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(Article begins on next page)

Consumers' food cycle and household waste. When behaviors matter

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Highlights

- Household food waste warrants the analysis of the whole consumer's food cycle.
- The more upstream is the phase the stronger is the influence on household waste.
- The gap between purchasing and outcome leads to additional uncertainty.
- Individuals resort to heuristics and deviate from the standard economic model.
- Situational factors (food retail) influence food waste generation in homes.

Abstract: Recent studies have shown that consumers encounter various conflicting motivations that influence the prevention of household food waste. Food choices are rooted in deep-seated judgments, such as emotions, habits, and values, thus raising the cognitive dissonance between motivation and behavior (intention-behavior gap). The complexity of this subject increases when considering that food waste is driven by repetitive, multiple, and hidden individual choices and influenced by a composite set of situational factors. This study argues the presence of a critical distance between food choices and waste generation in homes and this factual interval (behavior-outcome gap) further affects consumer's decision-making when comparing available options. Employing data from a three-year survey of a national representative panel of Italian consumers, this study develops a system of regression models using path analysis methodology. The objective is to measure the relationships between the different phases of the food consumption cycle and rank their contribution to waste. The results suggest that the more upstream the phase, the stronger the influence on food waste generation in homes. Purchasing emerges as the most critical choice of the consumers' food waste cycle. This gap between behavior and outcome adds uncertainty to food decisions, which reverberates on behavioral beliefs and as a result, leads consumers to resort to heuristics. The findings allow for the identification of a set of behavioral patterns with implications on food waste generation. Furthermore, purchasing decisions are exposed to out-of-home contextual factors, suggesting that food retail can affect consumer behaviors relevant to household food waste.

Keywords

Consumer; attitude; behavior; food waste; purchasing; food retail.

46 1. Introduction

47 Why do individuals make and repeat choices that reduce their utility and lead to negative
48 environmental and social impacts? What are the key behavioral factors explaining these apparently
49 irrational actions? These questions assume a high complexity in the context of household food
50 waste.

51 While at the global level, one-third of food production is wasted or lost along the entire food
52 chain (FAO, 2011), in industrialized nations, the largest share of waste is concentrated at the
53 household level (Griffin et al., 2009; Parfitt et al., 2010; Gustavsson et al., 2011; Gunders, 2012). In
54 the EU-28, it amounts to 46% of total and 173 kg food wasted per person each year (Stenmarck et
55 al., 2016). In the United Kingdom, more specifically, food waste represents an average annual cost
56 of £680 in household budget (WRAP, 2011).

57 The magnitude and pervasiveness of household food waste suggest a number of implications.
58 On the one hand, analyses of consumers' food choices (e.g., contingent valuation surveys) should
59 consider the realm of food waste and the implications on their payoff. On the other hand, the
60 drivers of food waste should include not only socioeconomic conditions (Andreasen, 2002; Vermeir
61 and Verbeke, 2006; Evans, 2012, 2011; Farr-Wharton et al., 2014; Setti et al., 2016), but also
62 individual motivations and behaviors pertaining to the general food domain. In fact, when
63 consumers deal with various food resources, their evaluations tend to include a series of volitional
64 factors such as food security, status concerns, time pressure, and food waste. Moreover, food
65 decisions are influenced by deep-rooted and repeated judgments such as emotions, hunger,
66 values, and habits (i.e., "visceral factors"; Lowenstein, 1996; Verplanken et al., 1998; Graham-
67 Rowe et al., 2014). Thus, a high uncertainty level tends to characterize consumers' food choices.

68 These conscious and unconscious behavioral precursors indicate that the performed food
69 behavior can generate an array of outcomes in terms of their intrinsic characteristics, subjective
70 relevance, and moment of perceived attainment. This leads consumers to face a set of personal
71 motivations—for each food behavior—that either compete or cohere with the intention to prevent or
72 reduce food waste. In this assortment, food waste-related motivation can show a cognitive
73 dissonance (Festinger et al., 1956) with the relevant food choices causing an intention-behavior
74 gap (Graham-Rowe et al., 2015). This study argues that a separation between food choices and
75 expected consequence (food waste), that is a behavior-outcome gap, can further influence
76 consumers' decision-making and the achievement of the goal.

77 Indeed, while in the broader waste domain, the separation between action and delayed impact
78 is relatively well-assessed, household food waste is the result of repetitive, multiple, interactive,
79 and sequential food behaviors (i.e., purchasing, storing, and portioning; Quested et al., 2013) that
80 are not fully covered by existing research. Although the various phases of the consumers' food
81 cycle have been taken into consideration, and surveys reveal heterogeneities among different
82 contexts, limited evidence shows major influences of the involved food decisions on household
83 waste generation. This highlights the need for a systemic approach to analyze the behavioral
84 process as a whole. Thus, this study attempts to answer the following research question: which
85 consumer food behavior is crucial in terms of consequences on the generation of household food
86 waste? The envisaged delay with which this food behavioral effect is perceived or experienced is
87 expected to entail a series of implications at both the individual and situational level.

88 As for the consumer, a behavior-outcome gap can deliver an additional degree of uncertainty
89 to food decisions. Considering the behaviors related to food and food waste are private and, thus,
90 in essence not visible, the inherent risks cannot be limited by simply learning from others'
91 experiences. This additional source of uncertainty raises the need for new research on the main
92 non-standard behavioral schemes that can influence the generation of household food waste and,
93 consequently, cause consumers to experience reduced private (and public) benefit or moral

94 concern. Moreover, the expected deviation from rational and reasoned choices can influence
95 consumer's overall decision-making with possible repercussions on its earlier precursors (i.e.,
96 beliefs). This, in turn, can amplify the trade-offs between individuals' motivations when they
97 compare available food options, triggering a feedback loop that further raises the level of
98 uncertainty.

99 At the situational level, the identification of food behavior(s) with a higher impact on household
100 food waste, and their pivotal predictors suggest more precise and effective preventive
101 interventions. Adopting data from a three-year survey of a statistically representative panel of
102 Italian consumers, this study develops a system of regression models using path analysis
103 methodology with three key research objectives. It aims to (i) rank food behaviors in their effect on
104 the generation of household food waste, (ii) deduce the most affected and, thus, critical food
105 behavioral precursor, and (iii) identify possible behavioral patterns consumers can adopt to react to
106 uncertainty. Thus, this study compares the influence of the single phases of a food consumption
107 cycle on household waste and then, analyzes the interactions among them. By identifying crucial
108 consumer decisions and their decisive antecedent, this research intends to contribute to a better
109 understanding of food waste-related behaviors and provide theoretical and operational insights on
110 possible strategies to prevent and reduce household food waste.

111

112 **2. Theoretical background**

113 A well-established behavioral theory that contributes to the understanding of human behaviors
114 is the Theory of Planned Behavior (TPB) (Ajzen, 1991, 2015). This socio-psychological construct
115 provides a general description of an individual's decision-making by identifying the determinants of
116 (food) behavior. With the objective of explaining individual behaviors and their predictors, TPB is
117 being adopted with success in different research fields—from environmental psychology
118 (Thøgersen, 2014; Russell et al., 2017; Schluter et al., 2017) to contingent valuation (Borger and
119 Hattam, 2017) and innovation diffusion (Kiesling et al., 2012)—and particularly, a growing number
120 of studies focused on household food waste.

121 Even if “TPB doesn't assume rationality on the part of the decision maker” (Ajzen, 2015, p.
122 126), the proposed framework largely refers to the cognitive antecedents of behavior. *Beliefs*
123 (considerations) are the earliest behavioral precursors TPB recognizes in individuals' decision-
124 making process. It distinguishes three types of beliefs (behavioral, normative, and control)
125 determined by the subjective perception of a specific factor (strength of belief) and a subjective
126 evaluation. As for behavioral beliefs, which are central to this study's objectives, TPB identifies the
127 former with the discerned consequences resulting from an action (“the subjective probability that
128 behavior produces the outcome in question”, Ajzen, 2015, p. 127). Coherently, the latter is
129 concerned with the normative value of behavioral outcome¹. The (perceived and evaluated)
130 relationship between behavior and its specific effect form the behavioral belief in its dual dimension
131 (awareness and knowledge).

132 In general, the literature on food waste deals with the integration of TPB's beliefs with non-
133 cognitive determinants such as moral norms (Graham-Rowe et al., 2015; Stancu et al., 2016;
134 Mondéjar-Jiménez et al., 2016; Diaz-Ruiz et al., 2018), habits (Visschers et al., 2016), and
135 emotions (Russell et al., 2017). This study, in perspective, analyzes the performance of each food
136 behavior by measuring the impact on household waste generation to elicit the implications for the
137 two components of the behavioral beliefs.

