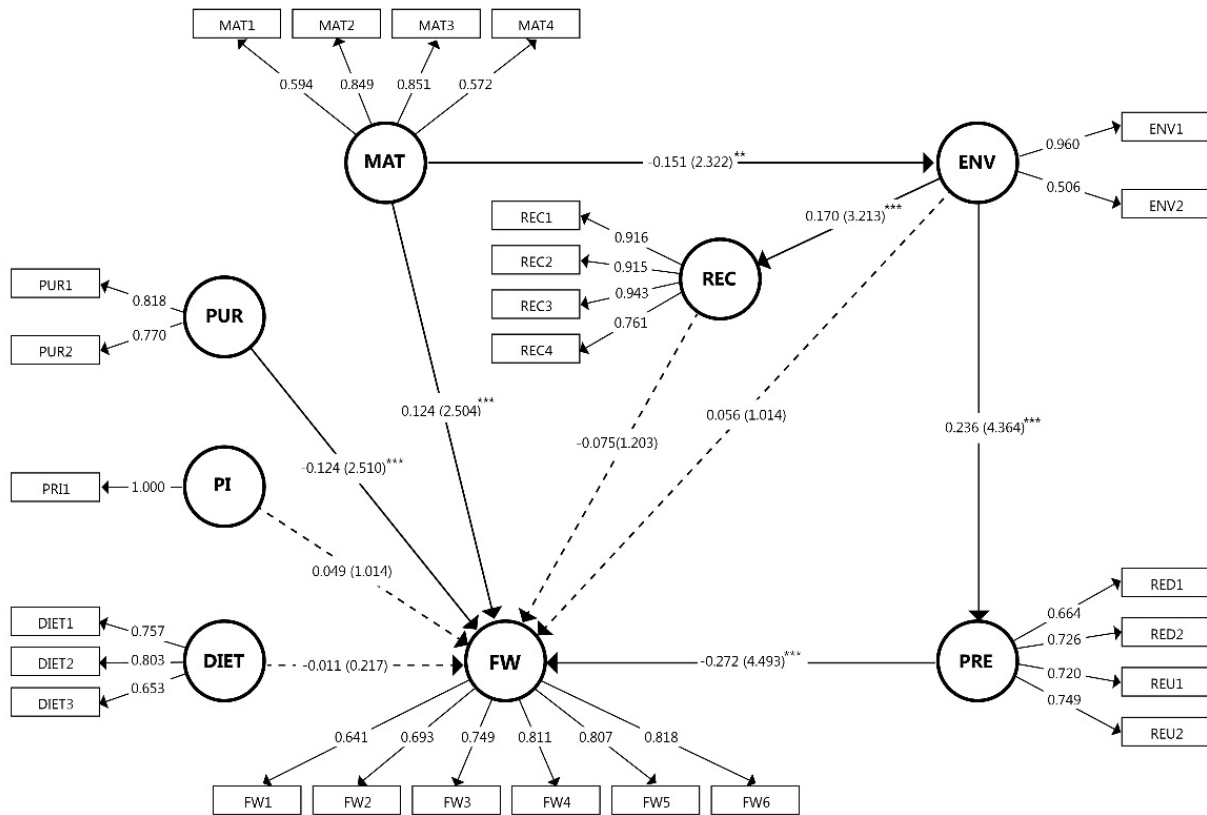
447   value we confirmed the predictive relevance of every endogenous construct in the model

448   (Environment concern = 0.008, Food waste = 0.090, Prevention = 0.025 and Recycling = 0.020). To

449   assess the Q^2 values a blindfolding procedure needs to be applied (see Hair et al., (2014)for details).

450   Values larger than zero indicate a satisfactory predictive relevance. Finally, environmental concern

451   has a significant indirect effect towards food waste through recycling and prevention (0.077, p-

452   value = 0.001).

