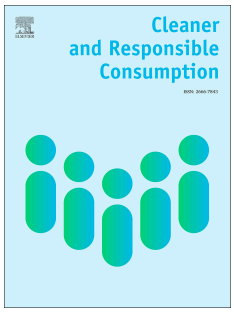

Citizens' deliberation on solutions to fight urban household food waste and nexus with growing urban gardens: The case of porto metropolitan area in Portugal

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Citizens' deliberation on solutions to fight urban household food waste and nexus with growing urban gardens: the case of Porto metropolitan area in Portugal.

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Abstract

Food waste is currently acknowledged as a major societal challenge, including the food waste at the household level estimated to be responsible for the wastage of one third of the food produced for human consumption. Hence, tackling household food waste (HFW) is gaining a momentum in societal and policy agendas accompanied by an increasing effort of the scientific community to deliver evidence to address the research gaps on the causes and on the solutions to address this multidimensional societal problem. The proposed solutions by published literature to mitigate HFW can be unfolded into four major types, actions to raise people awareness, participatory actions, economic incentives, and collective actions. However, there is little evidence on the household's assessment of the different types of actions and its combination. This paper contributes to this research gap by adopting an innovative participatory approach, using deliberative focus groups (DFG), and analyzing the collected data through content analysis resorting to the software Maxqda. We had conducted six DGF in the Porto metropolitan area before and during the pandemic COVID-19 crisis. Our results highlight the citizen's option for more holistic actions in comparison to separate actions as a way to effectively fight food waste at household level. Another finding of our study is that citizen's growing urban gardens found it the more effective way to reduce household food waste. These results suggest that urban policies and underlying legal frameworks should favour holistic solutions to incentivise fighting HFW and account for the urban gardens as a relevant part of the solution. In addition, the study has shown that qualitative deliberative citizen-led

approaches show insightful to understand how common people perceive as alternative or complementary the different types of actions to fight HFW proposed by the literature review.

Keywords: Food waste; Household food waste (HFW); urban gardens; deliberative methods; deliberative focus groups (DFG); sustainable food systems

1 Introduction

Food waste has gained attention due to significant and negative impacts on the economic, environmental, and social sustainability of food systems (FAO 2015) and is receiving growing attention from the scientific community (Papargyropoulou et al. 2019).

UNEP developed a food waste index, and the data reported show a high level of food waste at household level in European countries, based on reliable data for a significant number of countries (UNEP 2021). Nevertheless, the lack of reliable data on food waste at household level limits the monitoring of SDG target and the effective fighting of the problem. In order to achieve the objectives recommended by the United Nations, several efforts have been made. The European Union has already issued legislation which has been transposed to several member states with the aim of establishing action plans to reduce food waste. The Farm to Fork strategy (European Commission 2020) intends to support the EU Green Deal agenda (European Commission 2019) which is a mission-oriented mix of policies focused on putting in motion a sustainability transition during the current decade. The main aim of the Farm to Fork strategy is to address the challenges faced by the sustainability of agri-food systems in Europe. The transition of households' behaviour envisaged by this strategy has several dimensions, although the prevention and reduction of food waste at the household level is one of the key steps for its success (Ericksen 2007; Galli et al. 2020, Lal 2020). We intend to focus on food waste at the household level. Household food waste has gained a momentum in societal and policy agendas and is receiving an increasing contribution from the scientific community (Schanes et al. 2018; Flanagan et al. 2019).

The review of the available evidence in scientific literature highlights a significant research gap on the issue of household food waste accounting for the citizen´s participation on the process of identifying and implementing effective solutions. Most of the available studies focus on identifying the factors and behaviors leading households to waste food (Stenmarck 2016; Jimenez 2016; Roodhuyzen et al. 2017; Gaiani et al. 2018; Schanes et al. 2018; Stangherlin & Barcellos 2018). The available evidence according to our review is in line with UNEP (2021) data for food waste index, for instance the findings of Priefer et al. (2016) showing that most of the wastage occurs at the end of the food chain, and of Wohner et al. (2019) showing that most industrialized countries have higher rates of household food waste. The available data on household food waste in scientific literature are heterogeneous, differing not only in terms of

the definitions involved but also in terms of the methodology applied (Roodhuyzen et al. 2017; Spang et al. 2019; Ammann et al. 2021).

This study resorts to a participatory methodology, the focus groups using a Deliberative Discussion Approach (Rothwell et al. 2015), contributing to the literature gap respecting the lack of empirical evidence on citizen's perspective regarding the more effective way to fight food waste at the household level. It shows the value of qualitative deliberative citizen-led approaches to understand how common people perceives and evaluates as alternative or complementary the vast array of solutions that are proposed by the literature and the local and urban policies.

The review of literature shows that focus groups approach has been used to gather data from citizens' groups regarding municipality alternatives for food waste management (Refsgaard & Magnussen, 2009). However, the use of deliberative discussion focus groups to gather citizen's preferences towards different approaches and actions to fight household food waste was never applied as far we could ascertain by extensive literature search. And, yet this a case where pre-conditions to apply the deliberative focus groups are reunited, given that households comprise the "common citizen" that daily deals with own food waste. Hence, this study contributes by showing how the method of DFG can be implemented to deliver their perspective and their collective election of the best-fit actions from the wide range of household food waste solutions identified by the literature.

The paper is structured as follows, at first, introduction of the theme is presented, followed by the literature review and methods, where is described the design and the implementation of the deliberative focus groups. In the third part, the results are presented and discussed. Finally, we present the conclusions and policy recommendations. The concluding remarks comprise a brief reflection on the advantages and shortcoming of using in-person or online modes to conduct deliberative focus groups.

