



## **PR1: Baseline assessment**

### **T1.2: Implementation of surveys**

Project 2021-1-EL01-  
KA220-VET-000033247



Co-funded by  
the European Union



**Output factsheet:**

<b>Funding Programme</b>	Erasmus+ Programme of the European Union
<b>Funding NA</b>	EL01 Greek State Scholarship's Foundation (IKY)
<b>Project full title</b>	Advancing MuNicipal Circlular Economy – ADVANCE
<b>Field</b>	Vocational Education and Training
<b>Project Number</b>	2021-1-EL01-KA220-VET-000033247
<b>Project Duration</b>	24 months
<b>Project Start Date</b>	28-02-2022
<b>Project End Date:</b>	27-02-2024

**Output details:**

**Output title:** PR1: Baseline assessment

**Task Title:** Task 1.2 Implementation of Surveys

**Output leader:** D-WASTE

**Task leader:** City of Novi Sad

**Document Control**

Document version	Date	Rationale
V0.1	21/10/2022	First draft
V0.2	31/10/2022	Final

**Disclaimer**

This project has been funded with support from the European Commission. The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

## Contents

List of Tables .....	4
List of figures.....	5
Abbreviations.....	5
Executive summary.....	6
1 Introduction.....	1
2 Objectives and methodological approach .....	2
3 Results of the households survey .....	3
3.1 Survey characteristics.....	3
3.2 Sample characteristics.....	4
3.3 Food waste generation issues .....	5
3.4 Food waste management issues .....	11
4 Results of the HORECA SMEs survey .....	14
4.1 Survey characteristics.....	14
4.2 Sample characteristics.....	15
4.3 Food waste generation issues .....	17
4.4 Food waste management issues .....	22
5 Results of the Municipalities survey .....	31
5.1 Croatia.....	31
5.2 Serbia .....	33
6 Concluding remarks.....	35

## List of Tables

Table 1. Country of origin of the respondents .....	4
Table 2. Composition of sample household members.....	4
Table 3. Distribution of sample household income .....	4
Table 4. Popularity and mean quantity of food bought per week.....	5
Table 5. Popularity and mean quantity of food bought per week in Greece, Croatia, and Serbia.....	6
Table 6. Beliefs about the food that is wasted; least wasted (1) and most wasted (9).....	6
Table 7. Beliefs about food that is wasted per country .....	7
Table 8. Management of leftover food (suitable for consumption) (percent of positive responses).....	11
Table 9. Barriers to donating leftovers (percent of positive responses) .....	12
Table 10. Management of unavoidable food waste (percent of positive responses).....	12
Table 11. Interested in having or using a bin for separately collecting the food waste (if no separation today) (percent of positive responses) .....	13
Table 12. Transfer of biowaste to a specific bin located in the municipality (percent of positive responses).....	13
Table 13. Main benefits from sharing leftovers and separately collecting unavoidable food waste (percent of positive responses) .....	14
Table 14. Country of HORECA business location.....	15
Table 15. Interviewee’s position .....	15
Table 16. Responsibility for food supplies.....	16
Table 17. Business category .....	16
Table 18. Meals served .....	16
Table 19. Average number of customers served per week.....	16
Table 20. Types of food included in the menu.....	17
Table 21. Food being bought approximately every week (in kg) .....	18
Table 22. Food wasted approximately every week (in kg) .....	19
Table 23. How often are customers provided with packages containing their leftovers (percent of positive responses) .....	23
Table 24. What percentage of the customers get in a package their leftover food (percent of positive responses) .....	23
Table 25. Space availability for installing new bins (percent of positive responses).....	27
Table 26. Reduction of food waste in the HORECA sector compared to 10 years ago (percent of positive responses) .....	28
Table 27. Main reasons for the reduction of food waste in the HORECA sector (percent of positive responses) .....	28
Table 28. Existence of challenges relating to the utilisation of food waste (percent of positive responses).....	29
Table 29. What motivates you to reduce food waste .....	30
Table 30. Actions/measures considered in order to reduce food waste .....	31
Table 31. How often are the municipal food waste/biowaste bins collected .....	32

## List of figures

Figure 1. Reasons why food is wasted (regarding the three types of food that are wasted the most).....	8
Figure 2. Percentage of food bought and believed to be wasted pre-, post- and during meal preparation .....	9
Figure 3. Pre-kitchen reasons food gets wasted; least important (1) and most (5).....	9
Figure 4. Kitchen reasons food gets wasted; least important (1) and most (5) .....	10
Figure 5. Post-kitchen reasons food gets wasted; least important (1) and most (5) .....	11
Figure 6. Separate collection of food waste in the house, percentage of positive responses..	13
Figure 7. Adequacy of municipal waste management system regarding food waste (biowaste) .....	14
Figure 8. Percentage of the food believed to be wasted during consumption, preparation and maintenance .....	19
Figure 9. Reasons that food gets wasted during maintenance .....	20
Figure 10. Reasons that food gets wasted during preparation .....	21
Figure 11. Reasons that food gets wasted during consumption .....	22
Figure 12. Management of food waste that is not suitable for consumption .....	24
Figure 13. Management of leftover food.....	25
Figure 14. Separate collection for specific waste categories .....	26
Figure 15. Interested in installing bins for separate collection (if no separation takes place today).....	27
Figure 16. Main challenges relating to the utilisation of food waste.....	29
Figure 17. Location of the Croatian municipalities that participated in the survey .....	31
Figure 18. Barriers towards implementing biowaste separate collection programs .....	32
Figure 19. Main recovery methods of food waste .....	33
Figure 20. Location of the Serbian municipalities that participated in the survey.....	34

## Abbreviations

Abbreviation	Definition
MSW	Municipal solid waste
HORECA	Hotel, restaurant, café accommodation and food service activities
SMEs	Small and medium enterprises

## Executive summary

This report presents the results of “Task 1.2 Implementation of Surveys”, which aims to investigate the role of households, HORECA SMEs and Municipalities in food waste production and management. For the purposes of the project, three surveys were conducted by means of questionnaires, which were filled through online platforms and personal interviews. The main findings of the three surveys, are summarised, as follows.

The households’ survey collected 149 responses from Greece, Serbia, Croatia, and other countries (e.g., Italy and Germany). Overall, the food that is more susceptible to wastage is vegetables, followed by fruits, starchy, pastries and desserts. More than half of the food is wasted post-kitchen, about 30% is wasted pre-kitchen, and the rest during food preparation. There is a clear indication that when the households do not plan their meal properly, they tend to forget to consume the old meals that are stored in the fridge. As a result, a large proportion of leftover food (more than 35%), although suitable for consumption, ends up into trash bins. The management of unavoidable food waste follows similar patterns like the leftover food. Most of the households do not separate their food waste from other wastages because there is no organised waste management in their municipality to handle this stream. Although, there are differences between the three participating countries, it seems that food waste at the consumption stage is a direct consequence of consumer buying behaviour.

As regards the HORECA survey, 127 questionnaires were collected, in total, from Greece, Belgium and Cyprus, including 1 questionnaire from another country. Food waste production in the HORECA industry is in accordance with the amount of food purchased, that is the more food is purchased the bigger the amount of waste. Meat is the food waste leader, followed by vegetables and starchy food. Almost half of the total food waste arises during consumption, 25% during food preparation, and 25% during maintenance. Focusing on waste management issues, only one-third of the respondents said that customers are provided with packages containing their leftovers often or very often. The food waste that is not suitable for consumption is usually thrown away (around 75%). As for the management of leftover food, more than half of the businesses also throw it away, about 45% state that they donate it to charity, 9% that they compost it, 7% that they collaborate with external factors and 16% that they follow another practice. About 35% of the businesses stated that they have a separate collection system for organics/biowaste. However, there are major differences between the three partner countries. The lack of available space is one of the most important barriers in separate collection. Food waste in the HORECA industry has decreased compared to 10 years ago. The main reasons are the increased experience regarding food waste management and the increased attention for cost management, followed by the augmented environmental awareness. The incentives of companies in the HORECA sector to reduce food waste are environmental and cost reduction motives and legislation requirements. According to the participants, the most preferable action to reduce food waste is the employee training.

The municipalities survey involved 21 municipalities (18 from Croatia and 3 from Serbia, respectively). Within the Croatian municipalities, none has implemented separate collection of food waste. Yet around 45% of them have implemented separate collection of mixed biowaste. A small part, less than 40% conduct compositional analysis, but none is keeping a track of the

collected food waste. Collected mixed biowaste is mostly disposed of at landfills, and less than 30% is composted. However, the vast majority of the sampled municipalities intend to upgrade their existing waste management system relating to biowaste. From the sample of Serbian municipalities, it is concluded that there is no data regarding food waste quantities and composition because there is no legal obligation for them to keep track of the food being wasted. Further, there isn't any program for separate collection of food waste and the main reasons for that is the lack of funding and infrastructure. All municipalities use composting as a recovery method for food waste, but they need to improve this process. Finally, it seems that there is awareness about the food waste problem and municipalities have intention to upgrade their existing waste management system related to biowaste.

## 1 Introduction

ADVANCE is an EU co-funded project, which is funded by the Erasmus+ programme under the Action “KA220-VET - Cooperation partnerships in vocational education and training” (Agreement no. Project 2021-1-EL01-KA220-VET-000033247).

The main objectives of the ADVANCE project are, as follows:

- To assess the current food waste management practices in selected municipalities and SMEs in the HORECA sector and compare the assessment results with the best practices in the relevant fields
- To develop a concrete set of Circularity Indicators that will be used to describe both the current and the future description – monitoring of food waste management
- To assess the gap between the baseline assessment and the requirements posed by the EU Circular Economy Action Plan using the Circularity Indicators
- To develop two Roadmaps for municipalities and HORECA SMEs and a step-by-step methodology to implement the EU Circular Economy Action Plan requirements regarding food waste
- To prepare all the above as training/educational materials and implement training courses in selected municipalities and SMEs in the HORECA sector
- To develop an Open Education Resource online platform which will include & host all the above.

In this direction, ADVANCE will produce the following results:

- Baseline assessment (**PR1**) of the current waste food waste management practices in Municipalities and HORECA SMEs – the baseline assessment will also include benchmarking to existing best practices in EU.
- Gap Analysis methodology and tool (**PR2**) between current and required, according to the EU targets, waste management practices relevant to food waste. The main outcome of the Gap Analysis will be the Circularity Gap Indicators that could be used in other cases too. These indicators concern both the municipalities involved and the HORECA SMEs that will participate in the program.
- Development of Roadmaps (**PR3**) – The Roadmaps will be developed in two different types, one for Municipalities and one for HORECA SMEs. A special part of the Roadmaps will be to demonstrate how Industry 4.0 can help municipalities and SMEs to achieve better food waste management and advance food waste prevention. The Roadmaps will help to design and development of a step-by-step methodological framework for implementing the food waste targets.
- ADVANCE Course (**PR4**) – Creation of a training material broken down into certain learning modules for waste management adopted to the needs of target groups
- Open Education Resource (OER) (**PR5**) – An Online Platform, which will include and host interactively all the above.

This report presents the results of “Task 1.2 Implementation of Surveys”, which aims to investigate the role of households, HORECA SMEs and Municipalities in food waste production. More specifically, it discusses the results of three surveys conducted via online questionnaires and face-to-face interviews.

## 2 Objectives and methodological approach

As mentioned, the main aim of “Task 1.2 Implementation of Surveys” is to investigate the role of households, HORECA SMEs and Municipalities in food waste production, e.g., how much food is bought and wasted, which types of food are more susceptible to food waste, which are the main reasons that food is wasted, whether there are programs for separate food waste collection, etc. The findings from the three surveys will be used for the baseline assessment as well as for the design of the roadmaps. For the purposes of the survey three different questionnaires were developed under “Task 1.1 Define the Survey Context”, which are presented in the respective deliverable. Hereinafter, a brief description of each questionnaire is provided.

The questionnaire developed for the survey of households includes 20 questions. The first four questions ask for basic demographic characteristics of the household (i.e., country, number of household members and age classes, and income). The next six questions are referred to food waste and investigate the type and quantity of food bought every week, the foodstuffs that are mainly wasted, the main reasons that food is wasted in order of importance, etc. The last ten questions focus on the management of food waste, e.g., how are the leftover food and unavoidable food waste managed, whether food waste is collected separately and transferred to a specific bin, which are the main food waste donation barriers, which are the main benefits from sharing leftovers and separately collecting unavoidable food waste, etc.

The HORECA businesses questionnaire consists of a set of 24 questions. The first six questions collect information about the characteristics of the business investigated (e.g., country of operation, business category, person responsible for food supplies, types of food included in the menu, number of customers served, etc.). The next five questions investigate food waste generation issues, i.e., how much food is bought and wasted per week (or month) per type of food, what percentage of the food is wasted during maintenance, preparation and consumption, and which are the main reasons of food waste during maintenance, preparation and consumption. The rest of the questions are related to food waste reduction and management. In this direction, the role of customers is explored (i.e., whether they are provided with doggy bags and what percentage of them gets in a package their leftover food), how does the HORECA business manage leftover food and food waste that is not suitable for consumption, if there is separate collection of specific waste streams, whether food waste in the HORECA sector has decreased over the last 10 years and why, which are the main challenges and motivations towards reducing food waste, and which are the main actions the HORECA business would consider for reducing food waste.

The questionnaire used for the survey of municipalities included 16 questions. The first two questions were related to the size of the municipality (i.e., number of permanent residents) and whether there exists tourist activity and to what extent. The following six questions investigate basic characteristics of the municipal waste management system (e.g., existence of waste prevention initiatives, systematic compositional analysis of waste, data regarding food waste, etc.). The rest of the questions focus on food waste management, e.g., if the municipality has a separate collection program for food waste and, if not, why, whether the municipality provides small bins in the households to segregate food waste and how often are the municipal food waste/bio-waste bins collected, which are the main recovery methods for food waste, if there are any plans to upgrade the existing waste management system related to biowaste and how, etc.

The following sections present further details regarding the characteristics of the three surveys and analyse the main findings.

### 3 Results of the households survey

#### 3.1 Survey characteristics

According to the Application Form, NTUA had to identify 40 respondents representing households and run an online survey. Nevertheless, during the kick-off meeting the partners from Serbia and Croatia expressed interest to participate in the survey, as well. Therefore, the English questionnaire was translated to three national languages, i.e., Greek, Croatian and Serbian.