138 Along the process of human decision-making, TPB enrolls behavioral beliefs as the immediate

¹ With reference to normative value, Stern et al. (1999) underline the primordial characteristic of the precursor that implies low adaptability to changes and capacity to explain behavioral performance.

139 antecedents of *attitudes* toward behavior and its outcomes.² According to the sign of the behavioral
140 belief (i.e., subjective evaluation of outcome), attitude expresses positive or aversive thoughts and
141 feelings about behavioral performance (Graham-Rowe et al., 2015; Russell et al., 2017). While in
142 the more general context of food consumption, an individual's attitude can be a relevant predictor
143 of the decision (Ajzen, 2015), findings on household food waste show a high degree of variability.
144 On the one hand, numerous studies have clearly highlighted unfavorable attitudes toward
145 behaviors associated with food waste (outcome), often in terms of guilt (Brook Lyndhurst, 2007;
146 Evans, 2012; Quested et al., 2013; Graham-Rowe et al., 2014, 2015; Parizeau et al., 2015; Stancu
147 et al., 2016). On the other hand, attitude is considered a minor predictor of behaviors generating
148 food waste (Vermeir and Verbeke, 2006; Evans, 2012; Watson and Meah, 2013; Farr-Wharton et
149 al., 2014; Russell et al., 2017; Hebrok and Boks, 2017).

150 Despite the weak role attitude plays in predicting a specific behavior when food waste is the
151 evaluated consequence, in the TPB framework, an individual's attitude is assumed to be the
152 precursor of personal *motivation* (intention). Because each food behavior is typically associated
153 with various outcomes, a cluster of motivations influences consumers' decisions. In particular, the
154 motivation related to food waste can demonstrate a series of relationships with alternative and
155 complementary intentions to carry out a certain food behavior. The literature suggests food security
156 as a major conflicting intention that diverges consumers' attention from food waste reduction to
157 alternative goals. Indeed, food security is not strictly limited to the individual sphere (self-
158 gratification), but involves the desire to avoid the lack of food availability for family or guests (i.e.,
159 risk aversion and status concerns) (Evans, 2012, 2011; Graham-Rowe et al., 2014; Neff et al.,
160 2015; Visschers et al. 2016). Time constraints or pressure are additional reasons that causing
161 consumers (e.g., the youth; WRAP, 2014) to not consider food waste prevention among their
162 priorities. Moreover, some authors find that food safety (i.e., risk aversion and personal
163 preferences) can drive individuals to the adoption of rigid criteria in the assessment of food quality
164 and thus, discard edible food (Kriflik and Yeatman, 2005; Watson and Meah, 2013; WRAP, 2014;
165 Neff et al., 2015; Canali et al., 2017).

166 By contrast, some other studies suggest that the motivations to reduce food waste are mainly
167 supported by moral and ethical reasons (Evans, 2012; Gjerres and Gaiani, 2013; Stefan et al.,
168 2013; Graham-Rowe et al., 2015, 2014; Parizeau et al., 2015), whereas environmental concerns
169 do not appear particularly relevant (Watson and Meah, 2013; Quested et al., 2013; Graham-Rowe
170 et al., 2014). Given the growing attention paid to food quality and practices, health considerations
171 represent another factor that can positively stimulate food waste reduction (Quested et al., 2013;
172 WRAP, 2014; Parizeau et al., 2015).

173 As for economic concerns, recent findings reveal the ambiguity of related motivational
174 patterns. Price variability and income constraints can not only induce consumers to reduce
175 household food waste (Quested et al., 2013; Graham-Rowe et al., 2014; Stancu et al., 2016), but
176 also stimulate over-purchases of discounted, lower-quality foodstuffs that lead to increased
177 frequencies of in-home waste (Setti et al., 2016). While from the perspective of TPB, motivations
178 are the antecedent denoting a specific *behavior*, in food-related decision-making, the heterogeneity
179 of motivations implies, by design, possible inconsistencies with the behavior (cognitive gap). In
180 addition, when considering household food waste, certain moderators might contribute to the
181 misalignment between intention and behavior, such as habits (Graham-Rowe et al., 2015) and
182 perceived behavioral control (Ajzen, 2015). Furthermore, a series of consumers' food behaviors
183 may be held accountable for the growing disposal of foodstuffs; however, owing to local and
184 individual diversity, there is no unanimity in literature on the most impactful decisions.

185 Surveys show that consumers' planning and shopping routines significantly affect the

² Instead, normative and control beliefs are the cognitive antecedents of subjective norms and perceived behavioral control (Ajzen, 2015).

186 generation of household food waste (Brook Lyndhurst, 2007; Evans, 2012; Stefan et al., 2013;
187 Stancu et al., 2016; Mondéjar-Jiménez et al., 2016; Ponis et al., 2017). To this effect, certain
188 studies find that storage knowledge and procedures are the most influencing factors (Farr-Wharton
189 et al., 2014; Graham-Rowe et al., 2014; Parizeau et al., 2015; van Holsteijn and Kemna, 2018),
190 whereas when not directly linked, trained stockpiling practices are considered to play a strong
191 preventive role (Visschers et al., 2016). Attention toward food preparation habits (Parizeau et al.,
192 2015) and adoption of appropriate cooking procedures (Evans, 2011; WRAP, 2014; Graham-Rowe
193 et al., 2014; Stancu et al., 2016) are broadly recognized as effective interventions to reduce waste
194 generation, whereas leftovers are variably classified as either a major (Ventour, 2008; van der
195 Horst, 2012; Ponis et al., 2017) or minor factor of domestic food wastage (Farr-Wharton et al.,
196 2014).

197 The envisaged distance between food-related decisions and food waste generation (behavior-
198 outcome gap) can cause an additional degree of consumer uncertainty. In a similar conclusion, this
199 condition would reverberate on the antecedent behavioral beliefs causing a feedback loop (Ajzen,
200 2015). Understanding this presumed circumstance requires the analysis of individual's possible
201 responses to uncertainty. When dealing with uncertainty, individuals resort to heuristics and adopt
202 non-standard behavioral patterns (e.g., time-inconsistent decisions, excess diversification,
203 dependence on decision framing) that deviate from TPB's assumption of rational and reasoned
204 choices and the economic core (standard) model (DellaVigna, 2009).

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206 **3. Methodology**

207 *3.1 Sampling and data management*

208 This research analyzes data on the food choices of a nationally representative sample of
209 Italian consumers by region, age, and gender. Data are collected through annual computer-aided
210 web interviews (the Waste Watcher Observatory) conducted during 2013–2015 (i.e., 1,706, 1,518,
211 and 1,502 respondents, respectively)³. The first group of response or dependent (categorical
212 dichotomous) variables identifies the individual role of the phases of consumers' choice cycle (i.e.,
213 planning/purchasing, storing, preparing, and eating) in driving household food waste. These four
214 "phase variables" are measured in relation to food behaviors influencing waste generation
215 (respondent selection of at least one item confirms the role of a given phase).

216 The planning/purchasing phase variable as a driver of household food waste is defined using a
217 five-item scale, including incorrect appraisal of food needs and preferences, perception of food
218 insecurity, over-purchase, and weekly shopping. The storing phase variable relates to a four-item
219 scale covering food perishability and expired, moldy, or bad-tasting food. The preparing and eating
220 phase variables are assessed on a one-item scale comprising of over-cooking and plate-leftovers.
221 Next, two sets of explanatory variables are then selected. On the one hand, proximal factors
222 (directly linked to food use) describing consumers' specific food routines and behaviors are
223 associated with each related phase. On the other hand, distal factors depicting socioeconomic
224 conditions that can influence consumers along the entire food choice cycle are included in the
225 dataset (see tables 6–7 in the Appendix).

226 To compare and analyze the contribution of each phase of the consumers' choice cycle to the
227 food waste generation, this research focuses on a second group of response variables. The
228 frequency of household discarded edibles measures the self-reported monthly occurrence of

³ Italy, where consumers are the main responsible for food waste, shows a high level of socioeconomic and cultural heterogeneity among areas, which offers to this study the opportunity to analyze a spectrum of consumers' food behaviors. Additional details on sources of items and data collection process are described in the Appendix.

229 individuals' food waste behavior on an ordinal scale (i.e., never, sometimes, or often). To account
230 for heterogeneity in consumer behaviors when dealing with variety in food resources, the
231 comparative analysis is extended to six product categories—fresh bread, cheese, fruits and
232 vegetables, milk and yoghurt, cold cuts, and eggs—which are selected in relevance to the
233 observed frequency of food waste.

