Effects of the COVID-19 pandemic on consumer behaviour in relation to generation of food waste

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DECLARATION

I hereby declare that this thesis:

Effects of the COVID-19 pandemic on consumer behaviour in relation to generation of food waste is my own work. Where other people's work has been used it has been properly and clearly acknowledged in the text.

This work has not been accepted in substance for any degree or at any institution and has not been submitted for any award other that of MSc Food Safety and Quality Management at the Natural Resources Institute of the University of Greenwich.

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ABSTRACT

Food waste has negative environmental and economic impacts and its existence raises questions for society globally. For example, a tonne of food waste was in 2012 responsible for 4.5 tonnes of carbon dioxide (Aung and Chang 2013). Wherever food is produced, sold and eaten, there is always food wasted and consumers are the biggest source of food waste – 44% of total food waste is coming from domestic consumption (Think Eat Save 2020). That is why food waste reduction is critical to the Sustainable Development Goal 12, specifically target 12.3.

The amount of food wasted can be influenced by factors that have not been considered while building a better food system. A global pandemic leading to lockdown periods around the globe, could well be one of those factors. The COVID-19 pandemic brought about a change in consumer practices and behaviours, with panic and bulk purchases being made.

The aim of the project was therefore to determine, using an online questionnaire, the effects of the pandemic and lockdowns on consumer behaviour, in particular looking at how they handled food and whether this generated more or less waste.

The results attained showed that participants have a good understanding of food labels and food storage, and despite buying more food during the lockdown periods there is no evidence that more food waste was generated.

Another finding in the study is that participants did not have a daily shopping habit in any of the lockdown periods, which could contribute to reduced food waste. On average, 30.1% of the participants purchased food everyday outside the lockdown periods, with 28.3% doing this during lockdowns.

When it comes to online food shopping, the study found a significant increase regarding food bought through the Internet during lockdown periods, 55.8%, in comparison with outside lockdown periods, 30.8%.

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ABBREVIATIONS

COVID ……..... Coronavirus disease
EFSA ..... European Food Safety Authority
FAO …… Food and Agriculture Organization
FREC …….Faculty of Engineering and Science Research Ethics Committee
OECD..... Organisation for Economic Co-operation and Development
RTS ……..... Recycle Track Systems, Inc.
SDGs …….. Sustainable Development Goals
UN …….....…….....
UNDP …… United Nations Development Fund

CHAPTER 1 - INTRODUCTION

Food waste has become a very concerning issue worldwide and namely in developed countries. Wasting food that could safely be consumed has reached such considerable amounts, in terms of food treated as rubbish and the impact on global economies.

In 2015, the United Nations (UN) included food waste as a target in the Sustainable Development Goals (SDGs) or Global Goals. It aimed at decreasing by 50% the amount of food wasted per capita both at retail and consumer levels (Target 12.3). According to the United Nations Development Fund (UNDP), 1.3 billion tonnes of food are wasted every year while almost 2 billion people go hungry or undernourished (UNDP 2020).

Across the complex food chain, from farm to fork, a study made by of the Food and Agriculture Organisation (FAO) found that one third of the food produced for human consumption is never consumed (FAO 2015). FAO considers that it is either due to inefficiencies in food production and processing or because it has been thrown out by consumers (due to excess food shopping, food spoiled and consumer behaviours) at the end of the food chain. Food waste or loss happens depending on when it falls off the chain. In general, food waste is tendentiously observed when it occurs during industrial processing, distribution, and final consumption (consumer stratum).

Food waste can result from insufficient shopping and meal planning as well as promotions like "buy one get one free" as they lead to too much purchased or prepared food. Understanding why food waste occurs is critical in order to build more sustainable food systems.

The aim of the dissertation was to determine whether there was more food waste generated during the pandemic's lockdown periods. Through an online questionnaire, the objectives were to learn whether the effects of the pandemic and lockdowns changed participants' food shopping and consuming habits, as well as food handling, that could have contributed to an increase in food wasted at household level.

CHAPTER 2 - LITERATURE REVIEW

Food waste refers to food fit for human consumption but consciously being discarded at the consumption or retail phases and not redirected to animal feed or re-distributed for humans (Gustavsson *et al.* 2011).

Oversized dishes, fixed prices buffets (encouraging consumers to 'overload' their plates), trouble to access the number of customers and EU hygiene rules (Priefer *et al.* 2015) have been pointed out as reasons within the distribution and wholesale/retail stage.

Factors affecting food waste at households' level are lack of knowledge and/or planning regarding food purchase and storage, buying food that is not currently needed (impulse buying), large ready to eat meals and cooking oversized meals, poor storage management, misunderstanding of date labels ('use by', 'best before' and 'sell by'), lack of preparing food skills as well as recombining leftovers into other meals, and little experience in preparing meals. Other common reasons for industrialised countries' household food waste have included growing prosperity, reducing food prices, urbanisation, growing number of single households and increasing employment of women including "multiple burdens in work and family life" (Jörissen *et al.* 2015).

By contrast, in developing countries at consumer level food waste is minimal (Gustavsson *et al.* 2011) and the causes for it are mainly related to limited household income and poverty. Another factor that contributes to such minimal food waste is that consumers usually do not buy large quantities of food products at once but just the right amount for meals on the day that products are purchased (Shaw *et al.* 2018).

2.1 Food waste – general considerations and significance

Food is wasted, anywhere food is grown, sold or eaten. However, consumers are undeniably the biggest cause of food waste. In the end food is wasted across the whole food supply chain and according to Martinez (2020) the waste distribution goes from the industrial stage (2%) to the residential one (44%) and in between there are grocery (11%) stores and restaurants (33%).

The efforts to improve food security and combat hunger are also related to the important issue of food waste. According to FAO's Save Food! food is wasted at every stage of the "farm to table" or "farm to fork" food chain process, which includes production, post-harvest, processing, distribution, and consumption (Gustavsson *et al.* 2011). Moreover, the inefficiency of certain food systems excludes from the supply chain, food that was once fit for human consumption (Sadiku *et al.* 2019).

According to Eurostat data (2006), the quantity of food wasted annually in the European Union was 89 million tonnes, corresponding to 180 kg per capita – and this number does not consider food losses during the production and harvesting stages. Just considering household food waste, the Fondazione Barilla Center for Food & Nutrition (2012) reported that the amount of edible food wasted per person and per year was roughly 110 kg in Great Britain, 109 kg in the United States, 108 kg in Italy, 99 kg in France, 82 kg in Germany, and 72 kg in Sweden.

Household food waste, as recognised by organisations and governments, can be a difficult thing to measure. Some methods have been proposed such as measuring it by calories, weight, money value loss (Gallo 1980) or weight (WRAP 2020). Another method proposed by Gallo (1980) was the "plate examination" where subtracting the unconsumed portion of food from the portion of food served would be the value of food waste. The latter shows how difficult measuring food waste can be – how secure, honest and independent would the method be as recorded by individual households. It would also require a writing system and correct calculation, both on food served and food unconsumed. A more technological approach is the one of an artificial intelligence enabled scale that weighs and identifies food that is wasted.

Food waste is to a large extent generated at consumer level and consumers' behaviour and knowledge are key factors in the reduction of food waste (Meixner *et al.* 2020). Some authors and researchers have tried to examine the relationship between food waste prevention knowledge and prevention behaviour, and to understand if positive actions undertaken by individual consumers result in decreasing or preventing their contribution to food waste. Cooking leftovers or making fruit and vegetables pickles could be one of the ways to decrease the amount of food wasted. However, these actions require consumers to have cooking skills and information, and secondly requires awareness of their negative behaviours. What seems difficult is to educate consumers regarding subjects such as

cooking, including tips and time devoted to it, and preserving food products, which also demands interest in nutrition and recipes literature.

To maintain consumers informed and improve their understanding, common metrics and clear definitions are needed - harmonizing the collection of statistical data at an international level and assigning a standardized meaning to “food waste” could eventually help arise better consumers awareness and attitudes in order to reduce their contribution to food waste.

2.2 COVID-19 and consequent lockdowns

By March 2020 countries around the world started closing their external borders and internal boundaries due to the COVID-19 pandemic. Restaurants were closed as well as hypermarkets, open air markets and shopping malls. The vast majority of consumers were obliged to stay at home with outdoor movements restricted and social distancing imposed. The local shops and minimarkets were compelled to impose strict rules regarding distance and the number of customers that could be allowed inside at any one time. Food shopping online has become common place and progressively consumers have had to adapt to new behaviours regarding shopping, storage and food handling, and face new food shopping habits (Aldaco *et al.* 2020).

Through the lockdowns, consumers have adopted new practices namely regarding food shopping, cooking and storage, influenced by fear of not finding the necessary nutritional amount of food for the household or even not finding food at all. However, it is neither certain nor clear whether lockdowns have contributed to increasing or decreasing the amount of household food waste.

Replacement products were being purchased where consumers first choices were not available. With perceived shortages of food products, behaviour changed, and usual practices were not followed, e.g. expiry dates were not necessarily adhered to and more food eaten at home.

To challenge consumers on their practices even furthermore lockdowns have been imposed since the very first one in 2020. The difference between the March – May global lockdown and the ones that have been in place is that the majority of borders are open and citizens

have more freedom of movement. However, curfews have been introduced namely in the developed world making shopping business times tighter. All these actions have had a significant effect on consumers shopping habits and cooking practices (Meixner *et al.* 2020), and therefore influencing their food disposal and waste, as well as the way food has been handled and stored in households.

2.3 Pandemic, social and production factors regarding food waste

A few consumers' habits and behaviours have been considered as assumptions for this study: eventual excess purchases and portions prepared, trouble in understanding food labelling, misunderstand food storage and deterioration of products and food packaging. These could eventually be reasons for having an increase or decrease of food wasted by consumers during the COVID-19 pandemic lockdowns.

Coles (2019) reported that waste related to production and storage (mostly in developing countries) and consumption (mostly in developed countries) is roughly equal. As mentioned above 44% of food waste is generated by domestic food waste and putting this number into the UN sustainable development goals' perspective means that this percentage has been calculated while families were having lives without any forced constraints imposed by governments in developed countries. When lockdown measures were imposed around the world to tackle the spread of Covid-19 and consequently most of restaurants and take-out food outlets were either closed or partially functioning, depending on the lockdown period, consumers had to buy more food to be prepared and also be more aware of what they were purchasing.