453   **Table 7 Coefficient of determination and predictive relevance of endogenous latent variables**

	R^2	Q^2
Environmental concern (ENV)	0.023	0.008
Food waste generation (FW)	0.190	0.090
Prevention behaviour (PREV)	0.056	0.025
Recycling behaviour (REC)	0.029	0.020

454

455

457   **Figure 5 Measurement and structural model to predict consumer food waste behaviour**

458

5.   Discussion and conclusions

Over the past decade, many public institutions such as FAO, UN, the European commission or USDA among others together with NGOs and further stakeholders have alerted the society about the increasing amount of food being produced but not eaten. Some reports intended to quantify the amount of food lost or wasted within the different stages of the food chain reaching the conclusion that households are important points to be assessed due to the big amount of waste that they generate. In order to reduce household food waste a better understanding of the reasons that build consumers food waste behaviour is needed. Up to now a big part of the food waste literature is focused on the analysis of consumers' food attitudes to explain food waste behaviours. However, we argue that the environmental dimensions of consumers' actions together with consumer values can also play an important role in that behavioural process. To do that we developed a model that combine food-related and waste-related behaviours together with environmental and materialism values to explain household food waste behaviours.

It is the first time, to our knowledge, that food-related and waste-related behaviours and environmental and materialism values are used in the same model to predict food waste generation. To do the analysis we employed PLS-SEM, classified as soft modelling techniques where the exploratory nature of the models prevails to the confirmatory one. The results obtained from our model confirmed our hypothesis that food waste behaviour is a complex issue that needs to be analysed with an integrative approach. Overall, the main results of the present study suggest that consumers' purchasing discipline, waste prevention behaviours and materialism values are useful direct predictors of food waste behaviour. Specifically, high and committed waste prevention behaviour influences to declare low food waste generation. Also, a disciplined purchasing behaviour – namely   doing a shopping list or buying only what it is needed - also predicts lower food waste generation. Finally, the higher the materialistic values a consumer has the higher the amount of food waste he/she declares to generate. Moreover, we want to highlight that all three factors resulted equally important to predict food waste. In addition of the direct predictors indirect relations have also been identified. This is the case of environmentalism concern, that indirectly influence food waste perceived behaviour through waste prevention. Finally, we cannot assure that recycling behaviour, price and diet importance have an influence on food waste behaviour.

5.1. Research implications

We contribute to the literature supporting previous research mentioned in section 2 and developing a new angle for the understanding of household food waste generation. New variables considered

are consumers' purchasing discipline, price importance and diet importance. We are aware that recent studies demonstrated that other food factors such as date labelling knowledge and preference, planning, marketing sale attractions or leftovers management are also important to undertint the formation of consumers' food waste behaviour. Therefore, we suggest a further analysis must be performed consider all those factors together

Another contribution refers to the recognition of a relation between high environmental concern and positive recycling behaviour contrary to previous work Barr (2007); Refsgaard and Magnussen (2009); Tonglet et al. (2004a) who noticed that individuals' recycling behaviour is not conditioned by their environmental values and does not determine their waste behaviour. With our results, we cannot ensure that recycling has a predictive effect on food waste generation. It is interesting to highlight that our model reveals a lack of differentiation between two dimensions of waste prevention behaviour that have been considered in other works as conceptually different. Waste reducing and prevention have been jointly treated in this study for three main reasons. First, Barr, (2007), in his seminal paper, already indicated that both variables are very similar in people's mind. Second, previous research carried out in Catalonia (Díaz-Ruiz et al., 2015) corroborated this idea. Third, a discriminant analysis validated it. For future studies, it would worth it keep them separate it in order to evaluate the evolution through time. Moreover, other regions from Europe with other waste management background might have different outcomes.

This paper also contributes to the literature by relating materialism with environmentalism concern and with a specific environmental behaviour as food waste generation. The relationship between materialism and environmentalism is negative and significant confirming evidences from Hurst et al.,(2013) meta-analysis and Kilbourne and Pickett's (2008). We also tested in the same model, as recommended by Hurst et al., (2013), a direct relationship between environmentalism values and food waste generation. The relationship was positive and with almost the same intensity than towards environmental concern. These relationships are important, significant and negative, supporting Hurt et al. Moreover our model also supports the studies that relate consumerism culture life with food waste (Parfitt et al., 2010; WRAP et al., 2007; WRAP and Quested, 2009).

