



WHAT DETERMINES DAIRY HOUSEHOLD FOOD WASTE?. A CASE STUDY FROM THE COSTA RICAN DAIRY INDUSTRY

¿Qué determina el desperdicio de alimentos lácteos?. Estudio de caso de la industria láctea de Costa Rica

Mercedes Montero Vega^{1*}; Manuel García Barquero¹; José Sánchez Gómez²; Karsyl Mejía Valverde¹

¹ Universidad de Costa Rica, San José, Costa Rica.

² INCAE, Business School, San José, Costa Rica.

* E-mail: mercedes.montero@ucr.ac.cr

Recibido: 30/05/2022; Aceptado: 15/11/2022; Publicado: 10/01/2023

ABSTRACT

Household waste represents a big contributor to food waste, especially in higher-income countries. To understand consumer behavior, and therefore food waste, this study addresses food buying and storing routines, sociodemographic characteristics and intrinsic product characteristics. Food waste has usually been studied in high-income countries, especially in Europe and North America. However, this research includes 343 direct interviews with Costa Rican consumers. We constructed a structural equation model using the Theory of planned behavior to understand dairy food waste. Results indicate that the least important determinants of food waste are sociodemographic characteristics, nonetheless, income correlates positively higher waste rates, as expected. Intrinsic characteristics of dairy products were an important determinant of waste; as consumers place more importance on these characteristics, less waste is produced. This is the first study in which food waste includes all of these constructs and that is settled in a developing country. Based on our results and the determinants of food waste, we discuss the political and research implications for household food waste reduction.

Keywords: food | waste | dairy | consumer behavior | sustainability.

RESUMEN

Los desechos del hogar representan un gran aporte al desperdicio de alimentos, especialmente en los países de ingresos altos. Para comprender el comportamiento del consumidor y, por lo tanto, el desperdicio de alimentos, este estudio aborda las rutinas de compra y almacenamiento de alimentos, las características sociodemográficas y las características intrínsecas del producto. El desperdicio de alimentos ha sido estudiado en países de altos ingresos, especialmente en Europa y Norteamérica. Sin embargo, esta investigación incluye 343 entrevistas directas a consumidores costarricenses. Construimos un modelo de ecuación estructural utilizando la teoría del comportamiento planificado para comprender el desperdicio de productos lácteos. Los resultados indican que los determinantes menos importantes en el desperdicio de alimentos son características sociodemográficas, no obstante, el ingreso se

correlaciona positivamente con mayores tasas de desperdicio, como se esperaba. Las características intrínsecas de los productos lácteos fueron un determinante importante para el desperdicio, a medida que el consumidor da más importancia a estas características, se produce menos desperdicio. Este es el primer estudio en el que el desperdicio de alimentos incluye todos estos constructos y que se realiza en un país en desarrollo. De acuerdo con nuestros resultados y los determinantes del desperdicio de alimentos, discutimos las implicaciones políticas y de investigación para la reducción del desperdicio de alimentos en el hogar.

Palabras clave: alimentos | desperdicio | lácteos | comportamiento del consumidor | Sostenibilidad

Forma de citar el artículo (Formato APA):

Montero, M., García, M., Sánchez, J. & Mejía, K. (2022) What determines dairy household food waste?. A case study from the Costa Rican dairy industry. *Anales Científicos*. 83(2), 149-159. <http://dx.doi.org/10.21704/ac.v83i2.1848>

Autor de correspondencia (*): Mercedes Montero Vega. Email: mercedes.montero@ucr.ac.cr

© Los autores, Publicado por la Universidad Nacional Agraria La Molina,

This is an open access article under the CC BY

1. INTRODUCTION

The rapid rise of supermarkets has changed the structure of supply chains. These prefer to buy their products from medium and large farmers or manufacturing food companies that provide large variety and quantity of produce (Reardon and Hopkins 2006), instead of a small-farmer-based structure in which supermarkets buy their produce from a large variety of suppliers. Mass production of food, although has reduced food prices, due to demand and supply, has also redefined quality standards, which are now higher than former locally-determined ones. These standards also foster more waste not only because of the packaging specifications but because of the quality and safety best-before dates (Frieling et al., 2013; Devin and Richards, 2018; Porter et al., 2018).

