

Household food waste: what to expect from midwest Brazilians' intention

Desperdício de alimentos no domicílio: intenções de consumidores do Centro-Oeste brasileiro

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Abstract: The article deals with a relevant theme regarding problems related to food supply. The losses accounted at production process and consumer food waste justify research on the subject. The purpose of this paper is to explain food waste intention using the theory of planned behavior (TPB) as a theoretical lens. In addition to measuring the influence of attitudes, social norms, and perceived behavioral control on intention, additional constructs were introduced into the model. Affect, planning routines, food surplus, and environmental concerns were incorporated to fit a logistic regression model, presenting the probability of food waste occurrence as a proxy for the probability of intention to waste. An online questionnaire was developed to collect data from consumers in the Midwest of Brazil. The sample consisted of 419 responses. As a result, it was found that food waste occurred more in affluent households, fewer in number, better categorized as "waste people" by family and friends, and less adept at reusing leftovers or saving food. In general, the affective memory related to food corroborates the desire for an abundant table, making waste acceptable. This information is useful for the construction of action plans, public and private, aimed at behavioral changes related to waste.

Keywords: food waste, consumer behavior, logit.

Resumo: O artigo trata de problemas relacionados ao abastecimento alimentar. As perdas do processo produtivo e o desperdício no consumo justificam a realização de pesquisas no tema. O objetivo do artigo foi explicar a intenção em desperdiçar alimentos à luz da Teoria do Comportamento Planejado (TPB). Além da medida da influência de atitudes, normas sociais e controle comportamental percebido sobre a intenção, construtos adicionais foram introduzidos no modelo. O afeto, o planejamento de rotina, o reuso de sobras e as preocupações ambientais foram incorporados para o ajuste de um modelo de regressão logística, apresentando a probabilidade de ocorrer desperdício como *proxy* para a probabilidade da intenção em desperdiçar. A coleta de dados ocorreu com aplicação de questionário online junto a consumidores do Centro Oeste brasileiro. A amostra constituiu de 419 respostas. Como resultado, constatou-se que o desperdício aconteceu mais nos domicílios abastados, menos numerosos, melhor categorizados como "desperdições" pela família/amigos e menos hábeis em reutilizar sobras ou guardar comidas. De modo geral, a memória afetiva do alimento corrobora o desejo por mesa farta, tornando o desperdício aceitável. Essas informações são úteis para a construção de planos de ação, público e privados, visando mudanças de comportamento relacionadas ao desperdício.

Palavras-chave: perda de alimentos, comportamento do consumidor, regressão logística.

1. Introduction

Due to Brazil's leading role in food production and distribution, in the last fifty years, our country has become an agro-industrial power. Increased productivity with attention to socio-



environmental factors is a response to the demands of consumers and civil society regarding health and climate issues, as well as an effort to meet the Sustainable Development Goals (SDG). Nowadays, and even more so soon, the challenges to food supply for the growing world population will be closely related to the vulnerability and dangers of production founded on unsustainable bases. In the last ten years, policies (ABC Plan – Plan for Adaptation and Low Carbon Emission in Agriculture) and national programs have been implemented so that technologies that promote low-carbon agriculture and livestock were disseminated in part of Brazilian production units, making advances in productivity, and reducing greenhouse gas emissions (Cuadra et al., 2020). An example of these programs contributing to the reduction of greenhouse gases, with different expressivities among Brazilian regions, is the recovery of degraded pastures (Parente et al., 2019; Veloso et al., 2020) and the crop-livestock-forest integration systems (Leite et al., 2023; Reis et al., 2021).

However, a great controversy remains that must be addressed. Although agri-food production systems have proven to be more efficient over the years, a considerable part of the food that is produced is lost along the production chain and wasted during consumption. Technological solutions, in addition to public policies and education and communication actions to encourage a change in behavior are among the solutions to reduce losses that occur in the production, storage, packaging, and transport phases, while waste occurs in retail and in the act of consumption (Sarkar et al., 2022; Yadav et al., 2022; Ardekani et al., 2023).

Food waste in developed and developing countries varies in quantity and origin. Losses due to inefficient logistics, failures in the cold chain and management systems are more characteristic of developing countries. Wealthier countries suffer an annual loss of \$680 billion from food loss and waste. As for the poorest countries, they lose \$310 billion (Food and Agriculture Organization of the United Nations, 2017)¹.

According to United Nations Food and Agriculture Organization (Food and Agriculture Organization of the United Nations, 2021), 14% of the food produced in the world was lost and approximately 930 million tons is wasted annually (61% in households, 26% in Food Service and 13% in retail) (Capgemini, 2022).

In order to combat this waste, we could mention some international experiences aimed at preventing and reducing food waste. As stated in Melo et al. (2018), in the United States there is a tax reduction for food donations, in Canada the focus is on education to reduce food dumped in landfills, in the United Kingdom and Ireland a programme limits the amount of food that can go to landfill, in France there is a ban on disposing of what is fit for consumption and in Italy there are actions to recycle food waste and encourage the donation of surpluses. In Brazil, there are initiatives by public and private food banks to dispose of discarded food that has no commercial value. However, interesting analyses are presented in various chapters of Melo et al. (2018) regarding the challenges of governance and the effectiveness of these initiatives. One of the main obstacles in the fight against waste is its conceptualisation and the multiplicity of factors and problems involved in the act.

In addition to the environmental issues, attention should be drawn to the impact caused by the tons of food deposited in the environment, causing an overload of natural resources. It should also be remembered that the damage to nature doubles, considering the many hectares of land and millions of cubic meters of water used needlessly to produce all the food that ends up being discarded every year. The fact that the habit of discarding food is often disassociated from the use of natural resources needed for its production is noteworthy. Waste

¹ Other interesting information can be found at Reflect. Rethink. Reconsider. Why food waste is everybody's problem - Capgemini Research Institute 2022 (Capgemini, 2022).

reduction with the promotion of correct disposal, information campaigns and investment in waste treatment would promote sustainability in food systems and encourage individuals to behave more consciously and proactively with regard to the environment (Wakefield & Axon, 2020; Canto et al., 2021; Sharma et al., 2021; Varese et al., 2023).