2. Literature Review

Food waste at the household level is estimated to be responsible for one third of the food produced for human consumption (Nunkoo 2020; Coskun 2021; Scalvedi & Rossi 2021; Priefer et al 2016). Perishable food products, such as fresh vegetables and fruits, appear to account for one third of the total food wasted by households (Secondi et al., 2015; Stenmarck

et al. 2016; Priefer et al. 2016; Mattsson et al. 2018; World Biogas Association 2018). A study conducted by Garcia-Herrero (2018) concludes that in Spain, where the Mediterranean diet is still a popular dietary pattern, most of the household food waste is composed by wasted fruits and vegetables, evidencing the need of specific actions to prevent such a wastage.

An important fact in this discussion is the consumer behavior and how is it changing. Recent studies concluded that changes occurred in the behaviors of e-consumers, benefiting sustainable consumption. (Gajdzik. B and all, 2023). Studies also concluded that people in areas with higher levels of urban development were more prone to engage in pro-environmental behavior. (De Oliveira, U. and all, 2022).

Despite its novelty the food waste topic has been addressed by a relatively substantially number of studies, available in the published literature and in so-called grey literature, comprising reports and similar documents. The published studies address food waste in food industry, food retail, packing and delivering sector, households, the hospitality sector, and in large organisations, such as hospitals, or universities (Papargyropoulou et al. 2019). These studies are in its majority case studies about programs and campaigns concerning awareness, education, and economic aspects (Bazlyn et al. 2020). There are also studies on other food waste reduction at the household level, such as preventive practices (Secondi et al 2015; Stockli et al. 2018; Song et al. 208; Reynolds et al. 2019, economic incentives and legal instruments (Schanes et al. 2018; Amirudin & Gim 2019), and also practices which enhance healthy and sustainable lifestyles (Ganglbauer et al. 2013; Porpino et al. 2016; Mattsson et al 2018; Ribeiro et al. 2021).

Actions to tackle household food waste include more upstream solutions such as educational and technological (Ganglbauer et al. 2015), and as well downstream more in-depth solutions such as food self-cultivation (Ganglbauer et al. 2013, Porpino et al. 2016). Urban gardens are envisaged by some authors as a way to reduce urban household food waste, includable in these more radical solutions of perishable food, like the fresh vegetables, self-growing (Ganglbauer et al. 2013, Author et al. 2021). Food waste with prevention at the source, sometimes turn to be impossible, unattainable, or very difficult to achieve, through repair it is necessary to adopt actions that meet the goals to separate, prepare to reuse and recycle. Although public policies are always more linked to prevention, given its potential major effectiveness in fighting food waste (Fattibene et al. 2020), reparation actions are also needed and households need to be aware of those type of solutions.

There a substantial number of studies consisting of literature systematic reviews, most of them acknowledging that food waste prevention is the best way for addressing food waste problem. However, there is a need for a systematic inventory of actions and in particular of understanding the citizen perspectives about the proposed solutions.

The implementation of citizen-led deliberation processes in the context of the focus groups approach (Kitzinger 1995; Parker & Tritter 2006) requires that the participants are properly informed about what they have to deliberate so they can make informed and grounded statements (Rothwell et al. 2015). Hence, critical information needs to be conveyed in effective manners, and the deliberation processes benefit from the participants' experience on the issues to weight in the deliberation processes. An additional requirement for the successful implementation of deliberative discussion approaches is to ensure that the statements made by different participants are assessed by the other participants on the basis of its merit and not based on attributes of the participants that present it (Rothwell et al. 2015).

3. Methods and materials

The application of deliberative discussion approach needs preparation and invites the citizens to participate, as Petts argues on her study (2010), in a "serious civic task" encouraging participants to think as a collective rather than an individual driven by self-interests. Deliberative Focus Groups (DFG) aren't conversations without definite purposes, they need to be well focused to allow groups' reaching deliberation build on different individual views. Hence, deliberative discussions are a fundamental component in deliberative democracy and deliberative processes should make a significant difference in changing the attitude of how decisions are made.

There are a substantial number of studies concerning the deliberative focus groups. Deliberative discussion approach in the context of focus groups has been applied in numerous qualitative researches, including multiple topics such as healthcare (Blacksher 2013; Rothwell et al. 2015; Sullivan et al. 2017), energy planning (Pellizzone et al. 2017), or waste management (Petts 2010). However, there is a need of deliberative discussions concerning household food waste, in particular as said previously, of understanding the citizen perspectives about the proposed solutions for fighting household food waste. The application of participatory methodologies involving the citizens would convey relevant information for local governments and waste management entities to support urban households to substantially reduce their food waste. The relevance of this research gap is acknowledged by some authors that claim for a better understanding of drivers of urban food waste in order as a way to enable policy makers to design and implement effective solutions to curb this problem (Amirudin & Gim 2019).

This paper adopted the DFG given this approach offers the opportunity to engage common citizens in a citizen-led discussion aiming at conducting a deliberative process about a matter where they are the key part to build effective solutions. The aim was to obtain a selection of the most effective actions, a maximum of two per group, according to the perspective of the citizens recruited.

The citizens are the key decision-makers regarding the prevention and reduction of urban household food waste (UHFW). DFG were applied to compare and to elect by the citizens best-fitted solutions for their local and personal context. The DFG were conducted in a study area, the metropolitan area of the Porto city in Portugal, that has pioneering at national and even at

international level the search for innovative and effective solutions for waste management by actively involving local citizens.

3.1. The study area

Our research focused on two municipalities (Maia and Porto) that are part of the metropolitan area of Porto. It locates in the Northwest of Portugal (Figure 1) and it is the second largest metropolitan area in Portugal, comprising 17 municipalities and about 1,700,000 inhabitants.