Finally, it is important to take into account that consumer behaviour is measured on a self-report basis. As seen in Figure 6, people tend to answer that they do not generate food waste, or only a little. Interestingly, results coincide with the answer about the amount of food wasted in the Eurobarometer Flash EB Series 316 (European Commission, 2011), in which 71% of respondents believe they throw away less than 15% (is the answer with the lowest percentage) of the food they buy. In addition, in the latest version of Euro Barometer Flash EB Series 388 (European

Commission, 2014), people tend to say that they generate less food waste than in 2011. It seems that this is a general trend in consumer food waste self-reporting. In Neff et al., (2015) 73% of the sample reported that they discarded less than the average American, or, in Mondéjar-Jiménez et al., (2015), more than 75% of both groups in Italy and Spain reported that they waste none or up to 15% of the food (the second category available) that they purchased. The lack of official and cross-sectional data makes it difficult to evaluate if the estimations of consumers are correct. There is a debate on the literature between the positive and negative effects of self-reporting. On the one hand, Kormos and Gifford (2014) argue that there is a great variance (79%) between the objective behaviour and the self-reported, which remains unexplained. And, on the other hand, Milfont (2009) advocates the lack of empirical studies testing the effect of social desirability on self-reported environmental attitudes and ecological behaviour. We suggest testing different typologies of consumer food waste self-reporting and comparing those tests with real data for future studies. Improving the dependent variable variance will improve the predictive power of the models.

We encourage researchers to include variables from both perspectives, food and waste management to analyse consumers' food waste behaviour and to deepen in other cultural values such as materialism. Statistical modelling and consumers' studies have their limitations on the number of constructs we can capture from a single sample – such as the length of surveys, the cost of collecting data or the statistical performance of multiple hypotheses at the same time. However, there is a wide literature contributing to fill the gaps and improve the models. Our aim with this study was two-fold contributing to the academic literature and providing evidences to policy makers to better address food waste prevention. On the former we acknowledge the need for further empirical evidence and we encourage other researcher to include the variables proposed in the present model to their future studies, prioritizing waste prevention, shopping discipline and materialism values.

5.2. Policy implications

Given the urgency of the situation, structural changes need to be done to achieve significant reductions of food waste as indicated by the United Nations' SDGs. To do so, we encourage policymakers to treat the issue using a multiple dimension strategy, and involving as much expertise as possible to embrace the whole complexity of the food waste conundrum. Using this type of approach behavioural changes may be reached and last over time moving consumer to construct a more sustainable society.

23

555   We want to highlight the relevance of the prevention behaviour for food waste reduction. We

556   perceive that prevention behaviour is a complex issue very often confused with recycling

557   behaviours. Nevertheless, to prevent is not the same as to recycle, and the food waste prevention

558   campaigns should address the first in order to reduce waste generation. In addition, European

559   environmental legislation (UE 2008/98/EC) recommends to perform prevention actions as the first

560   option in the hierarchy to manage waste, as shown in Figure 1, but to date it does not receive

561   sufficient attention. As cited by the House of Lords (2014) according to FareShare[4]: 'at the

562   moment, we have a waste hierarchy that is completely out of kilter with the economic hierarchy that

563   sits alongside it'. It could create the temptation to prioritize energy recovery over redistribution or

564   prevention. Researchers and policy institutions should be able to facilitate the first stages of the

565   food waste prevention pyramid (see Fig. 3) by providing evidence and promoting certain

566   regulations to encourage food waste prevention. Campaigners might be careful not to confuse

567   consumers with the concepts of recycling, sorting or composting with prevention and not generation

568   of waste. Sorting organic waste or composting at home could be seen as a way of being more

569   concerned about food waste, but research on this specific topic is needed to find out the effect of

570   food sorting.