The online versions of English, Greek, Croatian and Serbian questionnaires were created in LimeSurvey platform:

English: <https://mirc.ntua.gr/surveys/index.php/144387?lang=en>;

Greek: <https://mirc.ntua.gr/surveys/index.php/144387?lang=el>;

Croatian: <https://mirc.ntua.gr/surveys/index.php/144387?lang=hr>;

Serbian: <https://mirc.ntua.gr/surveys/index.php/144387?lang=sr>

The survey was promoted via social media (e.g., LinkedIn). In total, 149 questionnaires were collected, including 8 questionnaires from other countries (e.g., Italy and Germany). As shown in Table 1, around 40% of the respondents were from Greece and Croatia, respectively, 12% from Serbia and 5% from other countries.

*Table 1. Country of origin of the respondents*

Country	Frequency	Percent (%)
Greece	62	41.6
Croatia	61	40.9
Other	8	5.4

Serbia	18	12.1
Total	149	100.0

### 3.2 Sample characteristics

As presented in Table 2, about 50% of the households have 3 or 4 members, 29.5% have 3 members, 13.4% are one-person households and the rest have 5 or more household members.

*Table 2. Composition of sample household members*

Household members	Frequency	Percent (%)
1	20	13.4
2	44	29.5
3	38	25.5
4	36	24.2
5	8	5.4
6	3	2.0
Total	149	100.0

Moreover, about 30% of the households have 1 or more members under 18 years old, 50% of them have 1 or more members between 18 and 34 years old, 50% also have 1 or more members between 35 and 54 years old, and 28% have 1 or more members over 55 years old.

As regards the household annual income, about one-third of the sample belongs to the 10,000-19,999 EUR income bracket, 18.8% to the 20,000-29,999 EUR income bracket, and 11.4% to the 30,000-39,999 EUR income bracket. Moreover, about 11% earns less than 10,000 EUR per year and 8.7% more than 40,000 EUR per year. Finally, 16.8% of the sample refrained from answering.

*Table 3. Distribution of sample household income*

Household annual income	Frequency	Percent (%)
Less than 10,000 €	16	10.7
10,000 to 19,999 €	50	33.6
20,000 to 29,999 €	28	18.8
30,000 to 39,999 €	17	11.4
40,000 € or more	13	8.7
Prefer not to answer	25	16.8
Total	149	100.0

### 3.3 Food waste generation issues

According to the responses given (Table 4), the most popular food is meat (bought by 91.3% of the households), followed by fruits and vegetables (90.6% each), starchy (83.9%), and dairy

(83.2%). Meat has traditionally held a central position in Western food culture, it is the food with the highest status in the hierarchy of foods. The least popular foods are seafood (55.7%) and desserts (49.7%). Concerning the quantity of food bought, the households buy more fruits (about 3.3 kg per week), vegetables (3.1 kg per week), meat, starchy and dairy (2.5 kg per week), and pastries (1.4 kg per week). In addition to being one of the least popular foods, seafood and desserts are also bought in lower quantities (i.e., 1 and 0.8 kg per week, respectively). This depicts the average Mediterranean dietary pattern, characterized by high intake of vegetables, legumes, fruits and nuts, cereals, and olive oil but a low intake of saturated fat and a moderate intake of fish.

Table 4. Popularity and mean quantity of food bought per week

Food type	Percent (%)	Mean quantity (kg per week)
Seafood	55.7	1.0
Fruit	90.6	3.3
Vegetables	90.6	3.1
Meat	91.3	2.5
Pastries	57.0	1.4
Starchy	83.9	2.5
Dairy	83.2	2.5
Desserts	49.7	0.8

Nevertheless, as shown in Table 5, there are notable differences between the three countries, i.e., Greece, Croatia, and Serbia. The total quantity of food bought per week is about 15.9 kg in Greece, 17.5 kg in Croatia and 22.3 kg in Serbia. In terms of popularity, seafood is mainly consumed in Croatia (63.9%) and less in Greece (35.9%), and Serbia (22.2%), but the average quantities bought are similar in the three countries. Fruits and vegetables are more popular in Croatia and Serbia (around 89%) compared to Greece (around 63%), and the same stands for meat (Croatia: 86.9%; Serbia: 83.3%; Greece: 65.2%) and starchy (Croatia: 85.2%; Serbia: 83.3%; Greece: 55.4%). The quantities of fruits, vegetables, meat and starchy differ, however. Serbians buy more fruits, vegetables and starchy than Croatians and Greeks (almost 0.5-1 kg more, on a weekly basis). Croatians buy more meat (around 3 kg per week) than Serbians (2.6 kg per week) and Greeks (2 kg per week). Pastry is more popular in Serbia (72.2%) and Greece (50.0%) than in Croatia (34.4%), and this is also reflected in the quantities bought per week (i.e., 2.9 kg in Serbia, 1.6 kg in Greece, and 0.5 kg in Croatia). Dairy is more popular in Croatia (83.6%) compared to the other two countries (i.e., Serbia: 61.1%; Greece: 58.7%). The quantities of dairy bought in Croatia and Serbia are the same (around 3 kg per week) and almost 50% higher than those in Greece (about 2 kg per week). Deserts are twice more popular in Serbia (72.2%) rather than in Croatia and Greece, but the quantities bought every week are similar (less than 1 kg).

Table 5. Popularity and mean quantity of food bought per week in Greece, Croatia, and Serbia

Country	Variable	Seafood	Fruit	Vegetables	Meat	Pastries	Starchy	Dairy	Desserts
Greece	Mean quantity (kg per week)	1.0	3.3	3.0	2.0	1.6	2.2	1.9	0.9
	Percent (%)	35.9	63.0	62.0	65.2	50.0	55.4	58.7	37.0
Croatia	Mean quantity (kg per week)	1.1	3.1	3.1	3.0	0.5	3.2	2.9	0.7
	Percent (%)	63.9	88.5	88.5	86.9	34.4	85.2	83.6	36.1
Serbia	Mean quantity (kg per week)	0.9	4.4	3.9	2.6	2.9	3.8	2.9	0.8
	Percent (%)	22.2	88.9	88.9	83.3	72.2	83.3	61.1	72.2

Overall, the food that is more susceptible to wastage is vegetables (4.5/9), followed by fruits (4.2/9), starchy (3.7/9) and pastries (3.6/9), desserts (2.7/9), other food (2.7/9), meat (2.6/9), and seafood (2.1/9) (Table 6). Once more, there are differences between the three participating countries, as presented in

Table 7. It has to be noted that regardless the average Mediterranean food consumption patterns, food waste at the consumption stage is a direct consequence of consumer buying behaviour. Specifically, in Greece, respondents consider that the three most wasted types of food are vegetables (5.2/9), fruits (4.7/9), and pastries (4.0/9). On Croatia, the three most wasted types of food are believed to be starchy (4.5/9), vegetables (4.0/9), and fruits (3.9/9). Finally, in Serbia, the three most wasted types of food are pastries (4.6/9), vegetables (3.4/9), and fruits (3.4/9). Yet, the general trends regarding the food waste in the households are similar for all the countries.

Table 6. Beliefs about the food that is wasted; least wasted (1) and most wasted (9)

Food	Percent (%)	Mean
Seafood	77.2	2.1
Fruit	92.6	4.2
Vegetables	94.0	4.5
Meat	87.2	2.6
Pastries	81.9	3.6
Starchy	89.9	3.7
Dairy	86.6	3,0
Desserts	69.8	2.7
Other	30.2	2.8

Table 7. Beliefs about food that is wasted per country

Country	Variable	Seafood	Fruit	Vegetables	Meat	Pastries	Starchy	Dairy	Desserts	Other
---------	----------	---------	-------	------------	------	----------	---------	-------	----------	-------

Greece	Mean	2.3	4.7	5.2	2.6	4.0	3.3	3.4	2.6	2.3
	Percent (%)	75.8	95.2	95.2	87.1	87.1	87.1	91.9	66.1	16.1
Croatia	Mean	2.0	3.9	4.0	2.7	2.8	4.5	2.7	2.8	3.4
	Percent (%)	83.6	93.4	93.4	90.2	77.0	95.1	85.2	72.1	36.1
Serbia	Mean	1.6	3.4	3.4	2.4	4.6	2.7	2.0	1.9	1.7
	Percent (%)	55.6	83.3	88.9	77.8	88.9	88.9	72.2	72.2	50.0

As illustrated in Figure 1, the main reasons according to the total sample, that the food is wasted (for the three most wasted types of food) are: “Usually it gets spoiled in the fridge, as I don’t use it very often” (65.8%), and “I don’t manage my supplies and tend to buy more food than I consume” (48.3%). When the households do not plan their meal properly by finishing the old food before consuming the new ones, they tend to forget to consume the old meals that are stored in the fridge. Also, the ways in which the edibility of food is assessed varies profoundly across consumers. The other reasons were reported less frequently, i.e., “Usually it gets spoiled in the fridge, as I don’t maintain it properly” (10.7%) and “I throw this food before the “best before” date” (6.7%), or rarely, i.e., “I throw this food before the “expiration” date” (4.0%) and “I don’t mind throwing food that is cheap” (2.0%).

Again, there exist differences between Greece, Croatia, and Serbia. For instance, in Serbia, the percentage of respondents who said that they throw away food before the “best before” date is more than twice as high as in Greece and Croatia. On the contrary, the percentage of respondents who said that they throw away food because they buy excess quantities is half of that in Greece and Croatia (Figure 1).

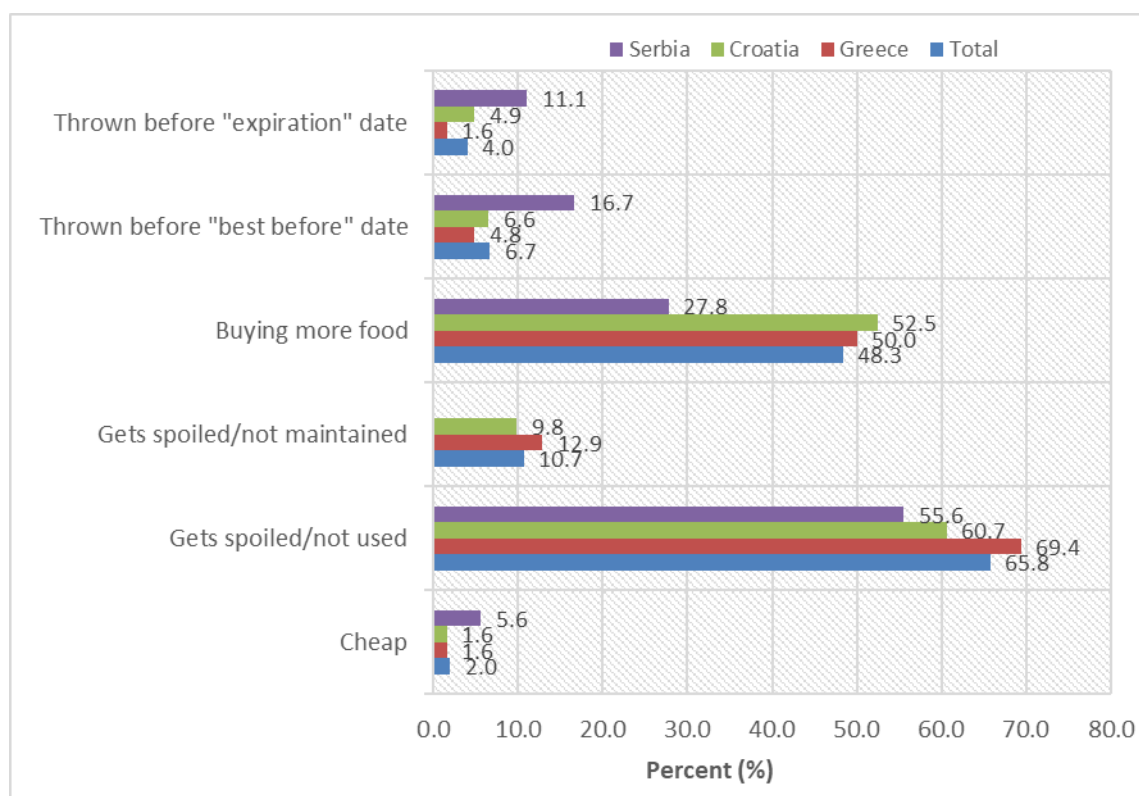


Figure 1. Reasons why food is wasted (regarding the three types of food that are wasted the most)

According to Figure 2, more than half of the food is wasted post-kitchen (e.g., due to the preparation of large portions, inadequate storage containers, food habits, etc.), about 30% is wasted pre-kitchen (e.g., rotten food, defective packaging, failure of kitchen equipment, etc.), and the rest during food preparation (e.g., burned food due to human error). As already investigated in various researches, nearly 50%–60% of food waste comes from the post-kitchen stage (e.g. leftovers) in both restaurants and households.

Croatia and Serbia show similar patterns, while Greece is differentiated. More specifically, the percentage of food waste during meal preparation is twice as high as in the other two countries, while post-kitchen food waste is significantly lower. Also, significant is the pre-kitchen food waste in Greece (36.44%).

