

Food waste in a Greek Higher Education institution: Students' attitudes, compositional analysis and environmental impacts

C. Gkikas, C. Marouli

Environmental Studies Department, Deree – The American College of Greece, Ag. Paraskevi 15342, Athens, Greece

Presenting author e-mail: c.gkikas@acg.edu

Abstract: Food waste is a significant problem of contemporary societies globally, with noteworthy environmental, social and ethical implications, and has attracted increased attention in the scientific and policy communities in the last decade. It is an important issue for higher education institutions too, in terms of both their operations' ecological footprint and their role in preparing the future responsible citizens and leaders. This paper documents the attitudes of students of a Greek higher education institution towards food waste, as well as provides a first recording of the food waste generated in the main dining facility on campus. Data was selected via a questionnaire applied to users of the dining facility and via a waste measurement campaign where avoidable and unavoidable waste were measured. Results show that college students are influenced by biases in the pre-acquisition, acquisition, and post-acquisition stages, such as their implicit theories, insufficient educational background on environmental issues, habits, tendency to conspicuously consume, and association of food purchase with identity signaling. Furthermore, in an effort to estimate the environmental impacts of food waste in this case and given that a significant component of the generated food waste refers to fried potatoes and orange peels, main environmental impacts are estimated for these two food waste products, with the use of relevant LCA results.

Keywords: avoidable and unavoidable food waste, higher education, Greece, students' attitudes, environmental impacts classification

1. Introduction

According to various studies and estimates, one-third of all food produced intended for human consumption is lost or wasted. This observed inefficiency of the global food system poses a severe threat to the environment, societies and global economies, causing approximately \$930 billion in economic losses, 8 % of annual greenhouse gasses (GHG) emissions and immense malnutrition, resource and land related conflicts (FAO, 2014; Lamb & Fountain, 2010; Scherhauer, Moates, Hartikainen, Waldron, & Obersteiner, 2018; Segrè, Falasconi, Politano & Vittuari, 2014). In addition, the current state of food habits and consumption is increasing the land footprint further exacerbating the climate change problem. Investigating and analyzing the food wasted in the service sector, i.e. restaurants, hotels, caterings, hospitals, is of tremendous importance as their share in the total food waste amounts is estimated at 33% (Quested & Murphy, 2014).

This study documents the composition of the food waste generated in the main dining facility on campus, as well the attitudes of students of a Greek higher education institution towards food waste. Furthermore, it attempts to show the way for a more focused estimation of the environmental impacts of food waste with the use of Life Cycle Assessment results.

2. Methods

As values and attitudes correlate with wastage, in this study we aim to document both the amounts of the food waste generated at the main dining facility of Deree –American College of Greece –, and student attitudes related with food waste generation. Through a waste measurement campaign, the quantity of food waste that was generated at the dining facility – both in the kitchen and the restaurant area – as well as its composition were documented in late March and in the middle of April 2019. Food waste was manually separated into two categories – avoidable and unavoidable – and was weighed. Via qualitative observations, the most frequently wasted food stuffs were identified. Since the food waste from the kitchen were not systematically provided for examination in this period, safe conclusions regarding the restaurant-management related waste behaviors cannot be reached.

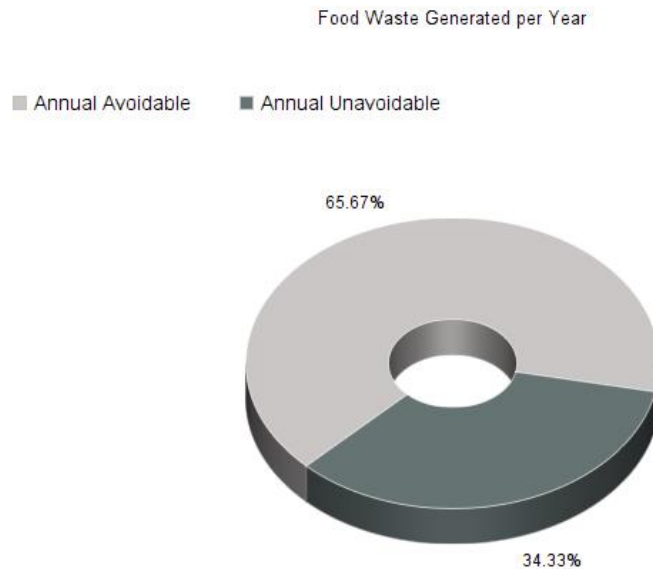
A questionnaire of 32 close-ended questions was used to investigate psychosocial factors that may determine students'/consumers' attitudes and behaviors that lead to food wastage in the context of the campus dining facility and outside the college. The questionnaires were self-administered and were distributed between 26 April 2018 and 7 May 2018; most were administered online (via google forms) but some were also collected in printed form from users of the dining hall.