571   In Europe, food waste prevention emerged from waste sectors. As Lucifero (2016) pointed out food

572   waste definition in Europe is more environmentally oriented and especially waste oriented. This fact

573   could influence food waste prevention initiatives, but our research encourages policymakers to pay

574   greater attention to food-related variables on food waste prevention campaigns. Notwithstanding,

575   simplifying it to mere tips on food management could be counterproductive. The results of our

576   survey and a previous one in the same region (Díaz-Ruiz et al., 2015) revealed high self-evaluations

577   in purchasing discipline, for example, making a shopping list, organizing the fridge or developing

578   cooking skills. Indeed, changing prevention behaviours is not as easy as influencing recycling

579   behaviours, as demonstrated in different studies to date. Prevention behaviours are influenced by a

580   set of actions and values distant from materialistic or direct economic issues. Furthermore, food

581   waste prevention, in particular, could be even more complex than other behaviours, such as energy

582   efficiency in households. As explained by Quested et al. (2013), turning off the lights has a direct

583   consequence, seen by the user (reducing the light bill, for instance), that food waste reduction does

584   not have. Food waste consequences happen outside of home and could be diverse: economic, social

585   and environmental among others. We finally recommend including the discussion of current

586   consumerism lifestyle into the debate. And to include values-based campaigns in the food waste

---

[4] http://www.fareshare.org.uk/

587 prevention agenda as previously proposed by other authors in the environmental field (Hurst et al.,

588 2013). This could be translated in proposing less resources consuming lifestyles, more frugality

589 related to decrease materialism values of individuals.

590 **5.3. Final remark**

591 To achieve the goal of reducing global food waste, special attention needs to be paid to individual

592 households. It is necessary to understand consumers' behaviour and attitudes towards food waste

593 generation and prevention. Since wasting food is caused by multiple factors, this paper proposes a

594 model to encourage both researchers and policymakers to broaden the perspectives and combine a

595 diversity of approaches to depict factors influencing the generation of food waste. And eventually,

596 more appropriate and effective solutions will be designed.

602 **References**

603 Abeliotis, K., Lasaridi, K., Chroni, C., 2014. Attitudes and behaviour of Greek households

604   regarding food waste prevention. Waste Manag. Res. 32, 237–40.

605   doi:10.1177/0734242X14521681

606 Akter, S., Fosso Wamba, S., Dewan, S., 2017. Why PLS-SEM is suitable for complex modelling?

607   An empirical illustration in big data analytics quality. Prod. Plan. Control 28, 1011–1021.

608   doi:10.1080/09537287.2016.1267411

609 AMB, 2012. Àrea metropolitana - URL http://www.amb.cat/s/home.html (accessed 7.21.14).

610 Barr, S., 2007. Factors Influencing Environmental Attitudes and Behaviors: A U.K. Case Study of

611   Household Waste Management, Environment and Behavior. doi:10.1177/0013916505283421

612 Bio Intelligence Service, 2010. Preparatory Study on Food Waste Across EU 27.

613   doi:10.2779/85947

614 Canali, M., Östergre, K., Amani, P., 2014. Drivers of current food waste generation , threats of

615   future increase and opportunities for reduction. Bologna.

616 Cecere, G., Mancinelli, S., Mazzanti, M., 2014. Waste prevention and social preferences: the role of
617   intrinsic and extrinsic motivations. Ecol. Econ. 107, 163–176.
618   doi:10.1016/j.ecolecon.2014.07.007

619 Chin, W.W., Peterson, R.A., Brown, S.P., 2008. Structural Equation Modeling in Marketing: Some
620   Practical Reminders. J. Mark. Theory Pract. 16, 287–298. doi:10.2753/MTP1069-6679160402

621 Cox, J., Giorgi, S., Sharp, V., Strange, K., Wilson, D.C., Blakey, N., 2010. Household waste
622   prevention--a review of evidence. Waste Manag. Res. 28, 193–219.
623   doi:10.1177/0734242X10361506

624 Díaz-Ruiz, R., Costa-Font, M., Gil, J.M., 2015a. A social perspective on food waste: to what extent
625   consumers are aware of their own food waste, in: Escajedo San-Epifanio, L., De Renobales
626   Scheifler, M. (Eds.), Envisioning a Future without Food Waste and Food Poverty. Wageningen
627   Academic Publishers, pp. 157–164. doi:doi:10.3920/978-90-8686-820-9_18

628 Dunlap, R.E., Van Liere, K.D., Mertig, A.G., Jones, R.E., 2000. New Trends in Measuring
629   Environmental Attitudes: Measuring Endorsement of the New Ecological Paradigm: A
630   Revised NEP Scale. J. Soc. Issues 56, 425–442. doi:10.1111/0022-4537.00176

631 EU, 2008. DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE
632   COUNCIL of 19 November 2008 Directives on waste and repealing certain. European
633   Parliament, European Union.

