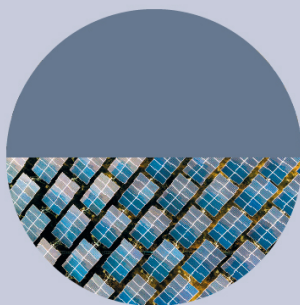


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Sustainability of animal origin food waste in Serbia

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Abstract. This research analysed attitudes related to food waste sustainability and estimated amounts of animal origin food waste and food packaging waste discarded in Serbia. The field survey covered 494 respondents from Belgrade, Serbia. Results present their degree of agreement with nine selected food waste sustainability statements and their reported quantities of discarded animal origin food waste and food packaging waste. Our study showed respondents have a higher rate of agreement related to the negative social and environmental dimensions of food waste, while they have no opinions associated with the economic dimensions. Regarding animal origin food waste quantities, it is estimated that households dispose around 200 g of waste every week (11.3 kg per year) and slightly under 30 different pieces of food packaging. On an annual basis, 7,234 tons of CO₂ emissions can be associated with animal origin food waste and 706.4 tons with food packaging waste in Serbia.

1. Introduction

It is a common belief that size of a household influences the amount of food waste discarded [1]. One of the main reasons is that different household members prefer different types of food and consequently produce more food waste [2]. However, when it comes to household members, homes with more members actually produce less waste per capita [3]. Therefore, four household factors that determine food waste are size, income, demographics and culture [4]. When it comes to determination of factors that affect food waste performance from purchasing to eating at home, Schanes et al. [5] point to the following: purchase planning and patronage, food storage, cooking habits, eating and managing leftovers. In consumer societies, various exaggerations influence food waste such as overbuying [6], purchasing oversized packaging [2] and cooking too much [7].

Sustainability as a modern concept consists of three pillars – social, environmental and economic [8]. The food industry recognizes “zero waste” as a food waste management idea that is overseen as an environmental objective leading to a more sustainable society and economy [9]. Therefore, besides the environmental dimension, food waste also has social and economic impacts [10]. Finally, looking at the Sustainable Development Goals [11], food waste is recognized as a hot topic where target 12.3 aims to halve per capita global food waste at retail and consumer levels and reduce food losses by 2030 [12].

The aim of this study was to analyse respondents’ sustainability beliefs related to food waste in Serbia and to calculate the amount of household wastes deployed from different animal origin foods and types of related food packaging. Also, we quantified CO₂ emissions from animal origin food waste and food packaging waste.



2. Materials and methods

Field research on food waste from the households in Serbia was performed during the first half of 2018 covering 494 questionnaires that were further processed [13]. The questionnaire was created taking into account published research on food waste [14-17].

Attitudes related to food waste were rated using a five-point Likert scale from 1 “strongly disagree”, 2 “disagree”, 3 “no opinion”, 4 “agree” to 5 “strongly agree”. Also, respondents were requested to indicate the frequency and the amount of food groups discarded in the last seven days, and the animal origin of the food, namely (i) fish and/or meat, or (ii) dairy products, which were further analysed. Animal origin food packaging waste generated in households was deployed in terms of tetra-pak packaging (associated with dairy products such as milk and yoghurt) or polyethylene films and paper (wrappers) used for packaging cheese, meat and/or meat products. Four frequency options were available as follows: every day (recorded as 7 times), 3 times per week (recorded as 3), 2 times per week (recorded as 2), and once a week (recorded as 1). Quantity of food waste was evaluated in handfuls of food waste, estimated as 20g or 20mL [13] or “zero” if they did not consume/discard this type of waste. Quantity of food packaging waste was evaluated in units of packaging or “zero” if they did not purchase/discard food with this type of waste. Weight measurement of typical representatives of each type of food packaging was performed at the Faculty of Agriculture with the following data (tetra-pak packaging – 27.0 g, paper and plastic wrappers – 2.5 g).

In order to calculate the global warming potential (GWP) associated with this type of food waste and packaging, the following assumptions were applied: (i) bearing in mind that food wastes from this urban city (Belgrade) are disposed at municipal landfills with no recycling, emission production was estimated as 0.513 kg CO₂/kg food waste; (ii) tetra-pak packaging – 0.045 kg CO₂/kg food packaging waste; (iii) plastic wrappers – 0.071 kg CO₂/kg food packaging waste; (iv) paper wrappers – 0.035 kg CO₂/kg food packaging waste. GWP data were extracted from ©CCaLC and Ecoinvest databases [18].