Approximately 1/3 of all food produced is lost or wasted along supply chains (Gustavsson, Cederberg, and Sonesson 2011). Research regarding food loss and waste has also indicated high income countries produce more household waste than lower income countries. Alternatively, these lower income countries produce more food losses along the supply chain due to poor infrastructure and logistics. Food waste is an environmental, economic, social and food security problem for most societies (Kosseva and Webb 2013), nonetheless, there is no specific information about consumer behavior and food loss and waste for most Latin American countries, including Costa Rica.

Although food loss and waste measurement has been a key task of FAO's SAVE FOOD initiative, this research

has not focused on its measurement but rather on the determinants of food waste in households, since there is little evidence regarding the determinants of consumer behavior related to food waste. Consumer waste behavior is a complex decision-making process shaped by socioeconomic variables and personal or societal values, and food waste habits. The lack of food waste analysis is especially true in Latin America, where we have found very limited research aligned with these topics.

The Costa Rican food market is no stranger to the abovementioned market circumstances, nonetheless the dairy local industry has followed a similar but not identical evolution pattern. In Costa Rica, most of dairy consumption is produced locally. Around 80% of fluid milk in the country is produced by a national cooperative which supplies dairy and other products to most supermarkets in the country and exports to Guatemala, Panama and Dominican Republic (Dairy in Costa Rica | Market Research Report | Euromonitor 2019). Therefore, international standards are met locally and abroad. Within this context, food losses and wastes produced along the supply chain occur inside the country's borders and stakeholders and consumers have some control among food dairy loss and waste. We have selected dairy products for analysis based on three characteristics: 1. The importance of the supply chain for Costa Rica, production and consumption-wise, 2. The short life-cycle of dairy products, 3. Since dairy are packed products, quality and safety information are indicated in the package.

Since the planet is facing the consequences of climate change, smarter production and consumption patterns are

mandatory for lower-impact systems and more sustainable supply chains. In the analysis of determinants of waste of the dairy supply chain we intend to address how to reduce consumer waste. Our main goal is to understand which are the intrinsic product characteristics and socioeconomic variables that influence consumer-related behavior, especially targeted to food waste in the dairy industry.

To understand and potentially improve the current consumption patterns, we first analyzed the reasons behind them and according to our results propose policy implications linked to food waste reduction, however, this research is based on consumer behavior, since the production is mainly managed by a few companies. Our hypothesis states that consumer behavior, intrinsic product characteristics and sociodemographic variables determine food waste, therefore, by shifting consumer's demands toward lower food waste, supply would follow. In this case: by shifting consumer behavior and the consumers' awareness of the consequences of food waste, behavior can adapt to a more sustainable pattern.

Theoretical Framework

Several previous studies have used the theory of planned behavior (TPB) introduced by Ajzen (1985) in order to explain food consumption patterns, and some others to analyze food waste. For this research, a modification of the TPB model, proposed by Stancu, Haugaard, and Lähteenmäki (2016) was adapted to food waste patterns in the dairy industry in Costa Rica. That model (Stancu, Haugaard, and Lähteenmäki 2016), included house-hold related constructs such as household skills, shopping planning and leftovers management: since the explanatory power of the model increased from 0,35 to 0,43 when these behavioral variables were included, it is expected that family patterns and consumer dynamics affect positively the explanatory power of food waste in the dairy industry as well.

With regards to drivers to reduce food waste, Schmidt and Matthies (2018) demonstrated that consumption practices referring to leftovers' managements and information regarding the expired food are the most effective behavioral drivers for food waste reduction for dairy and bakery products. Therefore, policy measures should focus on providing information about the economic, social, and environmental consequences of food waste and overconsumption. In this manner, conscious

overconsumption of food is reduced as an appropriate way to prevent food waste.

Aligned with several studies that considered socioeconomic variables as drivers of food loss and waste, Hebrok and Heidenstrøm (2019) addressed the sociocultural variables in 6 Norwegians households. Although these are case studies and cannot be linked to Costa Rican sociocultural characteristics, several interesting results are considered for this research. These are:

- Consumption of food items depends on how purchases and meals are conducted, planned and organized.
- Uncertainty about the edibility of food is not only affected by date labeling but also by the design of the packaging.
- When a product is partially used, it is easier wasted than an untouched, new product.
- Food items of low value, are more often wasted than food items that have a high perceived monetary value.
- Food waste often occurs when consumers handle products, they are not familiar with.