634 European Comission, 2017. Communication from the commission to the european parliament, the
635   council, the european economic and social committee and the committee of the regions.
636   Closing the loop - An EU action plan for the Circular Economy COM/2015/0614 final.

637 European Commission, 2011. Flash Eurobarometer Series 316, Attitudes of Europeans towards
638   resource efficiency Analytical report Attitudes of Europeans towards resource efficiency.

639 European Commission, 2014. Flash Eurobarometer 388 (Attitudes of Europeans Towards Waste
640   Management and Resource Efficiency). doi:10.2779/14825

641 European Parliament, 2011. Report in how to avoif food wastage: strategies for a more efficient
642   foos chain in the EU (2011/2175(INI)) Committee on Agriculture and Rural Development
643   Rapporteur: Slavatore Caronna.

644 Evans, D., 2011. Blaming the consumer – once again: the social and material contexts of everyday

645   food waste practices in some English households. Crit. Public Health 21, 429–440.
646   doi:10.1080/09581596.2011.608797

647 Fornell, C., Larcker, D.F., 1981. Evaluating Structural Equation Models with Unobservable
648   Variables and Measurement Error. J. Mark. Res. 18, 39. doi:10.2307/3151312

649 Geffen, L. van, Sijtsema, S.J., Újhelyi, K., Eisenhauer, P., Diedrich, A.-C., Brumbauer, T., Díaz-
650   Ruiz, R., López-i-Gelats, F., Reinoso Botsho, D., Winter, M. van H., Herpen, E. van, 2016.
651   National , Qualitative insight on Household & Catering Food Waste. Wageningen, Netherlands
652   Wageningen Univ. Econ. Res. 193.

653 Göbel, C., Teitscheid, P., Ritter, G., 2012. Reducing Food Waste - Identification of causes and
654   courses of action in North. Müntser.

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

658 Grandhi, B., Appaiah Singh, J., 2015. What a Waste! A Study of Food Wastage Behavior in
659   Singapore. J. Food Prod. Mark. 22, 1–16. doi:10.1080/10454446.2014.885863

660 Gustavsson, J., Cedeberg, C., Sonesson, U., Otterdijk, R. van, Meybeck, A., 2011. Global food
661   losses and food waste - Extent, causes and prevention. Rome.

662 Hair, J.F., Ringle, C.M., Sarstedt, M., 2011. PLS-SEM: Indeed a Silver Bullet. J. Mark. Theory
663   Pract. 19, 139–152. doi:10.2753/MTP1069-6679190202

664 Hair, J.F.J., Hult, G.T.M., Ringle, C., Sarstedt, M., 2014. A Primer on Partial Least Squares
665   Structural Equation Modeling (PLS-SEM), Long Range Planning.
666   doi:10.1016/j.lrp.2013.01.002

667 Henseler, J., Ringle, C.M., Sinkovics, R.R., 2009. The use of Partial Least Squares Path Modeling
668   in International Marketing. Adv. Int. Mark. 20, 277–319. doi:10.1016/0167-8116(92)90003-4

669 HLPE, 2014. Food losses and waste in the context of sustainable food systems. A Rep. by High
670   Lev. Panel Expert. Food Secur. Nutr. Comm. World Food Secur. Rome 2014.

671 House of Lords, 2014. Counting the cost of food waste: EU food waste prevention. House of Lords,
672   European Union Committee, 10th Report of Session 2013–14.

673 Hurst, M., Dittmar, H., Bond, R., Kasser, T., 2013. The relationship between materialistic values
674   and environmental attitudes and behaviors: A meta-analysis. J. Environ. Psychol. 36, 257–269.
675   doi:10.1016/j.jenvp.2013.09.003

676 Katajajuuri, J.-M., Silvennoinen, K., Hartikainen, H., Heikkilä, L., Reinikainen, A., 2014. Food
677   waste in the Finnish food chain. J. Clean. Prod. 73, 322–329.
678   doi:10.1016/j.jclepro.2013.12.057