234 *3.1.1 Limitations*

235 Two key issues limit this study's results. Firstly, the gathered variables may be subject to an
236 underestimation. This cognitive bias can be attributed to the formal participation in a survey using
237 computer-assisted web interviewing and the self-assessed measures of food waste drivers and
238 frequency (Ventour, 2008; Parizeau et al., 2015). Despite this limitation, the use of a survey is
239 considered appropriate because the work does not aim at food waste quantification and compared
240 to other methodologies (i.e., food waste diaries), it induces a smaller bias on consumers' food
241 waste behaviors and reports finding as though they are not observed or judged by researchers.

242 Secondly, the adopted data management process assigns heterogeneous sets of constitutive
243 items to the adopted phase variables and, in particular, a higher number to the
244 planning/purchasing and storing stages. However, this can imply an underestimation of the role of
245 the other phases (i.e., preparing and eating) in stimulating the generation of household food waste.
246 Nevertheless, it should be emphasized that the choice of at least one item is assumed to be
247 sufficient to consider the related phase relevant. Moreover, this does not hinder the storing phase
248 from having the weakest influence on the waste frequency, while food-preparing activities remain a
249 significant determinant of household waste.

250 *3.2 Methodological approach*

251 A system of regression models is implemented according to the path analysis methodology
252 (Wright, 1934; Mueller, 1996) for the three cumulated years and following a two-step approach.

253 Firstly, a set of logistic models is developed to identify the main drivers of the single phases of
254 the consumer's food choice cycle that contribute to food waste generation (Hosmer et al., 2013).
255 For each of the four analyzed segments of the cycle, the regression procedure assesses which
256 covariates, among the proximal and distal explanatory factors, are significantly related to the stage
257 responsibility for food waste (dependent phase variable). At each step, the influences of the
258 previous phases on the role of the currently modeled phase are included as potentially additional
259 explanatory variables.

260 Secondly, the study further develops six specific partial proportional odds regression models
261 (PPOM) (Peterson and Harrell, 1990) to rank the phases of consumers' food choice cycle
262 according to their contribution to household waste for each selected food item. The models identify
263 and measure the relationships between a set of covariates (e.g., phase variables and distal
264 explanatory factors) and the dependent level of (ordinal frequency of) household food waste (Fig.
265 1).

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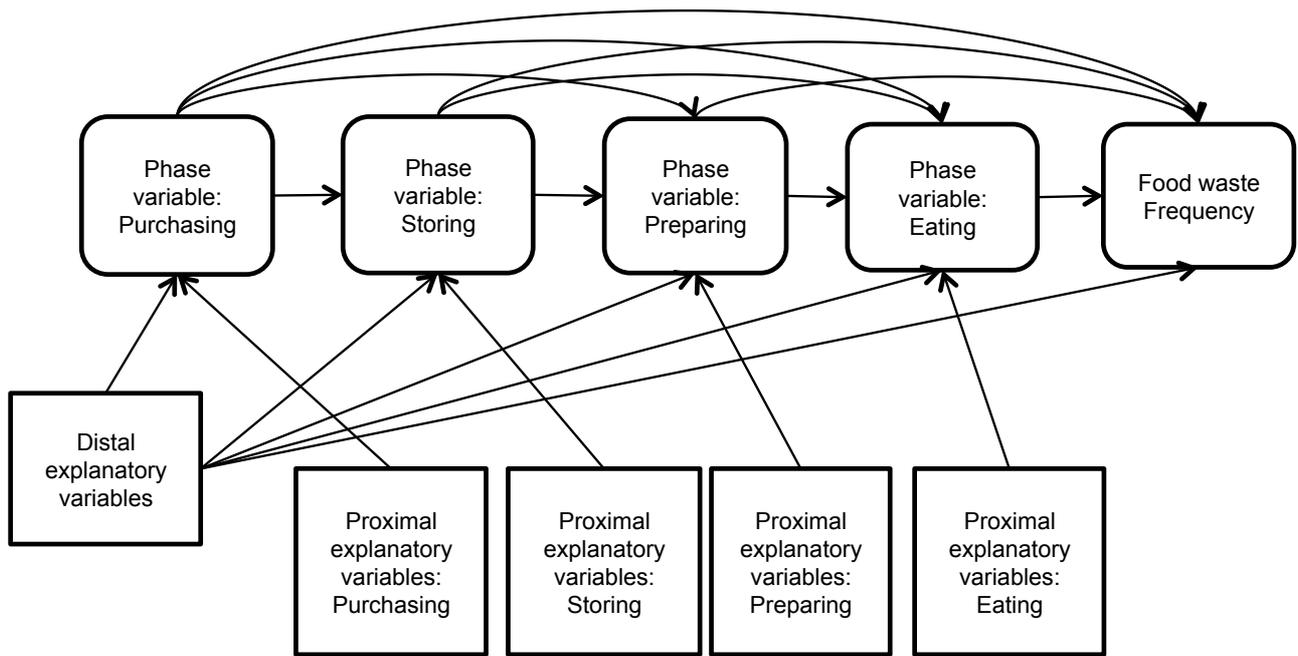


Fig. 1. Consumer's food waste cycle and path diagram: regression models framework

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The use of the PPOM concepts is motivated by their coherence with the odds assumption and nature of the modeled variables. Conversely, the standard statistical modeling technique for ordinal response variables, namely the proportional odds model (POM or ordinal logistic model), may not ensure the coherence of the results with the major proportional odds assumption. The PPOM framework is preferred since odds ratios related to certain explanatory variables are not restricted to being equal for all the increasing levels of the ordinal response variable (Peterson and Harrell, 1990).

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According to these considerations, a PPOM is developed for each food category by adopting a three-stage procedure:

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1. implement the PPOM that includes non-proportional odds for all explanatory variables;
2. identify explanatory variables by means of statistical hypothesis tests to assess the equivalence of odds ratios that satisfy the proportional odds assumption; and
3. develop the PPOM considering only non-proportional odds explanatory variables identified in the previous stage.

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For all the regression models, the significant results indicate odds ratio (OR) values with 95% confidence intervals (CI). For the logistic models, the odds ratios represent multiplicative coefficients on the odds of the related phase variable generating household food waste. In the case of PPOMs, the odds ratios describe multiplicative coefficients on the odds of the higher level of food waste frequency in the home (e.g., often). In particular, two odds ratios are considered when PPOMs measure non-proportional odds explanatory variables. The first OR compares food waste frequency (response level) "often" with "sometimes" or "never," while the second OR compares "often" or "sometimes" with "never".

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An OR value of less than one indicates that the associated category of explanatory variables has a lower frequency of household food waste than that of the reference category. For each logistic and partial proportional odds model, the goodness-of-fit is measured using general chi-square statistic and associated p-values, which ascertain the adherence to the stated assumption and significance of the results.

298 4. Results

299 The respondents are equally distributed by gender and mainly belong to the central classes in
300 terms of household size and age (e.g., 2—4 family members and 35—64 years; see Table 6 in the
301 Appendix). Approximately 54% of the respondents hold a secondary education diploma, while 26%
302 completed a primary education, and the remaining 20% had a university degree. Although
303 perceived monetary wealth marginally improves during the observed period, about 60% of the
304 respondents mention difficult economic conditions.

305 Several patterns emerge for main food routines and behaviors (proximal variables; Table 6,
306 Appendix): shopping lists represent a tool regularly adopted by about 50% of the respondents,
307 frequency of shopping is relatively high (2—3 times per week and every 2 days for about 50%),
308 seasonal and local food products are largely preferred, and special offers are often prioritized.
309 Although the respondents attest—in their large majority—a general concern regarding generation
310 of food waste in the home, the frequency of waste increases during the analyzed three-year period
311 and reaches high values for a large share of the respondents and different food products (see
312 Table 8 in the Appendix). These results reveal that 65% of respondents (sometimes or often)
313 discard fruits and vegetables. With a similar frequency of waste, 35%—38% respondents throw
314 away their dairy products and bread and about 30% wasted cold cuts and eggs.

315 Considering the connection between the purchasing phase and food waste generation, the
316 logistic model emphasizes the role of both distal and proximal explanatory factors of provisioning
317 food play (Table 1). On the one hand, a more active attitude toward food waste prevention
318 characterizes the members of larger households. This is revealed by the adoption of specific
319 measures during the provisioning phase such as the use of shopping lists. On the other hand, the
320 concentration of shopping responsibility on a single person and preference accorded to special
321 offers and out-of-season products are the main constitutive variables that make the purchasing
322 stage a driver of food waste.