Most of the abovementioned variables or behavior were also mentioned by Stancu, Haugaard, and Lähteenmäki (2016) model. In this regard and associated with packaging schemes, Thompson et al. (2018) addressed the consumption and willingness to consume dairy products associated with the best-before date knowledge. Higher risk perception was notably associated with higher levels of label trust. Consumers trust in labels, but there is no evidence this trust has a direct impact on food waste, instead it is strongly associated with perceived risk. Therefore, trying to improve consumer trust and confidence in labels alone, may not result in lower food waste; however, packaging does affect food buying decision, because of trust issues.

According to Kasza et al. (2019) in analysis the forecasting demand, planning resource coordination and shopping planning to address the balance between a decrease in food waste and food safety requirements, results indicate that unconscious elements of consumer behavior are difficult to address and therefore to manage. In this regard and associated with TPB, food waste analysis considering psychological elements can

contribute to achieving this balance between the desire to decrease food waste and requirements of food safety, however it requires a constant work to educate both consumers and food entrepreneurs.

Alternatively, Stöckli, Niklaus, and Dorn (2018) synthesize practical and academic evidence on anti-consumer-food-waste interventions since it analyzes a framework of behavioral change interventions. Some practices such as poor meal planning, cooking too much, the poor application of strategies to handle overproduction (failing to freeze leftovers promptly), not using leftovers, serving too much (at home: overestimating the needed portion; in restaurants: not ordering half portions and second helpings), using overlarge dishes are related to household food waste.

Aligned with Stöckli et al. (2018), Kaza et al. (2019) and Setti et al. (2018) addressed the planning, storing preparing and eating consume patterns that can potentially increase or decrease food waste. These include the use of shopping lists, purchase planning, frequency of dining at home, as well as socioeconomic variables such as household size, monetary wealth (and their perception), education level and age.

Some other household-characteristics correlated to higher food waste are higher income and the presence of children, who eat frequently (McCarthy and Liu 2017). In this regard, results indicated, a large proportion of food was thrown away due to spoilage, the short shelf-life of fresh food and because people forgot about food left in the fridge. This is aligned with similar results from Stancu et al. (2016) and Schmidt (2019). Although this was not expected, “green” consumers were similar in many aspects to the mainstream consumers.

In terms of policy changes, de Hooge et al. (2017) used a linear regression analysis to analyze the disposal of suboptimal products, results indicate that suboptimal products are not necessarily a cause of food waste, that consumers seem to be sensitive to discounts on suboptimal products, and that most consumers are willing to purchase any type of suboptimal product when a discount is given, so socioeconomic variables seem important in the decision-making process.

In addressing consumers’ response towards suboptimal foods in supermarkets, (Aschemann-Witzel, Giménez,

and Ares 2019) reported that consumers who are more price-focused report lower food waste levels and a lower tendency to choose the optimal food item first at home, than those who are not emphasizing the price-quality relationship or do not search for price offer to the same extent. Elderly consumers and high education levels also played a role, and the price-focus is lower in high-income groups and among single households. Consumers tend to desist from purchase of price-reduced suboptimal food if they might lead to a waste of food, and money. This result is further supported by the fact that price-focused consumers are the target group for price-reduced suboptimal food do not indicate higher food waste levels at home, but rather lower.

One of the many variables considered and analyzed for food loss and waste reduction is packaging. However, Heller, Selke, and Keoleian (2019), through a life cycle assessment study, demonstrated that at very high food to package ratios, emissions or resource use of food production are much larger than those of simpler packaging, therefore, investment in smarter, not larger packaging may can reduce over-all environmental impacts.

The only Latin American-based study we encountered was located in Uruguay (Aschemann-Witzel, Giménez, and Ares 2019) and analyzed 540 consumers assessing their own accounts of food waste and causes of food discard. Although the research was a descriptive study, most frequently disposed food category was leftovers of fresh produce of fruit and vegetables and bakery products. The abovementioned studies provide sufficient background to establish a theoretical analytical framework in which three main constructs were identified: 1) consumer behavior related to food planning and waste management and disposal, 2) socioeconomic environment, 3) intrinsic product characteristics (such as branding, packaging, size, price, environmentally friendly). These constructs are the basis for our research which are described in the following sections.

2. METHODOLOGY

2.1 Data collection

Data was collected by a direct-personal survey which was conducted from May to July of 2019 in Costa Rica. All participants were either located in the greater

metropolitan area (GMA) or in a rural located (Guápiles) selected for comparison and by convenience. The survey was targeted to Costa Ricans between the age of 18 and 74 who are responsible to some extent for cooking and buying in their household.