679 Kilbourne, W., Pickett, G., 2008. How materialism affects environmental beliefs, concern, and
680   environmentally responsible behavior. J. Bus. Res. 61, 885–893.
681   doi:10.1016/j.jbusres.2007.09.016

682 Kline, R.B., 2011. Principles and practice of structural equation modeling, Methodology in the
683   social sciences. doi:10.1038/156278a0

684 Kormos, C., Gifford, R., 2014. The validity of self-report measures of proenvironmental behavior:
685   Ameta-analytic review. J. Environ. Psychol. 40, 359–371. doi:10.1016/j.jenvp.2014.09.003

686 Kosseva, M.R., 2013. Introduction: Causes and Challenges of Food Wastage, in: Food Industry
687   Wastes. Assessment and Recuperation of Commodities. Elsevier, pp. xv–xxiv.
688   doi:10.1016/B978-0-12-391921-2.00019-6

689 Langley, J., Yoxall, A., Heppell, G., Rodriguez, E.M., Bradbury, S., Lewis, R., Luxmoore, J.,
690   Hodzic, A., Rowson, J., 2010. Food for thought?--A UK pilot study testing a methodology for
691   compositional domestic food waste analysis. Waste Manag. Res. 28, 220–227.
692   doi:10.1177/0734242X08095348

693 Lucifero, N., 2016. Food Loss and Waste in the EU Law between Sustainability of Well-being and
694   the Implications on Food System and on Environment. Agric. Agric. Sci. Procedia 8, 282–289.
695   doi:10.1016/j.aaspro.2016.02.022

696 Mallinson, L.J., Russell, J.M., Barker, M.E., 2016. Attitudes and behaviour towards convenience
697   food and food waste in the United Kingdom. Appetite 103, 17–28.
698   doi:10.1016/j.appet.2016.03.017

699 Milfont, T.L., 2009. The effects of social desirability on self-reported environmental attitudes and
700   ecological behaviour. Environmentalist 29, 263–269. doi:10.1007/s10669-008-9192-2

701 Mondéjar-Jiménez, J.A., Ferrari, G., Secondi, L., Principato, L., 2015. From the table to waste: An

exploratory study on behaviour towards food waste of Spanish and Italian youths. J. Clean. Prod. 138, 8–18. doi:10.1016/j.jclepro.2016.06.018

Neff, R. a., Spiker, M.L., Truant, P.L., 2015. Wasted Food: U.S. Consumers' Reported Awareness, Attitudes, and Behaviors. PLoS One 10, e0127881. doi:10.1371/journal.pone.0127881

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

Parfitt, J., Barthel, M., Macnaughton, S., 2010. Food waste within food supply chains: quantification and potential for change to 2050. Philos. Trans. R. Soc. Lond. B. Biol. Sci. 365, 3065–81. doi:10.1098/rstb.2010.0126

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

Porpino, G., Parente, J., Wansink, B., 2015. Food waste paradox: antecedents of food disposal in low income households. Int. J. Consum. Stud. 39, 619–629. doi:10.1111/ijcs.12207

Porpino, G., Wansink, B., Parente, J.G., 2016. Wasted Positive Intentions: The Role of Affection and Abundance on Household Food Waste. J. Food Prod. Mark. 4446, Forthcoming. doi:10.1080/10454446.2015.1121433

Principato, L., Secondi, L., Pratesi, C.A., 2015. Reducing food waste: an investigation on the behaviour of Italian youths. Br. Food J. 117, 731–748. doi:10.1108/BFJ-10-2013-0314

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, 1–19. doi: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. doi:10.1016/j.resconrec.2013.04.011

Quested, T.E., Parry, A.D., Easteal, S., Swannell, R., 2011. Food and drink waste from households in the UK. Nutr. Bull. 36, 460–467. doi:10.1111/j.1467-3010.2011.01924.x

Refsgaard, K., Magnussen, K., 2009. Household behaviour and attitudes with respect to recycling

731   food waste--experiences from focus groups. J. Environ. Manage. 90, 760–71.