323 The findings for the storing phase highlight a positive relationship between in-home food
324 stockpiling and waste generation: the higher the amount of food stored, the greater the waste
325 (Table 2). This is influenced by different categories of distal factors such as household size and
326 education level. Put differently, other storing routines and behaviors, such as the use of expired
327 foodstuffs and adoption of sustainable food management practices, constitute concrete actions in
328 the fight against food waste. In the preparing phase, food waste drivers present significant regional
329 differences: for instance, consumers living in the central and southern regions tend to discard food
330 more frequently while cooking (Table 3). In addition, there is a strong relationship between large
331 household groups and food waste generation during food preparation, whereas family size does
332 not have a considerable effect on final consumption (eating phase; Table 4).

333 The different stages of consumers' food cycle present well-identifiable characteristics with
334 specific food waste drivers and overall, show a clear pattern of inter-relationships (phase variables;
335 see Tables 2—4). As for food waste generation within households, food purchasing significantly
336 influences the contribution of the preparation phase. In turn, the preparation phase affects eating
337 activities, whereas storing is deemed an independent phase with limited linkages with other
338 segments of the food cycle.

339 Considering both the phase and distal variables, the series of PPOMs developed by this study
340 identifies the main determinants of the in-home waste frequency of six selected foodstuffs, and
341 enables comparisons among the roles each behavioral phase plays (Table 5; see also Tables 9—
342 14 in the Appendix). According to some recent studies (Section 2), the results show that
343 purchasing followed by preparing are the key phases of household food waste generation for all
344 the analyzed products. Storing, on the other hand, limits its influence to lower frequency cases of

345 waste (i.e., sometimes) and acts as a waste-preventing phase for the more perishable products
346 (i.e., dairies, fruits and vegetables, and cold cuts). Finally, eating is a significant driving phase only
347 for the waste of fresh bread in the home.

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Table 1. Logistic model: “Planning/Purchasing” phase's drivers of household food waste.

Variable	Category	Reference	OR	95% CI	P-value
Use of shopping list	Sometimes	Never	0.98	(0.77 - 1.25)	0.8903
	Always		0.67	(0.53 - 0.86)	0.0013
Weekly household food expenditure	50 - 100 €	0 - 50 €	1.39	(1.11 - 1.73)	0.0041
	100 - 200 €		1.63	(1.28 - 2.07)	<.0001
	200 - 300 €		1.75	(1.27 - 2.41)	0.0006
	More than 300 €		1.94	(1.19 - 3.14)	0.0074
Take advantage of special offers	Often	Sometimes / Never	1.27	(1.06 - 1.53)	0.0088
	Always		1.13	(0.94 - 1.37)	0.1983
Person responsible for shopping	Always the same	Different	1.23	(1.05 - 1.45)	0.0104
Shopping strategy	Pragmatic	Low-cost	1.02	(0.77 - 1.34)	0.8886
	High quality		1.18	(0.88 - 1.59)	0.2676
Frequency of food shopping	Every 2 days	Every day	1.22	(0.90 - 1.65)	0.1978
	2/3 times per week		1.09	(0.81 - 1.48)	0.5766
	1 time per week		1.42	(1.02 - 1.99)	0.0394
	Every 15 days or more		1.09	(0.78 - 1.51)	0.6199
Frequency of non-seasonal products purchasing	Rarely	Never	1.66	(1.24 - 2.22)	0.0006
	Sometimes		2.43	(1.80 - 3.29)	<.0001
	Often		3.28	(2.21 - 4.85)	<.0001
Frequency of non-local food purchasing	Rarely	Never	0.93	(0.70 - 1.23)	0.5882
	Sometimes		0.95	(0.71 - 1.27)	0.7125
	Often		0.90	(0.62 - 1.31)	0.5969
Gender	Female	Male	0.88	(0.78 - 1.00)	0.0523
Macro region	Center	North-West	1.05	(0.87 - 1.26)	0.6364
	Islands		0.96	(0.77 - 1.20)	0.7322
	North-East		0.94	(0.78 - 1.13)	0.4839
	South		1.19	(0.99 - 1.42)	0.0656
Household size	2	1	0.80	(0.64 - 1.02)	0.0681
	3		0.84	(0.65 - 1.07)	0.1535
	4		0.67	(0.52 - 0.87)	0.0023
	>4		0.52	(0.38 - 0.72)	<.0001
Perception of monetary wealth	Many difficulties	Feeling poor	1.36	(0.98 - 1.89)	0.0664
	Some difficulties		1.62	(1.20 - 2.20)	0.0018
	Safely		1.70	(1.24 - 2.31)	0.0008
Education level	High school	Primary / middle school	1.04	(0.87 - 1.23)	0.6895
	Master degree		1.20	(0.97 - 1.48)	0.0937
	PHD		1.18	(0.85 - 1.62)	0.3228
Age	18-34	35-64	1.04	(0.90 - 1.22)	0.5936
	65+		0.91	(0.77 - 1.09)	0.3171

Goodness-of-fit of the model: Chi-square statistic = 253.0, df=40, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

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Table 2. Logistic model: “Storing” phase’s drivers of household food waste.

Variable	Category	Reference	OR	95% CI	P-value
Planning/Purchasing phase	Yes	No	0.51	(0.45 - 0.59)	<.0001
Person responsible for storing	Always the same	Different	0.83	(0.69 - 1.00)	0.0438
Use of expired products	Reuse	Throw away	0.79	(0.66 - 0.95)	0.0104
	Other destinations		0.52	(0.41 - 0.66)	<.0001
Gender	Female	Male	0.94	(0.82 - 1.08)	0.3812
Macro region	Center	North-West	0.90	(0.74 - 1.11)	0.3210
	Islands		0.86	(0.67 - 1.10)	0.2263
	North-East		0.93	(0.76 - 1.15)	0.5184
	South		0.78	(0.64 - 0.95)	0.0123
Household size	2	1	1.31	(1.03 - 1.66)	0.0283
	3		1.38	(1.08 - 1.76)	0.0112
	4		1.08	(0.84 - 1.38)	0.5629
	>4		1.67	(1.20 - 2.34)	0.0027
Perception of monetary wealth	Many difficulties	Feeling poor	1.39	(1.00 - 1.92)	0.0493
	Some difficulties		1.18	(0.88 - 1.58)	0.2586
	Safely		1.12	(0.83 - 1.51)	0.4624
Education level	High school	Primary / middle school	1.32	(1.10 - 1.58)	0.0024
	Master degree		1.54	(1.23 - 1.94)	0.0002
	PHD		1.68	(1.17 - 2.41)	0.0048
Age	18-34	35-64	0.97	(0.82 - 1.14)	0.6932
	65+		0.94	(0.77 - 1.14)	0.5038

Goodness-of-fit of the model: Chi-square statistic = 189.1, df=23, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

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Table 3. Logistic model: “Preparing” phase’s drivers of household food waste.

Variable	Category	Reference	OR	95% CI	P-value
Storing phase	Yes	No	0.93	(0.77 - 1.13)	0.4637
Planning/Purchasing phase	Yes	No	1.37	(1.15 - 1.63)	0.0005
Person responsible for preparing	Always the same	Different	0.98	(0.76 - 1.27)	0.8946
Gender	Female	Male	0.90	(0.76 - 1.07)	0.2303
Macro region	Center	North-West	1.60	(1.22 - 2.10)	0.0007
	Islands		1.66	(1.22 - 2.26)	0.0014
	North-East		1.22	(0.91 - 1.62)	0.1807
	South		2.11	(1.64 - 2.71)	<.0001
Household size	2	1	1.34	(0.91 - 1.99)	0.1439
	3		2.05	(1.39 - 3.02)	0.0003
	4		2.62	(1.77 - 3.86)	<.0001
	>4		2.72	(1.74 - 4.24)	<.0001
Perception of monetary wealth	Many difficulties	Feeling poor	1.03	(0.66 - 1.60)	0.9076
	Some difficulties		1.40	(0.94 - 2.10)	0.0988
	Safely		1.17	(0.78 - 1.77)	0.4496
Education level	High school	Primary / middle school	1.22	(0.95 - 1.55)	0.1177
	Master degree		1.22	(0.91 - 1.65)	0.1845
	PHD		0.98	(0.61 - 1.58)	0.9482
Age	18-34	35-64	1.16	(0.95 - 1.42)	0.1381
	65+		1.20	(0.93 - 1.55)	0.1546

Goodness-of-fit of the model: Chi-square statistic = 148.3, df=22, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

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Table 4. Logistic model: “Eating” phase’s drivers of household food waste.