3. Results and discussion

3.1. Demography

Demographic characteristics show that females were the prevailing respondents (305 respondents, 61.7%), slightly above half of the respondents were below 35 years of age (258 respondents, 52.2%) and the majority of respondents (274 respondents, 55.4%) reported having at least four household members [13].

3.2. Sustainable attitudes

In order to enlighten our knowledge of respondents' attitudes towards food waste sustainability, nine statements (three statements related to the environmental dimension, three related to the economic dimension and three associated with the social dimension) were extracted and further processed from the research on household food waste in Serbia [13].

The environmental dimension shows that respondents see food packaging as a bigger problem than food waste, they feel disturbed by the amount of food being wasted and the wasted resources needed for food production, but they have no opinion whether food waste is an environmental problem due to food's biodegradability. The social dimension comprised of statements that respondents have a bad conscience when they waste food, they feel guilty because some people do not have enough to eat, but have no opinion whether food they waste would help undernourished people. The economic dimension was associated with no opinion about the cost of food thrown away, regardless of whether respondents buy more than they plan during sales/promotions and whether they buy only from their shopping lists. A graphical presentation of summarized results for the three sustainable pillars is presented in Figure 1.

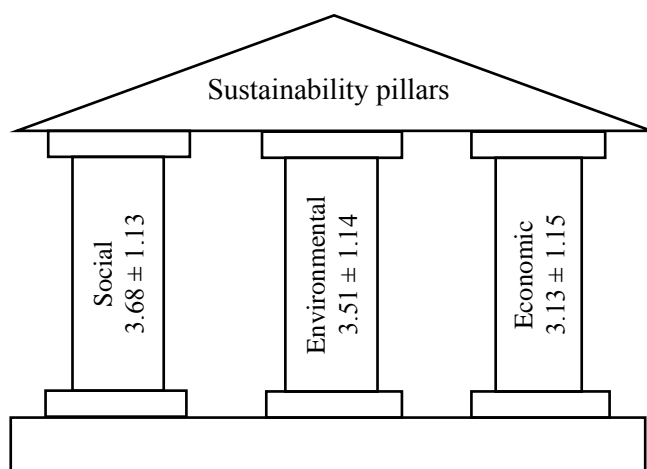


Figure 1. Sustainable attitudes towards food waste

Likert scale: (1) “Strongly disagree”, (2) “Disagree”, (3) “No opinion”, (4) “Agree”, (5) “Strongly agree

Table 1 shows amounts of self-reported total animal origin food waste/food packaging waste (N=494), per household and discarded in the last seven days. It can be observed that every second household discards more dairy products than meat or fish. It is assumed that half of the households discard this type of waste (dairy), and if they do, the amount is around 218.1 g (67.1 g per household member) or around 11.3 kg of food waste per year. Among 11 types of different food categories wasted in Serbia, quantities of discarded dairy products ranked fifth while fish and meat quantities were ranked ninth [13]. When it comes to food packaging waste, Table 1 shows that only 5% of respondents reported they did not discard food packaging waste. Speaking of numbers, below 30 pieces (around nine per household member) of different food packaging waste associated with animal origin food are discarded weekly. Innovative food packaging is recognized as an emerging future research perspective [19].

Taking into account the results from this study and the number of households in Belgrade and Serbia [20], we estimate that around 3,437 tons of animal origin food waste is annually discarded from Belgrade or 14,101 tons in Serbia. Regarding food packaging waste, the same calculations bring us to 3,723 tons of food packaging waste annually discarded from Belgrade or 15,275 tons in Serbia.

Table 1. Amount of self-reported animal origin food waste and food packaging waste in total (N=494), per household discarded in the last seven days (modified from [13])

Food category	Quantity per household, [gr] or [mL]	Number (%) of zero wasters
Dairy products	144.0 ± 364.1	265 (53.6%)
Fish/meat	74.1 ± 212.6	345 (69.8%)
Total amount of food waste per household	218.1 ± 482	234 (47.4%)
Food packaging category	Quantity per household [pieces]	Number (%) of zero wasters
Paper wrappers	12.7 ± 20.9	115 (23.3%)
Plastic wrappers	9.4 ± 18.8	168 (34.0%)
Tetra-pak packaging	6.7 ± 9.2	82 (16.6%)
Total amount of food packaging waste per household	28.8 ± 32.1	26 (5.3%)

Although meat and dairy products play an important role in human diets, they are associated with large amounts of greenhouse gas emissions during their life-cycle when compared to other foods of similar nutritive values [21, 22]. Based on the results from this study, further assumptions bring us to 1,763 tons of CO₂ emissions associated with annual animal origin food waste discarded in Belgrade and 7,234 tons in Serbia. When it comes to food packaging waste associated with this type of food, the CO₂ emissions are 172.2 tons in Belgrade and 706.4 tons in Serbia.