Waste is known to cause food insecurity and make natural resources more vulnerable, in addition to negatively contributing to climate change. Combating waste promotes social, environmental and economic sustainability. However, for the world to record advances in the reduction of food waste, especially food consumed at home, the act of wasting cannot be thought of rationally, because it reflects cultural ways of eating.

According to Alexander et al. (2013), one finds a reflection on the different reasons why waste happens. Depending on the perspective, be it economic, political, or cultural, the view on waste and those responsible for it changes. The authors, focusing on wealthier Western cultures, recall retail offerings, large and promotional packages, and lack of skill in dealing with leftovers, direct the focus of the waste problem to the behavior of households. With this, they mentioned environmental protection policies in the United States and the United Kingdom, aimed at reducing the disposal of discarded food in landfills. However, it is from the perspective of waste culture that Alexander et al. (2013), citing sociologists and anthropologists, dissertate on social reasons and gives other meanings to waste. Abundance is a synonym for power, for differentiation. The display of excess explains social relationships, and marks festive moments, customs, and class positions. Moreover, the authors point out that the advance of waste treatment technologies, as a response to the most current rules of food hygiene, the short shelf life of what is perishable, and the campaigns for more sustainable lifestyles, generate even more waste and confirm the defenses of Evans & Abrahamse (2009), Reynolds et al. (2019). All societies are manifested through codes, and the act of eating is one of the most striking. In Brazil, Matta (1984) explained that the moral ramifications of the food code determine not only society's relationship with food, but express gender relations, the use of space for preparing and handling food, the use of time dedicated to preparation and consumption, the different concerns related to food as well as their contradictions. Food defines identities, styles and ways of behaving. As it is an affective and complex code, for Brazilians, food is culturally appreciated and highly valued when the table is large, plentiful, joyful and harmonious (Matta, 1984).

Regarding the logic of disposal, it is worth highlighting the work of Barbosa & Campbell (2006) and her analyses as to what is determined proper and not proper for the consumption of Brazilians. These definitions are representative of values that explain different consumption modes among social classes. The author explains that even the way people handle food in a retail store is rich in a value system that endorses the abundance of food production in the country, the choice for the perfect appearance of food, and the purchasing power of individuals.

Considering the complexity that involves the theme and the frontiers of analysis of the food system, what this article intends is to present an approach related to the study of the intentions that lead to waste. Theory of Planned Behavior (TPB) was our theoretical lens (Ajzen, 2015). Investigations into food waste intentions was conducted with 419 consumers living in the Midwest region of Brazil. More details about the sample can be found in the methodology. The aim was to measure to what extent intentions can be weakened or strengthened by the traditional constructs of the Theory of Planned Behavior (attitude, social norms and perceived behavioral control). Furthermore, with the intention of exploring further the affective dimension in intention, additional variables were incorporated into the model to test whether they would have predictive validity regarding wasteful behavior or contrary to it. For this purpose, the data processing technique that was employed was logistic regression (Logit), since it allows the probability of food waste to be modeled.

2. Theoretical Foundation

For a better understanding of which factors generate behaviors that trigger food waste, one of the possible theoretical paths is to study intentions. According to Ajzen (1991, 2015), our behaviors derive from some prior influences, such as attitudes towards a certain action, social norms regarding that action and a person's knowledge and ability to perform it. The intention that leads to a certain behavior is determined by three types of beliefs: behavioral beliefs, referring to positive and negative perceived outcomes of the behavior and the subjective evaluation of these outcomes; normative beliefs, referring to the perceived expectations and behaviors of important individuals or groups that are considered as references, in addition to the personal motivation to comply with their references; and control beliefs, referring to the perceived presence of factors that can influence the capacity of an individual to perform the behavior, along with the perception that these factors can facilitate or interfere in behavioral fulfillment. In general, explained that the stronger the intention to engage in a behavior, the most likely its fulfillment must be.

According to the Theory of Planned Behavior (TPB), attitudes are formed by three components, cognitive, affective and conative. Individuals' attitudes are representative of their beliefs and values (Ajzen, 2015). Thus, considering the theme of food waste, a consumer's attitude should reveal the extent to which he considers this behavior positive or negative, declaring himself favorable or unfavorable towards the act of wasting. In relation to social norms (injunctive or descriptive), what is evaluated is the effect of social pressure on an individual's behavior (Ajzen, 1991, 2015). What do those I care about want/expect me to do about my food waste behavior (injunctive norms)? What do those I consider important to me do about food waste (descriptive standards)? Finally, perceived behavioral control reveals how much an individual's assessment of declaring himself more or less capable of behaving in a given way influences his intention and the behavior itself.

A good summary of the TPB is whether an individual feels favorable towards a certain action, believing that important people would approve of this behavior. Furthermore, if he felt safe in carrying it out, a positive intention would be triggered. The TPB model allows us to understand which factors most strongly predict a certain behavior based on the study of intentions. The stronger the intention to engage in a behavior, the more likely it is that an individual will act (Graham-Rowe et al., 2015; Ananda et al., 2023).

As already stated, behavior change is a complex process that is dependent on understanding values, individual and collective beliefs, as well as judgment regarding how difficult it is for an individual to perform an action. For the specific case of this article, we are interested in measuring which of the TPB constructs can significantly predict the intention of Brazilians regarding the act of not wasting food. Access to this information will also allow us to identify individual barriers that discourage changes in behavior.

Motivated by this research question, authors from all over the world have studied multiple influences concerning the intention to waste food at the consumption level (Stefan et al., 2013; Graham-Rowe et al., 2015; Russell et al., 2017). Through this research, they have gained a better understanding of beliefs related to the act of throwing food away, the types of social pressure that lead consumers to act differently to a greater or lesser extent, in addition to the difficulties and facilities that are declared with regard to behaving in a way that avoids waste. Behavior change is a complex process, dependent on learning and personal involvement in a given topic. Therefore, studies have incorporated additional constructs such as affection, guilt (Porpino et al., 2015; Aktas et al., 2018; La Barbera et al, 2022), routine planning (Stancu & Lähteenmäki, 2022; Flanagan & Priyadarshini, 2021), consumption of leftovers (Stancu &

Lähteenmäki, 2022; Aktas et al., 2018; Flanagan & Priyadarshini, 2021) and environmental concerns (Chen, 2019; Ng et al., 2021; Oliveira Costa et al., 2022) to measure how these additional factors might affect intention to act, a direct antecedent of human behavior.

