

Introduction: The issue of **food waste** is an intensifying field of study and research. There are actions to prevent food waste through the donation of edible food.

Redistributing food surpluses can be a way to alleviate coexisting food insecurity and food waste. The food waste hierarchy ranks surplus food donations for human consumption as the next best strategy when food waste can not be prevented (Sundin et al., 2022). However, the effectiveness of food **donation** in terms of the amount consumed or food donation as a food waste management measure has rarely been evaluated. Nevertheless, evaluation efforts have been made on food redistribution initiatives in terms of their effectiveness in terms of the mass of food rescued (Goossens et al., 2019) The present study focuses mainly on finding the **environmental benefit** achieved by the implementation of this action, as well as on identifying the foods that have the greatest environmental footprint, in order to **be reduced** as a priority.

Methods: 6 different menus were formed that meet the nutritional needs of an adult, according to the Greek National Nutrition Guide (table1)

Table 1 : The composition of the menus and the number of portions

Menu 1 (1000)	(g)	Menu 2 (2000)	(g)	Menu 3 (1000)	(g)	Menu 4 (2000)	(g)	Menu 5 (2000)	(g)	Menu 6 (2000)	(g)
Beef meat	200	Chicken	200	Fish	200	Legumes	200	Pasta	200	Split peas	200
Rice	150	Potatoes	150	Potatoes	150	Cheese	150	Carrot	50	Cheese	150
Paste	30	Tomatoes	150	Tomatoes	150	Tomatoes	150	Cabbage	150	Carrot	50
lettuce	100	Cucumber	50	Cucumber	50	Olive oil	100	Cheese	150	Lemon	100
Food fat	100	Olive oil	100	Olive oil	100	White bread	100	White bread	100	White bread	100
White bread	100	White bread	100	White bread	100	Orange	100	Banana	100	Mandarin	150
Apple	180	Peach	100	Orange	100						

Assessment for 16 impact categories.

The methodology was based on Life Cycle Assessment (LCA) with Simapro 9.2.0.1 software. The selected method is the ILCD 2011 Midpoint + V1.11 / EC-JRC Global, equal weighting.

The functional unit was designed by taking into account both the composition of the menus and the total amount of food waste that did not end up in landfills.

The average weight of the edible foods that make up each menu is 810 grams and given that the number of portions that will be redistributed is 10,000, the evaluation was made for the "redistribution of 8100 kg of food".

Results

The results of assessment indicate that among the menus, the ones that have the greatest contribution to the environmental burden are: "Menu 1", which has as its main dish a quantity of beef, followed by "Menu 3" - based on fish and "Menu 4", with legumes as the main dish (Figure 1). It is also becoming clear that the meat-based menu is the one that has the greatest impact, as the lifetime requirements of a meat-based portion are increased.