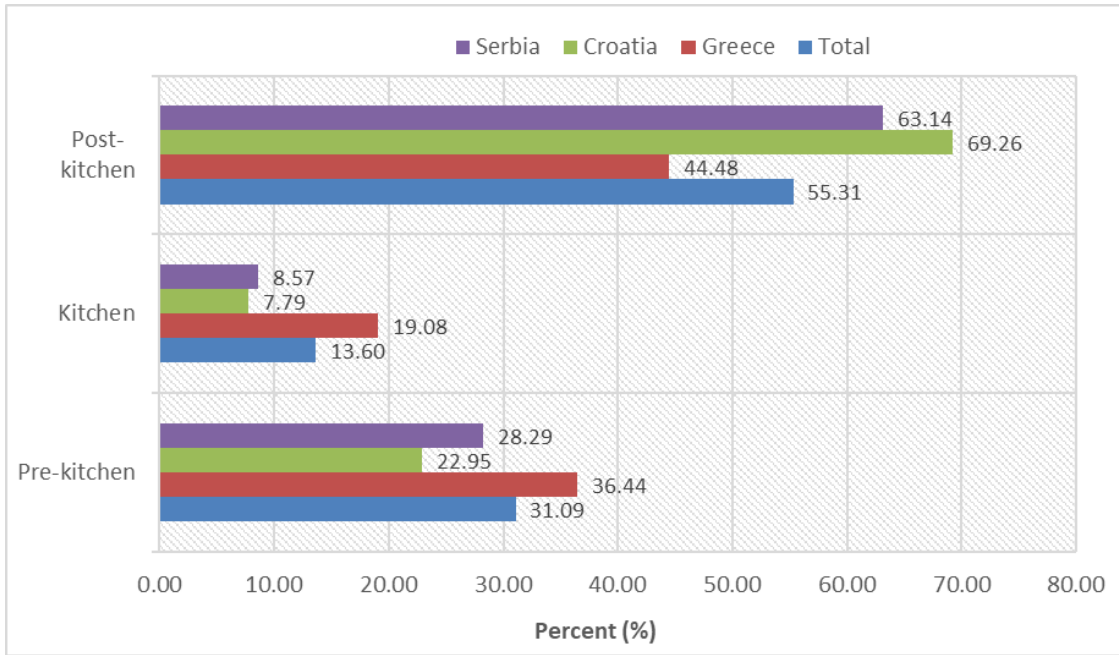


Figure 2. Percentage of food bought and believed to be wasted pre-, post- and during meal preparation

Figure 3 presents the main reasons why food is wasted before entering kitchen.

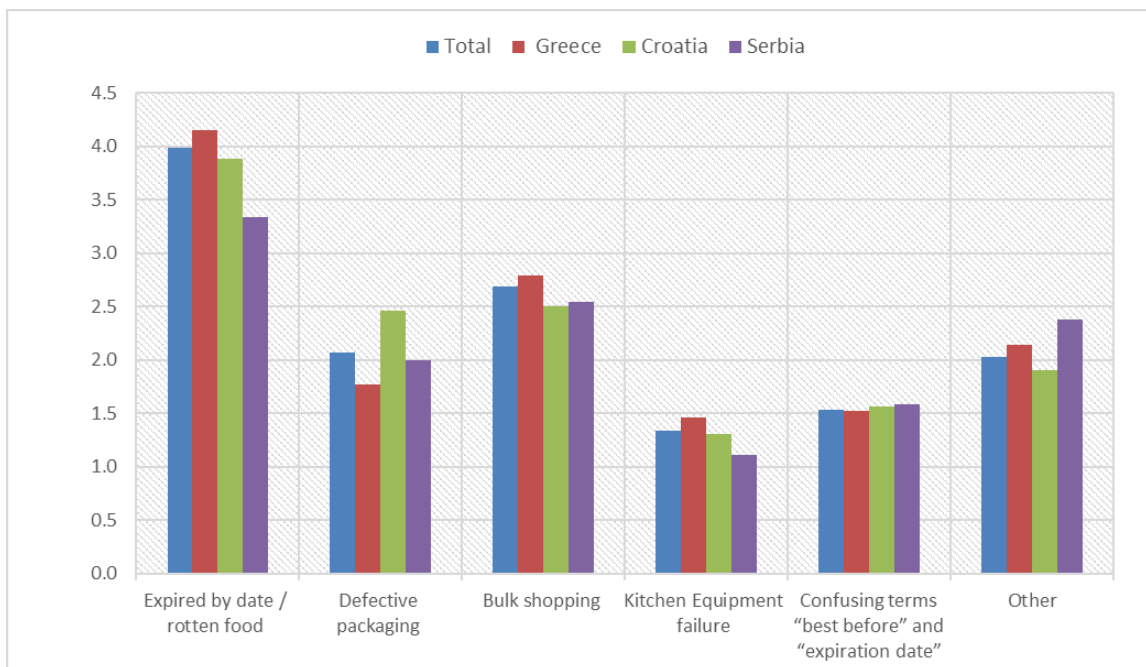


Figure 3. Pre-kitchen reasons food gets wasted; least important (1) and most (5)

All participants, regardless of their place of residence, seem to share similar beliefs. The most important reason for pre-kitchen food waste is expiry date-related, while bulk shopping and defective packaging are following. Based on the literature, households often throw away spoilt

or rotten food because they either bought too much food or did not realise that they had food hidden at the back of their fridge.

Regarding kitchen food waste, the most important reason by far is the preparation of excessive amount of food which is not consumed. In general, in all three countries participants provide, more or less, the same score in the prescribed reasons (Figure 4).

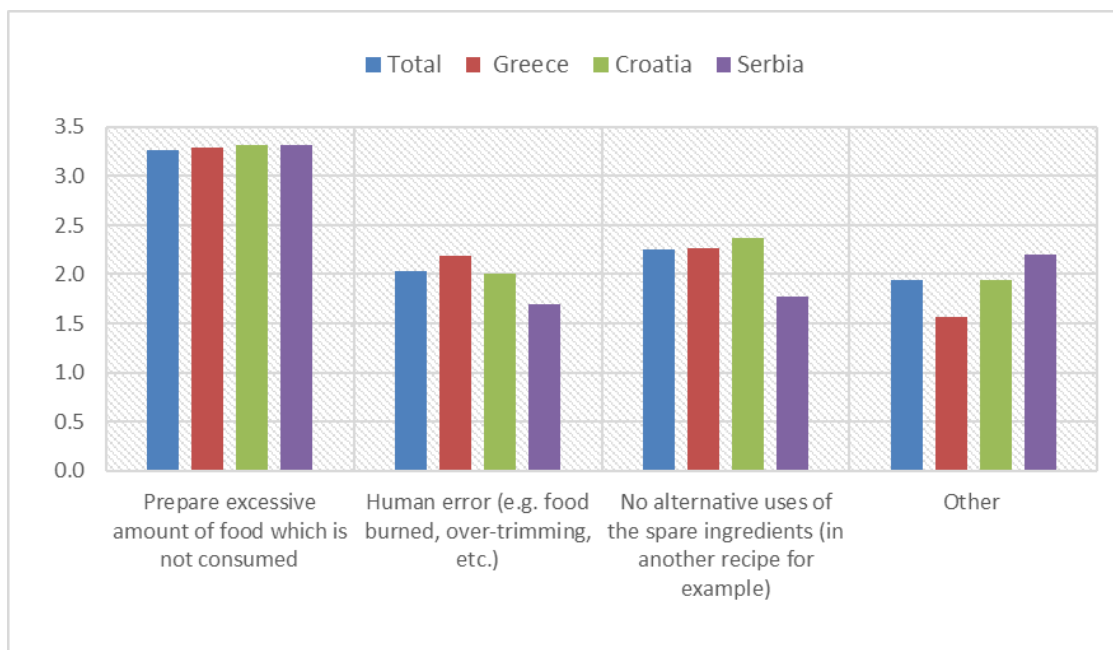


Figure 4. Kitchen reasons food gets wasted; least important (1) and most (5)

Finally, in the case of post-kitchen food waste (Figure 5) two reasons are equally important and more significant, namely large portions and food that is spoiled (which is associated with the preparation of excessive amount of food). Food habits and the use of storage containers that are not adequate for proper storage are less popular reasons. Again, all three countries present similar patterns, although Serbians score higher on the two most important reasons.

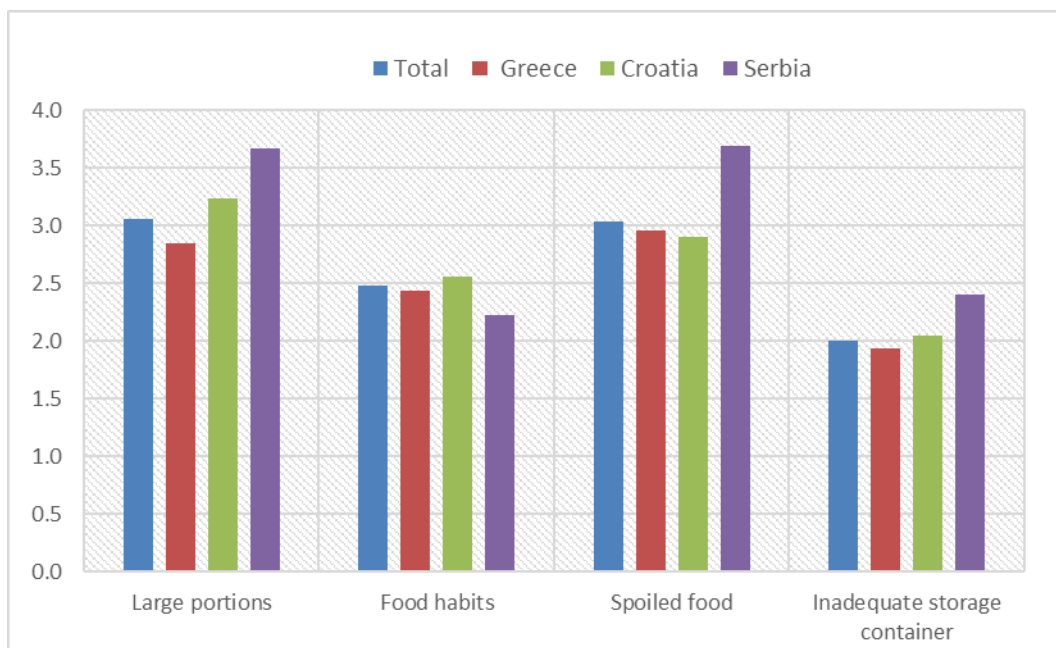


Figure 5. Post-kitchen reasons food gets wasted; least important (1) and most (5)

### 3.4 Food waste management issues

As presented in Table 8, a large proportion of the leftover food, although suitable for consumption, ends up into trash bins. In total, the percentage of the respondents who throw away, at least sometimes, leftover food is 36%. This percentage is lower in Greece (i.e., 30.6%) and significantly higher in Croatia and Serbia (i.e., 59.0% and 55.6%, respectively). On the other hand, it seems that usually leftover food is stored and eaten later. The percentage of this response is more than 94% in Serbia and about 84% in Greece, whereas in Croatia is about 66%, forming an overall rate of 78.5%. Also, in Croatia, unlike Greece and Serbia, the next most popular leftover food management options are sorting collection and disposal at municipality's separate collection system and home composting (in Serbia this option is practically non-existent). In all three countries, donation of leftover food which is suitable for consumption is the least popular practice.

Table 8. Management of leftover food (suitable for consumption) (percent of positive responses)

	Total	Greece	Croatia	Serbia
Trash	36.2	30.6	59.0	55.6
Eat it later	78.5	83.9	65.6	94.4
Donate it locally	6.0	6.5	3.3	11.1
Home Composting	10.7	6.5	16.4	5.6
Throw it in the municipality's separate collection system	11.4	6.5	21.3	0.0
Other	4.7	6.5	21.3	0.0

The main barriers to donating food (Table 9) are the lack of information on how to do so (more than 50%), the lack of platforms/apps for sharing the food with others (between 30% and 40%), and the lack of charity organisations (between 11% and 18%). In general, less than 10% of the respondents said that they are not interested in donating their leftover food.

Table 9. Barriers to donating leftovers (percent of positive responses)

	Total	Greece	Croatia	Serbia
Legislation	4.0	3.2	6.6	0.0
No available platform/app for sharing the food with others	34.9	30.6	41.0	27.8
There are no charities I can reach out to	16.8	17.7	18.0	11.1
Not interested in donating	6.0	8.1	3.3	11.1
I do not know how	52.3	53.2	52.5	50.0
Other	16.8	22.6	9.8	11.1

The management of unavoidable food waste follows similar patterns like the leftover food (Table 10). Especially in Greece and Serbia, more than 80% of the respondents said that it is discarded in mixed waste (trash). This practice is also the most popular one in Croatia but at significantly lower rates. Again, home composting and segregation and disposal at the municipality's separate collection system are more popular in Croatia than in the other two countries.

Table 10. Management of unavoidable food waste (percent of positive responses)

	Total	Greece	Croatia	Serbia
Trash	71.8	87.1	52.5	83.3
Home Composting	14.1	9.7	27.9	5.6
Throw it in the municipality's separate collection system	16.8	6.5	23.0	11.1
Other	3.4	4.8	1.6	5.6

Separate collection of food waste seems to be more widespread in Croatia (39.3%), less so in Greece (25.8%) and hardly at all in Serbia (5.6%) (Figure 6). This behaviour may also be related to the lack of a municipal waste management system regarding food waste, as presented in Table 11. Most of the households that do not separate their food waste from other wastages today, stated that they would like to have a bin for separately collecting the food waste but noted that there is no organised waste management in their municipality to handle this stream. The problem is particularly serious, considering that the households that separate food waste said that the average volume of food wasted throw away every week is more than two single-use supermarket or garbage bags on average.

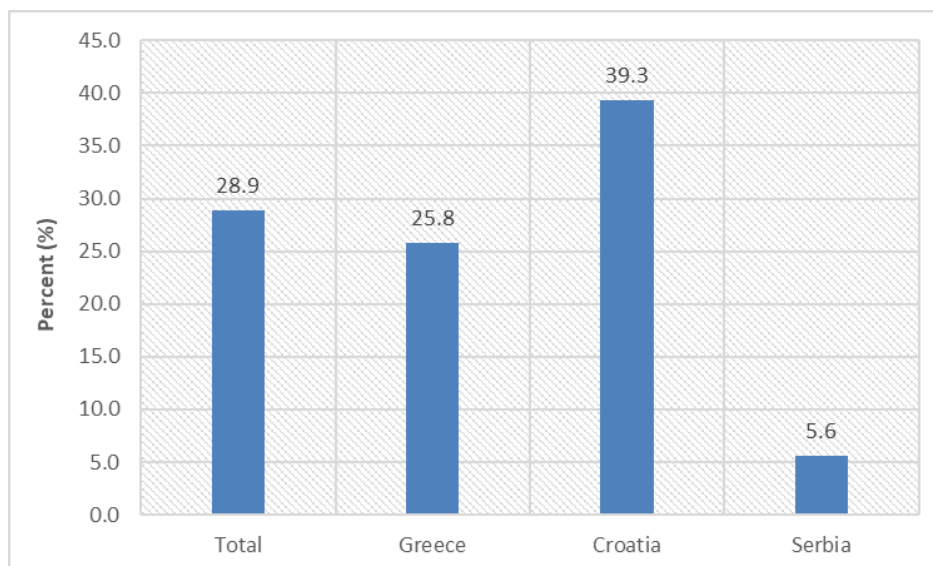


Figure 6. Separate collection of food waste in the house, percentage of positive responses

Table 11. Interested in having or using a bin for separately collecting the food waste (if no separation today) (percent of positive responses)

	Total	Greece	Croatia	Serbia
No	8.3	4.3	20.0	0.0
Yes, but there is no organised waste management in my municipality to handle this stream	66.7	78.3	53.3	57.1
Yes, I would like to start segregation of my food waste	25.0	17.4	26.7	42.9

In the same direction, the percentage of the households that transfers biowaste to a specific bin located in the municipality (Table 12) is lower (even if only slightly) than the percentage of those who segregate their food waste. Once more, it seems that the decisive factor in the problem is related to the existing municipal waste management system regarding food waste, as illustrated in Figure 7, especially in Greece and Serbia and to a lesser extent in Croatia.