With so much food wasted in households, losing all resource inputs (comprising water wasted that went into the food production) used for its production is a key factor taken into consideration by the Sustainable Development Goal 12 (Responsible consumption and production), including the environmental impact created by household food waste as a tonne of food waste is responsible for 4.5 tonnes of carbon dioxide (WRAP 2008).

All the literature reviewed agrees that there is no doubt that lockdown periods have changed consumers' behaviours. In Italy, for example, in spite of an increase in the number of households buying food, food waste decreased (Pappalardo *et al.* 2020). The study suggests that in the Italian context "the pandemic has reduced the amount of food waste for

a vast majority of households". However, the study does not take into consideration neither different socio-demographic groups nor consumers awareness of their purchases and conscient contribution, or the lack of it, to food waste.

2.4 Consumers' behaviours and awareness

Typical food waste at home is composed of 37% of organic waste (Sadiku *et al.* 2019) and according to Mantecchini (2019) consumers in urban centres are more susceptible to waste more food, as they feel more disconnected to the food chain than the ones living outside urban areas. However, this is not statistically proven and it is assumed that food waste perspectives vary from person to person and from place to place (Thyberg and Tonjes 2015). Conversely an Austrian study did not find any indication that a personal connection to agriculture or a residence in a rural place could lead to better food waste knowledge (Meixner *et al.* 2020).

One of the reasons why consumers in urban centres may be more prone to food waste could be their direct knowledge about the topic and how easy it is to throw out waste (not only food), which can happen just going down to a building's basement where waste bins are available. An interesting point raised in the work of Mantecchini (2019) is that food waste has been streamed into consumer politics instead of changes in the global food system, which points to the awareness of individuals and not the collective. The consequences of consumer behaviours, such as over purchasing food and understanding food labelling, packaging and storage are determined by individual actions rather than practices applied by the consumer as a whole due to the way global food system has been implemented. The study does not show whether the reduction of household food waste is a consequence of better consumer understanding of food storages, labelling and packaging.

According to some authors, during the early stages of the first outbreak, the amount of food waste generated by consumers increased by 12% (Aldaco *et al.* 2020), though this number also considered food loss (food that is lost during the harvesting and production stages). The study of Aldaco *et al.* (2020) demonstrates a very influential point in regard to food waste: significant consequences, both direct and indirect, of consumers' eating routines and changes during unusual periods such as COVID-19 lockdown periods. Interestingly the study also analysed some types of food consumed that increased during the first weeks of the lockdown; processed foods, snacks, pastries, and sweets. This is of particular

importance as they can ultimately be related to practices of food storage and deterioration and how certain types of food could contribute to an increase or decrease of food waste. Other food products that largely contributed to food waste were red meat, cereals, fruits and vegetables, while on the other hand lamb, fresh fish and especially beverages contributed to reducing the food waste cost (Aldaco *et al.* 2020).

Quantifying food waste with the purpose of knowing its variations during uncommon periods, such as pandemics and lockdowns, is of primordial importance in order to put in place tools and practices that consumers can understand and follow. However, as agreed by organisations and governments, quantifying food waste can be difficult due to the lack of measurement tools and systems that specifically target the issue. There are many challenges and barriers to achieve the reduction of food waste and besides quantification, systematic reporting and causes' evaluation (Chinie 2020) are also to be considered. The food waste issue is both a cause of poor business decisions and consumers' behavioural factors, and in general they are related to the refusal to buy food that does not look at its best anymore (Cicatiello *et al.* 2016), that is getting closer to the "best before" date, and also buying more food than is needed and then not being consumed in time (Chinie 2020).

Some researchers have asserted that householders would ideally only generate food waste that is not considered edible (unavoidable food waste) and the disposal of edible food (avoidable food waste) would be prevented (Shaw *et al.* 2018). However, the study done by Shaw *et al.* (2018), which agrees that consumers' food waste is an individual concern and domestic habits are critical, proposed that interventions to reduce food waste might be more successful if positive actions to develop householders' efficiency in the use of their food. Leaflet interventions promoting reduction of avoidable food waste, that were used for the study, had no statistically significant impact on households observed during a short-term field trial – the authors highlighted that consumers did not respond significantly to the information in the leaflets.

Poor consumers' food handling knowledge has also been pointed to as a cause for food waste increase and according to Meixner *et al.* (2020) this includes inadequate food storage and misconceptions about food safety, mainly deriving from expiration dates. What a number of studies have found is that consumers, due to their limited food handling knowledge, throw out edible food straight after the expiration date (Thyberg and Tonjes 2016).

One of the hypothesizes examined by the study of Meixner *et al.* (2020) in Austria was related to the relationship between knowledge about food and food handling and knowledge about food waste. The study did not find an expressive positive relationship, however a positive relationship connected to food waste prevention was observed. This would probably show that consumers knowing how to deal with food handling would help them prevent food waste, but not taking significant actions to avoid food waste. The study shows, in the Austria context, that the analysis of the variable “Food waste prevention knowledge” indicates that almost all participants knew about prevention of food waste, which brings an interesting point regarding the gap between food waste prevention knowledge and food waste prevention behaviour. Could lockdowns help invert this situation or create a positive relationship between food handling and food waste?

Another important finding by the same study (Meixner *et al.* 2020) is that cooking skills negatively influence consumers food waste behaviour. The study shows that hypothetically better cooking skills can lead to a behaviour where food is thrown away even earlier to provide high-quality cooking. Consumers with cooking skills are aware of, and have the knowledge about, food waste prevention, however they do not put into practice their knowledge when it comes to food waste. As the pandemic lockdowns have forced consumers to cook more at home and develop their cooking skills, one could eventually deduce that more food waste was generated during such periods for the benefit of better-quality cooking. However, some consumers have improved their cooking skills and at the same time have become more aware of their contribution to food waste due to restriction of movement imposed for purchasing food. Consequently, consumers might have also become aware or more interested in food storage and food recycling, that is, making pickles or jams with fruits and vegetables.

With such unpredictable consumers behaviours and the way food purchasing habits have been affected, it is difficult to define the right significant tools that could be put in place to measure household food waste. Additionally, consumers’ mindset that food is everywhere and in abundance leads to a general belief that people can afford to waste food. To some extent this attitude just adds another arduous challenge to food waste measuring tools and methods at the household level.

2.5 Food channels and consumers habits

Overproduction has been highlighted as another main cause for food waste (Sadiku *et al.* 2019) and at the same time supermarkets' business approach regarding the high appearance quality standards for fresh products also leads to food waste (Gustavsson *et al.* 2011) as weight, size, shape and appearance of crops are left at farm gates due to strict quality standards. This means that a considerable amount of edible food is left behind on farms and not consumed by humans (some rejected crops are used as animal feed). As reported by Stuart (2009) food that was grown for human consumption might be diverted to other uses - this also needs to be measured as food waste.

Furthermore, Gustavsson *et al.* (2011) mentioned that supermarkets' consumer surveys show that consumers are keen to buy diverse food products produce as long as the taste is not affected. However, the vast majority of supermarkets are convinced that food that does not have the 'right' weight, size or appearance will not be bought by consumers; interestingly enough, a large number of supermarkets actually lower the price of food products when they are just about to expire.

The fact that retail stores have to buy from the same manufacturers a variety of food types and brands in order to get beneficial prices, namely in industrialised countries, and then displaying large quantities of food products on the shelves with a broad range of brands can have a pronounced contribution to food waste. At the same time consumers in general expect a wide range of food products available in stores and shelves to be well filled with them, which in a pandemic lockdown period cannot really be expected.

The proportion of the monthly disposable income spent on food by Western countries is minute compared to developing countries, on the one hand, and a mindset that it is easier to dispose of food rather than re-use it, on the other hand, have an impact on the amount of food waste. Food quantity and consumer attitudes in industrialized countries, compared with developing countries, are leading to high levels of food waste. For example, retail stores frequently offer bargains for large packages of food products and "getting one for free" (Gustavsson *et al.* 2011), and restaurants serving buffets at fixed prices. It is also common to see oversized ready to eat meals.

As reported by Garcia-Garcia *et al.* (2017), the agreements with food banks and charities also help to distribute, to those in need, surplus food. In reality, the optimal alternative, when it comes to surplus and the eventual result of food waste, is redistribution for human consumption. Nevertheless, it is known that redistribution done directly by consumers is a poor habit and during lockdowns, with minimal contacts with other members of the public and community, this practice has become even feebler.

Priefer *et al.* (2015) also stated that regarding surplus food, redistribution promotion programmes to charitable organisations are one of the most relevant leverage facts and options for action against food wastage. However, food redistribution is confronted by a few important barriers related to economic, infrastructural and legal constraints. This is more noticeable in rural areas where the food rescue network often faces problems to organise in an economically feasible way the transport of surplus food going from the source to the food redistribution centre. The hospitality sector, by offering single portion sizes, improvement of internal routines and careful menu planning, can also fight food waste outside lockdown periods.

2.6 Strategies and prevention to reduce food waste

During the pandemic lockdown periods some consumers have changed their eating choices to ready to eat meals, due to the lack or insufficiency of their first-choice food products, as well as to try new forms of food. An important food waste prevention measure that could have been applied in these situations would be public awareness through education on these matters in schools, however once this has been seriously implemented it will take some time to practise it on a daily basis. This means that decent public awareness in place would push consumers to try their best to get away from ‘easy meals’ and their best creative cooking abilities, e.g. making jams or pickles.

The global positive attitude towards food waste prevention has been perceived as a common trend. As presented by Sadikul *et al.* (2019) effective food waste reduction involves a coordinated effort of effective technologies and policies. Despite the number of private and public organisations as well as consumer campaigns addressing food waste globally, the efforts and results are far from exhaustive. Additionally, these campaigns and policies have not been tested in a worldwide pandemic situation with intermittent strict lockdown periods.