To enrich the discussion, we incorporated affective factors and others related to individuals' attitudes towards environmental responsibility regarding food and the act of wasting it into the original TPB model. The inclusion of affective factors in TPB models to measure their influence on intention and behavior is required by the literature (Porpino et al., 2015; Aktas et al., 2018). There is a lack of research proving that affective and emotional factors play a role in shaping individual intentions to reduce food waste. These incorporations of constructs provide a better understanding and lend incremental validity to the original TPB model (La Barbera et al., 2022).

In the work by La Barbera et al. (2022), social emotions were considered predictors of intention and wasteful behavior. The role of Good Provider Norms in the TPB framework was discussed. Buying and making extra food, satisfying individuals' specific food desires in a household are actions present in the field of affection that inhibit intentions and behaviors to reduce waste, also impacting attitudes, subjective norms and perceived behavioral control.

Positive attitudes generate strong intentions to act in a certain way (Ajzen, 2015). When consumers declare that they feel bad about wasting, generating crises of conscience, they demonstrate concerns about the topic and prove the positive effect of attitudes on intentions (Blešić et al., 2021).

In the environmental field, emotions also show contrary attitudes regarding the adverse effects of waste (controversy regarding the volume of food produced and the number of people who still go hungry in the world, misuse of natural resources and harmful climate effects). However, works conducted in different cultures have shown that although attitudes and injunctive norms positively affect intentions to waste less food, individual beliefs about the doubt of executing specific behaviors to combat waste contribute negatively to this action (Chen, 2019; Ng et al., 2021). Thus, despite awareness of the problem and being emotionally touched by the cause of waste, feelings of inability or the difficulty involved in carrying out actions such as reducing portions served at meals, reusing food, consuming leftovers, planning shopping routines and even the separation of organic waste generated by households undermine intentions to engage in more responsible behavior to stop waste.

We know that reducing the tons of wasted food is crucial for a fairer and more environmentally friendly society and food systems. In households, addressing wasteful actions must be considered a multivariate problem, influenced by individuals' economic, social, environmental and psychological variables. This justifies academic interest in researching human actions regarding waste based on models that allow the measurement of these multiple factors.

3. Methodology

To collect the necessary data to assess food waste in Brazilian households, an online questionnaire was applied (Google Forms) to numerous consumers in the Midwest region of Brazil. Agribusiness is the main economic activity in the region, with emphasis on agroindustry and agricultural production. The region is a leader in the supply of raw materials for food industries in Brazil and abroad, mainly meat, soy, cotton, corn, sugar cane and rice.

The data sample consisted of information from 419 completed questionnaires considered valid for analysis. The collection method is characterized as non-probability sampling through reference chains known as "snow ball" (Vinuto, 2014; Morettin & Bussab, 2017). It should be noted that this research did not rely on any funding for data collection.

The sample size was estimated by the methodology proposed by Gil (1987). According to the author, for statistically infinite samples (above 100 thousand observations), this number depends on the percentage with which the phenomenon occurs (p), its complement (q), the maximum error allowed (e) and the confidence level chosen (σ), expressed in numbers of standard deviations. Thus, the sample size (n) is given by the Equation 1:

$$n = \frac{\sigma^2 \times p \times q}{e^2} \quad (1)$$

We adopted the metrics proposed by Pinheiro et al. (2003), of two standard deviations as confidence level and maximum permissible error (e) of 5%. For the probability of occurrence of the event “ p ”, 0.6 was adopted because, in the year 2022 (the sample collection), 13,359 undergraduate students of all courses studied at the Campo Grande campus (UFMS), out of a total of 22,272 students from all UFMS campuses (Universidade Federal de Mato Grosso do Sul, 2023). Consequently, “ q ” corresponds to 0.4. Therefore, the equation results in 384 individuals, and 419 individuals were collected for this study (considering an increase of about 10% over the calculated sample size). All the information allowed us to gain a better understanding of the respondents' intentions regarding food waste and segment the sample according to their sociodemographic and economic characteristics. With this information, a logistic regression model was fitted, presenting the likelihood of the occurrence of food waste as a proxy for the probability of intention to waste food.

3.1 Theoretical Model

Logistic regression, or Logit, is used as non-linear models specifically projected for binary dependent variables. This regression makes it possible to estimate the probability of the occurrence of a certain event given a set of explanatory variables (Stock & Watson, 2004). This model aims to understand the differences between certain groups and the probability of an individual or group belonging to a certain category (Ulkhay et al., 2018).

Thus, to model the probability of the occurrence of food waste, the Logit model was used, since the dependent variable (Y) can assume values 0 and 1. It was assumed that the selected (explanatory) variables can influence the occurrence of the “waste” or “non-waste” of food by the respondents. In this way, if an individual presents food waste, Y assumes the value one, and assumes zero otherwise.

The individuals' responses regarding how much food (leftovers from lunch and dinner) was discarded in a normal week was used as a measure. If an individual responded that leftovers represented less than 10% of waste, the dependent variable Y assumed the value of zero. If the individual responded that leftovers accounted for 10% or more of waste, Y assumed the value of 1, inferring the occurrence of waste².

Generically, a binary response model of a population with multiple regressors can be represented as Equation 2 below (Maddala, 2002):

$$P(Y=1|X_1, X_2, \dots, X_k) = G(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k) \quad (2)$$

which can be written as Equation 3, as follows:

² We chose to consider as waste everything that refers to the estimate of the volume declared by the consumer regarding the disposal of food from the main meals in a household. The value above 10% ($Y=1$) has as reference the work of Kymäläinen et al. (2021).

$$P(Y = 1)|x) = G(\beta_0 + x\beta) = G(q) \quad (3)$$

with $q = (\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)$.

where the variables X_k explain the binary dependent variable Y , which assumes values between zero and one. Thus, $0 < G(q) < 1$ for all real numbers q .