Table 12. Transfer of biowaste to a specific bin located in the municipality (percent of positive responses)

	Total	Greece	Croatia	Serbia
No	67.1	74.2	52.5	83.3
Yes	24.2	24.2	31.1	5.6
No response	8.7	1.6	16.4	11.1

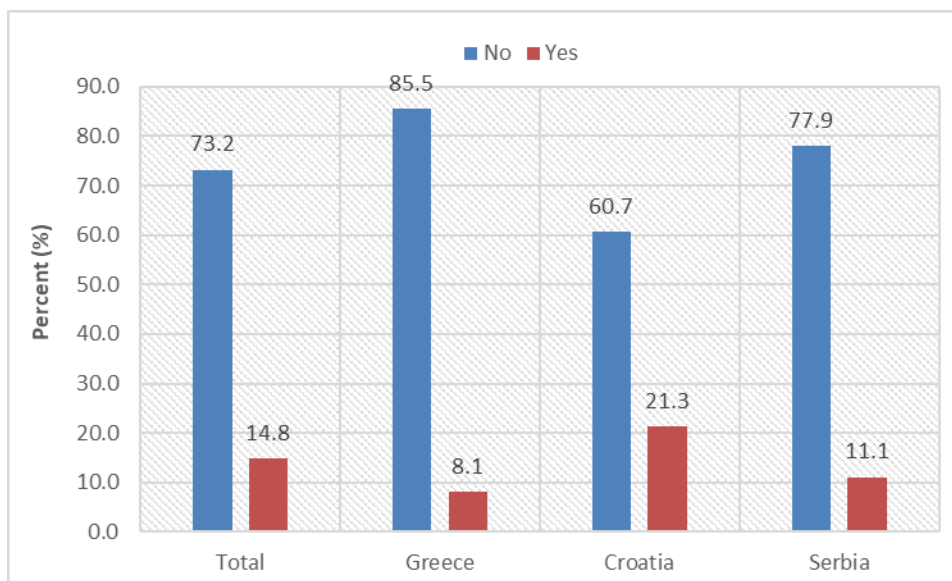


Figure 7. Adequacy of municipal waste management system regarding food waste (biowaste)

Finally, as presented in Table 13, respondents believe that sharing leftovers and collecting separately unavoidable food waste results in environmental and societal benefits and less to economic benefits. Nevertheless, most respondents believe that the proper management of food waste leads to environmental, societal, and economic benefits simultaneously, while a small percentage believes that there are no benefits at all.

Table 13. Main benefits from sharing leftovers and separately collecting unavoidable food waste (percent of positive responses)

	Total	Greece	Croatia	Serbia
All the above	58.4	71.0	49.2	38.9
Economic benefit	5.4	3.2	8.2	5.6
Environmental benefit	16.8	19.4	9.8	33.3
Societal benefit	14.1	6.5	21.3	16.7
None	2.7	0.0	4.9	5.6
No response	2.7	0.0	6.6	0.0

## 4 Results of the HORECA SMEs survey

### 4.1 Survey characteristics

According to the Application Form, SIGMA, D-WASTE, HORECA Partners and EUGENE had to identify 30 SMEs in total that are related with HORECA sector to run an online survey. During the kick-off meeting, it was mentioned that personal interviews would be useful to engage HORECA businesses in the survey. Therefore, it was decided that both survey options would be used. The English questionnaire was translated into Greek, and Dutch.

The online versions of the English, Greek, and Dutch questionnaires were created in LimeSurvey platform:

English: <https://mirc.ntua.gr/surveys/index.php/422144?lang=en>

Greek: <https://mirc.ntua.gr/surveys/index.php/422144?lang=el>

Dutch: <https://mirc.ntua.gr/surveys/index.php/422144?lang=nl>

The survey was promoted via social media (e.g., LinkedIn). In total, 127 questionnaires were collected, including 1 questionnaire from other countries (i.e., Toronto, Canada). As shown in Table 14, more than half of the respondents were from Greece (this is because two of the partners who were responsible for this survey were from Greece) and the rest were from Belgium and Cyprus.

Table 14. Country of HORECA business location

Country	Frequency	Percent (%)
Belgium	30	23.6
Cyprus	31	24.4
Greece	65	51.2
Other	1	.8
Total	127	100.0

#### 4.2 Sample characteristics

As seen in Table 15 most of the respondents (40.9%) were owners of HORECA businesses, followed by designated employees (inventory managers) (19.7%). Also, 18.1% of the respondents were working as chefs and 14.2% as general managers of the business. Finally, 10.2% of the respondents had another role in the business.

Table 15. Interviewee's position

Interviewee's position	Percent (%)
Owner	40.9
General manager	14.2
Designated employee (Inventory manager)	19.7
Chef	18.1
Other	10.2

As to whose responsibility is the supply of the food prepared by the business, 48.8% responded that it is the owner's responsibility, 34.6% stated that it is the responsibility of the inventory manager, 26% responded that the chef is responsible for the food supplies and 19.7% that the general manager is the one responsible (Table 16).

Table 16. Responsibility for food supplies

Responsible person	Percent (%)
Owner	48.8
General manager	19.7
Designated employee (Inventory manager)	34.6
Chef	26.0
Other	0.0

Regarding the category in which their business operates, as shown in Table 17 many of the businesses are able to provide food by different means. Specifically, 86.6% of the respondents stated that they provided food for dine-in, 45.7% that they provided food in the form of take away and 37.8% that they delivered the food they prepared.

Table 17. Business category

Business category	Percent (%)
Take away	45.7
Delivery	37.8
Dine-in	86.6

From Table 18 it is evident that most HORECA companies that participated in the questionnaire offer more than one type of meal. In particular, 81.9% of the respondents stated that they offer dinner, 74.8% they offered lunch, 27.6% they offered brunch and 28.3% that they offered breakfast.

Table 18. Meals served

Meal	Percent (%)
Breakfast	28.3
Brunch	27.6
Lunch	74.8
Dinner	81.9

When asked an estimate of the average number of customers served per week, 30.7% of the businesses stated 150-300 customers, 28.3% stated 0-150 customers, 19.7% stated 300-450 customers, 15.7% stated above 450 customers and 5.5% did not provide an answer (Table 19).

Table 19. Average number of customers served per week

Customers/week	Frequency	Percent
0 - 150	36	28.3
150 - 300	39	30.7
300 - 450	25	19.7
> 450	20	15.7
No response	7	5.5
Total	127	100.0

### 4.3 Food waste generation issues

Hospitality sector food waste is fast becoming a key concern, given its contribution to the total food waste. Furthermore, with the increasing trend of out-of-home dining, spurred by growth in incomes and tourism, hospitality waste has become a significant issue for both developed and developing countries. Although the amount of food-related waste generated in this sector is frequently discussed in the media, it has not yet got sufficient academic attention. The hospitality sector is quite complex, as already investigated, and even though there are some common tracks, nuances of food waste are different for the profit and cost sectors.

Before being questioned specifically on the food waste, participants were asked to provide information on the type of food they include in their menus as well as estimates on the amount of food that their business purchases every week. Table 20 shows that the vast majority (83.5%) of the businesses included meat in their menus. Additionally, 81.9% of the businesses reported that vegetables could be found in their menu options and 68.5% of the businesses included pastries in their menus. Dairy products and starchy food were less common menu options since 58.3% and 56.7% of the businesses mentioned them, respectively. The least common types of food that could be found on the menus of businesses participating in the study were desserts, fruits and seafood (51.2%, 49.6% and 45.7% respectively).

Table 20. Types of food included in the menu

Food	Percent (%)
Seafood	45.7
Fruit	49.6
Vegetables	81.9
Meat	83.5
Pastries	68.5
Dairy products	58.3
Starchy food	56.7
Desserts	51.2
Other	7.9

Table 21 summarises the findings on the amount of food purchased weekly by HORECA businesses. Overall, in terms of the amount of food purchased, HORECA businesses on average buy 77 kg of meat per week, which is consistent with the results above showing meat as the most common choice in HORECA menus. However, there are differences among the different countries. HORECA businesses in Cyprus purchase on average 125 kg of meat on a weekly basis, which is more than double the amount purchased by Greek HORECAs (61.3 kg) and well above the Belgian average (49.8 kg). Vegetables score second in the list, as businesses buy on average 51.7 kg per week. Cypriot HORECAs seem to purchase more vegetables (76 kg) compared to Greek and Belgian HORECAs (44.3 kg and 45.8 kg respectively). HORECAs reported that on average they purchased 48.7 kg of starchy food, Greek and Belgian businesses had similar numbers (48.7 and 44.8 respectively) and Cypriot businesses reported 70.8 kg. The amount of seafood bought was on average 34.7 kg, again Cypriot HORECAs were well above the average

(91 kg) and Greek below it (20.6 kg). HORECAs purchase on average 31.3 kg of pastries, 8 kg reported for Belgian HORECAs, 51.9 kg for Cypriot HORECAs and 25.2 kg for Greek HORECAs. 29.9 kg of dairy products reported to be purchased on average, however this time Belgian HORECAs were well above average (67.8 kg), followed by Cypriot (42.3 kg) and Greek businesses (20.6 kg). As far as the fruits are concerned, 23.2 kg were reported to be purchased on average on a weekly basis, 28.9 kg in Belgian HORECAs, 49 kg in Cypriot HORECAs and 15.4 in Greek HORECAs. Last, 19.5 kg of desserts were bought on average, 34.5 kg for Belgian businesses, 26.2 kg for Cypriot businesses and 16.6 kg for Greek HORECAs.

Table 21. Food being bought approximately every week (in kg)

Food	Total	Belgium	Cyprus	Greece
Seafood	34.7	36.7	91.0	20.6
Fruit	23.2	28.9	49.0	15.4
Vegetables	51.7	45.8	76.0	44.3
Meat	77.0	49.8	125.0	61.3
Pastries	31.3	8.0	51.9	25.2
Dairy products	29.9	67.8	42.3	20.6
Starchy food	48.7	49.8	70.8	44.8
Desserts	19.5	34.5	26.2	16.6
Other (nuts)	21.3	-	-	21.3

As for the amount of food wasted in the HORECA industry (presented in Table 22), the numbers are in accordance with the figures shown in the previous table. The more food is purchased the bigger the amount of waste. Meat is the leader again since on average 7.8 kg of meat are thrown away each week. Cypriot businesses waste approximately 13.6 kg of meat, more than double the amount that of Greek businesses (5.3 kg) and more than quadruple the amount Belgian businesses reported (3.6 kg). Vegetables come second on the list, having an average wastage rate of 7.5 kg/week. Cypriot HORECAs waste 10.6 kg of vegetables weekly, Greek businesses 7.3 kg and Belgian businesses 4.4 kg. Starchy food scores third on the wastage list, where on average 6.4 kg of it are wasted every week. Greek businesses waste 7.1 kg of starchy food, Cypriots 7.6 kg and Belgians 4 kg. HORECAs throw away 5.8 kg of pastries per week- Cypriots waste 6.6 kg, Greeks 5.9 kg and Belgians 2.1 kg. Seafood follows, where 4.3 kg are wasted each week, however there are big differences between the countries. Cypriot businesses of the HORECA sector waste 11 kg of seafood, Greek businesses 3.7 kg and Belgian businesses 2.6kg. Fruit and dairy product have similar waste rates (3.2 kg per week for each category). Fruits are wasted at a rate of 4.6 kg/week in Cypriot businesses, 3.1 kg per week in Belgian businesses and 2.8 kg per week in Greek HORECAs. Dairy products are wasted at a rate of 8.1 kg per week in Cypriot HORECAs, 1.6 kg/week in Belgian businesses and 3 kg per week in Greek HORECAs. The picture however is somewhat different when it comes to desserts. Even though the average amount of desserts wasted per week is low (2.9 kg), Belgian HORECAs waste well above average (7.5 kg/week), followed by Cypriots (3.8 kg/week) and Greeks 2.1 kg/week.

Table 22. Food wasted approximately every week (in kg)

Food	Total	Belgium	Cyprus	Greece
Seafood	4.3	2.6	11.0	3.7
Fruit	3.2	3.1	4.6	2.8
Vegetables	7.5	4.4	10.6	7.3
Meat	7.8	3.6	13.6	5.3
Pastries	5.8	2.1	6.6	5.9
Starchy food	6.4	4.0	7.6	7.1
Dairy products	3.2	1.6	8.1	3.0
Desserts	2.9	7.5	3.8	2.1
Other	3.9	-	2.0	4.5

As illustrated in Figure 8, when the interviewees were asked what percentage of food they believed is wasted during the different stages of the production-consumption process, there was a consensus among the different countries that the greatest amount of food is wasted during the consumption stage. Specifically, HORECAs agreed that almost half of the total food waste arises during consumption. There is uniformity in the percentages of countries - Cypriot HORECAs stated that 54.9% of the total food waste arises during consumption, Greeks stated 48% and Belgians 47.8%. The second most waste intense stage was the preparation stage, where HORECAs stated that  $\frac{1}{4}$  of the total food waste emerges. Cypriot and Greek HORECAs had similar figures (23.5% and 23.9% respectively) but Belgian had a slightly bigger figure (30.4%). Lastly, respondents stated that 25% of the total food waste occurs during maintenance – Greeks stated 28.1% which is slightly higher compared to Cypriots and Belgians (21.6% and 21.8%).