Variable	Category	Reference	OR	95% CI	P-value
Preparing phase	Yes	No	2.27	(1.58 - 3.25)	<.0001
Storing phase	Yes	No	0.50	(0.37 - 0.69)	<.0001
Planning/Purchasing phase	Yes	No	0.79	(0.58 - 1.09)	0.1566
Frequency of lunch at home	Sometimes	Rarely / Never	1.31	(0.57 - 3.00)	0.5289
	Often		1.46	(0.63 - 3.35)	0.3754
	Nearly always		1.27	(0.57 - 2.84)	0.5533
	Always		1.34	(0.61 - 2.95)	0.4667
Frequency of dinner at home	Often	Sometimes / Rarely / Never	1.10	(0.50 - 2.40)	0.8169
	Nearly always		1.06	(0.50 - 2.22)	0.8832
	Always		0.83	(0.39 - 1.78)	0.6361
Gender	Female	Male	0.80	(0.59 - 1.09)	0.1550
Macro region	Center	North-West	0.66	(0.39 - 1.11)	0.1169
	Islands		1.52	(0.92 - 2.51)	0.1035
	North-East		1.05	(0.66 - 1.68)	0.8405
	South		1.30	(0.84 - 2.01)	0.2382
Household size	2	1	0.50	(0.30 - 0.83)	0.0071
	3		0.70	(0.42 - 1.14)	0.1519
	4		0.55	(0.32 - 0.93)	0.0265
	>4		0.84	(0.44 - 1.60)	0.5901
Perception of monetary wealth	Many difficulties	Feeling poor	1.04	(0.52 - 2.12)	0.9059
	Some difficulties		0.80	(0.42 - 1.54)	0.5076
	Safely		1.07	(0.56 - 2.07)	0.8339
Education level	High school	Primary / middle school	0.76	(0.51 - 1.13)	0.1694
	Master degree		0.81	(0.50 - 1.34)	0.4147
	PHD		0.50	(0.20 - 1.24)	0.1345
Age	18-34	35-64	1.09	(0.75 - 1.59)	0.6548
	65+		1.51	(1.00 - 2.30)	0.0524

Goodness-of-fit of the model: Chi-square statistic = 75.2, df=29, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

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Table 5. Partial Proportional Odds Model: phase variables and waste frequencies per food category.

Phase variable	Response level	Odds Ratio					
		Fresh bread	Cheese	Vegetables and Fruits	Milk and Yoghurt	Cold cuts	Eggs
Planning/Purchasing phase	Both	2.62	2.80	3.19	2.59	2.81	2.92
Storing phase	Often vs. Sometimes/Never	-	0.55	-	0.65	0.53	0.53
	Often/Sometimes vs. Never	-	1.54	2.97	1.30	1.32	-
Preparing phase	Both	2.56	1.86	1.81	1.57	2.05	1.47
Eating phase	Both	1.41	-	-	-	-	-

Notes: non-statistically significant Odds Ratios (> 0.05) are not reported.

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372 5. Discussion

373 According to recent studies (Section 2), the results emphasize the complex structure of
374 consumers' food cycle while suggesting a potential ranking for its behavioral phases in their
375 contribution to the frequency of household food waste. The most upstream stage, provisioning,
376 exerts the highest influence on the generation of household food waste. The distance between
377 choice and outcome offers key implications at both the individual and situational level. At the
378 individual level, this gap delivers an additional element of uncertainty to consumers' decision-
379 making. Because of the early and crucial food choice made during the purchasing stage, there is a
380 time lapse in the generation of household food waste. The measure of this behavior-outcome gap
381 is a subjective perception rather than an ordinary temporal scale (Lapinski et al. 2005). The highest
382 odd ratio value reached by the planning/purchasing stage for the most perishable foodstuffs (i.e.,
383 wasted fruits and vegetables; see Table 11 in the Appendix) supports this assumption.

384 The time interval between food-provisioning behavior and the resulting waste emphasizes the
385 challenge consumers face when making their decision in response to their priorities. This limited
386 capacity to deal with this ultimate effect of the food behavior adds risk to the related process of
387 choice as a whole. According to TPB, the uncertainty that emerges from the behavior-outcome gap
388 is in fact envisaged to affect the cognitive determinants of an individual's decision-making.
389 Consumers perceive food waste as a weak effect of the purchasing choice. Thus, the first
390 component of the behavioral beliefs (the subjective probability that a decision produces the
391 consequence) is rendered enfeebled. The identification of this early behavioral precursor leads to
392 two main considerations. Firstly, it offers a possible explanation for the debated role of an
393 unfavorable attitude—its immediate descendant—toward food waste in food behaviors (Section 2).
394 While numerous studies ascertain the potential contribution that these attitudes can deliver to the
395 prevention and reduction of food waste, it is recognized that they are not sufficient to fight food
396 waste (i.e., contextual factors are pivotal to this goal) and they often do not denote food behavior.
397 Secondly, because the identified factual gap squeezes the first component of the behavioral
398 beliefs—perception of consequence—it appears necessary to boost the second element,
399 subjective evaluation of outcome. According to this objective, initiatives aimed at enhancing
400 knowledge about the food waste domain can determine a positive cascade effect on the related
401 behavioral belief, attitude, motivation, and behavior (food purchasing).

402 Without adequate interventions, the uncertainty generated from the behavior-outcome (factual)
403 gap not only merges with that caused by the intention-behavior (cognitive) gap but also propagates
404 (through behavioral beliefs) along an individual's decision-making like a constitutive condition.
405 Accounting for the hidden and repetitive characteristics of food waste-related choices, a possible
406 personal strategy that consumers can implement to face this cumulated uncertainty is the greater
407 use of heuristics. In the field of behavioral economics, the literature shows a large spectrum of
408 evidence and variables explaining the deviation of individuals' choices from the standard economic
409 model. To this effect, the emerged primary role of purchasing in the consumers' food waste cycle
410 allows for the identification of the main coherent, non-standard food behavioral patterns.

411 As for the classification proposed by DellaVigna (2009), the first group of deviations is related
412 to non-standard beliefs. Because of the (factual) gap between the dominant early-stage food
413 choice (purchasing) and expected outcome (food waste), consumers are inclined to identify their
414 future preferences with the current ones. This, however, forms *projection biases* (Read and van
415 Leeuwen, 1998).

416 A second class of deviations is represented by non-standard preferences. Since food waste is
417 conditioned by a considerable delay with respect to its driving choice (provisioning), when
418 expected alternative rewards are compared and evaluated, individuals may demonstrate *time-*
419 *inconsistent preferences*. This can be the case of ensuring food security against avoiding wastes in
420 the home when consumers are inclined to prioritize food security and consequently, to purchase

421 commensurate volumes of food (Stephen and Loewenstein, 1991; Frederick et al., 2002).
422 Moreover, consumers reveal *risk preferences* when they evaluate a food choice by comparing
423 losses and gains. The purchasing stage can influence the framing of possible outcomes such as
424 food-related status concerns (“reference point”), which is an alternative to the household waste
425 prevention target. The repartition of utility into substitutive components can lead individuals to
426 adopt probabilistic schemes that overweight losses (status erosion), subordinate alternatives (food
427 waste reduction), and favor risk-aversion behaviors (Kahneman and Tversky, 1979).

428 Non-standard decision-making characterizes the third class of deviations. During provisioning,
429 when the most influential decisions are made, consumers are exposed to diverse information and
430 complex choices. To simplify their decision-making process, individuals could use different types of
431 sub-optimal heuristics such as orienting their choice to familiarity and identity criteria (*habits*;
432 Verplanken and Orbell, 2003), preselecting available information (*limited attention*), or referring to
433 the most noticeable elements of alternative options (*saliency*). To this effect, the weight of the
434 relationship between “person responsible for shopping” and purchasing phase (source of
435 household food waste) suggests that this typology of consumers could be inclined to resort to non-
436 standard routines when buying food. By contrast, larger-sized households report higher food waste
437 frequency, which appears mainly due to mismanagement of food practices in the downstream
438 phases (e.g., storing and preparing ones) rather than to adoption of heuristics at the provisioning.