Several non-linear functions have been suggested for the $G(\cdot)$ function to ensure that the probabilities are between zero and one. In the present study, Logit regression was considered, which uses the logistic distribution function as $G(q)$, expressed as Equation 4, below (Wooldridge, 2010):

$$G(q) = P(Y = 1) = \frac{e^q}{1 + e^q} \quad (4)$$

The estimation of the parameters $\beta_0, \beta_1, \dots, \beta_k$, according to Torres-Reyna (2014), is made from the dataset using the maximum likelihood method, in which a combination of coefficients that maximizes the probability of the sample being observed is found.

Attention should be paid to the fact that, in non-linear models, the estimated coefficient is not equivalent to the marginal effect (MgE) of the dependent variable on the likelihood of an individual presenting waste, in other words $\frac{\partial P(Y=1)}{\partial X}$ will not directly be β as in the linear regression. Thus, according to Maddala (2002), the marginal effect will be given by Equation 5:

$$\frac{\partial P(Y=1)}{\partial X} = \beta \frac{e^q}{(1 + e^q)^2} \quad (5)$$

In other words, by multiplying the estimated coefficient β with the density function of the logistic distribution $\frac{e^q}{(1 + e^q)^2}$. The R program software is used to fit the models (R Core Team, 2022).

The process of fitting the model initially included the following explanatory variables:

Group 1 of the individuals' characterization variables: schooling, gender, marital status, age, family income and number of children;

Group 2 of variables with characteristics related to the interviewees' attitudes, to injunctive norms and perceived behavioral control;

Group 3 of variables associated with the individuals' relationships of affection with family meals and attitudes towards the environment regarding food waste.

These variables made up the two final models of this work, defined as the Original Model (containing explanatory variables from Groups 1 and 2) and the Expanded Model (containing variables from Groups 1, 2 and 3).

However, given the statistical fit criteria (such as evaluation of the Akaike Information Criterion - AIC and use of the stepwise algorithm), the final empirical model that was estimated presented a lower number of these initially considered variables. It should be noted that, although the empirical model presented fewer explanatory variables, this did not compromise the analysis conducted for this study, which achieved its main goal.

3.2 Empirical Model

In accordance with the aforementioned theoretical specifications on the logit model, the fitted empirical model (final model) is presented in Equation 6:

$$P(Y = 1|x) = G(\beta_0 + x\beta) = G(q) \quad (6)$$

where $G(q)$ is given by Equation 7:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_{12} X_{12} + u_t \quad (7)$$

with Y being the binary variable, where $Y=1$ characterizes the occurrence of food waste, while $Y=0$ indicates the non-occurrence.

As mentioned, the Y variable was defined based on the responses of individuals who declared that they discarded 10% or more of their lunch and dinner leftovers. In this case, Y assumed the value 1, and zero when these surpluses corresponded to less than 10%.

$\beta_0, \beta_1, \beta_2, \beta_3, \dots, \beta_{12}$ are the estimated parameters of the model (coefficients);

X_1 is equivalent to the gender binary variable, where $x_1=1$ corresponds to female individuals; x_1 assumes a value of zero for male individuals. In the empirical model, we will refer to this variable as "GENDER";

X_2 is equivalent to the binary variable where $x_2=1$ corresponds to individuals who have a child or children. x_2 assumes a value of zero for individuals who have no children. In the empirical model, we will refer to this variable as "CHILDREN";

X_3 is equivalent to the binary variable where $x_3=1$ corresponds to individuals with income of fifteen thousand reais or more. x_3 assumes a value of zero for individuals with income lower than fifteen thousand reais. In the empirical model, we will refer to this variable as "INCOME";

X_4 is equivalent to a score of 1 to 7³ assigned by the individuals regarding the following statement: "To me, making more food than necessary is an act of great generosity". In the empirical model, we will refer to this variable as "ATTITUDE";

X_5 is equivalent to the mean of scores ranging from 1 to 7¹ assigned by the respondents concerning to four statements: A1: "My friends think that at our house we waste a lot of food"; A2: "My family members think that in our house a lot of food is wasted"; A3: "My family members think that we should **not** consume leftovers"; and A4: "My family members think that we should **not** rethink the amount of food that we buy". In the empirical model, we will refer to this variable as "INJUNCTIVE";

X_6 is equivalent to the mean score ranging from 1 to 7¹ assigned by the respondents to three statements: A1: "I find it very **difficult** to change the behavior of the people in my house with regard to the amount of food that is thrown away"; A2: "I think it is very difficult to store food because I never know whether it should be kept in plastic or glass containers"; and A3: "I find it very difficult to store some kinds of food because certain foodstuffs cannot be refrigerated and then reheated, so it is better to throw these leftovers away". In the empirical model, we will refer to this variable as "PBC" (Perceived Behavioral Control);

X_7 is equivalent to the mean score ranging from 1 to 7¹ assigned by the respondents to three statements: A1: "My memory of family meals is of abundance, with several dishes to suit all tastes and with leftovers"; A2: "The children in my house always choose what they want to eat"; and A3: "At home, my mother always thought of buying finger food or other kinds of snacks that children were happy to eat before meals". In the empirical model, we will refer to this variable as "AFFECTIVE".

X_8 is equivalent to the mean score ranging from 1 to 7⁴ assigned by the respondents to the following statement: "In my opinion, overburdening the environment with food that is normally

³ According to the Likert scale: (1) I totally disagree; (2) I partly disagree; (3) I disagree; (4) I neither disagree nor agree; (5) I agree; (6) I partly agree; (7) I fully agree.

⁴ According to the scale: (1) Extremely Negative Attitude (ENA); (2) Partly Negative Attitude (PNA); (3) Negative Attitude (NA); (4) Neither a Negative nor a Positive Attitude (MMPA); (5) Partly Positive Attitude (PPA); (6) Positive Attitude (PA); (7) Extremely Positive Attitude (EPA).

thrown away in my house is an attitude with which...". In the empirical model, we will refer to this variable as "ENVIRONMENTAL".

u_t refers to the stochastic error term.