2.2 Measures

Dairy products selected for analysis were fluid milk, fresh cheese, cheese (others), sour cream and cream cheese, which are the most common dairy products consumed in the country, which can also be found in most stores and supermarkets. Unlike many regions, Costa Ricans consume mainly fresh cheese instead of other types of cheese; therefore, our questionnaire divided cheese into two categories.

- **Consumer behavior**

According to TPB, it has been identified that behavior is influenced mainly by intention. Here, respondents were asked how likely they were to accommodate to different behavior patterns in a 5-point-Likert Scale (Table 4). To estimate behavior, a simple regression was run in which $Y = \text{respondents' intention (int) not to waste food}$ and principal components were extracted from the variables indicated in Table 4. Therefore, explanatory variables were $x_1 = \text{PC1}$, $x_2 = \text{PC2}$, $x_3 = \text{PC3}$. Intention not to waste food was asked directly and was also estimated in a 5-point-Likert Scale, only 3 principal components were considered, explaining 70% of total variance.

- **Socioeconomic environment**

Waste patterns are usually also related to socioeconomic characteristics. In this case, higher-income consumers are prone to waste more food, since the proportion of their income invested in food is proportionally smaller to a medium or lower income consumer. However, according to our literature review, higher education is also related to higher income, the pattern of food waste is not straightforward. In this regard, highly educated consumers waste less, but higher income consumers waste more, so. Which variable is more significant for food waste?

Other variable considered for analysis is age. Older consumers usually waste less food; however, these consumers are usually wealthier than younger ones who are still studying. Occupation, rural/urban household location as well as household size were also considered.

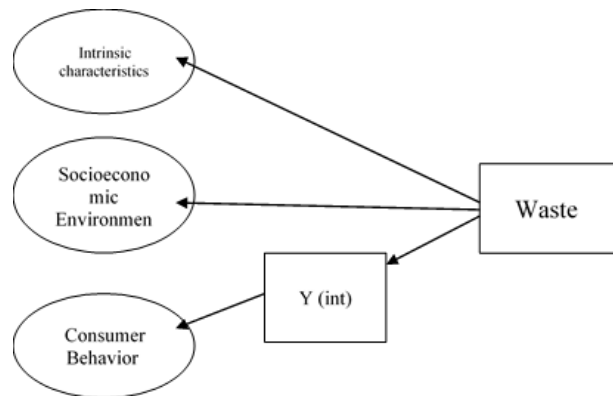
- **Intrinsic product characteristics**

Respondents were asked about the most important features to buy a dairy product, for each of the 5 products, consumers were asked to identify how important were the brand of the product, its price, best before date, product availability, packaging characteristics, size and taste. Here, as well as the previous sections, consumers had to rank in a 5-point Likert Scale, how important were the previously-mentioned characteristics, were 1:unimportant, 5: extremely important.

Regarding the waste, it was estimated according to buying rate and percentages of lost dairy products. In order to measure waste, consumers were asked to answer buying rates and percentages lost on each of the products independently to avoid confusion. Later, a weighted average of lost products was estimated.

- **Model measurement assessment**

A confirmatory factor analysis (CFA) was performed to test the measurement model using the maximum likelihood estimation. The initial model was modified; some variables were eliminated from the model and instead of using single variables to analyze psychological traits and how these modify behavior, principal components were used.



Notes:

- Socioeconomic variables: Table 1.
- Intrinsic characteristics: brand, price, flavor, best-before date, availability, packaging, size.
- Consumer behavior: Table 4.
- W (waste): sum of frequency of purchase*frequency of waste per produce.

Figure 1. Proposed model for waste estimation

The final model was evaluated using several fit indices such as Chi-square/degrees of freedom (χ^2/df), Goodness-of-fit index (GFI), Comparative fit index (CFI), Tucker Lewis index (TLI), Normed-fit index (NFI), and Root mean square error of approximation (RMSEA).

3. RESULTS AND DISCUSSION

3.1 Sample characteristics

Sample selection was based on the adult Costa Rican population. Therefore, respondents lower age-gap start at 18 years of age. We have decided these are decision-makers and therefore are aware of household dairy product consumption. Also, to address only those consumers in charge of household decision making in terms of food selection and preparation a screening was made to address only those consumers. Table 1 indicates the socio-demographic characteristics of the sample, which is of 343. As it was mentioned before, our sample stratification was done according to geographic and age constraints: respondents had to live either in GAM or in Guápiles and had to be adults.