732   doi:10.1016/j.jenvman.2008.01.018

733   Richins, M.L., 2004. The Material Values Scale: Measurement Properties and Development of a

734   Short Form. J. Consum. Res. doi:10.1086/383436

735   Ringle, C., Wende, S., Becker, J., 2015. Ringle, Christian M., Wende, Sven, & Becker, Jan-

736   Michael. (2015). SmartPLS 3. Bönningstedt: SmartPLS. Retrieved from

737   http://www.smartpls.com. Retrieved from.

738   Secondi, L., Principato, L., Laureti, T., 2015. Household food waste behaviour in EU-27 countries:

739   A multilevel analysis. Food Policy 56, 25–40. doi:10.1016/j.foodpol.2015.07.007

740   Setti, M., Falasconi, L., Segrè, A., Cusano, I., Vittuari, M., 2016. Italian consumers' income and

741   food waste behavior. Br. Food J. Iss Br. Food J. Br. Food J. Br. Food J. 118, 1731–1746.

742   doi:10.1108/02656710210415703

743   Stancu, V., Haugaard, P., Lähteenmäki, L., 2016. Determinants of consumer food waste behaviour:

744   Two routes to food waste. Appetite 96, 7–17. doi:10.1016/j.appet.2015.08.025

745   Stefan, V., van Herpen, E., Tudoran, A.A., Lähteenmäki, L., L??hteenm??ki, L., 2013. Avoiding

746   food waste by Romanian consumers: The importance of planning and shopping routines. Food

747   Qual. Prefer. 28, 375–381. doi:10.1016/j.foodqual.2012.11.001

748   Stenmarck, Å., Jensen, C., Quested, T., Moates, G., 2016. Estimates of European food waste levels.

749   Stuart, T., 2009. Waste: Uncovering the Global Food Scandal. Penguin books, London.

750   Sun, M., Trudel, R., 2016. The Effect of Recycling versus Trashing on Consumption: Theory and

751   Experimental Evidence. J. Mark. Res. doi:10.1509/jmr.15.0574

752   Tonglet, M., Phillips, P.S., Bates, M.P., 2004a. Determining the drivers for householder pro-

753   environmental behaviour: Waste minimisation compared to recycling. Resour. Conserv.

754   Recycl. 42, 27–48. doi:10.1016/j.resconrec.2004.02.001

755   Tonglet, M., Phillips, P.S., Read, A.D., 2004b. Using the Theory of Planned Behaviour to

756   investigate the determinants of recycling behaviour: A case study from Brixworth, UK.

757   Resour. Conserv. Recycl. 41, 191–214. doi:10.1016/j.resconrec.2003.11.001

758   Tucker, C. a., Farrelly, T., 2015. Household food waste: the implications of consumer choice in

759   food from purchase to disposal. Local Environ. 21, 682–706.

760   doi:10.1080/13549839.2015.1015972

761   UNEP, 2014. Prevention and reduction of food and drink waste in businesses and households -

762   Guidance for governments, local authorities, businesses and other organisations, Version 1.0.

763   Visschers, V.H.M.M., Wickli, N., Siegrist, M., 2016. Sorting out food waste behaviour: A survey

764   on the motivators and barriers of self-reported amounts of food waste in households. J.

765   Environ. Psychol. 45, 66–78. doi:10.1016/j.jenvp.2015.11.007

766   Watson, M., Meah, A., 2012. Food, Waste And Safety: Negotiating Conflicting Social Anxieties

767   Into The Practices Of Domestic Provisioning. Sociol. Rev. 60, 102–120. doi:10.1111/1467-

768   954X.12040

769   WRAP, Programme, R., Waste, F., Report, F., WRAP, 2007. Food Behaviour Consumer Research :

770   Quantitative Phase.

771   WRAP, Quested, T., 2009. Household Food and Drink Waste in the UK A report containing

772   quantification of the amount and types of household.

773   Xu, D.Y., Lin, Z.Y., Gordon, M.P.R., Robinson, N.K.L., Harder, M.K., 2016. Perceived key

774   elements of a successful residential food waste sorting program in urban apartments:

775   stakeholder views. J. Clean. Prod. 134, 362–370. doi:10.1016/j.jclepro.2015.12.107

776   Zorpas, A.A., Lasaridi, K., 2013. Measuring waste prevention. Waste Manag. 33, 1047–56.

777   doi:10.1016/j.wasman.2012.12.017

778

779