It should be highlighted that the data referring to the variables in the model (dependent and explanatory) were obtained through an electronic questionnaire. The analyses of the model were based on the marginal effect of the coefficients of the explanatory variables on the dependent variable.

4. Results and Discussion

4.1 Respondent's profile

The Table 1 contains the main results. Our sample is mostly female, young (18-29 years old), single, university students, and without children. Regarding income, the majority have salaries higher than three minimum wages.

The number of respondents is relatively aligned with the UFMS population, about gender and age group. Other categories were not possible to compare due to the unavailability of data on the university population at UFMS, specifically on the Campo Grande campus.

Table 1. Respondents' Profile⁵

| Gender | Respondents (%) | UFMS Population (%) | UFMS Campo Grande Population (%) |
|---|-----------------|---------------------|----------------------------------|
| Male | 40.3 | 45.9 | 50.7 |
| Female | 59.7 | 54.1 | 49.3 |
| Age group | Respondents (%) | UFMS Population (%) | UFMS Campo Grande Population (%) |
| 18 - 29 years old | 58.9 | 80.9 | 81.5 |
| 30 - 50 years old | 24.8 | 17.1 | 16.3 |
| 51 - 70 year old | 16.2 | 2.0 | 2.2 |
| Per capita Income | | Respondents (%) | |
| Up to minimum wage | | 11.0 | |
| Between 1 and 3 minimum wages | | 35.6 | |
| Between 3 and 12 minimum wages | | 45.3 | |
| Above 12 minimum wages | | 8.1 | |
| Education Level | | Respondents (%) | |
| Elementary School (incomplete+completed) | | 6.0 | |
| High School (incomplete+completed) | | 22.7 | |
| College/University (incomplete+completed) | | 53.0 | |
| Postgraduate (incomplete+completed) | | 18.4 | |
| Marital status | | Respondents (%) | |
| Single | | 60.1 | |
| Married | | 32.9 | |
| Divorced | | 4.8 | |
| Widowed | | 1.7 | |
| Number of children | | Respondents (%) | |
| 0 | | 62.5 | |
| 1 | | 12.6 | |
| 2 | | 14.8 | |
| 3 | | 6.2 | |
| 4 | | 1.7 | |
| Above 4 | | 2.1 | |

Source: data search (2022). *UFMS (2023); **Minimum wage of R\$1,212 is equivalent to US\$214.89 (1 USD = 5.05595, April 2023).

⁵ Source: Universidade Federal de Mato Grosso do Sul (2023).

The results obtained from the fit of the Logit model for the original model are presented in Table 2. For the expanded model, the results are shown in Table 3. It should be noted that other models were estimated considering the presence of other variables mentioned in the previous section. Using the "stepwise" method and with the help of the lowest value for the AIC, the model with the best statistical fit presented here was defined for both cases: original and expanded.

The "Stepwise"⁶ method aims to aid the selection of the variables that are important to the model and uses the AIC to combine the variables from the different simulated models to select the one with the best fit. The lower the AIC, the better the fit of the model (Wooldridge, 2009; Hair-Junior et al., 2009). The AIC is calculated using Equation 8:

$$AIC = -2\log(L_p) + 2[(p+1)+1] \quad (8)$$

where L_p is the maximum likelihood function and p is the number of explanatory variables in the model.

The results of the Original Model are presented in Table 2, below.

Table 2. Estimates of the coefficients of the Logit Model and respective values of the marginal effects – original model

| Variables | Coefficients | Standard Error | p-value ^{&} | MgE [#] |
|--|--------------|----------------|--------------------------|------------------|
| Intercept | -4.1961 | 0.6126 | 0.0000*** | - |
| Income | 0.9726 | 0.3961 | 0.0140** | 0.2257 |
| Gender | 0.3424 | 0.2350 | 0.1450 ^{NS} | 0.0690 |
| Children | -0.6884 | 0.2439 | 0.0047*** | -0.1361 |
| Attitude | 0.1402 | 0.0571 | 0.0143** | 0.0288 |
| Injunctive | 0.4962 | 0.1391 | 0.0003*** | 0.1023 |
| PBC | 0.3615 | 0.0915 | 0.0000*** | 0.0745 |
| <i>N</i> | | | | 419 |
| AIC | | | | 478.77 |
| Mc Fadden (Pseudo-R ²) | | | | 0.1124 |
| Cox-Snell (Pseudo-R ²) | | | | 0.1311 |
| Nagelkerke (Pseudo-R ²) | | | | 0.1838 |

***, **, * indicates significance of 1%, 5% and 10%, respectively; ^{NS} not significant (significance higher than 10%); [#] Marginal Effects (MgE). [&] p-value of the Wald test for the explanatory variables; *n* corresponds to the size of the data sample.

Source: research data.

The premise of interpreting only the marginal effects of the coefficients that showed significance below 10% was adopted. Thus, regarding the "INCOME" variable, the fact that individuals have a high income (over 15,000 reais or over 2,862 dollar) increases the probability of food waste by approximately 22.57%. It is necessary to evaluate the possibility of this high-income group becoming discretionary, as the individuals in the sample indicated the possibility of high income resulting in excessive consumption, leading to waste.

It should be mentioned that the coefficient of the "GENDER" variable was not analyzed because it showed a significance level greater than 10%. Despite a non-significant coefficient at 10%, the inclusion of this variable was necessary as it allowed a better fit of the final model.

⁶ For further details on the Stepwise methodology, see Chambers et al. (1992), in R Documentation (package 'stats' version 4.1.1 "Choose a model by AIC in a Stepwise Algorithm").

Regarding the "CHILDREN" variable, the fact that individuals have children reduces the probability of food waste by approximately 13.61%.

Regarding the "ATTITUDE" variable, there is an indication of an increase in the probability of food waste of 2.88% when there is a higher level of agreement with the statement "To me, making more food than necessary is an act of great generosity".

Considering the "INJUNCTIVE" variable, which represents the mean of the scores of four statements, there is an increase of approximately 10.23% in the probability of food waste, when the value is higher. Therefore, the more the individuals' friends and family members point out that a lot of food is wasted in the household, the greater the probability of that household wasting food.