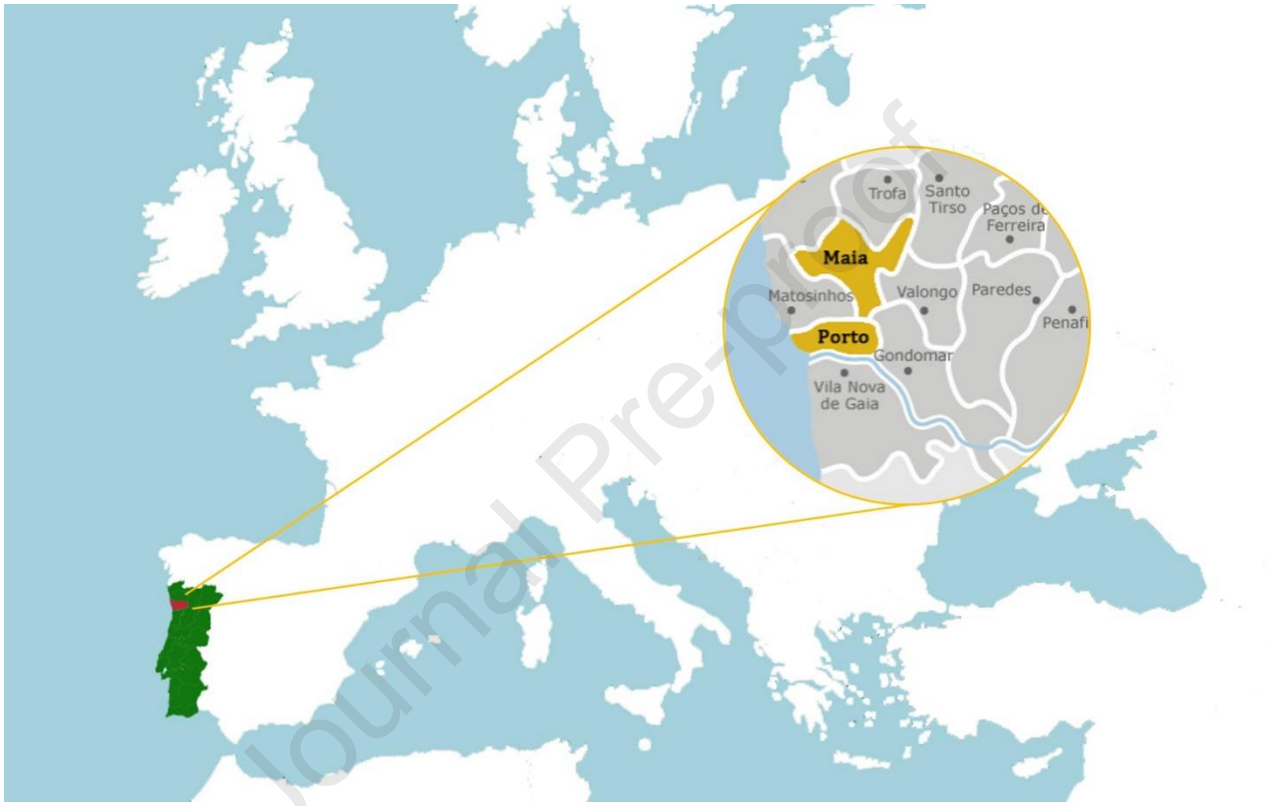


Figure 1 – Location of Porto' metropolitan area and the municipalities were the DFG where applied

Porto' metropolitan area includes a group of municipalities that have pioneering in Portugal the implementation of initiatives such as door-to-door selective collection of urban household waste and the installation of urban gardens in the form of allotments accessible to any interested household inhabiting the municipalities take make land available for the initiative (Ribeiro et al. 2020). These pioneering initiatives were launched, spread and managed by the multi-municipal non-profit organization that has been created back to 1982 to do the collection, management, recovery and treatment of municipal waste produced by the eight municipalities of the Porto conurbation that integrate the organization. The municipalities of Maia and Porto (see Figure 1) were the leading ones respecting the referred initiatives. They pioneered the successful launching of urban gardens, firstly introduced in these two municipalities in 2003, and then spread across remaining five municipalities. The Maia municipality was the first to

implement door-to-door selective collection of urban household waste, in 1998, diverging from the country-level spread adoption of bulk selective collection using containers and moloks.

More recently, in 2018, the multi-municipal organization in charge of waste management expanded, with the support of the respective local governments, door-to-door selective collection of urban waste to other municipalities, including the Porto municipality. The expansion of door-to-door collection was a response to acknowledge by the local governments that urban household waste bulk collection is an ineffective approach to the problem.

3.2 Deliberative focus groups

The research targeted to select four groups in each of the two selected municipalities, the Maia and Porto. The goal was to recruit between 6 up to 10 participants, household representatives, inhabiting in each one of the two municipalities. The participants have between 18 and 65 years old, from different economic and social context and ensuring gender equality. The groups could have between 5 or 15 each one. The criteria for the group selection were related to the pioneering initiatives above referred, comprising urban gardens make available by the municipality allotments and the schemes of door-to-door selective collection of urban household waste. The criteria for the group's selection are presented in Figure 2. Our target was to include the four possible combinations: 1) households included in door-to-door selective waste collection which were or not part of urban gardens initiative; 2) households with bulk waste collection, whom were or not part of urban gardens initiative. This selection matrix aimed at understanding the effects in the citizen's perspective and choices according to their experience with the municipalities' initiatives. We expected they have a significant awareness impact on the participants regarding the importance of fighting household food waste and on selecting 'upstream solutions' or more radical downstream actions, such as grow food in own urban gardens.