Most of the respondents are relatively young since 48,4% have less than 35 years of age. Additionally, 58,59% of respondents have some university experience, whether completed a university degree (30,02%) or incomplete university attendance (28,57%). In this regard, since most of the population was located in the GMA (68,51%), where higher standards of living are more common, it was expected that education rates are higher than the national average that is 8,6 years of schooling (Schawb 2019).

Wealth is commonly correlated with age and in this case, lower income can be associated with the younger population. Spearman's rho indicated a correlation between age and income of 0,33 (p-value 6,11e-10), therefore the correlation between these two variables is moderate.

Regarding the occupation, house work refers mostly to women who are in charge of household eating characteristics but do not get a personal income. Finally, Costa Rican household size on average is 4 people with slight differences between rural and urban population (urban =3,9, rural =4,1), thus our sample household size accommodates to the county's average size

Table 1. Socioeconomic features of the sample (n = 343).

	Sample (%)
Age	
18 – 25	25.95
26 – 35	22.45
36 – 45	19.83
46 – 55	14.58
More than 56	17.2
Education	
Elementary school (less than 6 years)	0.87
Elementary school (6 years)	10.2
High-school (from 7 to 10 years)	9.91
High-school (11 years)	16.61
University (incomplete)	28.57
University degree	30.02
Postgraduate degree	3.79
Occupation	
House work	20.11
Employed	45.19
Self-employed	13.99
Student	18.95
Retired	1.16
No answer	0.58
Personal monthly income[i]	
Less than \$ 362.07	26.23
\$ 362.07 - \$ 775.86	30.9
\$ 775.86 - \$ 1293.10	24.19
\$ 1293.10 - \$ 2068.97	10.49
More than \$ 2068.97	7.87
No answer	0.29
Average household size	3.51

Most consumers are frequent dairy product consumers. Milk (95,63%) and fresh cheese (94,75%) are the most frequently consumed. We made a distinction between fresh cheese and other types of cheese because of the cultural tendency to consume fresh cheese instead of processes cheese (71,14%). Sour cream (89,5%) and

cream cheese (85,71%) were also considered for this research and although their average consumption is comparatively lower, all products were bought by the majority of Costa Rican consumers.

Also, most respondents were located in GAM accordingly to the population's behavior, and Table 2 specifies the proportion of urban and rural inhabitants and the type of supermarkets visited in which consumers were interviewed. There is a correlation between GMA and urban population, nonetheless, there are some rural regions within GMA. Finally, supermarkets and stores were classified as low, median and high income, according to their niche market with respect to income.

Table 2. Socio-geographical features of the sample (N = 343).

	Sample (%)
Geographical locations	
Greater Metropolitan Area (GMA) ^[1]	68.51
Outside GMA	31.49
Rural or urban locations	
Rural	27.11
Urban	72.89
Supermarkets ¹ and stores ² (Income-based)	
Low income	34.69 (58) ¹ (42) ²
Median income	26.53 (100) ¹
High income	38.78 (50) ¹ (50) ²

¹ Exchange rate 1 USD = 580 CRC

² The greater metropolitan area (GMA) considers the main concentration the most developed urban cities

The last construct addressed in the model is based on intrinsic product characteristics. In this case, consumers were asked to rank the importance of the characteristics of each product in order to identify how important the following are for consumers' decision-making when buying a product. Results of the models presented in Table 4 indicated that brand is the main characteristic for all products except for other types of cheese. As it was abovementioned, most Costa Rican dairy market is an oligopoly in which there is brand loyalty, buying a specific brand is a safety net for Costa Ricans. "Other types of cheese" is the dairy category in which more brand diversity can be observed in the country, therefore it is expected to encounter less brand loyalty. Taste, although considered very important for quality standards is relatively less important than other characteristics, however, when consumers already know a specific brand, is an indicative of considering taste, as a positive characteristic due to brand loyalty.

Packaging and product availability are the least important variables for consumers, most dairy products can be encountered in all shops in the country, therefore it is expected consumers "take it for granted" since they do not represent a problem for consumers to obtain. Alternatively, packaging was also considered unimportant, however this can also be an indicative of lack of variety in dairy packaging, since most products are either packed in tetra brick or plastic (bottles or boxes). Both characteristics are neither important, nor did represent enough variability to be considered in the model.