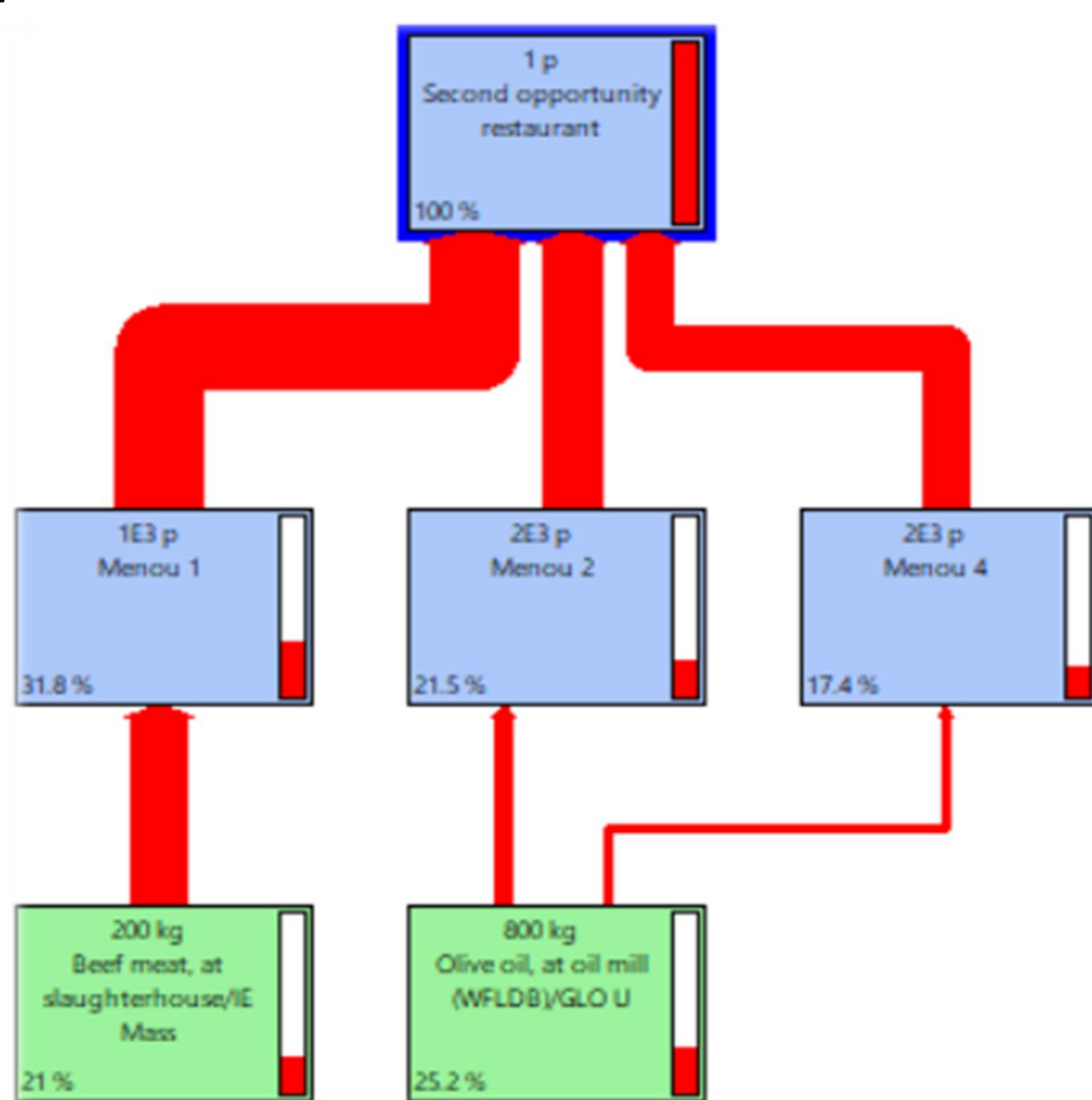


Figure 1 : Indicative contribution of the studied menus for the Human toxicity with cancer effect.