3. Results

A. Compositional analysis of food waste

As the food waste measurement campaign demonstrated most of the food waste is avoidable; 65.35 kg were avoidable, and 34.17 kg were unavoidable. Thus, given the cycle of operation of this college dining facility, it was estimated that 2,777 kg of avoidable and 1,452kg of unavoidable food waste are generated per year. (More measurements at different operational periods are needed for a safer approximation).

Figure 1: Composition of Food Waste Generated per Year

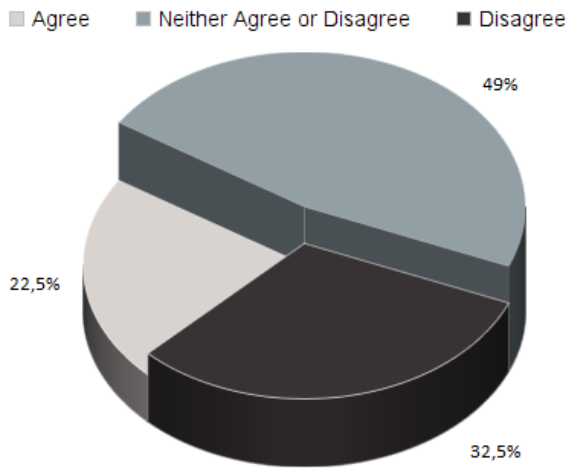


The qualitative observations revealed that avoidable waste was overwhelmingly (more than 80%) composed of French fries, with very little meat and salad remnants, while unavoidable waste was primarily composed of orange peels from the kitchen (more than 90%) with few bones. Furthermore, a large quantity of paper napkins and plastic packaging were disposed along with food waste.

B. Survey results

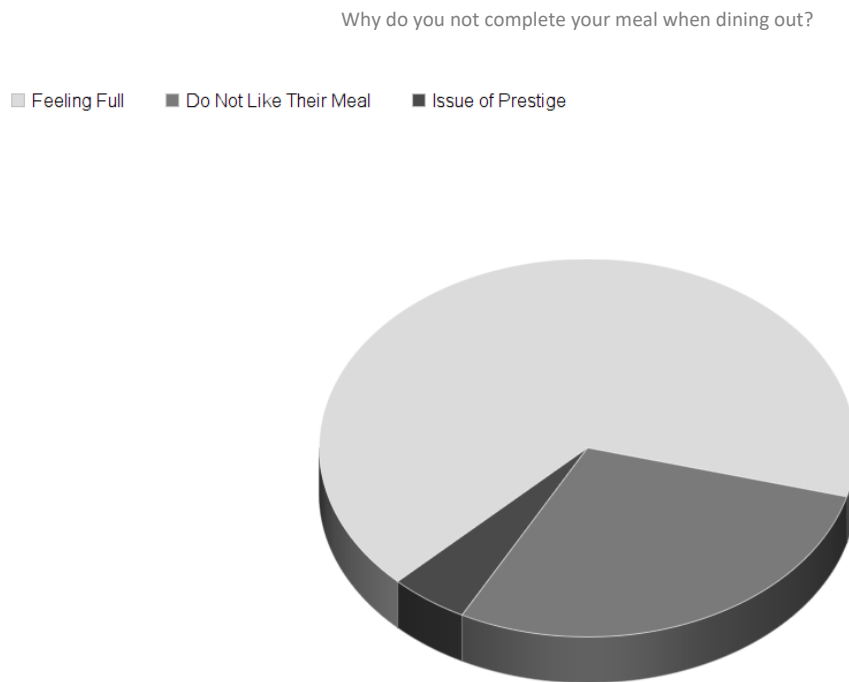
In terms of students' perceptions about food consumption, survey results demonstrated that respondents' satisfaction does not relate with the variety of plates (64.5%) they purchase, while there was no clear agreement that the variety of plates is a sign of social status (49% neither agree or disagree, 32.5% disagree and 22.5% agree).