Regarding the mean scores of the three statements referring to the "PBC" variable, when its value is higher, there is an increase of 7.45% in the probability of food waste. Thus, the more difficult it is to manage and store leftovers, the greater the likelihood of waste.

Finally, it should be noted that one way to assess the fit of the logistic regression to the data is the use of indicators known as Pseudo-R-Squared values. They play a role similar to that of the R-square (coefficient of determination) in linear regression, that is, they represent the proportion of variation occurring in the dependent variable that is explained by the model (Hair-Junior et al., 2009). According to the authors, these values can also be used to compare the performance of competing models between two equally valid logistic equations. Therefore, preference should be given to the one with the highest Pseudo-R². In choosing the most robust model, this criterion was adopted, in addition to the AIC and stepwise criteria (see Table 2).

The results of the Expanded Model are presented in Table 3, below.

Table 3. Estimates of the coefficients of the Logit Model and respective values of the marginal effects – EXTRA Model

| Variables | Coefficients | Standard Error | p-value [§] | MgE [#] |
|-------------------------------------|--------------|----------------|----------------------|------------------|
| Intercept | -4.4417 | 0.6355 | 0.0000*** | - |
| Income | 1.0862 | 0.4043 | 0.0072*** | 0.2532 |
| Gender | 0.4137 | 0.2413 | 0.0864 * | 0.0834 |
| Children | -0.7149 | 0.2457 | 0.0036*** | -0.1407 |
| Injunctive | 0.4790 | 0.1408 | 0.0006*** | 0.0984 |
| PBC | 0.3262 | 0.0930 | 0.0004*** | 0.0670 |
| Affective | 0.2357 | 0.0795 | 0.0030*** | 0.0484 |
| Environmental | 0.0719 | 0.0861 | 0.4033 ^{NS} | 0.0147 |
| N | | | | 419 |
| AIC | | | | 476.73 |
| Mc Fadden (Pseudo-R ²) | | | | 0.1201 |
| Cox-Snell (Pseudo-R ²) | | | | 0.1394 |
| Nagelkerke (Pseudo-R ²) | | | | 0.1955 |

***, **, * indicates significance of 1%, 5% and 10%, respectively; ^{NS} not significant (significance higher than 10%); # Marginal Effects (MgE). § p-value of the Wald test for the explanatory variables; n corresponds to the size of the data sample.

Source: Research data.

In this model, the premise of interpreting only the marginal effects of the coefficients that showed significance below 10% was also followed. Therefore, regarding the "INCOME" variable, the fact that the individuals have a high income (above 15,000 reais or above 2,862) increases the probability of food waste by approximately 25.32%.

Considering the "GENDER" variable, it was observed that the probability of an individual wasting food increases by 8.34% when individuals declare themselves to be female.

Regarding the variable "CHILDREN", the fact that individuals have children reduces the probability of food waste by approximately 14.07%.

The variable "INJUNCTIVE", which represents the mean scores of four statements, indicates an increase of approximately 9.84% in the likelihood of food waste, as its value increases. Therefore, the more that friends and family members of individuals point out that a lot of food is wasted at home, the greater the probability of food waste.

Regarding the mean scores of the three statements referring to the "PBC" variable, when the value is higher, the probability of food waste increases by 6.70%. The more the individual finds it difficult to manage and store leftovers, the greater the likelihood of waste.

Regarding the mean scores of three statements concerning the "AFFECTIVE" variable, when the value is higher, there is an increase of 4.84% in the probability of food waste. Thus, the greater the affective memory and desire to please family members with food, the more likely it is that the individual will waste it.

In the Expanded model, fits under the AIC and stepwise criteria revealed a model without the ATTITUDE variable. In a way, its inclusion could point out results correlated with those identified by the "AFFECTIVE" variable.

It should be mentioned that the coefficient of the "ENVIRONMENTAL" variable was not analyzed because its significance level was higher than 10%. Despite its coefficient not being significant at 10%, the inclusion of this variable was necessary because it allowed a better fit of the final model. It should also be highlighted that the fact that the coefficient was not significant does not imply that it has little relevance when it comes to explaining food waste.

Therefore, the question is: to what extent does declared concern for the environment compare with the percentage of food that an individual claims to waste at home? On the other hand, the declared percentage of waste indicates a relationship with an affective memory related to food and the desire to please family members with food. It was also evident that, considering the study sample, food waste occurs more in wealthy households, with fewer people, where it is better categorized as "waste" by family and friends and where people are less skilled at reusing leftovers or storing food in the refrigerator. This information is very useful for building action plans, both public and private, with the intention of changing behavior related to waste. It is known that what goes to waste has a social, environmental and economic impact. However, the same impact can be relativized when the affective aspect is called into question. At a large, plentiful, cheerful and harmonious table, what goes to waste can be considered acceptable.

Regarding the predicted values with the estimated model, compared with the observed values, the percentage of agreement of the model (success rate) is approximately 74.46%, which can be considered a good fit (Pino, 2007).

The descriptive statistics of the variables of the two empirical models (Original and Expanded) are shown in Table 4, below.

Table 4. Descriptive statistics of the variables used in the two fitted models (Original and Expanded).

| Variables | Descriptive Statistics | | | |
|-----------------|------------------------|--------|---------|---------|
| | Median | Mean | Maximum | Minimum |
| Income* | 0 | 0.0810 | 1 | 0 |
| Gender* | 1 | 0.5967 | 1 | 0 |
| Children* | 0 | 0.3747 | 1 | 0 |
| Attitude** | 4 | 3.7780 | 7 | 1 |
| Injunctive** | 3.5 | 3.3230 | 5.8 | 1 |
| PBC** | 3 | 3.0430 | 6.7 | 1 |
| Affective** | 3 | 3.1730 | 7 | 1 |
| Environmental** | 1 | 1.9700 | 7 | 1 |

*Binary variables; **Quantitative variable (integer values referring to scores).

For the binary variables, 59.67% of the sample identified as female, 37.47% of the individuals had children, and 8.10% of the sample were high-income individuals, with income of over 15,000 reais.