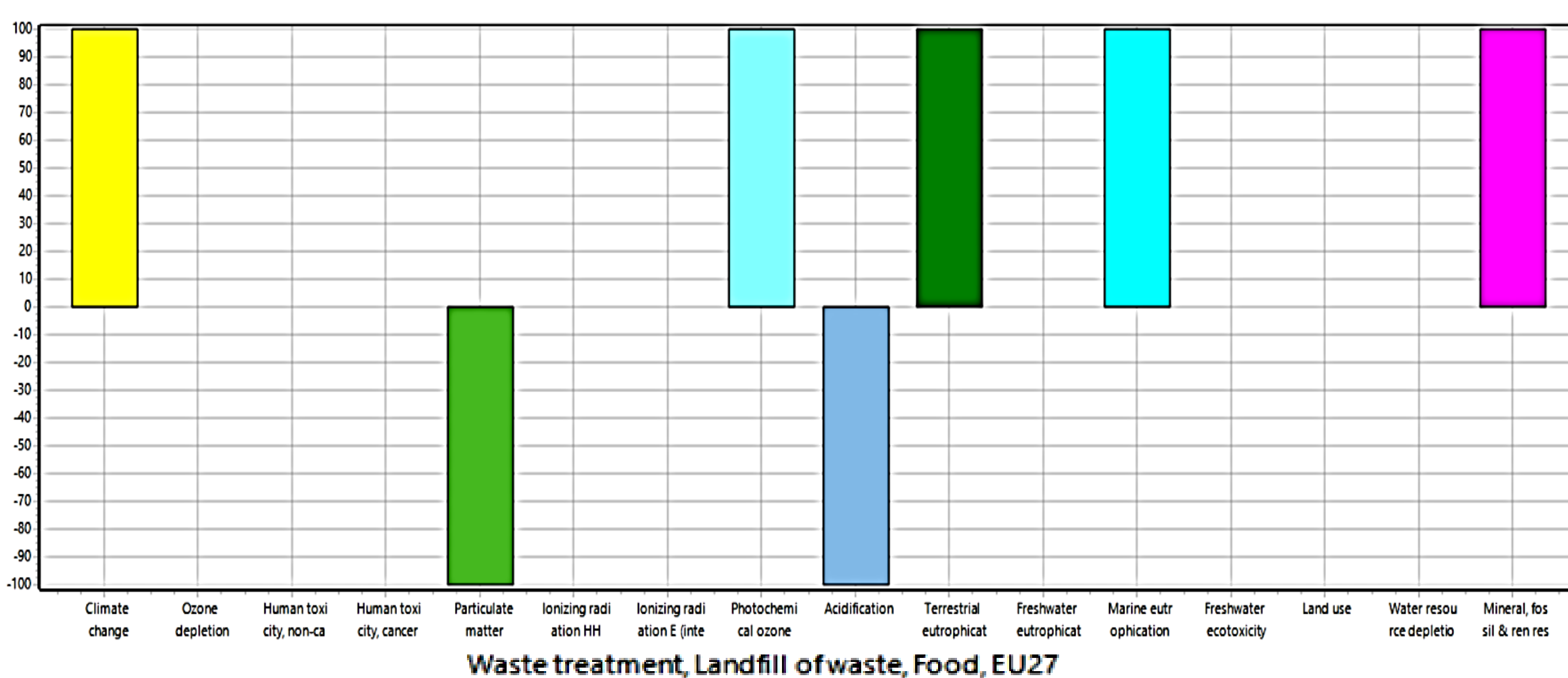


Figure 3: Impact assessment chart of characterization results, for the disposal in landfill of a specific food waste amount