Table 3. Importance of intrinsic characteristics of dairy products (N = 343).

Products	Brand	Price	Best- before date	Product availability	Packaging	Size	Taste	Non-consumers
Milk	41.98	20.12	23.03	3.5	2.04	4.37	8.16	2.04
Fresh cheese	23.91	26.24	13.70	4.66	2.04	4.08	27.11	2.92
Cheese (Other)	14.58	17.20	7.00	3.79	1.17	1.75	18.66	28.57
Sour cream	38.48	16.03	11.66	2.04	2.92	5.25	17.2	7.87
Cream cheese	37.9	15.74	12.83	1.46	1.75	4.66	11.66	10.79

*Answers are not exclusive, respondents could indicate several characteristics as important.

3.2 The model

Several models were tested, however all of them followed the same structure of Figure 1. Originally the model was conceived as if intention dependent on behavior, and therefore the intention would be an observable variable. All initial models included “intention” as an observed variable which was directly asked consumers whether it was their intention to reduce their personal or household food waste. However, intention is not always a good predictor of behavior, therefore, instead of analyzing intention as an observable variable, the model was changed and a latent variable named “behavior” (B), which is an expression of behavior.

Table 4 indicates consumer habits and behavior related to food waste which were later considered for the model.

Table 4. Consumer habits and behavior variables considered for análisis. (Likert scale indicating 1= completely disagree. 5=completely agree) (n = 343).

Reasons	1	2	3	4	5	No answer
“Although the product had a good appearance. I preferred to throw it away because I bought it a while ago”	27.11	10.2	17.2	13.41	28.86	0.29
“Sometimes I buy a lot of products and it goes bad because I don’t have time to consume it all”	45.77	12.24	13.99	14.58	10.5	-
“When I opened the product. it had already gone bad even though the best-before date was later”	44.61	12.83	17.78	14.58	7.29	-
“I bought the product close to its best-before date because I didn’t read it”	40.82	11.08	16.91	11.66	16.62	-
“The product I bought was damaged by pests (rats. cockroaches) or pets (cats. dogs) and I threw it away”	74.93	6.12	4.66	4.37	6.71	0.29
“I bought a product that I didn’t like and threw it away because of its taste”	50.15	11.95	13.41	10.79	10.79	-
“I always check the best-before date on dairy products I buy”	12.54	7.29	11.37	15.16	50.73	-
“I forgot that I had the product because I stored it in the refrigerator or pantry”	45.19	13.41	17.49	12.83	7.87	0.29
“It is my intention to reduce my dairy products waste from home”	16.03	9.91	9.91	9.91	51.31	-

All socioeconomic variables and those included in Table 2 and Table 3 were tested for several models. However, the following were the ones with the best overall fit. All variables were measured in a 5-point Likert scale; therefore, the model was categorical.

Model 1

W=B+IC+income

B=PC1+PC2

IC=brand+price+flavor+best-to-date

W=waste

Most of them are considered food, buying and storage habits. However, the last variable “It is my intention to reduce my dairy products waste from home” was first addressed as consumer intentions and therefore was originally considered an observable variable. However, when testing the model this variable was not explained by the mixture of the other variables, from which we concluded there is no direct link between behavior and intention. Due to this lack of correlation between these variables, Behavior was measured by observed variables only which were clustered in principal components. To reduce the number of dimensions of these, a PCA was conducted, the eigenvalues obtained from the PCA indicate the need of at least two principal components, explaining 52,03% of the variance.

B=behavior

IC=instincic characteristics

Where: B and IC are latent variables

Model 2

W=B+IC+SE

B=PC1+PC2

SE= income + education + age

IC=brand+price+flavor+best-to-date

Where: B, SE and IC are latent variables

Model 3

$$W=B+IC+SE$$

$$B=PC1+PC2+PC3$$

$$SE= \text{income} + \text{education} + \text{age}$$

$$IC=\text{brand}+\text{price}+\text{flavor}+\text{best-to-date}$$

Where: B, SE and IC are latent variables

Instead of including more socioeconomic variables, model 1 (which has the best overall fit) only considers income as a dependable variable for food waste; higher income indicates higher household waste rates which was expected. However, age and education have a positive correlation, higher education and elderly people tend to waste less food. Occupation was not significant in any model and therefore there is no evidence that occupation influences household waste.

Table 5. Comparative fit indexes for model approximation of food waste.