5. Conclusions

In this work, intention related to food waste was used to measure how much intention can be weakened or strengthened by the traditional constructs of the Theory of Planned Behavior (attitude, social norms and perceived behavioral control). To enrich the discussion, the affective and environmental dimensions were explored in an expanded model. The data processing technique that was employed was logistic regression. Having been conducted on a sample in the Brazilian Midwest. How people think about food is a determinant of the relationship between individuals and food disposal. Valuing a large, plentiful, cheerful and harmonious table minimizes the social, environmental and economic problem of waste. The act of "throwing away" is endorsed by hedonism.

Regarding the characteristics of the Brazilian individuals in the sample, it was possible to observe that high income can increase food waste. There is evidence to investigate the possibility that this high-income range (15,000 reais/2,862 dollar) becomes discretionary for individuals, since it can lead to excessive and even superfluous food consumption, subject to waste. This constitutes a theme for research.

It is noteworthy that there is a lack of public policies to combat food waste in the domestic environment in Brazil. It is necessary to stimulate consumer education actions so that they can make better choices in the acquisition, storage, preparation, consumption, and disposal of food.

Although it is a limitation of this study, this factor does not disqualify the sample; rather, it provides notes about this characteristic for future related work.

6. References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
- Ajzen, I. (2015). Consumer attitudes and behavior: the theory of planned behavior applied to food consumption decisions. *Italian Review of Agricultural Economics*, 70(2), 121-138.
- Aktas, E., Sahin, H., Topaloglu, Z., Oledinma, A., Huda, A. K. S., Irani, Z., Sharif, A. M., van't Wout, T., & Kamrava, M. (2018). A consumer behavioural approach to food waste. *Journal of Enterprise Information Management*, 31(5), 658-673.
- Alexander, C., Gregson, N., & Gille, Z. (2013). Food waste. In *The handbook of food research* (pp. 471-483). Bloomsbury Academic.
- Ananda, J., Karunasena, G. G., Kansal, M., Mitsis, A., & Pearson, D. (2023). Quantifying the effects of food management routines on household food waste. *Journal of Cleaner Production*, 391, 136230.
- Ardekani, Z. F., Sobhani, S. M. J., Barbosa, M. W., & Sousa, P. R. (2023). Transition to a sustainable food supply chain during disruptions: a study on the Brazilian food companies in the Covid-19 era. *International Journal of Production Economics*, 257, 108782.
- Barbosa, L., & Campbell, C. (2006). *Cultura, consumo e identidade*. São Paulo: FGV Editora.
- Blešić, I., Petrović, M. D., Gajić, T., Tretiakova, T. N., Syromiatnikova, J. A., Radovanović, M., Popov-Raljić, J., & Yakovenko, N. V. (2021). How the extended theory of planned behavior can be

- applied in the research of the influencing factors of food waste in restaurants: learning from Serbian urban centers. *Sustainability (Basel)*, 13(16), 9236. <http://dx.doi.org/10.3390/su13169236>
- Canto, N. R., Grunert, K. G., & De Barcellos, M. D. (2021). Circular food behaviors: a literature review. *Sustainability*, 13(4), 1872.
- Capgemini. (2022). *Reflect, rethink, reconsider: why food waste is everybody's problem*. Retrieved in 2023, February 9, from <https://www.capgemini.com/insights/research-library/food-waste/>
- Chambers, J., Hastie, T., & Pregibon, D. (1992). Statistical models in S. In *Proceedings of the 9th Computational Statistics (Compstat)* (pp. 317-321). Heidelberg: Physica-Verlag HD.
- Chen, H. S. (2019). Environmental concerns and food consumption: what drives consumers' actions to reduce food waste? *Journal of International Food & Agribusiness Marketing*, 31(3), 273-292.
- Cuadra, S. V., Heinemann, A. B., Barioni, L. G., Mozzer, G. B., & Bergier, I. (2020). *Climate action: contributions of Embrapa*. Brasília: Embrapa.
- Evans, D., & Abrahamse, W. (2009). Beyond rhetoric: the possibilities of and for 'sustainable lifestyles'. *Environmental Politics*, 18(4), 486-502.
- Flanagan, A., & Priyadarshini, A. (2021). A study of consumer behaviour towards food-waste in Ireland: attitudes, quantities and global warming potentials. *Journal of Environmental Management*, 284, 112046.
- Food and Agriculture Organization of the United Nations – FAO. (2017). *Pérdidas alimentos y desperdicios de alimentos en América Latina y El Caribe*. Rome.
- Food and Agriculture Organization of the United Nations – FAO. (2021). *Nutritive factors*. Rome.
- Gil, A. C. (1987). *Métodos e técnicas de pesquisa social*. São Paulo: Atlas.
- Graham-Rowe, E., Jessop, D. C., & Sparks, P. (2015). Predicting household food waste reduction using an extended theory of planned behaviour. *Resources, Conservation and Recycling*, 101, 194-202.
- Hair-Junior, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2009). *Análise multivariada de dados* (6ª ed., 688 p.). Bookman.
- Kymäläinen, T., Seisto, A., & Malila, R. (2021). Generation Z food waste, diet and consumption habits: A Finnish social design study with future consumers. *Sustainability*, 13(4), 2124.
- La Barbera, F., Amato, M., Rivero, R., & Verneau, F. (2022). Social emotions and good provider norms in tackling household food waste: an extension of the theory of planned behavior. *Sustainability*, 14(15), 9681.
- Leite, F. F. G. D., Nobrega, G. N., Baumgärtner, L. C., Alecrim, F. B., Silveira, J. G., Cordeiro, R. C., & Rodrigues, R. D. A. R. (2023). Greenhouse gas emissions and carbon sequestration associated with Integrated Crop-Livestock-Forestry (ICLF) systems. *Environmental Reviews*, er-2022-0095. <http://dx.doi.org/10.1139/er-2022-0095>
- Maddala, G. (2002). *Limited dependent and quantitative variables in Econometrics*. New York: Cambridge University Press.
- Matta, R. (1984). *O que faz o Brasil, Brasil?* (Vol. 7). Rio de Janeiro: Rocco.
- Melo, E. V., Dolabella, R., Peixoto, M., & Pinheiro, A. (2018). *Perdas e desperdício de alimentos: estratégias para redução* (Cadernos de Trabalhos e Debates, No. 3). Brasília: Câmara dos Deputados.