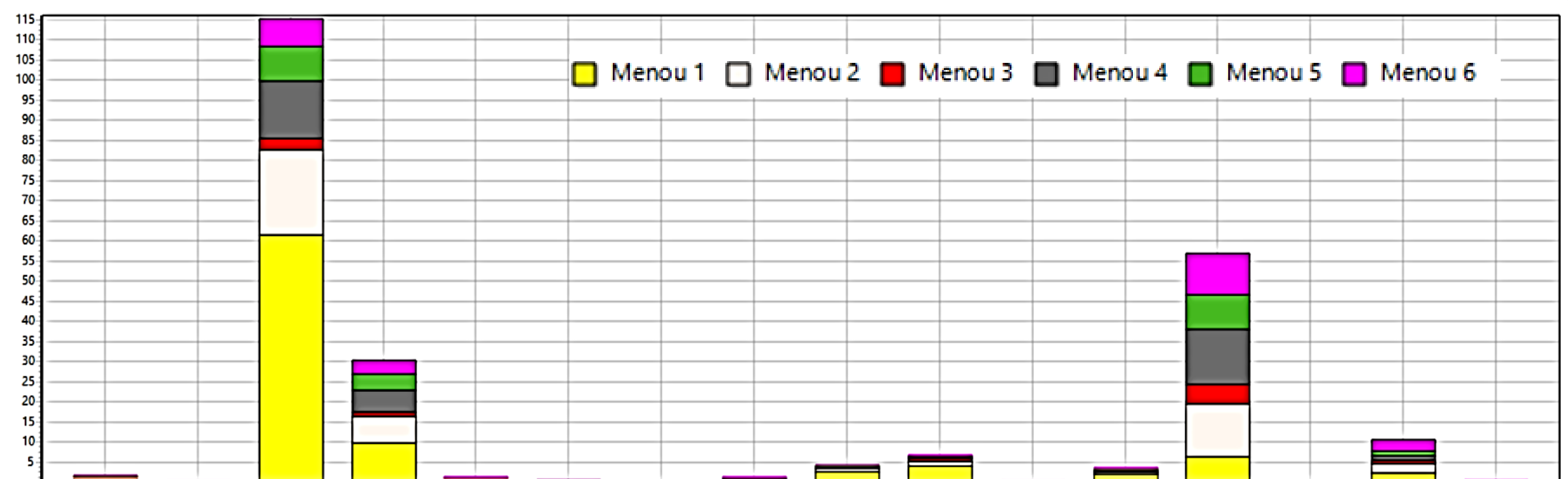


Figure 2: Impact assessment chart of normalized results for selected menu

The **main categories** of environmental impacts to which the above foods contribute with their production are: **toxicity to humans with no cancer effects, freshwater ecotoxicity, toxicity to humans with cancer effects and depletion of water resources**. Overall, the food surpluses that were redistributed, while otherwise they would end up in landfills, have the quantitative effects shown in the following table. According to the normalized diagram (Figure 2) of the scheme, the main categories of effects that were ultimately avoided, through redistribution are in order of priority, toxicity to humans not only without but also with cancer effects, freshwater ecotoxicity and eutrophication of aquatic ecosystems.

It is obvious that in addition to the final disposal of food waste, their production has an important environmental footprint, in all indiscriminately studied categories. The characterized values of the diagram in Figure 3 show the significant contribution of food waste to the exacerbation of the phenomenon of climate change, when they are deposited in landfills. From the values of table 1, it can be seen that with the operation of the second chance restaurant, **it prevents the creation of 19633.23 kg of equivalent carbon dioxide** (table 2) that would have been released even if this food waste was disposed of in a landfill.

Table 2 : Quantified impacts from food waste landfill (ILCD 2011 Midpoint+ V1.11)

Impact category	Unit	Landfill Characterization	Landfill Normalization
Climate change	kg CO ₂ eq	19633.23	2.78
Human toxicity, cancer effects	CTUh	0.00	0.00
Particulate matter	kg PM _{2.5} eq	-0.08	-0.02
Photochemical ozone formation	kg NMVOC eq	7.97	0.18
Acidification	molc H+ eq	-1.44	-0.03
Terrestrial eutrophication	molc N eq	2.24	0.01
Freshwater eutrophication	kg P eq	0.00	0.00
Marine eutrophication	kg N eq	0.16	0.01
Mineral, fossil & ren resource depletion	kg Sb eq	0.00	0.02

Conclusions: With the redistribution of food, a net environmental benefit is achieved due to the prevention of landfilling. The main categories of impacts that are prevented through this alternative management can be prioritized as such: the exacerbation of the phenomenon of climate change, the toxicity to humans with cancer effects or not, freshwater ecotoxicity and the marine eutrophication. Indicatively, it was estimated that the operation of the second chance restaurant and the provision of 10,000 portions of food, prevents the creation of 19633.23 kg of equivalent carbon dioxide that would have been released, if this food was disposed off in a landfill.

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Acknowledgments

This poster is a part of the project LIFE IP CEI Greece, cofounded by the LIFE EE Program [LIFE18 IPE/GR/000013] and the Green Fund.