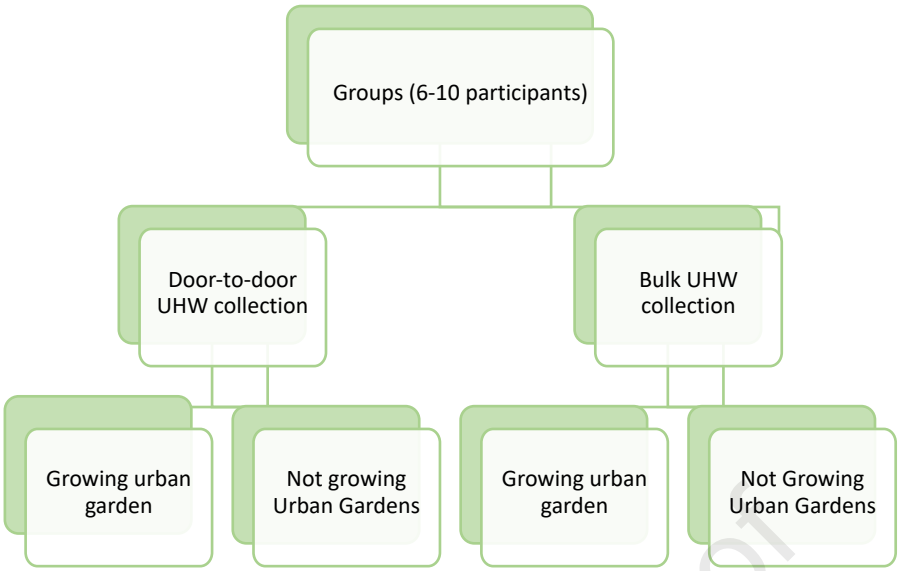


Figure 2 – Criteria for focus group selection

Group's selection

The research benefit from the support of the multi-municipal organization responsible of household waste management that was already referred, and as well of the local governments of Maia e Porto, to identify and to contact potential participants in the DFG.

The group's implementation was initiated in January of 2020. Three groups were conducted as planned to use the in-person mode. However, the COVID-19 outbreak and lockout in Portugal lead to the interruption of the field work. New groups were implemented only in September of 2020, using online mode, after excluding the possibility of pursing the in-person groups due to uncertain respecting lockout measures and the participant's safety and little willingness to join in-person. Thus, the overall groups´ works was conducted face to face and online. (Friess et al. 2020 and Kennedy et al. 2021). Literature respecting conducting DFG online was reviewed, with most of authors to point out their feasibility and reliability (Schröeder & Klering 2009). The online deliberative groups have worked very well and it is easier to recruit people, as they do not have the travel time (Kennedy et al. 2021). The only drawback with this methodology is that the discussions are richer when they are face-to-face, but they are less interventional.

Online groups were held in the Zoom platform with the supporting materials to be send previously to the meeting group by e-mail. These materials included a brief questionnaire to collect the participant and respective household socio-demographic characteristics and the elements for individual deliberation process and the pyramid to compare and posit the 18 actions to be considered by each participant and by the group meeting. The materials were send

a few days before to the online meeting with participants to be asked to have them downloaded to be used during the online meetings.

Table 1 summarizes the groups and respective composition respecting the criteria of selection and the number of participants.

Table 1 – Overview of selected groups

Group	Municipality	UHW door-to-door	Urban garden	Method	Date (year of 2000)	No of participants
1	Maia	Yes	Yes	In-person	4th February	10
2	Maia	No	Yes	In-person	6th February	6
3	Maia	Yes	No	In-person	10th February	6
4	Porto	Yes	Yes	On-line	17th September	6
5	Maia	No	No	On-line	13th October	5
6	Porto	No	Yes	On-line	7th December	7

Online has shown more difficult to recruit, namely in the Porto municipality due to difficulties in accessing potential participants. As a result, targeted groups were only implemented in the Maia municipality. Total of six DFG were conducted, with a number of participants ranging from 5 to 10, with the median to be 6 individuals. The group meetings took around 3 hours. In-person groups were conducted in January and February of 2020, and the online were held between September and December of 2020.

Implementation of the deliberative process

The DFG aimed at deliberating about the first and second most effective actions to implement municipal-level solutions to fight UHFW. The group discussion followed the individual exercise of analysis, comparison and selection of the two most effective actions according to each participant. The groups design and implementation were drawn to enhance the participant's active engagement by expressing their attitudes, perception and view regarding the effectiveness of the different actions presented to them, and by reflecting on trade-offs between effectiveness, efficiency and fairness of the various actions and type of actions.

Group discussions, both in-person and online were facilitated and mediated by a trained moderator experienced in the conduction of focus groups. Her main job was to ensure that all the participants actively engaged in the group discussion, that individual statements were fairly considered independently of the person making them, and that all contribute to the collective deliberative process. In addition, the moderator defined the steps and the timing for the

different tasks, starting with the introduction and description to the 18 actions inventoried as potentially relevant to fight UHFW at the municipal level in metropolitan areas. These actions are presented in Table 2, organized in four categories: economic incentives, informative measures, participatory actions and social actions.

Table 2 – List and description of actions to prevent and reduce UHFW

Economic Incentives	• Grant discounts on the waste tax to households that reduce organic waste more than the average of the Maia/ Porto municipality • Increase the waste rate to the households that produce more organic waste than the average of the Maia/ Porto municipality • Grant discounts on the waste tax to households that separate the organic waste correctly
Information actions	• Make available the good practices of Maia's /Porto´s households on websites and social networks • Information on how to help households plan weekly family meals • Information on how to help households better and longer preserve food and leftovers • Information on how to help households use leftovers to cook new meals • Information on how to help households plan their weekly shopping list • Information on how to help households prepare meals in quantities adjusted to their usual consumption
Participatory actions	• Share good practices of food waste reduction among Maia's /Porto´s households through participatory workshops • Promote the use of Food sharing Apps - applications for sharing food among friends and acquaintances • Organize creative cooking workshops - Recipes for using leftovers • Organize workshops on how to preserve food and leftovers better and for longer
Social actions	• Distinguish the champions in the fight against food waste (neighborhoods, buildings, streets) • Provide social supermarkets to deliver food that is close to its expiration date or that is not likely to be consumed at home • Providing plots of land for urban gardens • Provide support and plants for households to grow at home • Promote the Zero Waste Restaurants initiative - which delivers packaged leftovers to all customers

Given the large number of actions to be assessed and compared by each participant and within the deliberative process, we used the pyramids proposed by the Q-method (Brown 1993) to facilitate the success of task demanded to the participants. Q-Method pyramid asks participants to distinguish the actions by groups ranking from those that matter a lot to those that matter little, allowing for an intermediate area where relatively indifferent actions to the participant can be placed. This technique enables the participants to identify the two actions that “matter a lot”, meaning in our research the ones they found more effective to fight UHFW.