The limited evidence of the strategies' effectiveness has been considered one crucial challenge to food waste reduction and at the same time measurement-based studies need better policy making and mitigation strategies on the environmental impacts (Sadikul *et al.* 2019) with their public dissemination so that consumers and caterers can be informed and aware of the consequences of their food waste actions in terms of the environment and economy. It should be easy for consumers to perceive their contribution to food waste, why it is a serious issue and why their behaviours and habits can eventually have a very negative effect on the environment, society and global economy.

There are a few types of action for waste reduction as well as recuperation of food operations in some countries worldwide such as food waste awareness campaigns targeting mainly adolescents through projects started in schools. BCFN (2012) also laid a few feasible recommendations to be adopted by consumers in order to gradually reduce and eliminate food waste, amongst them some have possibly already been used during the lockdown periods: to buy only what they think they will use, to always check the expiration dates, to put products close to expiration where they can be seen, to reuse meal leftovers and not to serve excessive portions.

Some organisations, associations, community groups and programmes have published websites, pamphlets and brochures with suggestions and guidelines targeting consumers' behaviours in order to tackle food waste. The mainstream message is focused on reusing leftovers, composting, recycling and choosing recyclable/light packaging. However, there are organisations that also promote better understanding related to expiration labels on food, freezing food, food donation, planning meals and shopping lists, and purchasing imperfect food products (RTS 2020).

2.7 Gap in knowledge

The proposals for EU-level targets for food waste decrease, set to 2023, and for a revision of EU rules on date marking ('use by' and 'best before' dates), set to Q4 2022 (European Commission 2020), mean that the EU still needs some time to introduce food waste level targets and date marking. Nevertheless, EU citizens will be reached out to by the Commission to encourage them to partake in transforming the current food systems.

What remains unknown is the relation between, for example, the consumers' education level or age group and their approach to aspects such as food labelling and packaging while buying food. Have consumers started reading, or being more aware of, food labels? Another interesting subject that can eventually influence food waste and that has not been mentioned in the literature is the food shopping locations, during and outside the lockdowns. Consumers started ultimately going more often to local shops or supermarkets as open-air markets were closed – has this behaviour influenced not only the amount of food purchased but also wasted due to bad labelling or packaging, for example?

It is important to address food waste at consumer level and spread urgently amongst them a changing behaviour message in order to minimise this serious issue. Yet it is a very challenging task to have this done during a time when consumers are locked down and need to change their shopping and cooking habits.

Before the literature review a few assumptions were considered and related to over purchasing food, labelling, packing and food storage, and that all or most of consumers' food behaviours during lockdowns could eventually deteriorate and therefore contribute significantly to food waste. This has not really been shown in the literature reviewed and moreover it has exposed other factors that have influenced some of the research questions, e.g. how consumers could increase or raise awareness, during and outside lockdown periods, in the household and in addition to what they have bought during these periods it would be valuable to know whether they have changed food purchasing location.

The importance of whether consumers easily and clearly know how much food they are wasting and what would be the best tool to help them to understand their contribution to food waste and ways to help them change household behaviours to decrease their amount of food waste were issues that were identified. Moreover, it would also be useful to evaluate the effectiveness of online campaigns for reducing consumers' food waste.

CHAPTER 3 - MATERIALS AND METHODS

Supported by the literature review and the considered assumptions (over purchasing food, labelling, packing and food storage, and consumers' food behaviours during lockdowns could deteriorate and contribute significantly to food waste), identifying consumers' ability to know how much food they are wasting and the best tool to help them fight, reduce and prevent the amount of food waste in the household are of paramount importance for the subject of the study.

3.1 Survey design

As a result of the literature review, a set of 20 questions and multiple-choice answers were prepared to determine the effects of the pandemic and lockdown on consumer behaviours, in particular looking at how consumers handled food and their knowledge and awareness regarding their impact on food waste.

Table 1 presents the justification of all questions and choices presented in the survey to the participants (questions in which multiple answer options can be selected by respondents are mentioned in the question itself).

Table 1 Justification of the questions

Question	Justification
1. What is your age?	The aim of the question was to understand whether age had any influence on food habits and contribution to food waste.
2. Gender group.	The aim of this question is to find out whether gender has an impact on food waste. It is worth pointing out that females are more likely to participate in surveys than males, which may impact on the final results (Jörissen *et al.* 2015).
3. Highest level of education completed.	The aim is to know if the level of education has any influence on food waste.
4. Which setting do you live in?	The importance of knowing if a consumer lives in a rural or urban setting relates to how strict the movements

	during lockdowns and how behaviours could be different in these two settings.
5. How many people live in your household?	One of the factors that has influenced the amount of food waste is related to the number of people living in the household. It would be important to examine whether there is a relation between the number of people living in the same household and food waste generated.
6. Are you the main shopper for your household?	The reason for this question is related to the understanding of packaging information and the use of a shopping list. The main shopper is more likely to pay some attention to expiration dates and product origin.
7. How frequently do you buy food from the following locations? (You may choose more than one option)	As some food outlets and stores closed during the strictest lockdown periods, it would be noteworthy to know if consumers have changed their shopping location, closer to their house for example.
8. What quantity of food do you usually buy overall?	To assess the issue of over purchasing during and outside lockdown periods. The question is asked in terms of large and small quantities as well as buying just what is needed.
9. How often have you cooked meals outside and during the lockdown period?	This question assesses cooking abilities and connects to purchasing habits. It would be interesting to examine the relation between quantity of food bought and quantity of prepared or cooked meals.
10. When planning and shopping for meals during and outside lockdowns, which of the following best describe what you do? (you may choose 2 that apply)	The question aimed at finding out the level of knowledge of the participant in relation to food and food waste prevention (Meixner *et al.* 2020).
11. What percentage of the following food commodities have you thrown away during and outside lockdown?	The food commodities presented as a choice go from meat and fish to fruits and vegetables, including ready meals and cereals, 'pushing' the participant to grade the percentage of food thrown away in the household, during both periods, according to their own judgement. This will

	allow to compare and understand the impact of the lockdowns on the generation of food waste at the household level.
12. What is your main reason for throwing food commodities away? (You may choose all that apply)	This question relates directly to food waste knowledge and food waste prevention. It considers consumers' behaviours regarding food storage and cooking challenges during and outside lockdown periods. It also addresses Meixner *et al.* (2020) study findings in connection to the hypothetically better cooking skills leading to wasted food to provide high-quality cooking.
13. What do you generally do with leftover food? You may choose more than one option.	The question was asked to find out consumer habits regarding leftover and whether consumers had some knowledge related to safe preservation techniques or their ability to create new meals or staples with food that was not consumed at once.
14. How long do you keep your leftover food under the following storage condition before throwing it away?	The aim was to understand consumers habits regarding leftover food when kept in a cool place. Would they keep leftovers for the same, or almost the same, amount of time, cooked food in fridge and freezer without paying really attention to where it is kept.
15. Which definition best defines 'Best before date' and 'Use by'.	This option has been included in order to better analyse consumers labelling knowledge and understand what in the revision of EU rules on date marking (European Commission 2020) could be adjusted.
16. How often do you read the food label?	The question relates to the previous one, but it goes a lot more into detail including a frequency option and specific important information, e.g. ingredients, nutritional information, storage information, weight and certification marks, that consumers could read in order to help them prevent food waste.
17. Which of the following statements most closely match your concern regarding food waste?	As reported by Thyberg and Tonjes (2015) food waste perspectives vary from person to person and from place to place. This question could help to observe consumer's stance on food waste.

18. Did the amount of food waste that you produced change over the lockdown periods?	Related to food waste prevention knowledge and what is the participants' concerns about wasting food during lockdown periods. As the options that could be chosen were just 'Increased', 'Decreased' and 'Same amount', it might eventually tell that consumers are aware of food waste produced.
19. You would reduce your food waste if… (you may choose more than one option)	The purpose of this question was to find out what are the key drivers that would help reduce food waste in the future. A few authors have mentioned that educational, at school level, (BCFN 2012) and informational campaigns (online, through stores, media) have been implemented and with no certain, measured results.
20. Which of the following would you find useful to reduce food waste? (you may choose more than one option)	Based on food waste reduction knowledge and food waste prevention campaigns cited by BCFN (2012) and Sadikul *et al.* (2019), it would be useful to know whether consumers would participate in a discussion group either online or in the community, (which can be less appropriate due to the pandemic and lockdowns), subscribing a newsletter or even downloading a smartphone application.

3.2 Data collection

An online survey was prepared and set in order to gather data on which to base the research findings.

The decision behind choosing an online survey is quite self-explanatory. It is easy to reach participants anywhere and due to the pandemic lockdown various periods it has been almost impossible to go in the field and question consumers directly. Moreover, an online survey provides the functionality needed to create and run surveys, and analyse data without spending time going back and forth.

The platform used to collect data was Jisc Online Surveys, which provides the information and answers needed to help develop data analysis and is also approved by the University of Greenwich. To create the online survey the University provided access to the platform

and an account, for the sole purpose of the research, was created using the academic profile.

The survey URL link was sent first via email to recipients in the owner's contacts list, a few days later the link was disseminated through the platform LinkedIn and open to anyone who wanted to participate, and finally an open email invitation was sent to the students of University of Greenwich's Bachelors and Masters programmes.

The online survey was open to be answered any time from 15 December 2020 until 31 January 2021 and 52 respondents took part of in the survey. This period was chosen because it what was first an opportunity to participants look back and reflect about their connection between 2020 lockdown periods and food shopping and preparing meals. Secondly, in some countries another lockdown period was imposed during Christmas, and finally in January as COVID-19 cases increased another, in some places strict, lockdown period was imposed.

3.3 Data analysis

The survey does not consider participants' geographical location in terms of continent or country (only urban and rural settings) as the purpose of this paper is to analyse consumers behaviours and food waste habits and prevention outside and during pandemic lockdowns whatever their constraints and living location. What is known, through private email contacts when the online survey link was sent, is that the vast majority of the participants were based in industrialised countries at least during the strictest lockdown between March and June 2020.

With a limited number of participants, the visualisation built-in features available on Jisc survey platform was used. It compiles the data collected automatically and gives the possibility to present it in the format of a pie or graph chart. The data was exported to a spreadsheet to analyse it using a different software. SAS (a data analytics tool that is used in Data Science and Business Intelligence applications.) University Edition was used to handle and analyse the data extracted from Jisc.