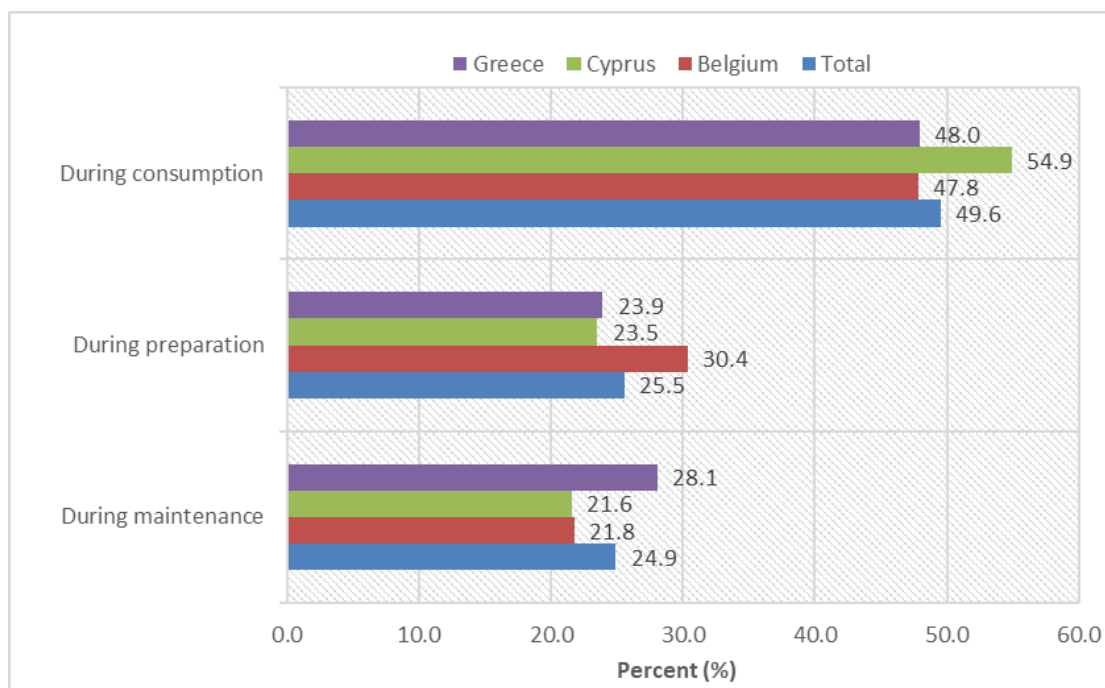


Figure 8. Percentage of the food believed to be wasted during consumption, preparation and maintenance

Next up, respondents were asked to provide details on the main reasons that food is wasted during the maintenance stage. As highlighted in Figure 9, 66.1% of the respondents agreed that food is wasted because the food has expired/rotted (73.3% of the Belgian HORECAs, 71% of Cypriot and 61.5% of the Greek). About 42.5% of the businesses identified defective packaging as a reason that contributed to the food waste emerging during maintenance (50% of the Belgian HORECAs, 47.7% of the Greek and 22.6% of the Cypriot). Also 38.6% of the HORECAs indicated the kitchen equipment failure a contributor – 46.2% of the Greek, 43.3% of the Belgian and 19.4% of the Cypriot. When it comes to throwing away food because of aesthetic reasons, 36.2% of the HORECAs stated that it is a contributing factor (almost half of Greek businesses, one third of the Belgian businesses and 12.9% of the Cypriot ones). 22.8% of the companies identified the out-of-season products as a factor leading to food waste (36.9% of the Greek HORECAs, 9.7% of the Cypriot and 6.7% of the Belgian). Finally, 15.7% of the firms stated other maintenance related reasons that contributed to the food waste.

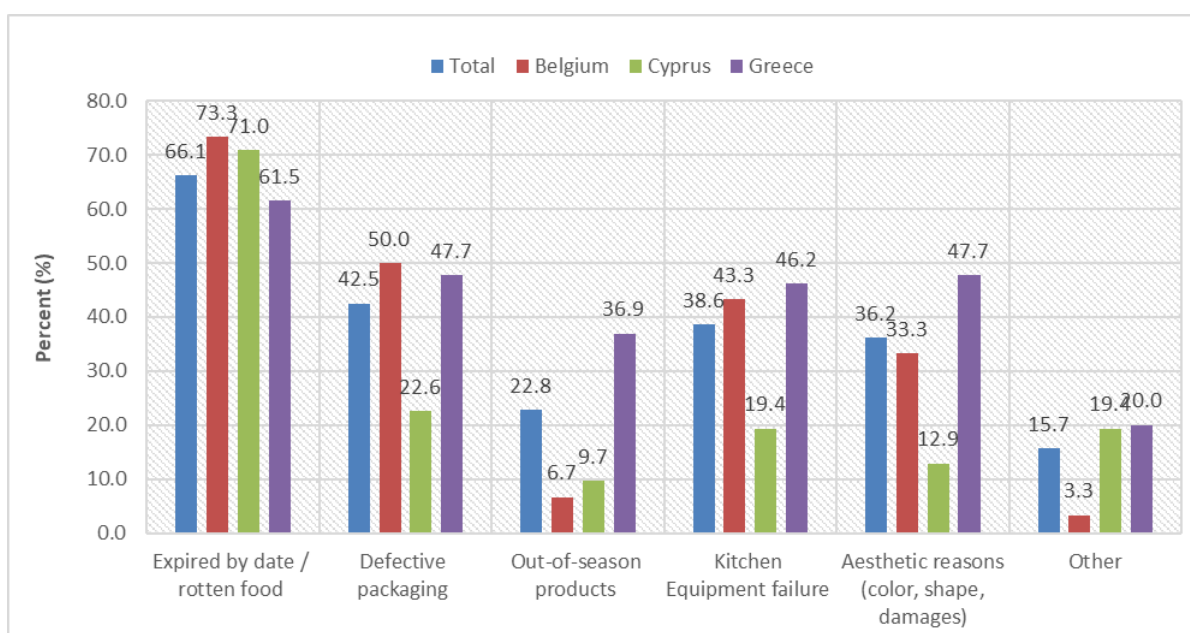


Figure 9. Reasons that food gets wasted during maintenance

When it comes to food waste emerging during the preparation of the food (Figure 10), the main reason identified by HORECA businesses was the human error. In particular, 69.3% of the HORECAs agreed that food waste can be attributed to human error (e.g., burned food) – 93.3% of the Belgian firms, 67.7% of the Greek and 48.4% of the Cypriot. Half of the companies agreed that the preparation of excessive amount of food that eventually is not served is a contributing factor of food waste. Greek and Cypriot firms had similar numbers (58.5% and 54.8%, respectively) unlike Belgian firms (30%). About 15.7% of the respondents, identified other reasons that food waste is generated during the preparation stage.

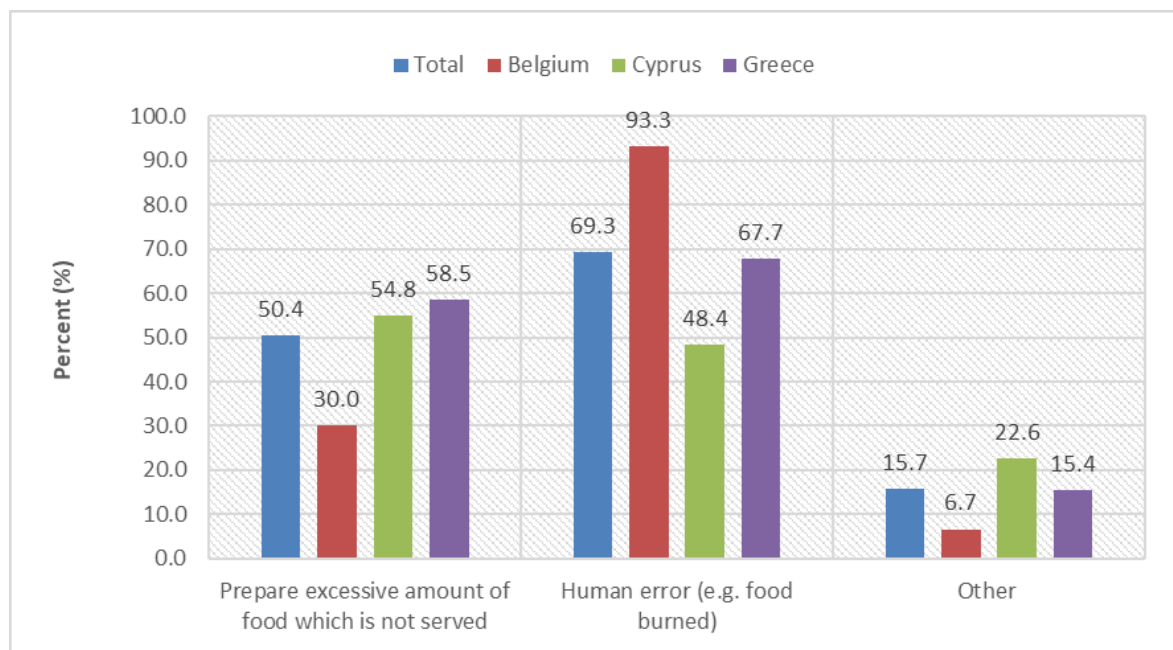


Figure 10. Reasons that food gets wasted during preparation

In the last part of food waste reason identification, interviewees were asked to provide the main reasons that they believe food is wasted during consumption (Figure 11). Customer indifference/ignorance was the main factor affecting food waste amount according to 53.5% of the responding HORECAs. This is not however the case for all the countries participating in the questionnaire. Specifically, 63.1% and 58.1% of Greek and Cypriot businesses identified that as a prominent reason, but only 30% of the Belgian HORECAs agreed on that. Around 47.2% of the firms stated that the large number of orders leads to consumption related food waste – 61.5% of the Greek firms, 41.9% of the Cypriot and 23.3% of the Belgian. Further, 44.9% of the businesses stated that the large portions served contributed to the food waste at a consumption level (50% of the Belgian businesses, 46.2% of the Greek and 35.5% of the Cypriot). One in three businesses that participated in the study agreed that the excessive menu choices provided by the business is a factor that affects the amount of food that is wasted at the end of the day. No major differences for this question between the countries was observed – (35.4% of the Greek firms, 30% of the Belgian and 19.4% of the Cypriot agreed). Lastly, 9.4% of the respondents were able to identify other consumption related factors that are not presented in the study.

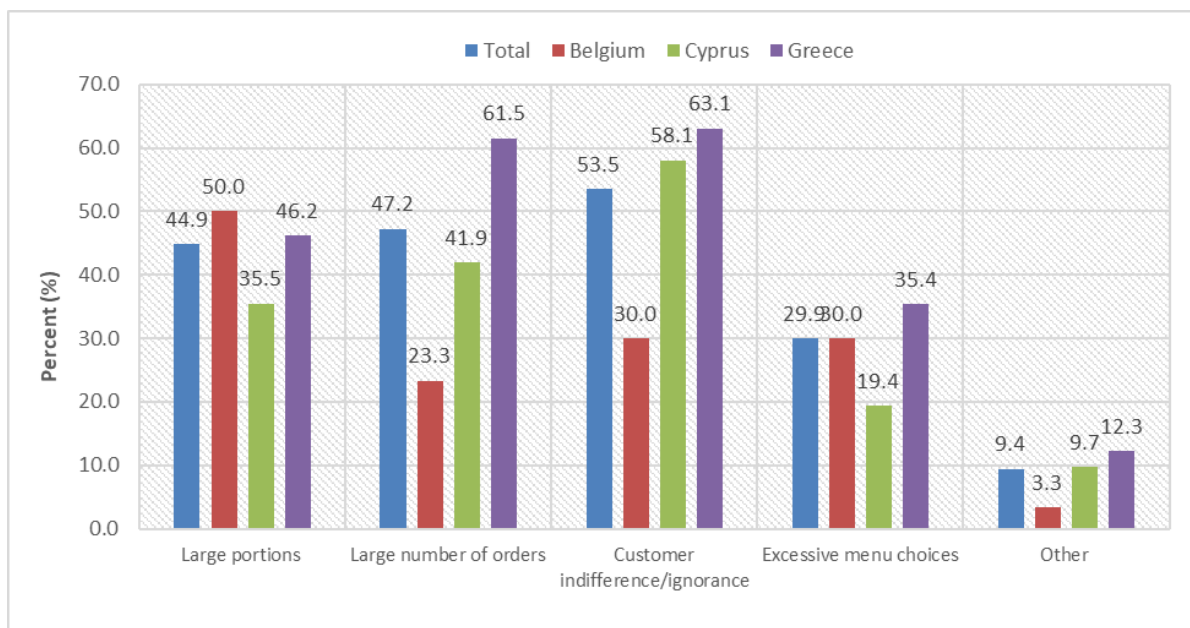


Figure 11. Reasons that food gets wasted during consumption

During the face-to-face interviews the above observations were made:

- People were hesitant to answer truly the questions. This could be attributed to the feel of embarrassment for example, as it was easier to pass the responsibility to the customers/consumers.
- The same questions were being asked using different words ensuring that the interview depicts or approaches the existing situation of food waste in the hospitality sector.
- The majority of businesses that were approached for a face-to-face interview denied participating.
- The businesses that participated denied a waste audit, with the interview being held in the main dining room.

#### 4.4 Food waste management issues

The last part of the questionnaire focused on food waste management issues. In particular, HORECA representatives were asked a number of questions that were able to capture the reality of how companies prevent and manage food waste.

The first question had to do with how often the customers are provided with packages containing their leftovers (Table 23). About 29.1% of the firms replied “Rarely”, 18.9% replied “Sometimes” or “Very Often”, 13.4% stated “Often” and 11% replied “Never”. Interestingly enough, there are major differences in the answers to this question among the different countries participating in the survey that highlight that this is not a common practice followed by the industry. Specifically, 40% of the Belgian businesses stated that they never provide packages containing leftovers to their customers, 53.3% replied that they rarely do and 6.7% that they do it sometimes. At the opposite end of the spectrum are the Greek HORECAs, where 30.8% of the respondents stated that they provide customers packages containing the leftovers

of their meal, 27.7% said they do it sometimes, 18.5% that they do it often and 15.4% that they do it rarely. Cypriot businesses stand somewhere in between – 35.5% of the firms agreed that they do it rarely, 16.1% that they follow this practice often, 12.9% that they do it sometimes and 6.5% that they never do it.