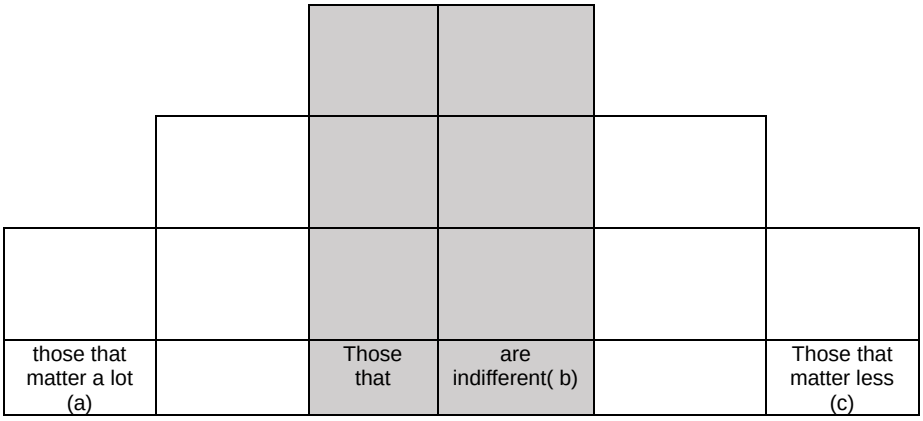


Figure 3 – Q-Method pyramid adapted to help participants to compare actions to effectively fight UHFW

The group's implementation was done along four stages, comprising:

- The introduction of the urban household food waste across the world and the in the Porto metropolitan area;
- Afterwards participants completed an individual questionnaire based on the European food waste questionnaire, allowing to better understand their household position on food waste. This questionnaire allowed for the collection of information on the characterization of the groups by age, gender, literacy and household size;
- The pyramids were given to the participants, in the case of on-line format, they opened the document previously sent by email, and started their individual pyramid election processes;
- The deliberative discussion took place build on arguments presented for each of the participants, and with the help of the moderator, successive steps for consensus were achieved until final consensus to be reached. In some groups the consensus on two measures was more difficult to reach, although in all groups participants have to move from their personal election after considering the statements brought-in to discussion by different participants.

Content analysis of the deliberative discussions

To do an in-depth analysis of the data gathered through the six deliberative discussion held within the six DFG, MAXDA software was applied. This software is a tool recommended for

qualitative analysis (Oliveira 2016, Kuckartz et al. 2019). Hence we used this software for a computer-supported qualitative content analysis, given it allows for filtering the structure of our transcripts and to code them (Kuckartz 2013; Kuckartz & Rädiker 2019, Tiberio et al. 2020).

The 17 actions were coded individually. This software allows to analyze and categorize the results of the six DFG according to the predefined map of codes, which were in this research the actions to fight UHFW. The categorical analysis was segmented into 18 codes corresponding to each one of the 18 actions that participants had to assess and to elect. The software created the map of connections between the actions, where the frequency of the connections in the interval of one paragraph is established. This software is appropriate and helps in interpreting the data due to its ability to generate outputs. The Software organizes and graphically presents the correlations which allows for a more sustained analysis. Maxqda maps are used to clarify ideas and visually perceive the hypothetical relationships between the defined categories (Schönfelder 2011).

4. Results

4.1 Actions elected by individual and group deliberation

A total of 40 participants were involved in eight DFG. A limitation refers to the municipality of Porto were only two of the initially planned four groups. Table 3 summarizes the results of the election of the two more effective actions to fight UHFW according to the participants both at the individual level and as a result of the group deliberation.

Table 3 – Actions election resulting from individual and group deliberation

Type of actions	Actions description	Individual election		Group election	
		No	%	No	%
Economic Incentives	Grant discounts on the waste tax to households that reduce organic waste more than the average of the city of Maia/ Porto	8	10.4		
	Increase the waste rate to the households that produce more organic waste than the average of the city of Maia/ Porto	3	3.9		
	Grant discounts on the waste tax to households that always separate the organic waste correctly	8	10.4	2	16.7
Information actions	Make available the good practices of Maia's /Porto´s households on websites and social networks	3	3.9	1	8.3
	Information on how to help households better and longer preserve food and leftovers	5	6.5	1	8.3
	Information on how to help households use leftovers to cook new meals	5	6.5	1	8.3
	Information on how to help households plan their weekly shopping list	3	3.9	1	8.3
	Information on how to help households prepare meals in quantities adjusted to their usual consumption	4	5.2		
	Information on how to help households plan weekly family meals	3	3.9		
Participatory actions	Share good practices of food waste reduction among Maia's /Porto´s households through participatory workshops	6	7.8		
	Promote the use of Food sharing Apps - applications for sharing food among friends and acquaintances	1	1.3		
	Organize creative cooking workshops - Recipes for using leftovers	2	2.6		
	Organize workshops on how to preserve food and leftovers better and for longer	2	2.6		
Social actions	Distinguish the champions in the fight against food waste (neighborhoods, buildings, streets)	2	2.6		
	Provide a social supermarket to deliver food that is close to its expiration date or that is not likely to be consumed at home	4	5.2	1	8.3
	Providing plots of land for urban gardens	13	16.9	5	41.7
	Provide support and plants for households to grow at home	3	3.9		
	Promoting the Zero Waste Restaurants initiative - which delivers packaged leftovers to all customers	2	2.6		
Total		77	100.0	12	100.0

The results highlight the individual's election of solutions involving social actions (in total 31.2% of the elections) and informative actions (in total 29.9% of the elections). Economic incentives got 24.7% of the individual elections, and the participatory actions only 14.3%.