- Morettin, P. A., & Bussab, W. O. (2017). *Estatística básica*. Saraiva Educação SA.
- Ng, P. Y., Ho, P. L., & Sia, J. K. M. (2021). Integrative model of behavioural intention: the influence of environmental concern and condition factors on food waste separation. *Management of Environmental Quality*, 32(3), 631-645.
- Oliveira Costa, F. H., Moraes, C. C., Silva, A. L., Delai, I., Chaudhuri, A., & Pereira, C. R. (2022). Does resilience reduce food waste? Analysis of Brazilian supplier-retailer dyad. *Journal of Cleaner Production*, 338, 130488.
- Parente, L., Mesquita, V., Miziara, F., Baumann, L., & Ferreira, L. (2019). Assessing the pasturelands and livestock dynamics in Brazil, from 1985 to 2017: a novel approach based on high spatial resolution imagery and Google Earth Engine cloud computing. *Remote Sensing of Environment*, 232, 111301.
- Pinheiro, P. J., Andrade e Silva, J. M., & de Lourdes Centeno, M. (2003). Bootstrap methodology in claim reserving. *The Journal of Risk and Insurance*, 70(4), 701-714.
- Pino, F. (2007). Modelos de decisão binários: uma revisão. *Revista de Economia Agrícola*, 54(1), 44-57.
- Porpino, G., Parente, J., & Wansink, B. (2015). Food waste paradox: antecedents of food disposal in low income households. *International Journal of Consumer Studies*, 39(6), 619-629.
- R Core Team. (2022). *R: a language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing. Retrieved in 2023, February 9, from <https://www.R-project.org/>
- Reis, J. C., Rodrigues, G. S., Barros, I., Rodrigues, R. D. A. R., Garrett, R. D., Valentim, J. F., Kamoi, M. Y. T., Michetti, M., Wruck, F. J., Rodrigues-Filho, S., Pimentel, P. E. O., & Smukler, S. (2021). Integrated crop-livestock systems: a sustainable land-use alternative for food production in the Brazilian Cerrado and Amazon. *Journal of Cleaner Production*, 283, 124580.
- Reynolds, C., Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V. K., Evans, D., Koh, L., Carlsson Kanyama, A., Katzeff, C., Svenfelt, Å., & Jackson, P. (2019). Consumption-stage food waste reduction interventions: what works and how to design better interventions. *Food Policy*, 83, 7-27. <http://dx.doi.org/10.1016/j.foodpol.2019.01.009>
- Russell, S. V., Young, C. W., Unsworth, K. L., & Robinson, C. (2017). Bringing habits and emotions into food waste behaviour. *Resources, Conservation and Recycling*, 125, 107-114.
- Sarkar, B., Debnath, A., Chiu, A. S., & Ahmed, W. (2022). Circular economy-driven two-stage supply chain management for nullifying waste. *Journal of Cleaner Production*, 339, 130513.
- Sharma, D., Malhotra, H., & Mittal, R. (2021). Post-harvest Management Practice (PHMP): a systematic program to attain food security. In *Sustainable agriculture for food security* (pp. 179-207). Apple Academic Press.
- Stancu, V., & Lähteenmäki, L. (2022). Consumer-related antecedents of food provisioning behaviors that promote food waste. *Food Policy*, 108, 102236.
- Stefan, V., van Herpen, E., Tudoran, A. A., & Lähteenmäki, L. (2013). Avoiding food waste by Romanian consumers: the importance of planning and shopping routines. *Food Quality and Preference*, 28(1), 375-381.
- Stock, J. H., & Watson, M. W. (2004). Regressão com uma variável dependente binária. In *Econometria* (cap. 9, pp. 202-218). São Paulo: Addison Wesley.
- Torres-Reyna, O. (2014). *Logit, probit and multinomial logit models in R*. Princeton University. Retrieved in 2023, February 9, from <https://www.princeton.edu/~otorres/LogitR101.pdf>

- Ulkhag, M. M., Widodo, A. K., Yulianto, M. F. A., Widhiyaningrum, Mustikasari, A., & Akshint, P. Y. (2018). A logistic regression approach to model the willingness of consumers to adopt renewable energy sources. In *International Conference on Renewable Energy and Environment*. Toronto, Canada.
- Universidade Federal de Mato Grosso do Sul – UFMS. (2023). *Números UFMS*. Campo Grande. Retrieved in 2023, February 9, from <https://numeros.ufms.br/graduacao-alunos>
- Varese, E., Cesarani, M. C., & Wojnarowska, M. (2023). Consumers' perception of suboptimal food: strategies to reduce food waste. *British Food Journal*, *125*(1), 361-378.
- Veloso, G. A., Ferreira, M. E., Ferreira Júnior, L. G., & Silva, B. B. (2020). Modelling gross primary productivity in tropical savanna pasturelands for livestock intensification in Brazil. *Remote Sensing Applications: Society and Environment*, *17*, 100288.
- Vinuto, J. (2014). A amostragem em bola de neve na pesquisa qualitativa: um debate em aberto. *Temáticas*, *22*(44), 203-220.
- Wakefield, A., & Axon, S. (2020). "I'm a bit of a waster": identifying the enablers of, and barriers to, sustainable food waste practices. *Journal of Cleaner Production*, *275*, 122803.
- Wooldridge, J. M. (2009). Limited dependent variable models and sample selection corrections. In *Introductory econometrics: a modern approach* (4th ed., cap. 17, pp. 575-621). South-Western.
- Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT Press.
- Yadav, V. S., Singh, A. R., Gunasekaran, A., Raut, R. D., & Narkhede, B. E. (2022). A systematic literature review of the agro-food supply chain: challenges, network design, and performance measurement perspectives. *Sustainable Production and Consumption*, *29*, 685-704.

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