The data is visually presented in the form of tables and graphs with explanations and observations as clear as possible, based on quantitative discrete data. Mean, variance and standard deviation from frequency tables are provided.

3.4 Ethical considerations

The survey was completed by 52 participants over the age of 18 that were recruited through personal and professional contacts and then using a snowballing approach to reach the required numbers of participants. The anonymised digital data were accessed only by the researchers directly involved in the study and no data was used to identify any participant. Besides, once the study has been completed all the data collected will be deleted.

A copy of the FREC (Faculty of Engineering and Science Research Ethics Committee) was signed by the applicant and supervisor. The participant's informed consent was managed by asking their agreement to participate when completing the electronic form and they were also able to withdraw from the study at any point without having to give a reason, although data once anonymised could not be withdrawn. Besides, by signing the FREC the applicant also agreed with the participant data management confidentiality, e.g. data was collected anonymously and stored in an encrypted form as well as password protected, and the impossibility to link data to any participant who took part in the study.

A participant online form was also presented to participants. Before taking part in the survey, respondents were asked to first agree with participation in the study and secondly to reiterate the understanding about data collected and their will to be opted out and have their anonymous data not being used for any other project. The participants were also assured that data was only be accessed by the researcher and any data that could identify individuals was not made public.

3.5 Limitation of the research

One of the limitations of the research is related to the COVID-19 pandemic itself and its consequent lockdowns. An important input of the research would also have been some field work composed by a questionnaire that could be answered directly by consumers while on their way to or from food stores and markets, and this could have been done in four EU

countries. However, due to the COVID-19 pandemic and the risk of virus infection and social distancing all the questionnaires were answered through an online survey.

It would also be useful to examine how these assumptions have accounted for food waste during outside lockdown periods. Would it be possible to correlate and measure the amount of food wasted outside and during lockdown periods? Evaluating consumers habits in both periods would be a good starting point, although the different times lockdowns have been imposed and their formats may have an influence on the results as consumers might eventually have become more aware of their shopping habits and food waste impact in relation to the first lockdown, for example, and not compared to an outside lockdown period.

The limitations, and risks, associated to this online survey are linked to digital and online security namely on the respondents' computing client side. In addition, respondents could feel insecure regarding the survey platform itself. Participants could also have been influenced by other household members and been biased towards them while answering the survey.

Another relevant limitation concerns the number of respondents that have participated in the survey. The results are hardly a statistical representation of the wider population due to a low participation, which could be a consequence of the limited amount of time the survey was open - around seven weeks.

One of the survey's questions regards the percentage of food thrown away during and outside lockdowns and the range of values that could be selected (Figure 6). It could be deceitful leaving participants estimating themselves a precise percentage of food thrown away based on total food purchased during a large period.

Firstly, the results can be biased due to the perception of each respondent while attributing a value, percentage, to the amount of food that was not consumed. Secondly, it is difficult to respondents to go back to the first lockdown, that stared in March 2020, and recall the percentage of edible food that was thrown away and what kind of commodities were not consumed and ended being wasted.

Consequently, the data presented has a large span to be really reliable. This specific data should have been focused on the very last lockdown period and therefore be more precise, from respondents view point, when compared to an outside lockdown period.

It is shown that respondents are generally concerned and feel uncomfortable about wasting food. Unfortunately, participants' feelings of discomfort have not been analysed in this paper and it would be of interest to know if personal concerns of food waste such as financial loss, are stronger or weaker than concerns about the social and environmental implications.

The online survey did not give the opportunity for participants to ask direct questions to, and develop them with, the researcher neither to make any side comments and particular feedback as during face to face questionnaires.

CHAPTER 4. RESULTS and DISCUSSION

Shortage of food products during the COVID-19 pandemic lockdowns was acknowledged to have an impact on food waste as consumers' usual food practices changed during these periods. As the aim of the project was to determine the effects of the pandemic and lockdown periods on consumer behaviour, in particular looking at how they handled food and whether this generated more or less waste, the following graphs and tables show the answers given by all 52 survey participants.

4.1 Demographic information

As seen in Figure 1, there were more female participants, 67.3%, than male with a range of ages varying from 18 to 60+ and the highest percentage of respondents with 30.8% and 25.0% were between 18-29 and 40-49 years old, respectively (Figure 2).

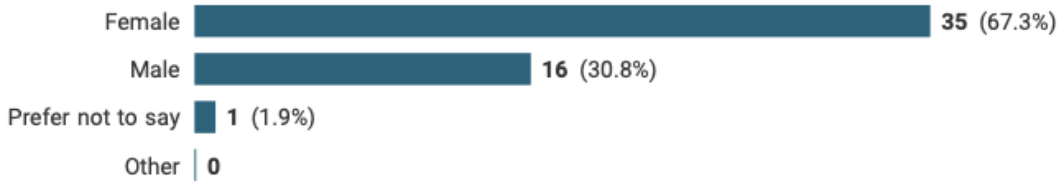


Figure 1 Select the gender you identify with

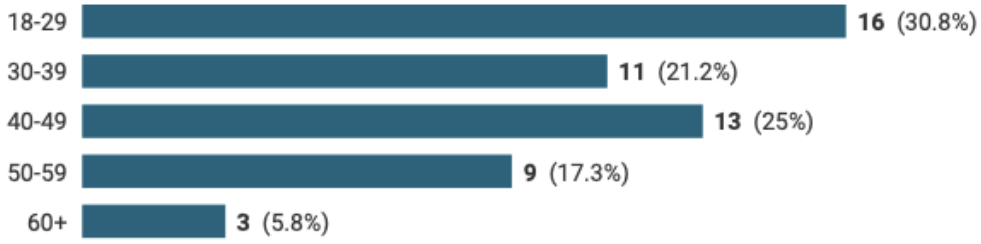


Figure 2 Participants ages ranges

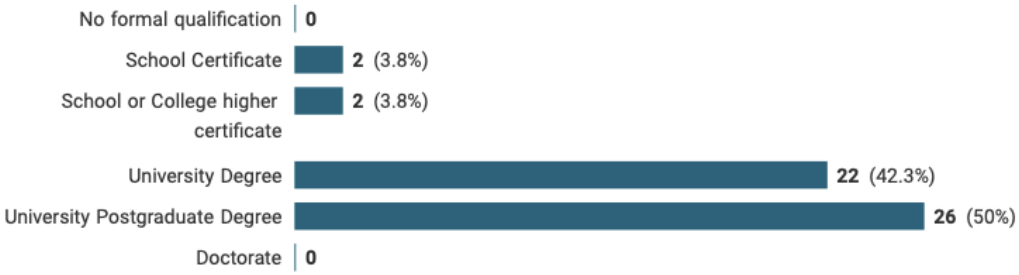


Figure 3 Participants education level

Regarding participants education level (Figure 3), 92.3% have a university level. This result might be related to the fact that the students of University of Greenwich's Bachelors and Masters programmes were also invited to answer the online questionnaire. There was no respondent without some qualification. This educational level could eventually be seen as a positive trend in terms of food waste knowledge and food waste prevention. As a side note for a better grasp regarding respondents' educational level, according to the Organisation for Economic Co-operation and Development (OECD) the percentage regarding the highest level of education completed by the adult population in the 37 most developed countries is 41.0% for upper secondary and 38.0% for tertiary education (OECD 2019).

Table 2 Number of people in households

Number of household members	Number of respondents	Percentages of respondents
1	15	28.8%
2	14	26.9%
3-4	16	30.8%
5-8	7	13.5%
9+	0	0.0%

As seen in Table 2, the vast majority of participants, 86.5%, live in a household ranging from 1 to 4 people with a similar percentage either living on their own (28.8%), with someone else (26.9%) or with two or three others (30.8%). In general, as assumed by the public, a low number of household occupants is perceived as contributing to less food waste than a higher number. As reported by Schanes *et al.* (2018) households with fewer members produce less waste than the ones with more people whereas the amount, per capita, of food waste generated decreases with increasing household size. It is also mentioned that households with one member are wasting more food per capita due to single persons' lifestyles (Schanes *et al.* 2018).

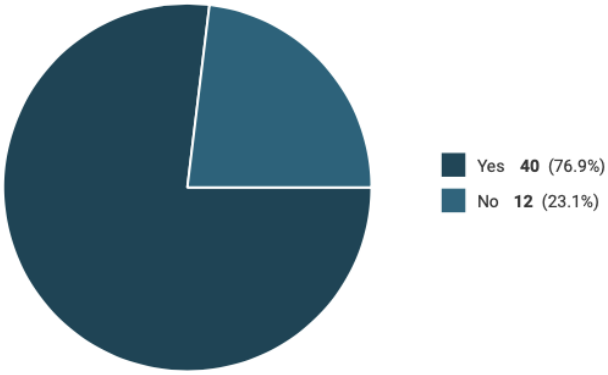


Figure 4 Are you the main shopper for your household?

The large majority of the respondents (76.9%) were the main shoppers in the household (Figure 4). As it has been mentioned above, non-main shoppers could just purchase food following a shopping list given by a member of the household and besides, answer the survey in the name of someone else (e.g. the household's main shopper). It is interesting to observe from Figure 5 that three quarters of the respondents lived in an urban setting, which is normally considered a setting with easy access to food outlets and food choices.

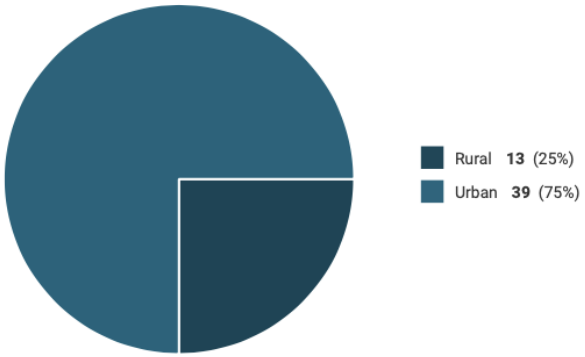


Figure 5 Which setting do you live in?