Concerning economic incentives grants are clearly preferred to waste rate increases. Amongst the informative actions the individual election tends to favor actions related with better preserving food and reusing leftovers. In the case of participatory actions, the sharing of good practices of food waste reduction through workshops is found the most effective action. Social actions are the most considered either at the individual or the collective level, with 'urban gardens' to assume a leading role within this type of actions but as well as in the overall actions, although the deliberative group discussions rise up substantially the preponderance of 'urban gardens' election regarding the individual deliberations.

The action of 'providing plots of land for urban gardens' was considered the more effective action to fight UHFW. Only one DFG didn´t elect this action.

The analysis for the Maia municipality shows that in the case of the two groups that didn´t were involved with the 'urban garden' initiative, one of them elected this action. Precisely the one that wasn't involved in none of the initiatives, neither 'door-to-door waste collection' nor 'urban gardens', as shown in Figure 4.

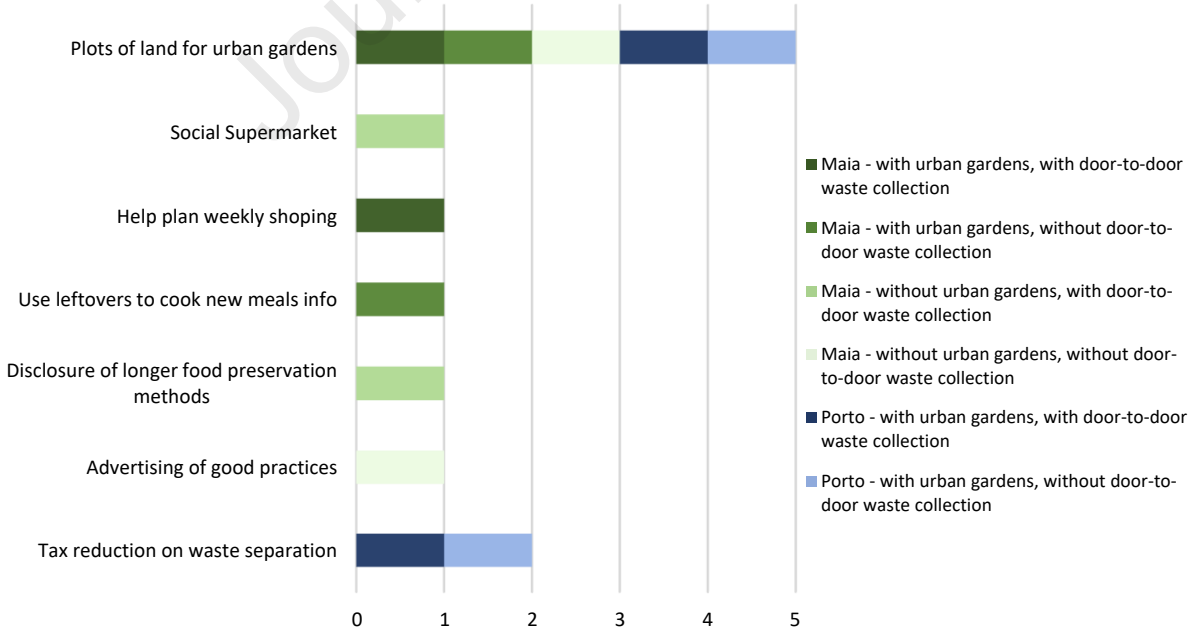


Figure 4 – Actions elected by the FGD according with the municipality and the criteria for group selection

Figure 4 evidences the Porto DFG election of economic incentives as effective actions to fight UHFW, which they pick alongside with the "provision of land plot for urban gardens". The groups from the Maia municipality also consider, with a sole exception, the 'urban gardens' the most effective action, although they elect it alongside with mainly informative actions. The DFG from Maia that didn´t elect the 'urban gardens', elected the creation of social supermarkets also together with informative actions. It's worth to mention that the four Maia groups informative elected four different informative actions.

The justification of Porto DFGs deliberation towards economic incentives is illustrated by the statement of one of the participants in the one of this groups (the group integrating both urban gardens and door-to-door initiatives): "There *are many countries, mainly Nordic, that have measures like this. You pay according to the amount you generate. (not exactly a benefit, or a tax), it works either through weighing, or volume control. (...) To be effective people have to feel a benefit or a loss in their pocket because they are mismanaging their house. The most recycled waste in Portugal was glass because it traditionally has some value. The bottle tarts. The rest has no value and people don't worry so much about separating it."*

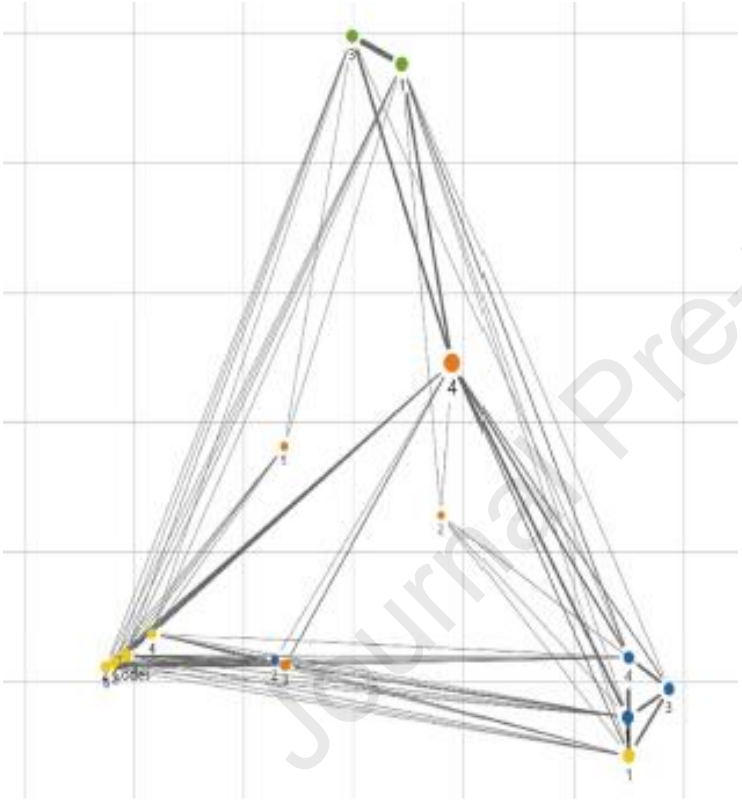
A Chi-square analysis, conducted with SPSS v.25, identified statistically significant associations between some of the actions elected and the sociodemographic characteristics of the respondents. The election of economic incentives tends to be associated with a higher level of education and with the fact of being part of groups with urban gardens. The fact of Porto DFG includes only participants with urban gardens and with a high level of education in comparison with the Maia' groups likely explained their collective deliberative towards the economic incentives in detriment other actions, such as informative or participatory. On the other hand, participants inhabiting Maia municipality tend to elect informative actions, which election is associated with lower education levels.