Figure 2: Question: "I consider a greater variety of plates as a sign of economic, social and cultural status."



The main reasons that respondents do not complete their meal are: because they are full (70%); because they don't like the food (30%); and only 5% as an issue of prestige. Only 2.5% of the respondents always complete their meal.

Figure 3. Reasons consumers do not finish their meal inside the dining facility.

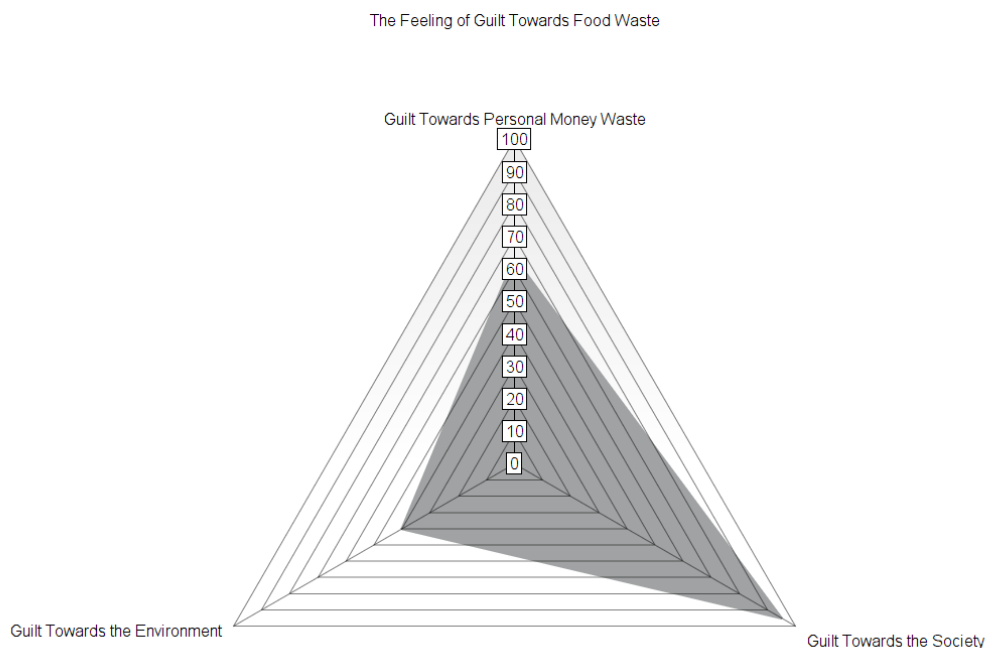


Additionally, 42.5% of respondents are influenced in terms of their menu choices by marketing strategies. 42% of the respondents are satisfied with larger portions, even though they may know they would not eat the whole dish. 22.5% did not connect their satisfaction with larger portions. 60% of the respondents welcomed the availability of portions of different size.

Other findings regarding consumers' perceptions of the environmental impacts or the social and economic valuation of food waste revealed that:

- Most of the respondents were aware of the negative environmental impacts of food waste. 50% of the respondents considered food waste an important environmental problem (very or extremely environmentally harmful), while 7.5% thought that it had no negative environmental impacts.
- Respondents generally felt some guilt relating with food waste, indicating some sense of responsibility for the possible harm done. The overwhelming majority felt guilty towards needy people when wasting food (95%); only 5% did not. Regarding their guilt feelings towards the environment, their responses are mixed: 40% agreed or strongly agreed and 27.5% disagreed or strongly disagreed. Most of the respondents felt guilt regarding the subsequent waste of money (63.5% agreed or strongly agreed), while 15% disagreed and none strongly disagreed. Figure 1.3. presents how consumers perception towards food waste hazards is distributed.

Figure 4. Respondents' guilt feelings towards society, environment and personal money waste.