4.2 Household shopping habits during and outside lockdowns

Food habits are habits that have been adopted by consumers when purchasing food including the location (local shops, supermarkets, open air markets, etc), food shopping frequency and quantities bought each time (Jiang *et al*. 2018).

When analysing the data provided in Table 3, related to food purchasing frequency and the location where participants shop, the number of times food was daily purchased slightly decreased, from 11 occurrences during outside lockdown down to 10 during lockdown.

Table 3 How frequently do you buy food from the following locations?

Everyday		No.	%	2/3 times week		No.	%	Once per week		No.	%	Once per fortnight		No.	%	Once per month		No.	%
Supermarket	During lockdown	2	4.3%	Supermarket	During lockdown	7	15.2%	Supermarket	During lockdown	25	54.3%	Supermarket	During lockdown	9	19.6%	Supermarket	During lockdown	3	6.5%
	Outside lockdown	3	5.5%		Outside lockdown	21	38.2%		Outside lockdown	16	29.1%		Outside lockdown	9	16.4%		Outside lockdown	6	10.9%
Open-air market	During lockdown	0	0.0%	Open-air market	During lockdown	2	9.5%	Open-air market	During lockdown	9	42.9%	Open-air market	During lockdown	1	4.8%	Open-air market	During lockdown	9	42.9%
	Outside lockdown	3	8.8%		Outside lockdown	6	17.6%		Outside lockdown	9	26.5%		Outside lockdown	5	14.7%		Outside lockdown	11	32.4%
Local / independent shops	During lockdown	6	14.3%	Local / independent shops	During lockdown	12	28.6%	Local / independent shops	During lockdown	14	33.3%	Local / independent shops	During lockdown	3	7.1%	Local / independent shops	During lockdown	7	16.7%
	Outside lockdown	3	7.5%		Outside lockdown	13	32.5%		Outside lockdown	8	20.0%		Outside lockdown	6	15.0%		Outside lockdown	10	25.0%
Directly from farmers or farm shops	During lockdown	1	6.3%	Directly from farmers or farm shops	During lockdown	1	6.3%	Directly from farmers or farm shops	During lockdown	7	43.8%	Directly from farmers or farm shops	During lockdown	2	12.5%	Directly from farmers or farm shops	During lockdown	5	31.3%
	Outside lockdown	2	8.3%		Outside lockdown	1	4.2%		Outside lockdown	10	41.7%		Outside lockdown	3	12.5%		Outside lockdown	8	33.3%
Online	During lockdown	1	3.4%	Online	During lockdown	4	13.8%	Online	During lockdown	3	10.3%	Online	During lockdown	7	24.1%	Online	During lockdown	14	48.3%
	Outside lockdown	0	0.0%		Outside lockdown	0	0.0%		Outside lockdown	2	12.5%		Outside lockdown	5	31.3%		Outside lockdown	9	56.3%

In reality, not many participants bought food on a daily basis regardless of the period. It was also interesting to observe that most food shopping occurrences remained constant during and outside lockdowns. That is, participants purchased food mainly once per week or once per month. Participants during lockdown purchased food more frequently once per week than outside lockdown, 37.7% and 26.6% respectively. However, monthly and every few days purchases decreased during lockdown in comparison to the outside lockdown period. The reasons for this change could have been related to consumers' fear of not being able to find enough food supplies the following month, not being able to find enough for a full month right at the moment they were shopping or restriction on the number of items that could be purchased at once. They could have also been trying to avoid making too many trips and exposing themselves to COVID when going to the supermarket/market.

Another relevant analysis from Table 3 is that there was more food purchased outside lockdown periods, 169 times, than during lockdown, 154 times. This fact does not really mean that participants purchased less food during lockdowns, but it shows that they went out to buy food fewer times than in the normal period. Moreover, if online delivery is taken out of the account, the gap between the two periods was even larger.

Table 4 Total number of occurrences in different shopping locations

		No.	%
Supermarket	During lockdown	46	29.9%
	Outside lockdown	55	32.5%
Open-air market	During lockdown	21	13.6%
	Outside lockdown	34	20.1%
Local / independent shops	During lockdown	42	27.3%
	Outside lockdown	40	23.7%
Directly from farmers or farm shops	During lockdown	16	10.4%
	Outside lockdown	24	14.2%
Online	During lockdown	29	18.8%
	Outside lockdown	16	9.5%

Two interesting observations in Table 4 concern the increasing number of times participants bought food from local / independent shops and from online services during lockdown periods. Outside lockdown periods participants went more frequently to supermarkets, open-air markets, shopping directly from farmers or farm shops. One of the advantages of purchasing food from local / independent shops is that consumers had the choice to buy food in bulk, which could contribute to reducing food waste and also decrease over purchasing due to 'a more visible' restriction on food products availability. Online shopping doubled during the lockdown periods with purchases being made mainly once a month (56.3%) or fortnightly (31.3%) (Table 3). Outside lockdown, none of the respondents reported food shopping online daily or a few times a week (Table 3).

However, the participants' answers regarding the quantity of food they usually buy, was quite different from the logic of going more frequently to local shops and consequently buying less food in bulk. As shown in Figure 6, during lockdown periods participants purchased larger food quantities in contrast to outside lockdown periods, 48.1% and 21.2% respectively. If participants preferred to purchase food once per week, in any period, and the number of large food quantities increased it could be inferred that actually participants were buying more food for the same amount of time without going shopping.

Quite logically, the amount of food bought during lockdown when needed dropped from 50.0% to 23.1%. Yet participants buying small quantities of food and more frequently was almost the same during, 26.9%, and outside lockdowns, 28.8% as shown in Figure 6.

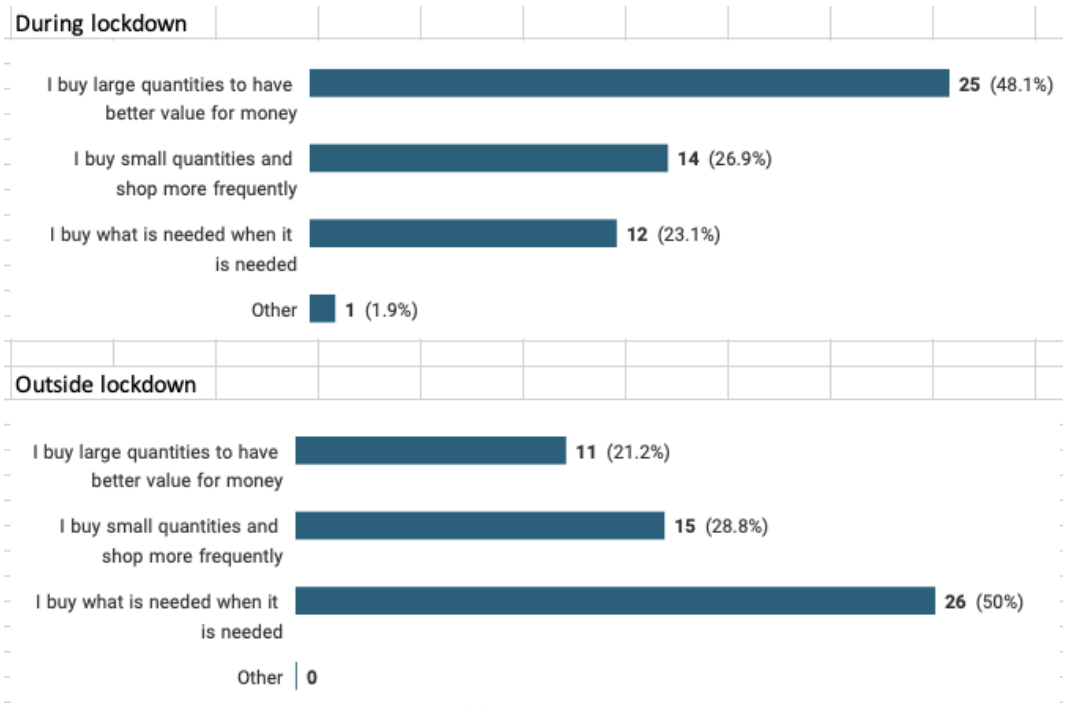


Figure 6 Quantity of food usually bought overall during both periods

Would this imply that participants during lockdowns ate more and developed their cooking skills causing more food waste as observed by Meixner *et al.* (2020), stored a lot more food or poorly planned their meals? According to Figure 7, 75.0% of respondents cooked every day during lockdowns against 51.0% outside lockdowns.

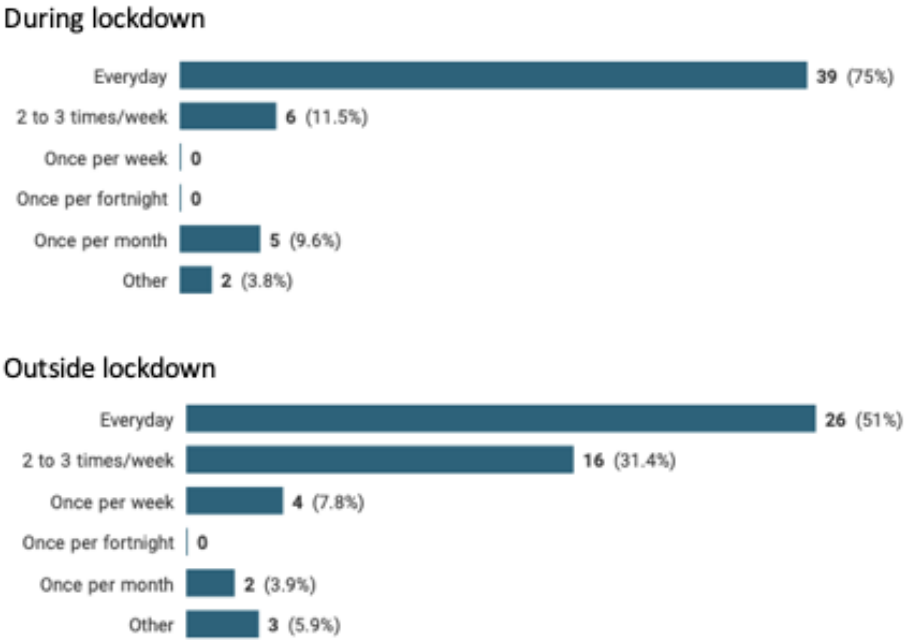


Figure 7 How often have you cooked meals outside and during the lockdown period?