4. Conclusion

This study builds on current knowledge of the overall environmental impact of animal origin food waste, as it is based on analysing reported data on food and food packaging waste in Serbia. Also, it provides a snapshot of respondents' attitudes towards the sustainability of food waste. Finally, this study shows that promotion of sustainable beliefs could help households improve their food management and decrease their quantities of animal origin food and food packaging.

References

- [1] Koivupuro H K, Hartikainen H, Silvennoinen K, Katajajuuri J M, Heikintalo N, Reinikainen A, and Jalkanen L 2012 Influence of socio- demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households *Int. J. Consum. Stud.* **36**(2) 183–91
- [2] Evans D 2012 Beyond the throwaway society: ordinary domestic practice and a sociological approach to household food waste *Sociology* **46**(1) 41–56
- [3] Quested T, Marsh E, Stunell D and Parry A 2013 Spaghetti soup: The complex world of food waste behaviours *Resour. Conserv. Recy.* **79** 43–51
- [4] Parfitt J, Barthel M and Macnaughton S 2010 Food waste within food supply chains: quantification and potential for change to 2050 *Philos. T. Roy. Soc. B* **365**(1554) 3065– 81
- [5] Schanes K, Dobernig K and Gözet B 2018 Food waste matters - A systematic review of household food waste practices and their policy implications *J. Clean Prod.* **182** 978–91
- [6] Parizeau K, von Massow M and Martin R 2015 Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario *Waste Manage.* **35** 207–17
- [7] Porpino G, Parente J and Wansink B 2015 Food waste paradox: antecedents of food disposal in low income households *Int. J. Consum. Stud.* **39**(6) 619–29
- [8] Dhahri S and Omri A 2018 Entrepreneurship contribution to the three pillars of sustainable development: What does the evidence really say? *World Dev.* **106** 64–77
- [9] Mirabella N, Castellani V and Sala S 2014 Current options for the valorization of food manufacturing waste: a review *J. Clean Prod.* **65**(0) 28–41
- [10] Quested TE, Parry AD, Eastel S and Swannell R 2011 Food and drink waste from households in the UK *Nutr. Bull.* **36**(4) 460–7
- [11] UN 2019 *Sustainable Development Goals, in About the Sustainable Development Goals* (United Nations: New York, USA)
- [12] Thamagasorn M. and Pharino C 2019 An analysis of food waste from a flight catering business for sustainable food waste management: A case study of halal food production process *J. Clean Prod.* **228** 845–55
- [13] Djekic I, Miloradovic Z, Djekic S and Tomasevic I 2019 Household food waste in Serbia – Attitudes, quantities and global warming potential. *J. Clean Prod.* **229** 44-52
- [14] Richter B 2017 Knowledge and perception of food waste among German consumers *J. Clean Prod.* **166** 641–48
- [15] McCarthy B and Liu HB 2017 Food waste and the 'green' consumer *Australas Mar. J.* **25**(2) 126–32

- [16] Visschers VHM, Wickli N and Siegrist M 2016 Sorting out food waste behaviour: A survey on the motivators and barriers of self-reported amounts of food waste in households *J. Environ. Psychol.* **45**(Supplement C) 66–78
- [17] Romani S, Grappi S, Bagozzi RP and Barone AM 2018 Domestic food practices: A study of food management behaviors and the role of food preparation planning in reducing waste *Appetite* **121** 215–27
- [18] CCaLC 2018, *Carbon Calculations over the Life Cycle of Industrial Activities* (The University of Manchester: Manchester, UK)
- [19] Djekic I, Sanjuán N, Clemente G, Jambrak AR, Djukić-Vuković A, Brodnjak UV, Pop E, Thomopoulos R and Tonda A 2018 Review on environmental models in the food chain - Current status and future perspectives *J. Clean Prod.* **176** 1012–25
- [20] Yearbook 2017 *Statistical yearbook of the Republic of Serbia for 2016* (Statistical Office of the Republic of Serbia: Belgrade, Serbia)
- [21] Djekic I, Miocinovic J, Tomasevic I, Smigic N and Tomic N 2014 Environmental life-cycle assessment of various dairy products *J. Clean Prod.* **68**(0) 64–72
- [22] Djekic I and Tomasevic I 2016 Environmental impacts of the meat chain – Current status and future perspectives *Trends Food Sci. Tech.* **54** 94–102