These results are in line with the Maia groups' deliberation towards informative actions, showing they value this type of action as way to effectively fight food waste. However, participatory actions weren´t elected in the group deliberations neither in Porto nor in the Maia's DFG.

4.2.Content analysis of the Deliberative Focus Groups

The application of the MAXQDA software allowed for a categorical analysis segmented into 18 codes corresponding to each of the 18 actions to fight UHFW presented to the participants

in the DFG. The software created the map of connections between the actions (Figure 5), where the frequency of the connections in the interval of one paragraph is established. While the proximity of the categories (actions) reflected on the map indicates a greater proximity between the codes across the deliberate focus groups, the lines width shows the recurrence of these connections. Figure 5 shows the map of connections between categories (actions) by a minimum frequency of 1 in a one-paragraph interval from the analysis of the transcripts of the six deliberative focus groups.



1. Grant discounts households that reduce
2. Increase the waste rate
3. Grant discounts who separate correctly

1. Good practices on websites and social networks
2. Information how to plan weekly family meals
3. Information how to Use leftovers to cook new meals
4. Information how to adjust real consumption
5. Information how to Better and longer preserve food and leftovers
6. Information how to plan weekly shopping list

1. Share good Practices
2. Promote Food sharing apps
3. Organize creative WS- using leftovers
4. Organize WS how to preserve food longer and better

1. Zero Waste restaurants
2. Provide support of plants
3. Social Supermarket
4. Plots of land for Urban Gardens
5. Distinguish the champions

Figure 5 – Inter - connections between the actions to fight UHFW

The network of links shown in figure 5 makes explicit a deeper correlational analysis between the actions. This figure reveals the relationship between the actions and their proximity during the content analysis. Its careful analysis shows a clear trend of connection between the concession of urban gardens and the economic incentives, which show a relevant correlation between them. It is also important to mention that informative actions, incentives, and more participatory actions are grouped together, unlike social innovation actions, which are autonomous in themselves. It is also evident that there is a strong connection between the informative and participatory actions because they are both close to the preventive action that

this whole process requires. The connections form a kind of cluster, and four clusters can be identified, one for each group of actions. A consistent relationship is also found between participatory and social innovation actions. It should be noted that the good practices of websites and social networks tend to be more related to the participatory actions than to the informative ones. Social innovation actions and in particular the provision of more urban gardens is related to all the emerging themes, but in some areas this connection is not particularly pronounced. In terms of influence on the analyzed content, this category seems to be more present in more general groups of measures.

The map also shows by the frequency of connections the predominance of actions related to urban gardens and economic incentives, having however the frequency of connections with the most participative and the informative actions shown a strong frequency by the width of the lines. The proximity allows us to establish relations between the 4 categories of actions. The graph visibly shows the proximity by type of action.

This visual analysis of the global results of the participants of the 6 groups point by consensus that the innovation social action such as urban gardens and the actions regarding economic incentives are in the cluster referring to the actions that matter most (Setti et al. 2018). In this line are the following authors (Abdelradi 2018; Teng & Chih 2020 and Aleshaiwi & Harries 2021). In the map (figure) the connections that are not verified mean that those actions were little discussed in reference to the others.

4.3.Insights from the deliberative processes

The deliberative process was uneven across the different DFG. It took more time and discussion to reach consensus in some of the groups in comparison with others. However, the DFG shown an effective tool to obtain group deliberations, in spite of diversity of individual perspectives on the most effective action to fight household food waste. It shows that individual was able to introduce and to discuss statements and to create a fruitful discussion in the sense that they were able to decide. The relative homogeneity of the groups, as required by the focus groups approach seems to be determinant to facilitate the discussions towards final deliberations.

The DFG of Porto municipality although the prevalence of individual preferences towards economic incentives were able through the deliberative process to gave way this position in favor of social actions and even actions of a more informative nature. This compromise is corroborated by the arguments expressed during the deliberative process, in which some

participants pointed out that in the short term, incentive actions might work well, but they are certainly not the best actions in the long term. A participant state that he is "*More an advocate of long-term measures. I agree that the belt works more effectively in the short term, but we should focus on awareness and training. If we give people, the conditions to do it simply and effectively they will eventually adhere* ". To support this position concerning the economic incentives as short time actions, the literature has argued that economic and financial incentives have been used extensively to motivate more sustainable behavior and also for individual motivation to reduce food waste (Katare et al. 2019).