Table 23. How often are customers provided with packages containing their leftovers (percent of positive responses)

	Total	Belgium	Cyprus	Greece
Never	11.0	40.0	6.5	0.0
Often	13.4	0.0	16.1	18.5
Rarely	29.1	53.3	35.5	15.4
Sometimes	18.9	6.7	12.9	27.7
Very often	18.9	0.0	9.7	30.8
No response	8.7	19.4	0.0	7.7

A similar question that this time underlines customers' intention of getting their leftovers back home was asked (Table 24). Specifically, HORECA representatives were asked what percentage of the customers get in a package their leftover food. Overall, 43.3% of the respondents stated that 0%-20% of the customers get their leftovers in a package, 25.2% of the respondents that 60%-80% of the customers do so, 10.2% of the respondents that 20%-40% do so and 10.2% of the representatives that 40%-60% of the customers do so. Again, there are differences that highlight that this practice is not common for customers coming from different locations. On the one hand, 79% of the Greek representatives stated that 20%-80% of the customers get their leftovers in a package, while the corresponding figure for Belgian companies was only 3.3%. Cypriot businesses stand somewhere in the middle – 23% of the Cypriot HORECAs stated that 20%-80% of the customers get their leftovers in a package. 93.3% of the Belgian firms declared that 0-20% of the customers get in a package their leftover food, 41.9% of the Cypriot and 21.5% of the Greek.

Table 24. What percentage of the customers get in a package their leftover food (percent of positive responses)

	Total	Belgium	Cyprus	Greece
0% - 20%	43.3	93.3	41.9	21.5
20% - 40%	10.2	3.3	6.5	13.8
40% - 60%	8.7	0.0	12.9	10.8
60% - 80%	25.2	0.0	3.2	47.7
80% - 100%	4.7	0.0	12.9	3.1
No response	7.9	0.0	22.6	3.1

Next, survey participants were asked how they manage food waste that is not suitable for consumption. Figure 12 summarizes the findings; 74% of the HORECA representatives said that they throw it away, 17.3% that they collaborate with external factors, 12.6% that they compost it and 10.2% that they follow another practice. Specifically, 96.7% of the Belgian HORECAs

indicated that they throw away food that is not suitable for consumption, a figure that is somewhat higher compared to Greek and Cypriot HORECAs (70.8% and 58.1% respectively). Around a fifth of the Greek and Cypriot representatives stated that they collaborated with external factors in order to manage food waste, a figure that is significantly higher compared to Belgian HORECAs (6.7%). On the contrary, Belgian HORECAs seem to be more familiar with the practice of composting (20% of the firms choose it), compared to their Greek counterparts (7.7% of the firms follow this practice). The Cypriots stand somewhere in the middle, since 16.1% of the firms apply composting.

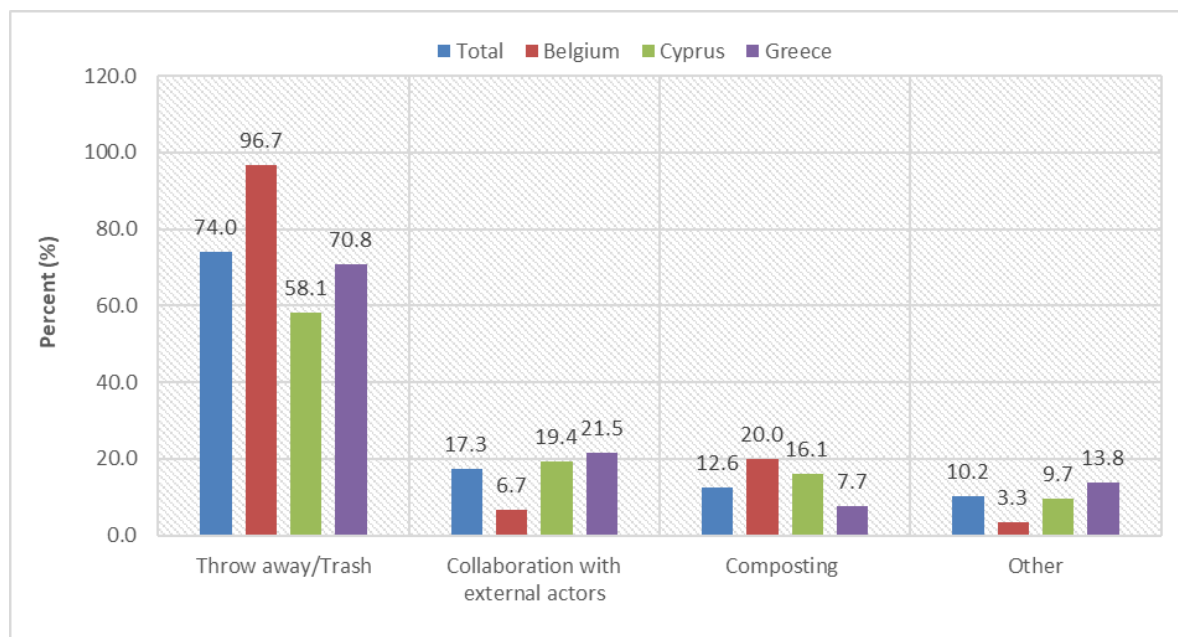


Figure 12. Management of food waste that is not suitable for consumption

As for the management of leftover food, 55.1% of the businesses throw it away, 44.1% state that they donate it to charity, 9.4% that they compost it, 7.1% that they collaborate with external factors and 15.7% that they follow another practice (Figure 13). Again, 80% of the Belgian businesses state that they throw away leftover food which is significantly higher than the Greek (47.7%) and the Cypriot ones (38.7%). Almost half of the Greek businesses donate their leftover food to charity, 41.9% of the Cypriot and one third of the Belgian. Further, 12.9% of the Cypriot HORECAs state that they collaborate with external actors in order to manage leftover food, 10% of the Belgian and 3.1% of the Greek firms. Lastly, 16.1% of the Cypriot companies said that the compost leftover food, 13.3% of the Belgian and 4.6% of the Greek.

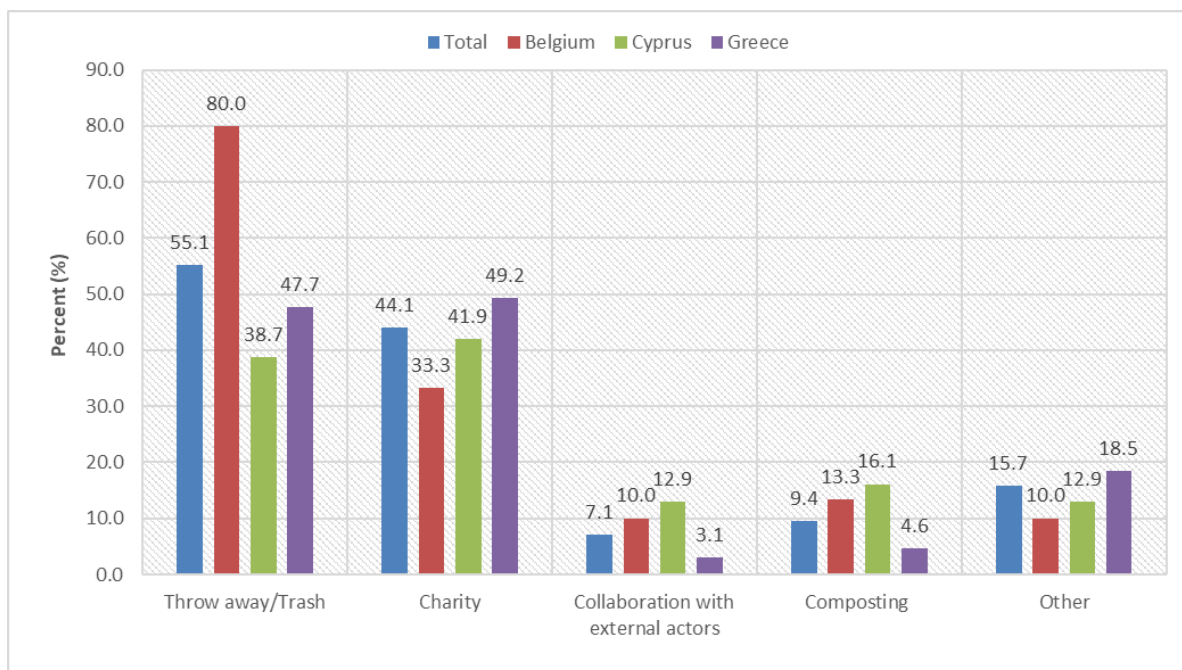


Figure 13. Management of leftover food

HORECA representatives were asked whether they apply separate collection for the different categories of outflows (Figure 14). About 34.6% of the businesses stated that they had a separate collection system for organics/biowaste. However, there are major differences between the countries, 9 out of 10 businesses in Belgium separate organics/biowaste, 24.6% of the Greek and only 3.2% of the Cypriot. The picture is somewhat different when it comes to oil/frying oil, since 74% of the businesses stated that they have a separate collection for it. In Belgium, oil collection is a standard practice (96.7% of the businesses apply it), the corresponding percentages for Greece and Cyprus are 72.3% and 54.8%, respectively. As for the food that is not served, 35.4% of the interviewees stated that they have a separate collection system – 58.1% of the Cypriot firms, 33.3% of the Belgian and 26.2% of the Greek. Lastly, as regards the separate collection of other outflows (e.g., packaging waste), 33.3% of the Belgian firms apply it, 10.8% of the Greek and 3.2% of the Cypriot.

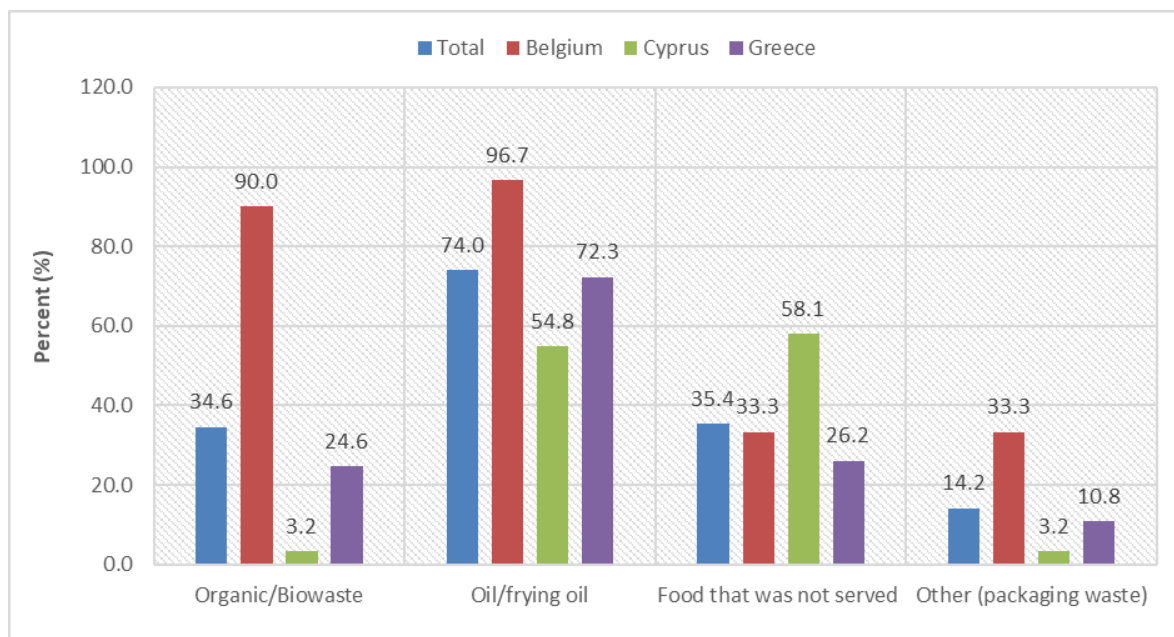


Figure 14. Separate collection for specific waste categories

Figure 15 presents the results of whether HORECAs would be interested in installing separate collection for the different outflows of their operations (if no separation takes place already). Around 36.2% of the respondents said that they would be interested in installing an organic/biowaste collection system, however only 6.7% of the Belgian firms, as it is evident that this practice is already implemented in Belgium. Further, 56.9% of the Greek and 19.4% of the Cypriot respondents would be interested in doing so. Regarding cooking oil, 26% of respondents would be interested in installing a separate collection. The results again complement the previous graph since in countries where this measure has already been implemented either fully or partially (Belgium and Greece) there is low interest in following such a practice (6.7% and 21.5% of respondents, respectively). In Cyprus, where cooking oil collection is not widespread, there is increased interest in installing separate cooking oil collection (54.8% of Cypriot HORECAs). Finally, almost half of the respondents showed interest in setting up a separate collection of food that was not served and there was even uniformity of percentages between countries (50% of respondents from Belgium, 46.2% of Greeks and 45.2% of Cypriots).

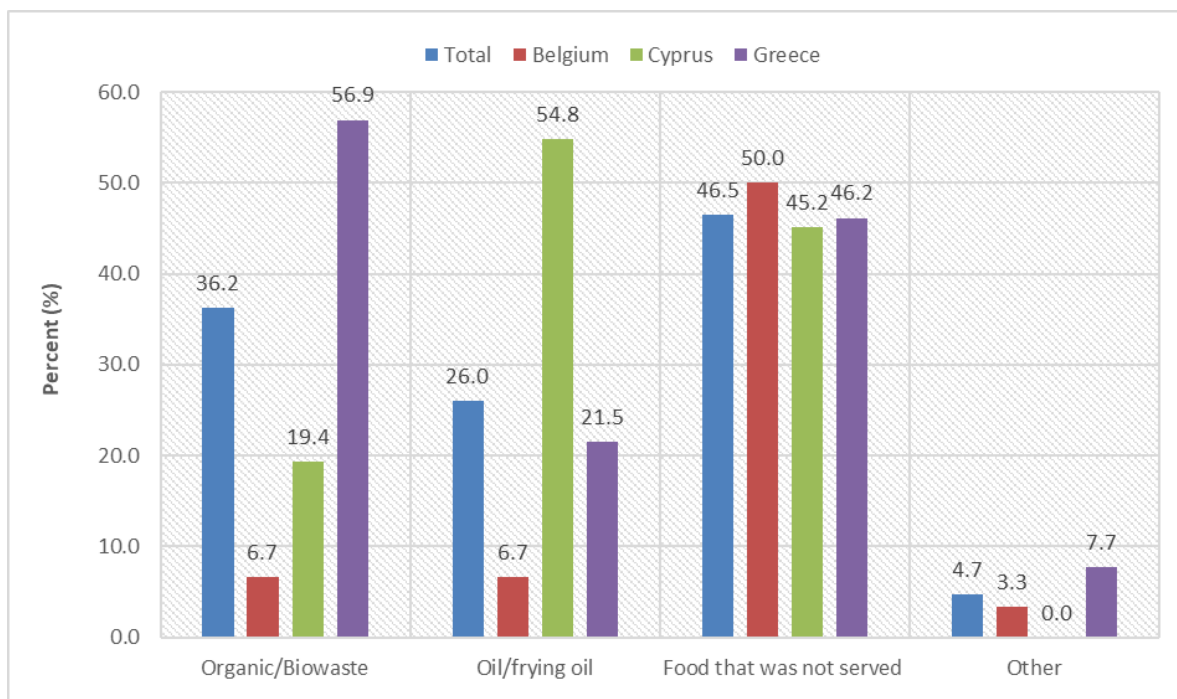


Figure 15. Interested in installing bins for separate collection (if no separation takes place today)

When employees of the HORECA sector were asked about the availability of space for installing new bins, the results were divided (Table 25). Specifically, 44.1% of the respondents replied “No” and 42.5% replied “Yes”. Belgian firms said that there is space available at a rate of 76.7%, Cypriot firms at 32.3% and Greek firms at 30.8%.