Criteria for model fit	Model 1	Model 2	Model 3
Gfi	0,977	0,959	0,945
Agfi	0,955	0,925	0,926
X^2/df	1,53	2,5	2,1
TLI	0,942	0,845	0,847
CFI	0,963	0,896	0,886
RMSEA	0,04	0,06	0,057

Behavior (B) understood as the combined effect of the variables shown in Table 4, were all transformed into positive behavior toward food waste reduction, therefore, higher positive behavior would indicate lower waste rates (-0.069, p-value: 0,112). On the other hand, importance placed on intrinsic characteristics also has a negative relationship toward waste. (-0,684, p-value: 0,020). Finally, income has a positive relationship to waste; higher income, higher waste rates (0,164, p-value: 0,002). Intrinsic characteristics determine the largest proportion of food waste explanation in this model. We have supported previous research by including components of theory of planned behavior, however we modified not only these criteria but also included intrinsic characteristics and the importance consumers place on the later. Socioeconomic characteristics were included; however, the best fit was obtained when only income was used as an observable variable. Nonetheless, age and education were positively correlated to less waste rates.

4. CONCLUSIONS

Although academic publications on food waste in Latin America are scarce, this is a first attempt to start a path toward a more sustainable region by analyzing consumer household food waste behavior in Costa Rica. Although plenty of information and advocacy towards the reduction of food waste has been analyzed through the SAVE FOOD network, it has not translated in a totally sustainable consumer behavior. Waste, according to the results of our model(s), is influenced by socioeconomic variables but to a lesser degree, when compared to the other constructs (behavior and intrinsic characteristics).

Results indicate income is positively correlated to waste, which was expected, nonetheless, intrinsic characteristics and consumer behavior are more important when determining waste than any of the socioeconomic variables in the model. In this regard, behavioral patterns and buying decision-making should be considered. Although education was considered as a socioeconomic characteristic in the model, it was measured as formal education of consumers, however, formal education in the Costa Rican system does not address directly food waste or any other food management criteria. If these topics were included in the elementary and high school system, it could potentially be correlated with consumer behavior and psychologic characteristics, since waste and sustainability can become thought behavior patterns.

Alternatively, benefits from recycling have proven to modify behavior, therefore, by understanding the benefits of reducing waste, consumers could decrease their waste volume in their households. Previous research has shown how price-sensitive consumers are more sensitive to buying these types of products. Also, if recycling were to be linked to an economic profit, consumers would be encouraged to recycle; this could include not only food but also packing. Although this research did not address supermarket “lower-priced” goods that are near their best-before date, further research is needed to analyze how consumers would react to these offers and how they could modify their behavior, especially when income is a determinant variable for food waste (which is the case for Costa Rica).

Conflictos de intereses

Los autores firmantes del presente trabajo de investigación declaran no tener ningún potencial

conflicto de interés personal o económico con otras personas u organizaciones que puedan influir indebidamente con el presente manuscrito.

Contribuciones de los autores

Preparación y ejecución: MM, MG, JS, KM; Desarrollo de la metodología: MM, MG, JS; Concepción y diseño: MM, MG, JS; Edición del artículo: MM, MG, JS; Supervisión del estudio: MM.