From the data shown below on Figure 8, it is possible to see that respondents during and outside lockdown planned meals and wrote detailed shopping lists in almost the same

manner. The number of occurrences for planned meals actually increased (from 28.8% to 36.5%) during lockdowns.

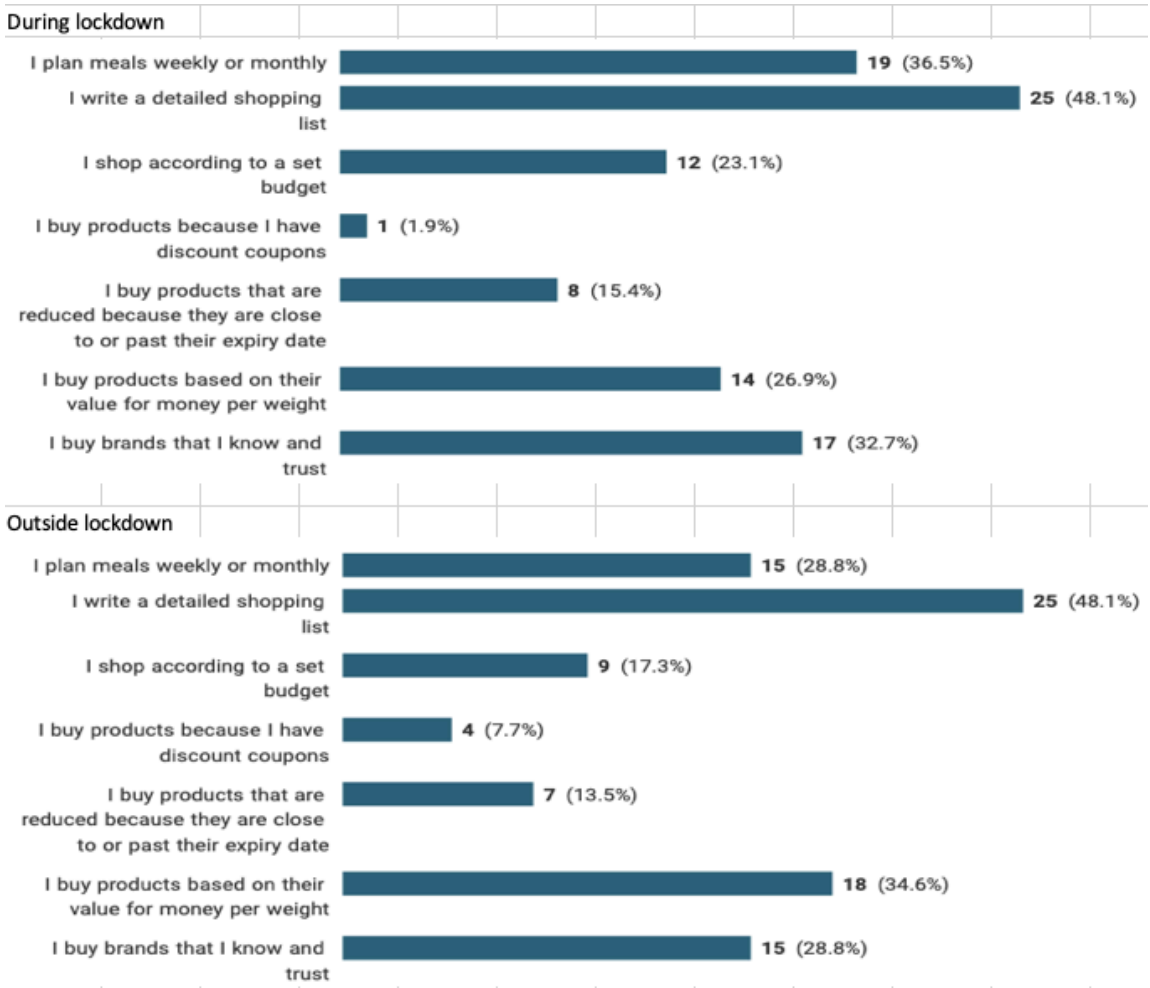


Figure 8 When planning and shopping for meals, which of the following best describe what you do?

Another compelling fact is that the number of occurrences regarding products purchased based on their value for money per weight (Figure 8) declined during lockdowns, from 34.6% to 26.9%, showing the possibility that participants when planning and shopping for meals purchased what was available in the stores without having the chance to buy products based on their value for money, which exposes a change in consumers' food habits and at the same time some potential knowledge in regards to food waste prevention and developing better cooking skills (Sadikul *et al.* 2019; Meixner *et al.* 2020).

4.3 Reasons for throwing food commodities away and food storage

There is always food wasted at household level. The diverse food commodities that consumers purchase need to be consumed at different times – they cannot be consumed all at the same time. During lockdown periods, as seen in Figure 9, participants threw away more fresh products such as fruits (9.6%) and vegetables (13.5%) but there was a reduction of waste in some product categories such as chilled ready to eat food. In this product category it is interesting to observe that the number of participants buying chilled ready to eat food during lockdown decreased from 9.6% to 7.7%. A noteworthy observation is that an average 12.5% of participants did not buy any meat and fish at any time.

	During lockdown	Outside lockdown	During lockdown	Outside lockdown	During lockdown	Outside lockdown	During lockdown	Outside lockdown
	Fresh meat (beef, veal, lamb, and pork)		*Chilled ready to eat food (salad)*		*Milk and dairy products*		*Cereal and bakery products (bread, pasta…)*	
0%	53.8%	50.0%	30.8%	32.7%	50.5%	51.9%	59.6%	59.6%
< 6%	23.1%	21.2%	50.0%	38.5%	36.5%	32.7%	21.2%	23.1%
6% to 20%	7.7%	13.5%	3.8%	13.5%	5.8%	11.5%	13.5%	13.5%
> 20%	0.0%	3.8%	7.7%	5.8%	5.8%	1.9%	3.8%	1.9%
I do not buy this	15.4%	15.4%	7.7%	9.6%	1.9%	1.9%	1.9%	1.9%
	Root and tubers (potatoes…)		*Legumes and oilseeds (chickpeas, peas)*		*Fresh fish and seafood*		*Cooked meat or poultry*	
0%	53.8%	53.8%	65.4%	65.4%	63.5%	65.4%	53.8%	48.1%
< 6%	28.8%	25.0%	17.3%	15.4%	19.2%	19.2%	23.1%	28.8%
6% to 20%	9.6%	11.5%	7.7%	9.6%	1.9%	1.9%	5.8%	7.7%
> 20%	5.8%	5.8%	3.8%	3.8%	1.9%	1.9%	3.8%	1.9%
I do not buy this	1.9%	3.8%	5.8%	5.8%	13.5%	11.5%	13.5%	15.4%
	Ready meal (pizza, soup..)		*Fruits*		*Vegetables*			
0%	59.6%	51.9%	30.8%	28.8%	21.1%	26.9%		
< 6%	17.3%	25.0%	48.1%	50.0%	55.8%	44.2%		
6% to 20%	3.8%	7.7%	11.5%	15.4%	9.6%	17.3%		
> 20%	7.7%	3.8%	9.6%	5.8%	13.5%	11.5%		
I do not buy this	11.5%	11.5%	0.0%	0.0%	0.0%	0.0%		

Figure 9 What percentage of the following food commodities have you thrown away during and outside lockdown?

The reasons with the highest number of occurrences chosen by the participants, as pointed in Table 5, are ‘food has gone mouldy’ (35%), ‘food smells off’ (28%) and ‘food stored in fridge or cupboard for too long’ (24%), which can be interpreted as a consequence of over

purchasing food. A drawback of this question is related to the fact that it did not cover the during lockdown and outside lockdown periods separately. Nevertheless, it brings up the participants' perception about food storage and food waste knowledge, inferring that both raw and cooked food are not kept in the most suitable conditions, neither in the fridge nor outside, e.g. exposed to light, room temperature not appropriate or not rightly placed in the fridge.

On the other hand, data in Table 5 illustrates that participants in general were aware of or paid attention to expiry dates. For example, 5.5% stated that 'best before date has passed' as a reason for throwing food which could be considered as participants' lack of understanding of the meaning of 'best before' and 'use by' dates. The 'use by' date (12.3%) being the fourth highest main reason for throwing food away, also suggests that participants either kept food for too long or bought food products too close to the expiry date. Two explanations can be given regarding the latter, participants had not read the label while shopping or they did and thought they could consume those food products before the expiry date, making this habit even more critical during a lockdown period due to the increase in food purchasing.

Table 5 *What is your main reason for throwing food commodities away?*

Reason	Number of occurrences	%
Food smells off	28	19.2%
Food stored in fridge or cupboard for too long	24	16.4%
Food has not been stored properly	11	7.5%
Best before date has passed	8	5.5%
Use by date has passed	18	12.3%
Food does not look good	15	10.3%
Food has gone mouldy	35	24.0%
Poor cooking skills	0	0.0%
Portion cooked was too big	6	4.1%
Other	1	0.7%

It is also worthy to observe that no food was wasted due to poor cooking skills, meaning that whatever was cooked was eaten by the household members.

Figure 10 relates to the consumer habits regarding leftover food and whether consumers had some knowledge related to safe preservation techniques. The majority of respondents chose the option 'I cool it to room temperature and then store it in the fridge', which represents 82.7% of participants' choices. It is interesting to note that 16.4% of respondents said, in the previous question, that storing food for too long was a reason to throw food away (Table 5). The food thrown away due to staying for too long in a fridge could have been a result of not knowing where to place food in a fridge. With more than three quarters of the participants storing food in the fridge and then throwing it away because of mould or smelling off could be the result of cooked food left for too long outside the fridge prior to be refrigerated or not cooled quickly enough. Another interesting hint is that food was placed in the fridge without being monitored afterwards and then forgotten. This contradicts what has been mentioned above in regard to food waste prevention knowledge as food storage in the fridge or freezer information still needs to be much improved.