In terms of student practices, most of survey respondents report that they throw away side dishes or condiments (47.5%) or main dish remnants (15%). This is in general agreement with the compositional analysis. According to survey findings, the food categories that are mostly wasted are: "Bread, rice, spaghetti" and salads (each one 35%), meat and fish (17.5%) and French fries (7%). This contradicts the findings of the compositional analysis (see Figure 1 above).

4. Discussion

Human behavior is a complex phenomenon which requires understanding of both psychological processes and social institutions (Aschemann-Witzel, Hooge, Amani, Bech-Larsen and Oostindjer, 2015; Ahuvia & Wong, 2002; Ajzen, 1991; Belk, 1985). Due to these factors, the interpretation of the results

is aiming to identify both the psychological and social parameters that can influence or determine consumers' behavioral patterns relating to food wastage.

Analyzing the results from the questionnaires, it was found that the students dining in the facility do not associate satisfaction with the variety and the abundance of food choices or plates. Additionally, it is unclear whether there is a correlation of conspicuous consumption and identity-signaling; results do not clearly support the idea that food selection correlates with a desire to demonstrate social status or internal sense of worth. It must be noted that abundance alongside variety are considered by the marketers as prominent marketing strategies that enhance the dining experience. It is generally accepted that both concepts stem from identity signaling, a major and recognizable characteristic of consumers' behavior (Block, et al., 2016; Reed II, Forehand, Puntoni & Warlop, 2012). Based on the results of the survey, marketing strategies appear to moderately influence students' choice of food plates and their desire for larger portions. There is evidence that lay theories such as "more is better" (Hong, Levy & Chiu, 2001), can affect students' behaviors leading to increased food waste.

Students believe that they have adequate general knowledge of the environmental impacts of food waste (but this should be further investigated). Despite students' claim of sufficient knowledge, their feelings of responsibility for these impacts are weak. It is interesting to note that they do express some sense of guilt relating with hungry people when they waste food, and they identify money/cost as a main source of influence for their sense of responsibility related with food waste. These findings highlight the complexity of the motivators for change in environmental behaviors; knowledge by itself is not sufficient, diverse feelings may be involved, while monetary parameters are significant.

Finally, it is noteworthy that both the students' survey and the compositional analysis verify that mainly side dishes or condiments are wasted. Students also indicated that they often do not finish meat or fish dishes, but the claimed frequency was not in complete agreement with the quantitative analysis. This may indicate that the perceived value of meat and fish dishes is higher than other types of food waste.

According to the authors, it is worth categorizing the potential drivers of food waste generation into three (3) categories/stages at the consumer level: pre-acquisition, food consumption and post - consumption. This categorization can help decision makers identify the points in the food waste generation process where action is needed and can be more effective. "Pre-acquisition" refers to the elements that influence a consumer's choice of what s/he will purchase to eat, such as marketing strategies and psychosocial factors (like personal implicit theories or worldviews, the correlation of conspicuous consumption with self worth) relating with individual decisions. The category "Food consumption" refers to the stage after food selection and describes the elements that can influence potential food wastage. Such elements include preferences in terms of taste, texture and ingredients, a factor that may compel consumers to finish or not their food or their perception of wasted side dish and condiments as food waste or not. Finally, "Post - consumption" refers to the possible ways of handling the food waste that has already been generated (e.g. "take-away" of the food leftovers for further use, composting, or utilizing food waste as pet food).

Another concern of this study was the estimation of the environmental impacts arising from food wastage in the college dining facility. In an attempt to identify an effective method for this estimation, results of Life Cycle Assessment studies were used for the main two components identified in the food waste: French fries and orange peels. Based on the results of the French fries LCA conducted by Mouron, Willersinn, Möbius, & Lansche (2016), it was estimated that on an annual basis the Deree dining facility produces 4,551 kg of CO₂ equivalents (global warming potential), 91,375 MJ equivalents (demand for nonrenewable energy resources), 1,576.2 kg 1.4-DB equivalents (human toxicity), 8.88 kg 1.4-DB equivalents (terrestrial ecotoxicity), and 888 kg 1.4-DB equivalents (aquatic ecotoxicity) (Mouron et al., 2016). The estimation of the impacts of orange peels could not be effectively concluded as the retrieved LCA results referred to the whole orange juice production process in an industrial setting.