439 At the situational level, since in the purchasing stage individuals make the most critical choices
440 in terms of generation of food waste within the household, understanding consumers’ uncertainty
441 requires extending the analysis to influences exerted in out-of-home contexts (Evans, 2012, 2011).
442 In particular, throughout provisioning, individuals make subjective judgments contingent on the
443 conditions at the food retail level and (potential) mutual exposure to other consumers’ behavior.
444 Since the purchasing phase is crucial for the food waste pattern, its quasi-social dimension should
445 contribute to moderating the related behavioral-outcome gap. The literature focused on household
446 food waste and the motivation-behavior gap shows that social norms could affect food waste-
447 related intentions; however, the complexity of the subject reveals additional specific elements.
448 While Quested et al. (2013) assume that social norms exert a limited influence on the—scarcely
449 visible—household food waste, Graham-Rowe et al. (2014) identify “a lack of perceived social
450 pressure” as a barrier to the consumers’ intention to reduce the food waste. Further, there is no
451 evidence on the relationship between awareness about other individuals’ food waste
452 countermeasures (descriptive norms) and individual’s motivation to replicate it. Nevertheless, there
453 is a significant association with the perception of what the others think (injunctive norms; Graham-
454 Rowe et al., 2015; Stancu et al., 2016).

455 According to Aschemann-Witzel et al. (2017) and Lee (2018), the findings of this study
456 demonstrate that the contextual factors (e.g., retailers’ special offers and purchase frequency of
457 non-seasonal products) are significant when modeling the contribution of the provisioning phase to
458 the generation of food waste within the household. In particular, this is proved by the significant
459 contradiction between the respondents’ self-assessed general concern for food waste and the
460 increase in waste frequency during the study period. Moreover, this positive trend and long-lasting
461 pre-eminence of the purchasing stage as the major source of waste behavior in homes (factual
462 gap) suggest a persistency in consumers’ uncertainty.

463

464 **6. Conclusions**

465 Purchasing emerges as the most crucial consumer choice for the generation of food waste
466 in the household and it became increasingly important during the three-year period covered by the
467 survey.

468 The first theoretical contribution derived from this main findings is the detection of a
469 distance between behavior and outcome. While the literature has largely focused on a motivation-
470 behavior (cognitive) gap, this study shows an additional (factual) gap in consumer's decision-
471 making, which raises the complexity of the food waste domain. Unclear and deferred
472 consequences, such as to avoid discarding edible products at home, can be a detrimental to the
473 originating food decision when compared to alternatives leading to clearly recognizable and near
474 results. This is particularly significant when consumers deal with food waste-related choices
475 influenced by concurrent outcomes, such as timing, risk, and social factors. In other words, it is a
476 set of converging elements that deliver uncertainty and weaken waste-adverse attitudes.

477 Indeed, the identification of the purchasing action as the most influential for the generation
478 of household food waste underlines that this choice is part of a complex series of interrelated
479 behavioral precursors. To the effect of TPB, this study suggests that the behavior-outcome gap
480 and resultant uncertainty can have a feedback influence on individuals' behavioral beliefs. The
481 second theoretical contribution of this study is the detection of the most relevant behavioral
482 precursor in tackling food waste generation. In particular, the revealed factual gap compresses the
483 subjective perception of the behavioral effect (i.e., awareness of food waste). Therefore, it is the
484 other component of the behavioral beliefs—the subjective evaluation of outcome (i.e.,
485 knowledge)—the earliest behavioral antecedent that can lead to more robust behavioral beliefs
486 and attitudes against food waste. Without initiatives supporting knowledge of the food field,
487 uncertainty can further diffuse across an individual's overall decision-making process and become
488 a constitutive driver of food waste. Moreover, because the food-related experiences of other
489 individuals are, generally, not visible and therefore, not helpful in orienting or modifying the
490 decisions and reducing uncertainty, consumers are more likely to resort to heuristics.

491 The third important theoretical contribution of this work is the analysis of household food
492 waste represented by the extension of the TPB approach to a series of individuals' not rational
493 food-related decisions through the lens of behavioral economics. Considering the role of
494 provisioning, this study suggests the main non-standard behavioral patterns (e.g., projection
495 biases, risk preferences, and salience) that can influence food waste generation. The centrality of
496 the purchasing stage and the deriving behavior-outcome gap highlight that consumers' uncertainty
497 is the foremost obstacle to preventing household food waste. This leads to a two-fold order of
498 implications.

499 At the individual level, the need to limit uncertainty and use of heuristics require the
500 enhancing of consumers' knowledge of food waste and, in general, the boosting of food culture.
501 These leverages should favor the correct assessment of food waste repercussions and, in turn,
502 form responsible behavioral beliefs and mature attitudes toward food waste prevention and
503 reduction. With this aim, concrete interventions should prioritize educational programs targeted at
504 students and informative campaigns at the food retail level by operators and experts of the supply
505 chains. Furthermore, given the importance of provisioning behaviors demonstrated by consumers
506 in out-of-home contexts (food retail), additional research efforts should be oriented toward
507 analyzing the role of social norms (normative beliefs) in influencing the individuals' purchase
508 decisions in relation to food waste. Given this objective, laboratory and field experiments focused
509 on food-provisioning situations should investigate consumers' deviations from standard behaviors
510 with reference to the role of both *social preferences* (e.g., responsible behaviors; Forsythe et al.,
511 1994) and *social pressures* (e.g., other individuals' choices and retailers' options; Abrahamse and
512 Steg, 2013; Young et al., 2017) in food decision-making.

513 Finally, at food retail level, it is necessary to transform related situational features from the
514 source of uncertainty into opportunities of strengthening customers' understanding of food values
515 and a guiding framework for coherent food behaviors. Negotiated voluntary agreements engaging
516 retailers and consumers could stimulate multi-stakeholder governance and corporate social

517 responsibility patterns. They could also represent the structural condition to favor sustainable food
518 purchasing choices and joint solutions to address household food waste.
519

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718 **Appendix**

719 Residents in Italy aged between 18 and 74 years represent the concerned population. The
 720 parameters of this population refer to four study domains (i.e., national territory, five geographical
 721 areas, geographical regions, and municipal typologies in their effect on socioeconomic and
 722 demographic characteristics).

723 The population has been partitioned into four strata: age, gender, macro-area (Nielsen) of
 724 residence, and qualification. All the strata's parameters are conform to ISTAT's categories (the
 725 National Institute for Statistics).

726 The surveyed sample has been derived from a panel of 60,000 individuals—components have
 727 been recruited by means of online and phone sourcing techniques—and selected through stratified
 728 random sampling. Finally, a post-stratification survey weighting has been adopted.

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Table 6. Distal explanatory variables (number and % of respondents).

Distal variable	Value	Tot	%
Macro region	North-West	1,289	27.3%
	North-East	896	19.0%
	Center	919	19.5%
	South	1,079	22.8%
	Islands	543	11.5%
Household size	1	516	10.9%
	2	1,365	28.9%
	3	1,260	26.7%
	4	1,202	25.4%
	>4	383	8.1%
Perception of monetary wealth	Feeling Poor	306	6.5%
	Many Difficulties	677	14.3%
	Some Difficulties	1,959	41.5%
	Safely	1,784	37.8%
Education level	Primary / middle school	964	20.4%
	High school	2,551	54.0%
	Master degree	968	20.5%
	PHD	243	5.1%
Yearly respondents	2013	1,706	36.1%
	2014	1,518	32.1%
	2015	1,502	31.8%
Gender	Male	2,286	48.4%
	Female	2,440	51.6%
Age	18-34	1,262	26.7%
	35-64	2,541	53.8%
	65+	923	19.5%

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Table 7. “Planning/Purchasing” phase: proximal explanatory variables (number and % of respondents).

Proximal variable	Value	Tot	%
Use of shopping list	Never	396	8.4%
	Sometimes	1,933	40.9%
	Often	2,397	50.7%
Frequency of food shopping	Every 15 days or more	274	5.8%
	1 time per week	1,456	30.8%
	2/3 times per week	1,707	36.1%
	Every 2 days	582	12.3%
	Every day	707	15.0%
Weekly household food expenditure	0 - 50 €	544	11.5%
	50 - 100 €	2,012	42.6%
	100 - 200 €	1,556	32.9%
	200 - 300 €	320	6.8%
	More than 300 €	91	1.9%
	MISSING	203	4.3%
Frequency of non-seasonal products purchasing	Never	369	7.8%
	Rarely	2,121	44.9%
	Sometimes	1,941	41.1%
	Often	295	6.2%
Frequency of non-local food purchasing	Never	351	7.4%
	Rarely	1,954	41.4%
	Sometimes	2,081	44.0%
	Often	340	7.2%
Person responsible for shopping	Different	1,022	21.6%
	Always the same	3,704	78.4%
Take advantage of special offers	Sometimes/Never	826	17.5%
	Often	2,107	44.6%
	Always	1,793	38.0%
Shopping strategy	Low cost	281	6.0%
	Pragmatic	3,232	68.4%
	High quality	1,113	23.6%
	MISSING	100	2.1%

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Table 8. Frequency of waste per food category and year (number and % of respondents).