Participants who defended the social actions appeared to be able to present arguments that were took in consideration by others that individually have not elected it (Galvan et al 2018). In the final deliberation, the participatory actions were the target of a generalized compromise, which leads to the conclusion that in a comparative analysis they are not the most effective in fighting food waste. Other reasons that may have led to the ceding of more participatory actions in favor of more informative and economic incentive ones, and which occurred across all groups, may be related to people's predisposition to public intervention and exposure, which is not normally a situation they like. A participant from Porto 2 (F4) states that "*I don't really like controlling measures. There ends up being a control of people's lives and in a city like Porto that has liberal traditions, I don't think it's very appropriate to watch the lifestyle of each person. If you eat more at home or out, if you produce a lot of waste or little waste, I find it a bit invasive*. He also argues that he prefers awareness-raising or training actions to create ways for people to be active in protecting the environment, such as urban gardens or information workshops for people to do at home and support for home cultivation. Based on these arguments, during the deliberative process, the individual options and choices of many participants changed. Some participants also mentioned that in this time of pandemic, urban gardens as a social innovation action would have helped a lot, not only in fighting food waste, but also in the possibility of growing their own food, which would make it easier not to be afraid of contagion. Urban gardens, being considered a type of actions that cannot be totally framed either in prevention or in incentives or in awareness raising, but at the same time being able to be all of these at the same time, effectively have a strong prevention component because they prevent wasteful behavior and help households to harvest only what they are going to cook, preventing excesses in the refrigerator that often, due to lack of information on how to preserve them, end up spoiling.

Some participants found this individual and collective process difficult because was very hard to choose only one or two actions, arguing that it is a holistic process and that even some actions only make sense if they are implemented in an aggregated way. In fact, it is essential to create a strategy that covers all parties, but a broad strategy, not just betting on education or betting everything on economic incentive. In this line, Menna et al. (2018). Any holistic action will be the most effective. Innovative Social actions such as the social supermarket can make all the difference, allowing the overflow of food that is not consumed and channeling it to those who need it. The participants of this Porto group continued in their argumentative process by stating that "*Bags to put food in, we have to get the scientists to think of a solution to take food home without increasing the level of waste with the plastic"* and this opinion is in line with some authors that argue that if it is difficult to prevent it, then at least we'll try to reuse what we waste. Regarding this position, the authors Morone et al. (2020) and Mazzucchelli et al. (2021).

It would therefore be fundamental to continue this study in the concrete experimentation of these actions in the municipalities to support more solidly their establishment as well as public policies in line with these actions to fight food waste.

Underpinned by the transition of citizens' behaviors, the current legislative framework with regard to methodologies that allow for consultation with citizens in order to create alternative legislative frameworks is starting to become a reality. This experimental study (and other approaches with civil society) are important to make the actions as effective and efficient as possible. The participants risked other concrete public policy proposals such as "*taking advantage of the revision of many municipal master plans to foresee urban gardens and considering that Porto wants to be more and more green, educate and raise awareness on the correct reading of labels, provide training on the purchase and management of leftovers*".

Finally, this content analysis of the groups carried out (Bardin 2002) shows that social innovation actions are the most effective actions to address food waste problem among urban households in Porto and Maia. To sum up, when looking at the groups deliberations with the actions organized by importance, it can be concluded that innovative social actions and the actions related economic incentives and information are the most referenced by all groups. However, and contrary informative or economic incentive actions, which are quite associated to each other, social innovation actions are quite different from each other, they appeal and act on different stages of innovation.

5.Conclusions

This way of bringing the opinions of a group of citizens in a clear bottom-up approach, can have positive results and indeed be the ideal methodology for successful implementation of a possible public policy aiming at the adoption of measures in municipalities that can help fight food waste in urban households. The aim of this study was to create the conditions for the successful implementation of a new local public policy based on the deliberations resulting from this analysis and as a continuation of this concrete experience, in line with the provisions of the Council of the European Union (13026/20).

In all groups the participants had some difficulty in focusing on one or another action or one type of action, but actions that are both incentive, awareness, or prevention, seem to have brought the most results from the participants' perspective. Consequently, one of the conclusions that can be drawn is that actions that are both incentive, awareness or prevention seem to be the most effective in reducing food waste from the perspective of the participants, followed by incentives and raising awareness among citizens. Economic and financial incentives are allied to gardens and at the base of deliberations.

The urban gardens are considered more effective to fight food waste in urban households by those who already have a garden. The sharing of best practices and actions of a more informative nature are transversal but not fundamental in the deliberations (Lal 2020). The increased allocation of urban gardens by municipalities was a measure mentioned by many participants as very effective. We also concluded that is necessary more research concerning participatory actions, due to their low interest from participants' choices. Another conclusion is that most of the participants of the different groups defend a more holistic way of approaching the problem.

Additional conclusion of this research is that the groups carried out remotely gave rise to better informed participants about the topics to be deliberated because the elements were sent by email beforehand. On the one hand, the recognized disadvantages relate to the fact that, as the discussions are online, the richness of lively discussions in which everyone speaks at the same time is lost. This does not happen online. On the other hand, the advantages mentioned, such as more in-depth prior knowledge of the topic and the ease of scheduling, outweigh any inconvenience. This conclusion is relevant for future events.

Regarding the implementation factors, we propose that they be implemented by experimenting with the actions resulting from the deliberative groups. The allocation of more urban gardens is an action that should be treated at a more local level according to the specificity of the municipalities, both in terms of urban agriculture and in terms of its implication in the reduction of urban household food waste. Indeed, besides the fact that people are different, and their socio-economic backgrounds and ages are also different, the municipality where they live also has a different attitude towards food waste (Refsgaard & Magnussen 2009), being Porto and Maia pioneers in this matter.

Does urban gardens as sustainable food systems (FAO 2015b) make it possible to address food waste issues in the households of city residents? This study links urban gardens as sustainable food systems, the sustainability of cities that is achieved through the proliferation of these food systems, reducing the ecological footprint, prioritizing the right to adequate food and the effective fight against food waste demonstrated by this participatory and experimental study. These deliberative groups we have made are fundamental to understand the importance of food waste, urban agriculture, and sustainable food systems in households and to understand how local public policies can be more effective both in fighting food waste, in fostering urban gardens and in the sustainability of cities, because are based on citizens' contribution. This type of participatory methodology, listening to citizens in a structured way and being knowledgeable about the topic to be deliberated, could start to be an excellent support to municipal decision making.

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Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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