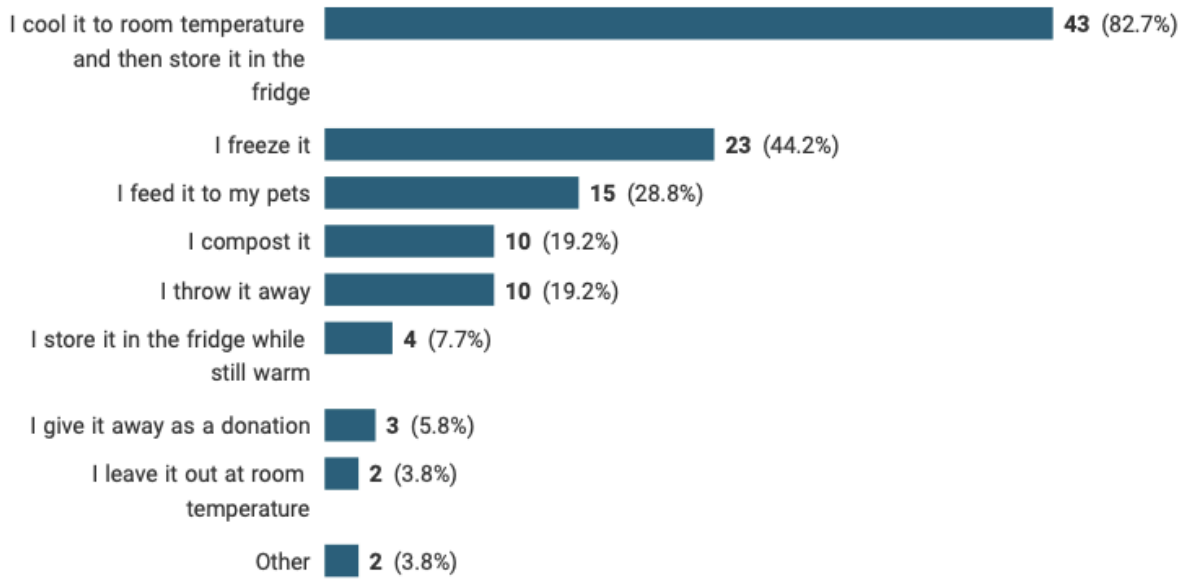


Figure 10 What is generally done with leftover food

As seen from Figure 10, 19.2% of the respondents threw their leftover food away. It was selected by almost 1/5 of the participants, when 92.3% of them had studied at university level. The discussion here could go much wider, but one blunt analysis from this relation would be that 19.2% of the participants either did not have enough food waste knowledge or the concept of food waste was somehow mistaken for the term compost – exactly the same number of respondents, on Figure 10, chose this option. Another argument that could be discussed in relation to the number of 'I throw it away" option occurrences is associated

with cooking skills' improvement and its influence on keeping leftover food to be used as or added to another meal.

Regarding the amount of time leftover food was kept in the fridge and freezer, there were significant differences between during lockdown and outside lockdown periods. It is also significant to mention, as per Table 6, that no respondents kept leftover food for a single day in the freezer in any of the lockdown periods, during or outside, and nobody kept leftovers in the fridge for more than one week at any time.

Table 6 How long do you keep your leftover food under the following storage condition before throwing it away?

	During lockdown		Outside lockdown	
	In the fridge	In the freezer	In the fridge	In the freezer
I don not keep leftovers	0%	19.2%	1.9%	21.2%
1 day	23.1%	0.0%	15.4%	0.0%
2-3 days	42.3%	9.6%	44.2%	7.7%
4-6 days	23.1%	3.8%	26.9%	3.8%
1 week	11.5%	5.8%	11.5%	1.9%
1-2 weeks	0%	7.7%	0.0%	5.8%
3-4 weeks	0%	13.5%	0.0%	19.2%
2-6 months	0%	30.8%	0.0%	25.0%
more than 6 months	0%	9.6%	0.0%	15.4%

4.4 Consumers habits towards food labels

Food labelling has also been considered a feature that can contribute to food waste. It helps to ensure that food is fit to be eaten during its shelf life – having the correct information written on the pack makes it possible to notably reduce food waste.

Expiry dates are a practical example of food labelling impact on food waste as food products reaching the "Use by" date without being sold are most of the time wasted. The continuous refilling of shelves means that food products close to the expiry date are habitually disregarded by consumers, unless there is some sort of deal to get them off the shelves. That is, food products close to their expiry date are ignored by consumers, which contributes to food waste, or consumers buy them because of a promotion (not because of need), which potentially contributes to food waste.

By asking participants to choose the best option, according to their understanding, of the "Best before" and "Use by" terms (Table 7), it showed firstly their knowledge about different expiry dates and secondly their awareness regarding the importance of food labels. Consumers' familiarity with food labels can have a significant impact on food waste. As Table 7 shows, most of the participants understood the difference between "Best before" and "Use by" (36.2% and 37.0% respectively) and were well aware that consuming a food product after the "best before" date would not represent a food safety issue and therefore does not need to be thrown away. Over 60% nevertheless were confused or did not fully grasp the concept of these dates that could lead to food being wasted (particularly in the case of the Best before date).

Table 7 Which definition best defines 'Best before date' and 'Use by'? (choose one definition for each)

	Best Before	Use by
Up to this date, the manufacturer guarantees the quality of the food if it has been stored under the correct conditions	36.2%	12.3%
After this date, the consumer cannot get a refund for the food	17.0%	34.0%
Even if the food tastes and smells bad before this date has passed, the consumer should not be concerned	32.4%	16.7%
After this date, the manufacturer cannot guarantee the safety of the food if it has been stored under the correct conditions	14.4%	37.0%

When it comes to reading food labels, as shown on Table 8, participants had mixed habits. More than 50.0% of the respondents never read the information about allergens while the majority always read the expire date including Best Before and use by dates and only sometimes read the information about storage for the product purchased. 73.1% - 75.0% said that they never or sometimes read information about storage whatever lockdown situation.

Buying too much food is perceived as a contributor to food waste increase (Shaw *et al.* 2018). This does not only refer to the quantity of the same food product purchased but also the individual weight of a product. That is, purchasing bulk food is buying more of the same product, more packages, and also larger packages for a better price. Not paying attention to food weight can indeed generate more food waste, unless surplus food is used for a purpose different from the original one (fruits into jams or vegetables into pickles).

According to Table 8, 60.0% of the participants sometimes read the weight of a food product they are purchasing while 20.0% never read that information, it means that some of the participants do not really know the weight of a specific food product they are buying and this attitude is more or less the same during and outside lockdown periods.

Table 8 How often the food label was read

		Always	*Sometimes*	*Never*
Ingredients	During lockdown	32.7%	63.5%	3.8%
	Outside lockdown	23.1%	71.2%	5.8%
Nutritional information	During lockdown	25.0%	51.9%	23.1%
	Outside lockdown	17.3%	59.6%	23.1%
Allergens	During lockdown	15.4%	21.2%	63.5%
	Outside lockdown	13.5%	28.8%	57.7%
Storage information	During lockdown	26.9%	53.8%	19.2%
	Outside lockdown	25.0%	53.8%	21.2%
Cooking instructions	During lockdown	24.6%	51.9%	13.5%
	Outside lockdown	32.7%	51.9%	15.4%
Expiry date	During lockdown	69.2%	23.1%	7.7%
	Outside lockdown	59.6%	32.7%	7.7%
Best before date	During lockdown	57.7%	36.5%	5.8%
	Outside lockdown	55.8%	38.5%	5.8%
Use by date	During lockdown	51.9%	34.6%	13.5%
	Outside lockdown	48.1%	34.6%	17.3%
Weight	During lockdown	23.1%	57.7%	19.2%
	Outside lockdown	23.1%	53.8%	23.1%
Country of origin	During lockdown	28.8%	55.8%	15.4%
	Outside lockdown	26.9%	55.8%	17.3%
Certification marks (Fair trade, organic…)	During lockdown	34.6%	51.9%	13.5%
	Outside lockdown	32.7%	53.8%	13.5%

A few participants also addressed, through the contact provided in the online survey, the absence of a dedicated question regarding the country of origin as this apparently has some influence on choosing food products that consumers purchase.

4.5 Participants perception of food waste produced and concerns

Table 9 and Figure 11 represent participants' concerns about their behaviours and perceptions regarding food waste in general and their food waste contribution during and outside lockdown periods.

Table 9 Which of the following statements most closely match your concern regarding food waste?

	No. of occurrences	%
I am concerned about food waste and do my best to reduce it	48	92.3%
I am concerned about food waste but do not do much about it	3	5.8%
I was concerned about food waste in the past but since COVID-19 I have other concerns	0	0.0%
I do not believe that food waste is an issue and I am not doing anything about it	1	1.9%
I have never thought about food waste	0	0.0%

Almost all the participants, 92.3%, were concerned about the problem of food waste with the vast majority doing their best to reduce the amount of food waste they produce. It is worthy to mention that 100.0% of the responders had thought about food waste, which shows that they all were aware of the subject.

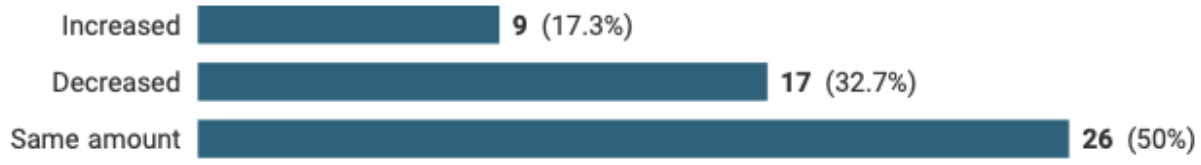


Figure 11 Participant's perception about the amount of food waste produced during lockdown periods in comparison with outside lockdowns

With regard to participants' perceptions about the amount of food waste they have produced during the different periods, it is noteworthy that 50.0% answered that they had not changed the amount food waste produced in their household. Nevertheless, it is quite striking that 32.7% of the respondents perceived that they had produced less food waste during lockdown periods and better planning, meals and shopping as previously discussed (see Figure 8), has possibly been a factor that contributed to this result.