Food category	Year	Never	Sometimes	Often	Missing
Fresh bread	Total	2,895 (61.3%)	1,327 (28.1%)	284 (6.0%)	220 (4.7%)
	2013	1,050 (61.6%)	469 (27.5%)	76 (4.4%)	111 (6.5%)
	2014	976 (64.3%)	387 (25.5%)	109 (7.2%)	46 (3.0%)
	2015	869 (57.9%)	471 (31.4%)	99 (6.6%)	63 (4.2%)
Cheese	Total	2,929 (62.0%)	1,502 (31.8%)	211 (4.5%)	84 (1.8%)
	2013	1,102 (64.6%)	526 (30.8%)	56 (3.3%)	22 (1.3%)
	2014	962 (63.4%)	445 (29.3%)	79 (5.2%)	32 (2.1%)
	2015	865 (57.6%)	531 (35.3%)	76 (5.1%)	30 (2.0%)
Fruits and vegetables	Total	1,637 (34.6%)	2,680 (56.7%)	382 (8.1%)	27 (0.6%)
	2013	642 (37.6%)	915 (53.6%)	142 (8.3%)	7 (0.4%)
	2014	529 (34.9%)	860 (56.6%)	121 (8.0%)	8 (0.5%)
	2015	466 (31.0%)	905 (60.3%)	119 (7.9%)	12 (0.8%)
Milk and yoghurt	Total	2,967 (62.8%)	1,402 (29.7%)	240 (5.1%)	117 (2.5%)
	2013	1,219 (71.5%)	384 (22.5%)	72 (4.2%)	31 (1.8%)
	2014	917 (60.4%)	468 (30.8%)	96 (6.3%)	37 (2.4%)
	2015	831 (55.3%)	550 (36.6%)	72 (4.8%)	49 (3.3%)
Cold cuts	Total	3,184 (67.4%)	1,155 (24.4%)	199 (4.2%)	188 (4.0%)
	2013	1,197 (70.2%)	378 (22.2%)	72 (4.2%)	59 (3.5%)
	2014	1,063 (70.0%)	335 (22.1%)	64 (4.2%)	56 (3.7%)
	2015	924 (61.5%)	442 (29.4%)	63 (4.2%)	73 (4.9%)
Eggs	Total	3,391 (71.8%)	1,046 (22.1%)	185 (3.9%)	104 (2.2%)
	2013	1,270 (74.4%)	336 (19.7%)	68 (4.0%)	32 (1.9%)
	2014	1,093 (72.0%)	336 (22.1%)	52 (3.4%)	37 (2.4%)
	2015	1,028 (68.4%)	374 (24.9%)	65 (4.3%)	35 (2.3%)

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Table 9. Partial Proportional Odds Model: drivers of fresh bread waste.

Phase and distal variable	Category	Reference Category	Response level	OR	95% CI	P-value
Planning/Purchasing phase	Yes	No	Both	2.62	(2.30 - 2.98)	<.0001
Storing phase	Yes	No	Often vs. Sometimes/Never	0.80	(0.62 - 1.04)	0.0886
			Often/Sometimes vs. Never	1.15	(0.99 - 1.34)	0.0610
Preparing phase	Yes	No	Both	2.56	(2.16 - 3.04)	<.0001
Eating phase	Yes	No	Both	1.41	(1.03 - 1.94)	0.0323
Gender	Female	Male	Both	0.85	(0.74 - 0.96)	0.0093
Macro region	Center	North-West	Both	1.35	(1.12 - 1.64)	0.0016
	Islands		Both	1.18	(0.94 - 1.48)	0.1498
	North-East		Both	1.04	(0.86 - 1.27)	0.6917
	South		Both	1.45	(1.21 - 1.75)	<.0001
Household size	2	1	Both	1.01	(0.79 - 1.29)	0.9267
	3		Both	1.28	(1.00 - 1.63)	0.0475
	4		Both	1.36	(1.06 - 1.75)	0.0156
	>4		Both	1.38	(1.02 - 1.88)	0.0380
Perception of monetary wealth	Many difficulties	Feeling poor	Both	0.92	(0.68 - 1.24)	0.5759
	Some difficulties		Both	0.82	(0.62 - 1.09)	0.1717
	Safely		Both	1.14	(0.86 - 1.51)	0.3701
Education level	High school	Primary / middle school	Both	1.00	(0.84 - 1.2)	0.9757
	Master degree		Both	1.21	(0.97 - 1.49)	0.0871
	PHD		Both	1.07	(0.78 - 1.47)	0.6637
Yearly respondents	2014	2013	Often vs. Sometimes/Never	1.57	(1.16 - 2.14)	0.0038
			Often/Sometimes vs. Never	0.99	(0.84 - 1.15)	0.8513
	2015		Often vs. Sometimes/Never	1.41	(1.03 - 1.93)	0.0327
			Often/Sometimes vs. Never	1.24	(1.05 - 1.45)	0.0091
Age	18-34	35-64	Both	1.07	(0.92 - 1.24)	0.3956
	65+		Both	0.69	(0.57 - 0.84)	0.0001

Goodness-of-fit of the model: Chi-square statistic = 541.2, df=26, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

751 **Table 10.** Partial Proportional Odds Model: drivers of cheese waste.

Phase and distal variable	Category	Reference Category	Response level	OR	95% CI	P-value
Planning/Purchasing phase	Yes	No	Both	2.80	(2.46 - 3.18)	<.0001
Storing phase	Yes	No	Often vs. Sometimes/Never	0.55	(0.42 - 0.74)	<.0001
			Often/Sometimes vs. Never	1.54	(1.33 - 1.78)	<.0001
Preparing phase	Yes	No	Both	1.86	(1.57 - 2.22)	<.0001
Eating phase	Yes	No	Both	0.76	(0.54 - 1.07)	0.1109
Gender	Female	Male	Both	1.02	(0.90 - 1.16)	0.7396
Macro region	Center	North-West	Both	1.14	(0.95 - 1.37)	0.1556
	Islands		Both	1.09	(0.87 - 1.36)	0.4459
	North-East		Both	0.96	(0.80 - 1.16)	0.6976
	South		Both	0.94	(0.79 - 1.13)	0.5204
Household size	2	1	Both	0.80	(0.64 - 1.01)	0.0589
	3		Both	1.16	(0.92 - 1.45)	0.2138
	4		Both	1.04	(0.82 - 1.31)	0.7759
	>4		Both	1.16	(0.87 - 1.56)	0.3178
Perception of monetary wealth	Many difficulties	Feeling poor	Both	1.07	(0.78 - 1.46)	0.6783
	Some difficulties		Both	1.17	(0.88 - 1.56)	0.2706
	Safely		Both	1.38	(1.03 - 1.84)	0.0291
Education level	High school	Primary / middle school	Both	0.97	(0.82 - 1.16)	0.7521
	Master degree		Both	1.09	(0.88 - 1.34)	0.4300
	PHD		Both	1.14	(0.83 - 1.55)	0.4209
Yearly respondents	2014	2013	Both	1.10	(0.95 - 1.29)	0.2013
	2015		Both	1.34	(1.15 - 1.56)	0.0002
Age	18-34	35-64	Both	1.44	(1.24 - 1.66)	<.0001
	65+		Both	0.73	(0.61 - 0.87)	0.0007

Goodness-of-fit of the model: Chi-square statistic = 524.4, df=24, p-value < 0.0001
 Bolded odds ratio parameters are statistically significant (0.05).

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Table 11. Partial Proportional Odds Model: drivers of fruits and vegetables waste.

Phase and distal variable	Category	Reference Category	Response level	OR	95% CI	P-value
Planning/Purchasing phase	Yes	No	Both	3.19	(2.80 - 3.63)	<.0001
Storing phase	Yes	No	Often vs. Sometimes/Never	0.91	(0.72 - 1.15)	0.4224
			Often/Sometimes vs. Never	2.97	(2.57 - 3.44)	<.0001
Preparing phase	Yes	No	Both	1.81	(1.51 - 2.16)	<.0001
Eating phase	Yes	No	Both	1.01	(0.74 - 1.39)	0.9334
Gender	Female	Male	Both	0.95	(0.84 - 1.07)	0.3825
Macro region	Center	North-West	Both	0.89	(0.75 - 1.06)	0.1834
	Islands		Both	0.85	(0.69 - 1.05)	0.1368
	North-East		Both	0.97	(0.81 - 1.15)	0.6885
	South		Both	0.86	(0.72 - 1.02)	0.0843
Household size	2	1	Both	1.02	(0.83 - 1.26)	0.8613
	3		Both	1.08	(0.87 - 1.34)	0.4765
	4		Both	1.14	(0.91 - 1.42)	0.2574
	>4		Both	1.05	(0.79 - 1.39)	0.7345
Perception of monetary wealth	Many difficulties	Feeling poor	Both	1.00	(0.76 - 1.33)	0.9763
	Some difficulties		Both	1.06	(0.82 - 1.37)	0.6627
	Safely		Both	1.22	(0.94 - 1.59)	0.1340
Education level	High school	Primary / middle school	Both	1.11	(0.95 - 1.30)	0.2014
	Master degree		Both	1.27	(1.04 - 1.55)	0.0204
	PHD		Both	1.42	(1.05 - 1.93)	0.0221
Yearly respondents	2014	2013	Both	1.14	(0.99 - 1.32)	0.0719
	2015		Both	1.21	(1.05 - 1.40)	0.0099
Age	18-34	35-64	Both	1.09	(0.94 - 1.25)	0.2516
	65+		Both	0.75	(0.64 - 0.89)	0.0009

Goodness-of-fit of the model: Chi-square statistic = 651.3, df=24, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

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761 **Table 12.** Partial Proportional Odds Model: drivers of milk and yoghurt waste.