REFERENCCESS

- Ajzen, I. (1985) From Intentions to Actions: A Theory of Planned Behavior. Chapter 2. In *Action Control: From Cognition to Behavior*, SSSP Springer Series in Social Psychology, eds. Julius Kuhl and Jürgen Beckmann. Berlin, Heidelberg: Springer Berlin Heidelberg, 11–39. https://doi.org/10.1007/978-3-642-69746-3_2
- Aschemann-Witzel, J., Giménez, A. & Ares, G. (2019) Household food waste in an emerging country and the reasons why: Consumer's own accounts and how it differs for target groups. *Resources, Conservation and Recycling* 145, 332–38. <https://doi.org/10.1016/j.resconrec.2019.03.001>
- Dairy in Costa Rica (2019). Market Research Report, Euromonitor (2019) <https://www.euromonitor.com/drinking-milk-products-in-costa-rica/report>
- Devin, B. & Richards, C. (2018) Food Waste, Power, and Corporate Social Responsibility in the Australian Food Supply Chain. *J Bus Ethics* 150, 199–210. <https://doi.org/10.1007/s10551-016-3181-z>
- Gustavsson, J., Cederberg, C., Sonesson, U. (2011) *Global food losses and food waste – Extent, causes and prevention*. Rome
- Frieling D., Stricks V., Wildenberg M. Schneider F. (2013) The beauty and the beast – how quality management criteria at supermarkets create food waste. In: CPM - The Swedish Life Cycle Center (Eds.), *Perspectives on Managing Life Cycles*. 6th International Conference on Life Cycle Management, Gothenburg, Sweden, 25.-28. August. <http://conferences.chalmers.se/index.php/LCM/LCM2013/paper/viewFile/724/338>
- Hebrok, M. & Heidenstrøm, N. (2019) Contextualising food waste prevention - Decisive moments within everyday practices. *Journal of Cleaner Production* 210, 1435–48. <https://doi.org/10.1016/j.jclepro.2018.11.141>
- Heller, M., C., S, Selke, E M., & Keoleian, G.A. (2019) Mapping the Influence of Food Waste in Food Packaging Environmental Performance Assessments. *Journal of Industrial Ecology* 23(2): 480–95. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12743>
- de Hooge, I.E., Oostindjer, M., Aschemann-Witzel, J, Normann,A., Mueller Loose, S & Lengard Almli, V. (2017) This apple is too ugly for me!: Consumer preferences for suboptimal food products in the supermarket and at home, *Food Quality and Preference*, Volume 56. <https://doi.org/10.1016/j.foodqual.2016.09.012>.
- Kasza, G., Szabó-Bódi, B., Lakner, Z & Tekla Izsó, T. (2019) Balancing the Desire to Decrease Food Waste with Requirements of Food Safety. *Trends in Food Science & Technology* 84: 74–76. <http://www.sciencedirect.com/science/article/pii/S0924224417303709>
- Kosseva, M & Webb, C. (2013) *Food Industry Wastes: Assessment and Recuperation of Commodities*. Academic Press. ISBN-10: 0123919215. ISBN-13: 978-0123919212
- McCarthy, B & Liu, H.B. (2017) Food Waste and the “Green” Consumer. *Australasian Marketing Journal* 25(2): 126–32. <https://doi.org/10.1016/j.ausmj.2017.04.007>.
- Porter, S.D., Reay, D.S., Bomberg,E. & Higgins, P. (2018) Avoidable Food Losses and Associated Production-Phase Greenhouse Gas Emissions Arising from Application of Cosmetic Standards to Fresh Fruit and Vegetables in Europe and the UK. *Journal of Cleaner Production* 201: 869–78. <https://doi.org/10.1016/j.jclepro.2018.08.079>.
- Reardon, T & Hopkins, R (2006) The Supermarket Revolution in Developing Countries: Policies to Address Emerging Tensions Among Supermarkets, Suppliers and Traditional Retailers. *The European Journal of Development Research* 18: 522–45.
- Schawb, K. (2019) *The Global Competitiveness Report*. World Economic Forum. http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf

- Schmidt, K. (2019) Predicting the Consumption of Expired Food by an Extended Theory of Planned Behavior. *Food Quality and Preference* 78: 103746. <http://www.sciencedirect.com/science/article/pii/S0950329319300539>
- Schmidt, K & Matthies E. (2018) Where to Start Fighting the Food Waste Problem? Identifying Most Promising Entry Points for Intervention Programs to Reduce Household Food Waste and Overconsumption of Food?. *Resources, Conservation and Recycling* 139: 1–14. <https://doi.org/10.1016/j.resconrec.2018.07.023>.
- Setti, M., Banchelli, F., Falasconi, L., Segrè, A., Vittuari, M (2018) Consumers' food cycle and household waste. When behaviors matter. *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2018.03.024>.
- Stancu, V., Haugaard, P & Lähteenmäki, L. (2016) Determinants of Consumer Food Waste Behaviour: Two Routes to Food Waste?. *Appetite* 96: 7–17. <https://doi.org/10.1016/j.appet.2015.08.025>.
- Stöckli, S., Niklaus, E., & Dorn., M. (2018) Call for Testing Interventions to Prevent Consumer Food Waste. *Resources, Conservation and Recycling* 136: 445–62. <https://doi.org/10.1016/j.resconrec.2018.03.029>.
- Thompson, B., Luiza Toma, L., Barnes AP., & Revoredo-Giha, C. (2018) The Effect of Date Labels on Willingness to Consume Dairy Products: Implications for Food Waste Reduction. *Waste Management* 78: 124–34. <https://doi.org/10.1016/j.wasman.2018.05.021>.