4.6 Helping reducing food waste – participants suggestions

The online questionnaire also aimed at the participants' opinions regarding the best approaches to reducing food waste. Above all, getting recommendations or ideas that they would find useful for themselves to help reducing waste at the household level, and not only in the system as a whole. It was also worthy to know how much respondents were willing to

participate in new or different ways to reduce food waste and whether they had been contributing to individually decrease food waste.

As shown in Figure 12, the majority of participants emphasised the use of technology, smartphone applications and videos, to help reduce food waste. From the questionnaire it could be deduced that participants would like to have quick access to reliable digital information that could help or advise them when buying a food product or at home when it comes to expiry dates. The same applies regarding recipes for cooking leftovers – short online or downloadable videos could encourage participants to reduce food waste.

On the other hand, there were only 9.6% who viewed community discussion groups as a good approach. This can be linked to the pandemic and fear of being too close to people and keeping social distancing outside lockdown periods, and the difficulty of being involved in these groups during lockdown periods. The option 'online discussion groups' is the one with less occurrences and of the possible reasons for not being popular has to do with the fact that these kinds of discussion groups are difficult to follow as it is difficult to find the right moment for all members.

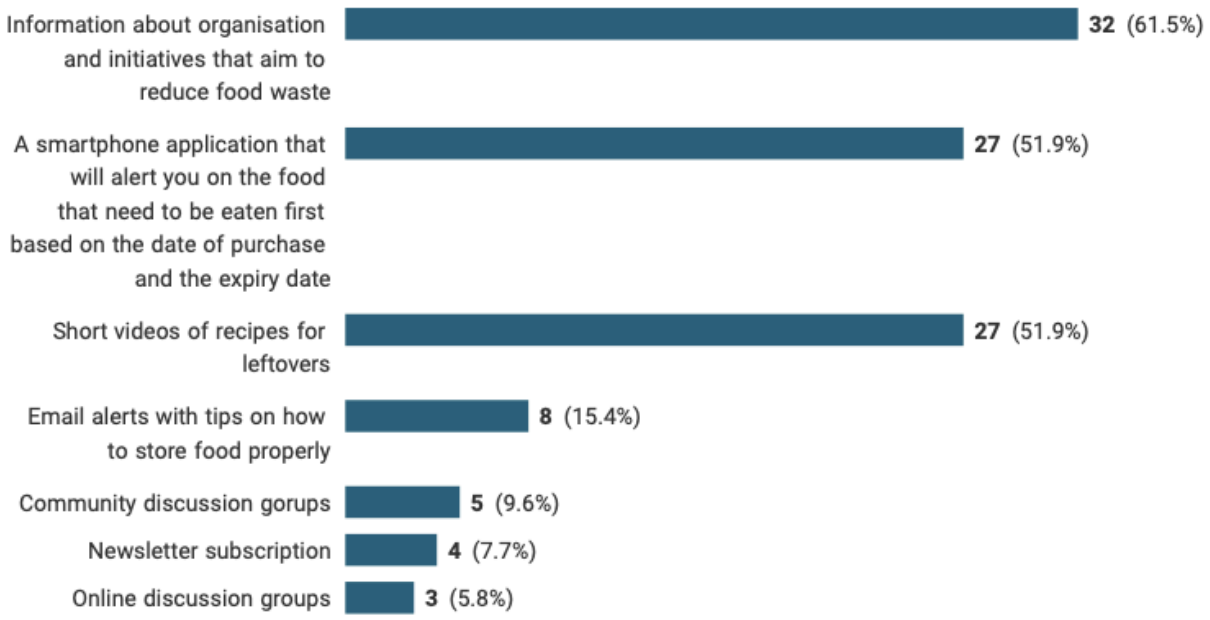
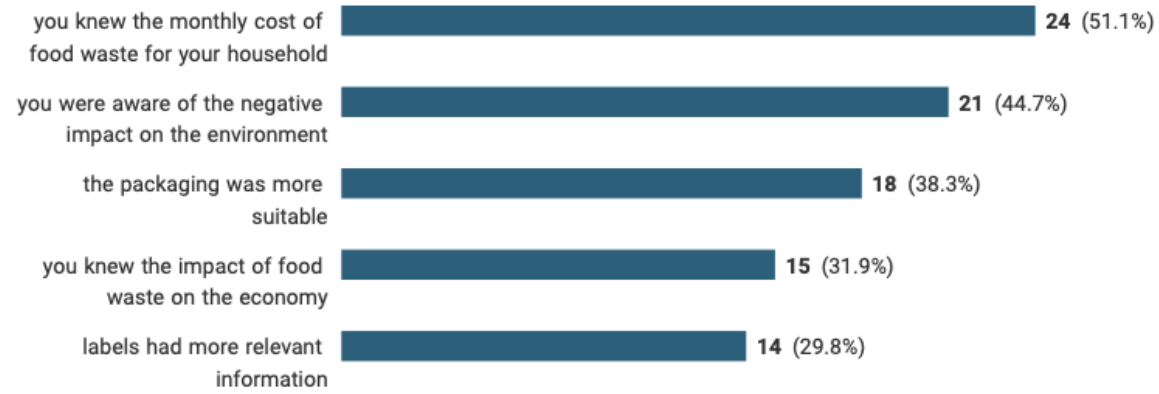


Figure 12 Which of the following would you find useful to help reduce food waste?

Finally, the three most chosen options that would help respondents reduce food waste, as shown in Figure 13, would be to 'see' the financial impact of food waste on their household budget and the general economy with 51.1% and 38.3% respectively as well the negative

impact on the environment (44.7%). Additionally, as per what was aforementioned by a third of the answers, having more relevant information on food packaging could also to play a part in reducing food waste.

With regard to the optional answers, it would be particularly interesting to have “learning to compost” or “compost better” as part of a smartphone application or educational easy access video and “smaller pre-packed fresh food” as a purchase choice - though there would be a risk of increasing plastic waste.



Other specific answers:

no food waste in my house
Easier access to market and local shops
Already have little waste
very rarely I produce food waste
there was an easy way to compost it
i knew of ways to recycle or compost food waste.
Smaller quantities in pre-packed fresh foods
If there were local organizations collecting and distributing edible leftovers and surplus food

Figure 13 You would reduce your food waste if…

CHAPTER 5 - CONCLUSIONS and RECOMMENDATIONS

Lockdowns have affected consumer food purchase habits and behaviours. During lockdown periods, larger quantities of food were purchased for the same amount of time in between two shopping trips. It is also meaningful to notice that participants did not have a daily shopping habit, in any of the periods, which can have a contradictory effect on food waste generation per household; the number of occurrences for everyday shopping remained constant during lockdown and outside the lockdown periods.

5.1 Conclusions

Through the analysis of the data collected from the online survey, a quite straightforward conclusion that can be taken is that despite the rise in the amount of food purchased during lockdown periods, food waste did not increase. This is in line with the Pappalardo *et al.* (2020) Italian case study. Analysing the survey results and comparing them with some arguments in the literature review, it cannot be assumed that cooking skills at household level contributed to food waste increase.

Shopping habits have not had a significant variation. During and outside lockdown periods participants purchased food mainly once per week from different shopping locations. On the other hand, the number of occurrences regarding food purchased monthly during lockdown periods decreased. One of the explanations could be the fact that participants during lockdown periods purchased food a lot more from online food platforms which eventually contributed to a more rigorous shopping and ordering precise quantities. As the occurrences regarding food shopping in open-air markets plunged during lockdown, periods could also have had an influence as participants were buying smaller quantities of supposedly fresh food.

Another interesting aspect that has emerged during data analysis relates to the participants' lack of clear understanding differentiating food waste and organic compost, which can be connected to better food waste knowledge campaigns. For example, some participants did not consider food waste when disposing leftovers or spoiled raw food in compost bins for being used as a fertilizer at a later stage.

Participants living in rural settings, outside lockdown periods, have trouble accessing community campaigns and initiatives as well as getting involved in community discussion groups due to distances and limited hubs or branches. This paper has not found a significant connection between self-reported food waste behaviour and urban residence. However, some authors, such as Jiang *et al.* (2018), have associated regional differences to a higher amount of food waste.

It would also have been worthy to examine the relationship between household income and generation of food waste, which this study does not address, as some studies suggest that for the last 10 to 15 years, families with higher income have tended to produce more food waste.

5.2 Recommendations

The data collected shows that food waste campaigns at all levels, from schools to workplaces, stores and markets, are an important vehicle, such as the food waste awareness campaigns (BCFN 2012), to help inform consumers so that they can behave accordingly. As per FAO's SAVE FOOD! website, a few awareness campaigns have taken place worldwide, and their digital flyers and reports can be downloaded for free in different languages. BCFN (2020), on the private corporations' side, has also been promoting food waste alertness campaigns.

Despite this type of digital information and campaigns, most of the participants conveyed the idea that they needed something simpler, without searching for links and digital addresses, and with access at their fingertips to an immediate response to their doubts, and in a more interactive way, so that they can react quickly and in an appropriate and engaging way regarding food waste reduction.

Monthly household's cost of food waste, awareness of negative impact on the environment, having more suitable food packaging and knowing the impact of food waste on the economy were the biggest concerns mentioned by participants, and as suggested some of these could be included in a food waste dedicated smartphone application.

Participants suggested an app that could alert consumers about the food that needed to be eaten first based on the date of purchase and the expiry date in order to help prevent food

waste. It was also suggested that short videos of recipes for leftover food could be of great help and eventually be integrated in an app.

Besides, labels with more relevant information, including information about producers, manufacturers, retailers and product traceability, more suitable packaging (made of recyclable materials) and reduction of food waste initiatives promoted by supermarkets and open markets could, according to respondents, have a positive impact on generating less food waste.

All fridges and freezers should have clear information on what kind of food, what kind of container or wrapping to be used, and the amount of time on all shelves and drawers in order to avoid food spoiling. They also could come with a leaflet or short manual targeting specifically the food waste issue.

Finally, a revision easily accessed by consumers in a digital form or displayed as a placard in food outlets, conducted by government food agencies and EFSA, of food product standards could improve the defiance of consumers' acceptance of imperfect food offered in shops and markets. This is already happening, but by lowering the cost of the products so that consumers are more likely to buy them. They are referred to as 'wonky' vegetables by the big retailers.

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