Finally, distinguishing environmental impacts of food waste into direct – impacts produced by the food waste material itself – and indirect – those related with the production, processing, distribution (i.e. the life cycle) of the food that ends up as food waste – may be useful for designing effective policies to minimize food waste.

5. Conclusion

The purpose of this paper was to investigate the food waste generation at a Higher Education institution, in terms of quantities generated, composition of food waste as well as potential causes (attitudes and practices). It found that side dishes and condiments (especially French fries) are main contributors to food waste in this case. Main attitudinal or value-based aspects that contribute to food waste generation include individuals' implicit theories (e.g. "more is better") and insufficient environmental education regarding food waste generation and its impacts. Furthermore, it attempted to identify a reliable method for the estimation of the environmental impacts of the wasted food. In this effort, it proposes a novel approach to the analysis of the drivers of food waste generation at the consumers' level – identifying three relevant stages in the process (food acquisition, food consumption, post-food consumption). It also points to the usefulness of further specifying the environmental impacts of food waste, potentially with the use of LCA results, thus identifying an important area for further research.

References

- Ahuvia, A.C. & Wong, N. (2002). Personality and Values Based Materialism: Their Relationship and Origins. *Journal of Consumer Psychology* 12(4):389-402. DOI: 10.1207/S15327663JCP1204_10
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*. 50(2), pages 179-211.
- Aschemann-Witzel, J., Hooge, I., Amani, P., Bech-Larsen, T. and Oostindjer, M. (2015). Consumer-Related Food Waste: Causes and Potential for Action. *Sustainability*, 7(6), pages 6457-6477.
- Belk, RW. (1985). Materialism: Trait Aspects of Living in the Material World. *Journal of Consumer Research*, 12(3):265-80. DOI: 10.1086/208515
- Bervar, M., & Bertoncelj, A. (2016). The Five Pillars of Sustainability: Economic, Social, Environmental, Cultural and Security Aspects. MIC – Management Information Conference, Pula, Croatia, 1-4 June 2016. Retrieved from <http://www.hippocampus.si/ISBN/978-961-6984-26-3/151.pdf>
- Block, L.G., Keller, P.A., Vallen, B., Williamson, S., Birau, M.M, Grinstein, A., Haws, K.L., LaBarge, M.C., et al. (2016). The Squander Sequence: Understanding Food Waste at Each Stage of the Consumer Decision-Making Process. *Journal of Public Policy and Marketing*, 35(2), 292-304.
- FAO. (2015). Global Initiative on Food Loss and Waste Reduction. Retrieved from <http://www.fao.org/3/a-i4068e.pdf>,
- Hong, Y., Levy, S.R. & Chiu, C. (2001). The Contribution of the Lay Theories Approach to the Study of Groups. *Personality and Social Psychology Review*, 5 (2), 98-106.
- Lamb, G., & Fountain, L. (2010). An investigation into food waste management. WRAP. Retrieved from http://www.actiondechets.fr/upload/medias/group_b_report_compressed.pdf
- Mouron, P., Willersinn, C., Möbius, S. & Lansche, J. (2016). Environmental Profile of the Swiss Supply Chain for French Fries: Effects of Food Loss Reduction, Loss Treatments and Process Modifications. *Sustainability*, 8(12), 1214; <https://doi.org/10.3390/su8121214>
- Quested, T. & Murphy, L. (2014). Household food and drink waste: A product focus. WRAP. Retrieved from http://www.wrap.org.uk/sites/files/wrap/Product-focused%20report%20v5_3.pdf.)
- Reed II, A., Forehand, M., Puntoni, S. & Warlop, L. (2012). Identity-based consumer behavior. *International Journal of Research in Marketing* 29(4), 310-321. DOI: 10.2139/ssrn.2176665
- Scherhauer, S., Moates, G., Hartikainen, H., Waldron, K., & Obersteiner, G. (2018). Environmental impacts of food waste in Europe. *Waste Management*, 77, 98-113. doi: 10.1016/j.wasman.2018.04.038.

Segrè, A., Falasconi, L., Politano, A., & Vittuari, M. (2014). Background paper on the economics of food loss and waste (working paper). Rome: FAO. Retrieved from <http://www.fao.org/3/a-at143e.pdf>