Phase and distal variable	Category	Reference Category	Response level	OR	95% CI	P-value
Planning/Purchasing phase	Yes	No	Both	2.59	(2.27 - 2.94)	<.0001
Storing phase	Yes	No	Often vs. Sometimes/Never	0.65	(0.49 - 0.85)	0.0019
			Often/Sometimes vs. Never	1.30	(1.12 - 1.50)	0.0006
Preparing phase	Yes	No	Both	1.57	(1.32 - 1.87)	<.0001
Eating phase	Yes	No	Both	1.23	(0.89 - 1.69)	0.2090
Gender	Female	Male	Both	0.91	(0.80 - 1.03)	0.1461
Macro region	Center	North-West	Both	1.10	(0.92 - 1.33)	0.2966
	Islands		Both	1.04	(0.83 - 1.30)	0.7420
	North-East		Both	1.05	(0.87 - 1.27)	0.5915
	South		Both	1.15	(0.96 - 1.38)	0.1278
Household size	2	1	Both	0.87	(0.69 - 1.10)	0.2425
	3		Both	1.17	(0.93 - 1.48)	0.1899
	4		Both	1.27	(1.00 - 1.61)	0.0545
	>4		Both	1.17	(0.87 - 1.59)	0.2960
Perception of monetary wealth	Many difficulties	Feeling poor	Both	0.99	(0.72 - 1.37)	0.9446
	Some difficulties		Both	1.20	(0.90 - 1.61)	0.2192
	Safely		Both	1.36	(1.01 - 1.83)	0.0458
Education level	High school	Primary / middle school	Both	1.10	(0.92 - 1.32)	0.2905
	Master degree		Both	1.29	(1.04 - 1.59)	0.0213
	PHD		Both	1.47	(1.08 - 2.00)	0.0154
Yearly respondents	2014	2013	Often vs. Sometimes/Never	1.58	(1.15 - 2.17)	0.0044
			Often/Sometimes vs. Never	1.76	(1.50 - 2.06)	<.0001
	2015		Often vs. Sometimes/Never	1.10	(0.79 - 1.54)	0.5780
			Often/Sometimes vs. Never	1.99	(1.70 - 2.33)	<.0001
Age	18-34	35-64	Both	1.48	(1.28 - 1.71)	<.0001
	65+		Both	0.71	(0.59 - 0.86)	0.0004

Goodness-of-fit of the model: Chi-square statistic = 552.2, df=26, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

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765 **Table 13.** Partial Proportional Odds Model: drivers of cold cuts waste.

Phase and distal variable	Category	Reference Category	Response level	OR	95% CI	P-value
Planning/Purchasing phase	Yes	No	Both	2.81	(2.45 - 3.22)	<.0001
Storing phase	Yes	No	Often vs. Sometimes/Never	0.53	(0.40 - 0.72)	<.0001
			Often/Sometimes vs. Never	1.32	(1.13 - 1.54)	0.0006
Preparing phase	Yes	No	Both	2.05	(1.72 - 2.45)	<.0001
Eating phase	Yes	No	Both	1.29	(0.92 - 1.81)	0.1422
Gender	Female	Male	Both	1.03	(0.90 - 1.18)	0.6852
Macro region	Center	North-West	Both	1.35	(1.10 - 1.65)	0.0034
	Islands		Both	1.92	(1.53 - 2.42)	<.0001
	North-East		Both	0.96	(0.78 - 1.18)	0.6697
	South		Both	1.47	(1.21 - 1.78)	0.0001
Household size	2	1	Often vs. Sometimes/Never	0.60	(0.35 - 1.03)	0.0632
			Often/Sometimes vs. Never	0.98	(0.75 - 1.27)	0.8779
	3		Often vs. Sometimes/Never	1.05	(0.64 - 1.73)	0.8553
			Often/Sometimes vs. Never	1.29	(1.00 - 1.68)	0.0546
	4		Often vs. Sometimes/Never	1.00	(0.61 - 1.66)	0.9954
			Often/Sometimes vs. Never	1.43	(1.10 - 1.87)	0.0081
	>4		Often vs. Sometimes/Never	0.66	(0.32 - 1.35)	0.2527
			Often/Sometimes vs. Never	1.72	(1.25 - 2.38)	0.0010
Perception of monetary wealth	Many difficulties	Feeling poor	Both	1.07	(0.76 - 1.50)	0.6980
	Some difficulties		Both	1.09	(0.80 - 1.48)	0.5922
	Safely		Both	1.33	(0.98 - 1.82)	0.0710
Education level	High school	Primary / middle school	Both	0.87	(0.73 - 1.05)	0.1562
	Master degree		Both	1.06	(0.85 - 1.32)	0.6242
	PHD		Both	1.07	(0.77 - 1.49)	0.6744
Yearly respondents	2014	2013	Both	1.03	(0.87 - 1.21)	0.7317
	2015		Both	1.43	(1.22 - 1.68)	<.0001
Age	18-34	35-64	Both	1.18	(1.01 - 1.38)	0.0346
	65+		Both	0.78	(0.64 - 0.95)	0.0125

Goodness-of-fit of the model: Chi-square statistic = 534.5, df=28, p-value < 0.0001

Bolded odds ratio parameters are statistically significant (0.05).

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770 **Table 14.** Partial Proportional Odds Model: drivers of eggs waste.

Phase and distal variable	Category	Reference Category	Response level	OR	95% CI	P-value
Planning/Purchasing phase	Yes	No	Both	2.92	(2.55 - 3.36)	<.0001
Storing phase	Yes	No	Often vs. Sometimes/Never	0.53	(0.39 - 0.72)	<.0001
			Often/Sometimes vs. Never	1.02	(0.87 - 1.19)	0.8437
Preparing phase	Yes	No	Both	1.47	(1.22 - 1.77)	<.0001
Eating phase	Yes	No	Both	1.11	(0.78 - 1.56)	0.5677
Gender	Female	Male	Both	0.86	(0.75 - 0.99)	0.0360
Macro region	Center	North-West	Both	1.01	(0.83 - 1.24)	0.9176
	Islands		Both	1.06	(0.83 - 1.36)	0.6236
	North-East		Both	0.95	(0.78 - 1.17)	0.6503
	South		Both	1.07	(0.88 - 1.30)	0.4835
Household size	2	1	Both	0.67	(0.53 - 0.85)	0.0009
	3		Both	0.76	(0.60 - 0.96)	0.0217
	4		Both	0.63	(0.49 - 0.81)	0.0003
	>4		Both	0.57	(0.41 - 0.79)	0.0007
Perception of monetary wealth	Many difficulties	Feeling poor	Both	0.87	(0.62 - 1.22)	0.4089
	Some difficulties		Both	0.82	(0.60 - 1.11)	0.1961
	Safely		Both	1.00	(0.73 - 1.36)	0.9792
Education level	High school	Primary / middle school	Both	0.92	(0.77 - 1.12)	0.4145
	Master degree		Both	1.08	(0.86 - 1.35)	0.5305
	PHD		Both	1.65	(1.20 - 2.27)	0.0023
Yearly respondents	2014	2013	Both	1.11	(0.94 - 1.31)	0.2078
	2015		Both	1.27	(1.07 - 1.50)	0.0051
Age	18-34	35-64	Both	1.33	(1.14 - 1.56)	0.0004
	65+		Both	0.71	(0.58 - 0.87)	0.0010

Goodness-of-fit of the model: Chi-square statistic = 403.7, df=24, p-value < 0.0001
 Bolded odds ratio parameters are statistically significant (0.05).

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