Table 25. Space availability for installing new bins (percent of positive responses)

	Total	Belgium	Cyprus	Greece
No response	13.4	0	38.7	7.7
No	44.1	23.3	29.0	61.5
Yes	42.5	76.7	32.3	30.8

Respondents were then asked to answer whether they think that food waste in the HORECA industry has decreased compared to 10 years ago (Table 26). About 68.5% of the HORECA representatives agreed on the statement, 20.5% disagreed and 11% did not respond. Even if the percentages vary slightly there is a clear trend; the majority of respondents agree with this statement regardless of their country of origin (60% of the Belgian HORECA, 58.1% of the Cypriot and 76.9% of the Greek).

Table 26. Reduction of food waste in the HORECA sector compared to 10 years ago (percent of positive responses)

	Total	Belgium	Cyprus	Greece
No response	11.0	6.7	25.8	6.2
No	20.5	33.3	16.1	16.9
Yes	68.5	60.0	58.1	76.9

Table 27 presents the results of the main reasons that led to the aforementioned reduction according to the answers given by HORECA representatives who agreed that such a reduction has been achieved. Overall, the first two main reasons were the increased experience with regard to food waste management (chosen by 52% of the respondents) and the increased attention for cost management (due to the financial crisis) (chosen by 45.7% of the respondents). 38.6% of the HORECA representatives stated that the augmented environmental awareness and 8.7% that the legislative changes lead to this reduction. Based on the per country figures, increased attention for cost management contributed more to the 10-year food waste reduction in Belgium and Greece (60% and 49.2% of the respondents, respectively) compared to the Cypriot (22.6%). A fourth of the Belgian representatives stated that legislative changes paved the way for food waste mitigation, a figure significantly higher compared to that of the Greek and Cypriot HORECAs (3.1% and 3.2% respectively). 63.1% of Greek HORECAs, 40% of the Belgian and 38.7% of the Cypriot believed that the increased experience with regard to food waste management has led to a reduction in food waste. Finally, the augmented environmental awareness was identified as a factor by 43.1% of the Greek, 38.7% of the Cypriot and 26.7% of the Belgian businesses.

Table 27. Main reasons for the reduction of food waste in the HORECA sector (percent of positive responses)

	Total	Belgium	Cyprus	Greece
Augmented environmental awareness	38.6	26.7	38.7	43.1
Increased experience with regard to food waste management	52.0	40.0	38.7	63.1
Legislative changes	8.7	26.7	3.2	3.1
Increased attention for cost management/reductions (due to financial crisis)	45.7	60.0	22.6	49.2

Next, HORECA representatives were asked if they felt that there are specific challenges related to the utilisation of food waste (Table 28). 63% of respondents answered “Yes” (83.3% of the Belgian, 60% of the Greek and 51.6% of the Cypriot), 21.3% responded “No” (16.7% of Belgians, 30.8% of Greek and 3.2% of Cypriot) and 16% did not answer (45.2% of the Cypriot and 9.2% of the Greek).

Table 28. Existence of challenges relating to the utilisation of food waste (percent of positive responses)

	Total	Belgium	Cyprus	Greece
No response	15.7	0	45.2	9.2
No	21.3	16.7	3.2	30.8
Yes	63.0	83.3	51.6	60.0

Subsequently, HORECA representatives that answered “Yes” to the previous question were asked to identify these challenges. As seen in Figure 16, the main challenge related to the utilisation of food waste was identified to be the lack of awareness by 46.5% of the questionnaire participants. The figures are roughly the same for the different countries – 50.8% of the Greek HORECAs, 45.2% of the Cypriot and 40% of the Belgian. The second most prominent challenge that HORECAs face was the lack of motivation (chosen by 38.6% of the respondents). The figures are slightly higher for this category for Greek and Cypriot HORECAs (43.1% and 38.7% of the respondents respectively) compared to the Belgian (30%). The difficulties associated with waste management was selected by the same percentage of respondents (38.6%) – 46.2% of the Greek HORECAs, 40% of the Belgian and 22.6% of the Cypriot. The higher cost arising from the utilisation of food waste was chosen by 37% of the participants but the percentages were not uniform for the different countries – 44.6% of the Greek, 40% of the Belgian and 19.4% of the Cypriot participants. Lastly, 31.5% of the participants stated that utilisation of food waste is a time-consuming process (43.1% of the Greek HORECAs, 26.7% of the Belgian and 12.9% of the Cypriot).

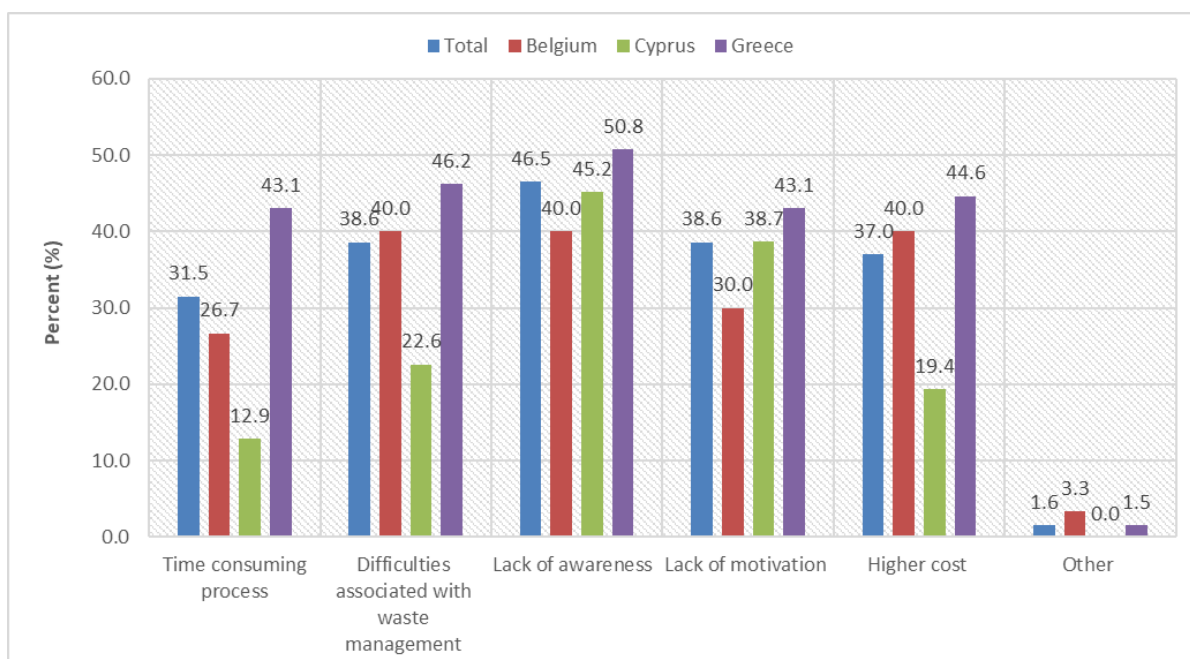


Figure 16. Main challenges relating to the utilisation of food waste

The penultimate question aimed to point out the incentives of companies in the HORECA sector to reduce food waste (Table 29). About 70.9% of the participants identified environmental and cost reduction motives to reduce food waste and the figures are roughly similar for the countries participating (between 60% and 75%). Moreover, 38.6% of participants chose the economic benefit of reducing food waste as an incentive and again the differences between countries are minimal (between 35% and 40%). Finally, 11.8% of the HORECAs identified legislation as an incentive for food waste reduction. However, the percentages were different for the countries participating – one-third of the Belgian businesses compared to only 6.5% and 4.6% of the Cypriot and Greek, respectively. Marketing actions/advertising were only reported as a motive by 10.2% of the firms (10% of the Belgian, 16.1% of the Cypriot and 7.7% of the Greek). The least chosen incentive was the tax incentive with a rate of 7.9%. Belgium had a higher rate (16.7%) compared to Cyprus (6.5%) and Greece (4.6%).

Table 29. What motivates you to reduce food waste

	Total	Belgium	Cyprus	Greece
Reduction of expenses from food waste	70.9	63.3	64.5	76.9
Environmental awareness	70.9	70.0	61.3	75.4
Marketing actions/Advertising	10.2	10.0	16.1	7.7
Economic benefit (e.g. lower landfill fees)	38.6	40.0	35.5	38.5
Tax incentives	7.9	16.7	6.5	4.6
Legislation	11.8	33.3	6.5	4.6
Other	1.6	0.0	0.0	3.1

In the last question participants were asked to provide the actions and measures that are considered by the HORECA businesses in order to reduce food waste (Table 30). The most preferable action is the employee training chosen by the majority (71.1%) of the participants. Cypriot and Greek HORECAs had higher rates (83.9% and 76.9% respectively) compared to the Belgian (46.7%). The second most preferred measure was identified to be the raising of consumer awareness on food waste, chosen by 57.5% of the businesses. Belgian firms were more inclined to such an action (70% rate) compared to Greek (58.5%) and Cypriot (41.9%). The implementation of the First In, First Out (FIFO) method in their operations was chosen by 44.1% of the firms. Belgian HORECAs had a smaller rate (20%) compared to Cypriot (58.1%) and Greek (47.7%). Moreover, 35.4% of the HORECAs said that they were considering encouraging staff communication to reduce food waste. On average, 33.9% of the firms were interested in keeping track of the food bought and wasted using an application. Belgian firms were keener on that (53.3% of the firms) compared to Greek (33.8%) and Cypriot (16.1%). Finally, the collaboration with external actors was chosen by 20.5% of the HORECAs (23.1% of the Greek, 19.4% of the Cypriot and 16.7% of the Belgian).

Table 30. Actions/measures considered in order to reduce food waste

	Total	Belgium	Cyprus	Greece
Employee training	71.7	46.7	83.9	76.9
Follow the First In, First Out (FIFO) method	44.1	20.0	58.1	47.7
Keep track of food bought and wasted using an app	33.9	53.3	16.1	33.8
Collaboration with external actors	20.5	16.7	19.4	23.1
Encourage staff communication	35.4	40.0	35.5	32.3
Raise Consumer awareness	57.5	70.0	41.9	58.5
Other	1.6	3.3	0.0	1.5

## 5 Results of the Municipalities survey

### 5.1 Croatia

The results of the analysis are based on a sample of 18 Croatian municipalities, the location of which on the map of the Republic of Croatia is shown in Figure 17. The total population of the investigated municipalities is 301,548 inhabitants. Further, more than half of them are tourist destinations but the number of tourists is relatively low and does not affect food waste production, while 28% are popular tourist destinations and thus the number of tourists significantly affects the amount of food waste during the peak tourist season.



Figure 17. Location of the Croatian municipalities that participated in the survey

Less than 40% of the surveyed municipalities implement prevention programs or initiatives. These activities are related to educational campaigns and programmes, sorting, distribution of composters for free, distribution of leaflets and brochures, education activities in kindergartens, schools, nursing homes, organization of competitions in schools, marking of

important dates, web pages, public forums, radio campaigns and applications for smart phones. One city stated that in 2022 started a pilot project of collection of kitchen biowaste in public institutions and HORECA.

Similarly, less than 40% of the municipalities conduct compositional analysis. None of the municipalities conducting compositional analysis weighs and records the mass and type of biowaste. About 86% record the overall quantity of biowaste and 14% carry out quality analysis. In 80% of the municipalities the analysis is conducted once a year, while in the rest it is conducted occasionally, when there is a need to prepare relevant studies. None of the municipalities keeps track of the food waste.

Less than half of the sample municipalities have a program for the separate collection of food waste. In addition, none of the municipalities provides small bins for food waste in households.

In 12.5% of the municipalities biowaste is collected 3-4 times per week, in 62.5% once a week, and in 25% every 2 weeks (

Table 31). The main barriers towards implementing separate collection programs for food waste are the lack of infrastructure (61.5%), the lack of funding (30%), and the lack of awareness and legislation (with 7.7% each). Finally, 38.5% of the municipalities stated other reasons (Figure 18).

Table 31. How often are the municipal food waste/biowaste bins collected

Frequency of collection	Percent (%)
Every day	0.0
3-4 times/week	12.5
2-3 times/week	0.0
1 time/week	62.5
1 time/2 weeks	25.0

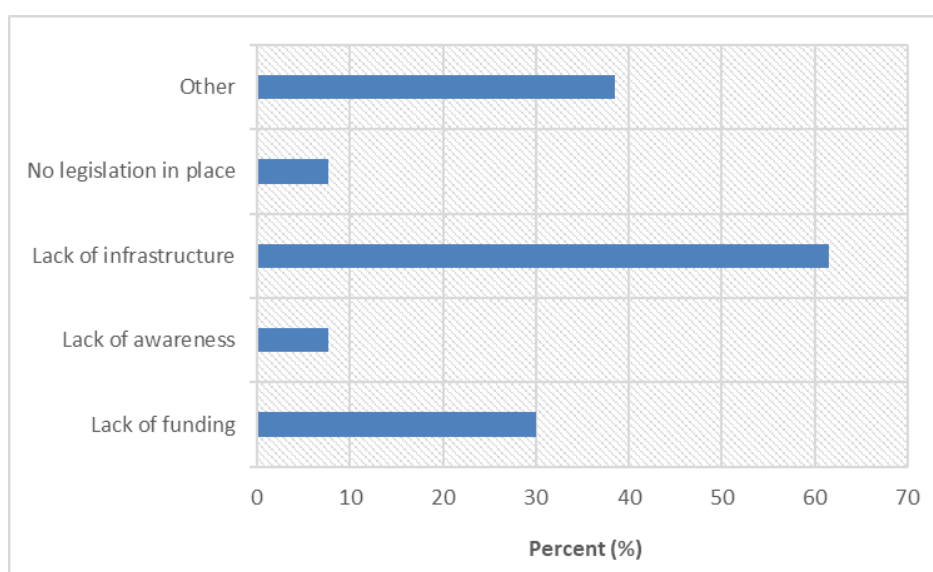


Figure 18. Barriers towards implementing biowaste separate collection programs

Two-thirds of the municipalities simply dispose of the collected biowaste to landfills, less than 30% use it for composting and 5.5% for energy production via anaerobic digestion. None of them incinerates the collected biowaste or use it as animal feed (Figure 19).

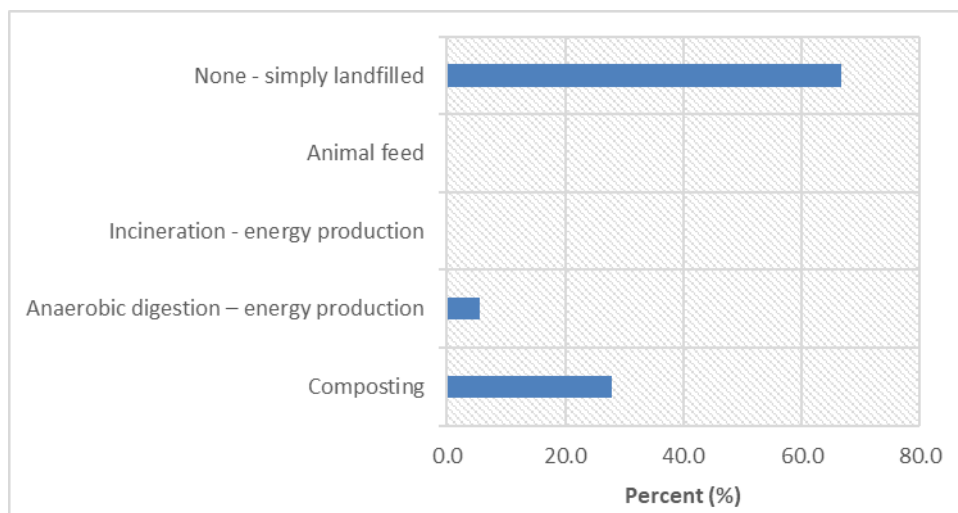


Figure 19. Main recovery methods of food waste

The produced compost is sold (25%), given to anyone who needs it (25%) or used in municipal parks and fields (50%).

Nine out of ten of the sample municipalities intend to upgrade their biowaste management system. About 75% of these municipalities aim to introduce food waste prevention programs and initiatives, 50% want to implement separate collection of food waste and 50% to launch municipal composting. The municipalities which are not interested in upgrading their biowaste management system are completely rural environments, have no residential buildings and their inhabitants live in family houses where they compost their biowaste.

Concluding, within the sample municipalities, none has implemented separate collection of food waste. Yet around 45% of them have implemented separate collection of mixed biowaste. A small part, less than 40% conduct compositional analysis, but none is keeping a track of the collected food waste. Two-thirds of the municipalities dispose of the collected mixed biowaste at landfills, and less than 30% use it for composting. The vast majority of the sampled municipalities intend to upgrade their existing waste management system relating to biowaste.

## 5.2 Serbia

In Serbia, three municipalities, namely Subotica, Niš, and Bačka Palanka were surveyed with a total population of about 450,000 inhabitants (Figure 20).

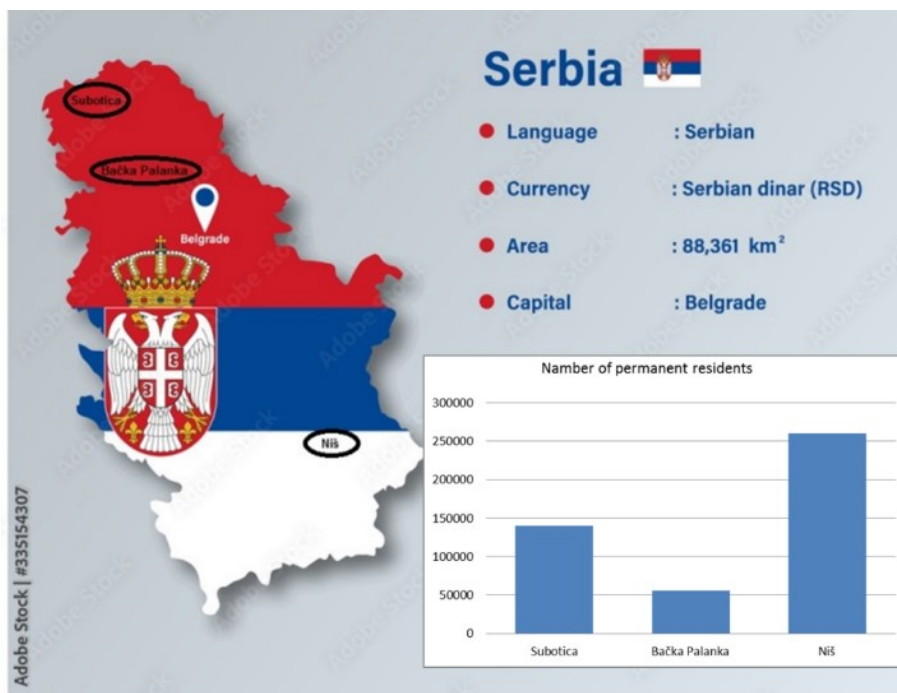


Figure 20. Location of the Serbian municipalities that participated in the survey

All three municipalities are tourist destination but there is no data to what extent the number of tourists affects the production of food waste. Only one municipality (Subotica) has programs and initiatives for food waste, i.e.:

- Promotional activities encouraging composting in households and announcing thematic contests aimed at citizens associations.
- A regional centre for waste management, which has an equipped composting facility where green and biowaste, including degradable fractions separated in the secondary selection process, is composted.

Two municipalities (Subotica and Niš) conduct compositional analysis. Subotica carries out determination of the morphological composition of waste at the old non-sanitary landfill and the Regional Centre for Waste Management, and Niš records the total amount of collected bio-waste. Yet, none of them have data of annual amount of food waste. The analysis is conducted on a daily basis at the Regional Centre in Subotica and once per trimester in Niš.

None of the municipalities have any program for separate collection of food waste. In the same direction, none of them provides small bins for the households to segregate food waste. The main reasons why they do not implement separate collection of food waste are the lack of funding, the lack of infrastructure and the absence of a market-operator for the management of this category of waste.

In Bačka Palanka and Niš all collected food waste is used for composting, while in Subotica a part of the food waste is used for composting and the rest is disposed of at landfills. The

compost is used mainly for public parks. In Subotica it is also used as landfill cover and in Niš some compost is sold in the market.

Finally, two municipalities (Subotica and Bačka Palanka) stated that they plan to improve their existing waste management system related to biowaste with food waste prevention programs and initiatives and separate collection of food waste. Niš provided no comments on this matter.

From the sample of Serbian municipalities, it is concluded that there is no data regarding food waste quantities and composition because there is no legal obligation for them to keep track of the food being wasted. Further, there isn't any program for separate collection of food waste and the main reasons for that is the lack of funding and infrastructure. All municipalities use composting as a recovery method for food waste, but they need to improve this process. Finally, it seems that there is awareness about the food waste problem and municipalities have intention to upgrade their existing waste management system related to biowaste.

## 6 Concluding remarks

The “Task 1.2 Implementation of Surveys” aims to investigate the role of households, HORECA SMEs and Municipalities in food waste production and management. The surveys were conducted by means of questionnaires which were filled either online or through personal interviews.

The households' survey collected 149 responses from Greece, Serbia, Croatia, and other countries (e.g., Italy and Germany). Overall, the food that is more susceptible to wastage is vegetables, followed by fruits, starchy, pastries and desserts. The main reasons that the food is wasted (for the three most wasted types of food) are: “Usually it gets spoiled in the fridge, as I don't use it very often” (65.8%), and “I don't manage my supplies and tend to buy more food than I consume” (48.3%). This is a clear indication that when the households do not plan their meal properly by finishing the old food before consuming the new ones, they tend to forget to consume the old meals that are stored in the fridge. More than half of the food is wasted post-kitchen, about 30% is wasted pre-kitchen, and the rest during food preparation. These findings coincide with those of previous researchers, who note that nearly 50%–60% of food waste comes from the post-kitchen stage in both restaurants and households. In the case of post-kitchen food waste, the main drivers are the large portions and food that is spoiled (which is associated with the preparation of excessive amount of food. Leftover food is usually stored and eaten later. Yet, a large proportion of it (more than 35%), although suitable for consumption, ends up into trash bins. The main barriers to donating food are the lack of information on how to do so, the lack of platforms/apps for sharing the food with others, and the lack of charity organisations. The management of unavoidable food waste follows similar patterns like the leftover food. Especially in Greece and Serbia, more than 80% of the respondents said that it is discarded in mixed waste (trash). Most of the households that do not separate their food waste from other wastages today, stated that they would like to have a bin

for separately collecting the food waste but noted that there is no organised waste management in their municipality to handle this stream.

Although, there are differences between the three participating countries, it seems that food waste at the consumption stage is a direct consequence of consumer buying behaviour.

As regards the HORECA businesses survey, 127 questionnaires were collected, in total, from Greece, Belgium and Cyprus, including 1 questionnaire from other countries (i.e., Toronto, Canada). Almost 90% of the respondents were owners of HORECA businesses, designated employees (inventory managers), chefs and general managers of the business, offering reliability in the results. Moreover, the survey included small, medium and large businesses, i.e., from 0-150 to above customers served per week. Food waste production in the HORECA industry is in accordance with the amount of food purchased, that is the more food is purchased the bigger the amount of waste. Meat is the food waste leader since on average 7.8 kg of meat are thrown away each week. Vegetables come second on the list, having an average wastage rate of 7.5 kg/week. Starchy food scores third on the wastage list, where on average 6.4 kg of it are wasted every week. HORECA representatives agree that almost half of the total food waste arises during consumption. The second most waste intense stage is the food preparation stage, where HORECAs stated that 25% of the total food waste emerges. Lastly, respondents stated that 25% of the total food waste occurs during maintenance. Regarding the maintenance stage, two-thirds of the respondents agree that food is wasted because it has expired/rotted. Food is wasted during the preparation stage mainly due to human errors. Finally, food is wasted during consumption due to customer indifference/ignorance, the large portions served and the excessive menu choices, among others. Focusing on waste management issues, only one-third of the respondents said that customers are provided with packages containing their leftovers often or very often. Also, not all customers get their leftovers in a package. Especially in Belgium, only 3.3% of the survey participants said that 20%-80% of the customers get their leftovers in a package. The food waste that is not suitable for consumption is usually thrown away (around 75%). As for the management of leftover food, more than half of the businesses throw it away, about 45% state that they donate it to charity, 9% that they compost it, 7% that they collaborate with external factors and 16% that they follow another practice. About 35% of the businesses stated that they have a separate collection system for organics/biowaste. However, there are major differences between the countries since 9 out of 10 businesses in Belgium, 1 out of 4 in Greece and only 3 out of 10 in Cyprus separate organics/biowaste. Further, oil collection is a standard practice in Belgium (the corresponding percentages for Greece and Cyprus are 72.3% and 54.8%, respectively). Lastly, as regards the separate collection of other outflows (e.g., packaging waste), 33.3% of the Belgian firms apply it, 10.8% of the Greek and 3.2% of the Cypriot. As for the food that is not served, about 35% stated that they have a separate collection system and almost half of the respondents showed interest in setting up a separate collection of this stream. Nevertheless, it seems that the lack of available space is one of the most important barriers in separate collection. The good news is that about 70% of the respondents believe that food waste in the HORECA industry has decreased compared to 10 years ago. The main reasons are the increased experience with regard to food waste management and the increased attention for cost management, followed by the

augmented environmental awareness. Regarding the main challenges related to the utilisation of food waste, the HORECA representatives identified the lack of awareness, the lack of motivation, the difficulties associated with waste management, and the higher cost arising from the utilisation of food waste. The incentives of companies in the HORECA sector to reduce food waste are environmental and cost reduction motives and legislation requirements. The least chosen incentive was the tax incentive. Finally, according to the HORECA participants the most preferable action to reduce food waste is the employee training, followed the raising of consumer awareness on food waste, and the implementation of the First In First Out (FIFO) method in their operations. Less favourable options are encouraging staff communication to reduce food waste, keeping track of the food bought and wasted using an application, and collaborating with external actors.

The municipalities survey involved 21 municipalities (18 from Croatia and 3 from Serbia, respectively). As far as the Croatian municipalities are concerned, less than 40% implement prevention programs or initiatives and conduct compositional analysis. Moreover, less than half of the sample municipalities have a program for the separate collection of food waste, and none of them provides small bins for food waste in households. Two-thirds of the municipalities simply dispose of the collected biowaste to landfills, less than 30% use it for composting and 5.5% for energy production via anaerobic digestion. None of them incinerates the collected biowaste or use it as animal feed. Nevertheless, 9 out of 10 of the municipalities intend to upgrade their biowaste management system. In the Serbian sample, two municipalities conduct compositional analysis and one has programs and initiatives for food waste. In general, however, there is no data regarding food waste quantities and composition because there is no legal obligation for them to keep track of the food being wasted. None of the municipalities have any program for separate collection of food waste, and, in the same direction, none of them provides small bins for the households to segregate food waste. Part of the collected food waste is used for composting, and the rest is disposed of at landfills. Two municipalities plan to improve their existing waste management system related to biowaste with food waste prevention programs and initiatives and separate collection of food waste.