FOOD SECURITY AND FOOD WASTE DURING COVID-19 PANDEMIC

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Abstract
At the beginning of 2020 the whole world has been infected by COVID-19 virus. An immediate negative consequence, besides population health, has been the high impact over all the industrial sectors, from primary (agriculture) to secondary level (food manufacturing) involving also food sector. Food consumption out-of-home in some country is almost over, while the at-home one reached high peaks like never before. This pandemic so far caused worldwide more than 1.9 million confirmed cases and over 130,000 deaths, and its socio-economics side effects involve social distancing, self-isolation and travel restrictions. To this extend, entire countries are facing lockdowns, thousands of jobs have been lost and several industries at any level as well as schools, hotels, canteens and restaurants, have been closed. This paper, focusing on previous and actual food consumption behaviors, analyzes similarities and differences pre and during pandemic. Subsequently, the authors will try to understand how Covid-19 will influence food waste concern, considering positive and negative scenarios.

Keywords
Food security, food waste, food vulnerability, food resilience, Covid-19.

JEL Classification
Q01, Q5, Q53.

Introduction

Global economy, society and environment face several challenges such as climate change, population growth and land depletion, requiring innovations and strategies in production technologies and consumption behaviors in order to match the 17 international Sustainable Development Goals (SDGs). Among them, main concerns are related to Goal 2 "*Zero Hunger"*, Goal 13 "*Climate Action*" and Goal 15 "*Life on Land*", with particular reference to water, energy, climate, oceans, science and technological innovation (Kukreja and Meredith 2011; Springmann et al., 2018; United Nations Department of Public Information, 2019). The agri-food system represents a core business for international and national economy and plays at the same time a fundamental role to ensure food safety and food security to human beings

all over the world. However, its management from cradle to grave – from agricultural to consumption stage – requires a large amount of energy and produces at the same time several typologies of wastes, of which food waste represents an increasing quota. Food system utilizes approximately 25 – 30% of global energy consumption and more than 70% of it occurs from primary processing to consumption stage, producing over 20% of total green-house gases emissions (FAO, 2014a; Vourdoubas and Dubois, 2016; IEA, 2019). In terms of FLW, it is estimated that more than one-third of food production is thrown away each year, with wastage-related losses of money and energy which amount respectively to 940 billion dollars (USD) and approximately 38% of energy consumed in the whole food system (FAO, 2014b; Philippidis et al., 2019). With regards to green-house gases emissions, it is estimated that approximately 170 million tons (Mt) of CO_2 are related to European (EU) FLW (3% of global EU emissions), of which more than 45% are registered at household level (Monier et al., 2010; Philippidis et al., 2019). According to Kummu et al. (2017), roughly 25% of global production of food crops in calories is lost or wasted along the food system, with related natural resources depletion of a similar percentage (FAO, 2019a).
In such context, 2020 the Covid-19 pandemic spread all over the world, immediately changing all industrial sectors, from primary (agriculture) to secondary sectors (food manufacturing), impacting to a high degree in food consumption behaviors at-home and out-of-home. According to World Health Organization (2020a), at 16th April 2020 the Covid-19 pandemic results in more than 1.9 million confirmed cases since the beginning of the pandemic and over 130,000 deaths worldwide. In Europe, more than 1 million cases have been confirmed and over 89,000 deaths have been accounted. Italy suffered 15% of cases and more than 23% of deaths (Shaw et al., 2020; World Health Organization, 2020b). Its socio-economic negative side effects involve social distancing, self-isolation and travel restrictions and resulted in entire countries lockdowns, thousands of jobs lost and closed industries (both at primary, secondary and tertiary sectors), as well as schools, hotels, canteens and restaurants. In order to mitigate an economic disaster, Europe has announced a € 1.7tn rescue package destined to the eurozone (Nicola et al., 2020).
This paper, focusing on previous and actual food consumption behaviors, analyzes similarities and differences prior to and during pandemic. Subsequently, the authors try to understand how Covid-19 will influence food waste concern, considering positive and negative scenarios.

Food security and food waste during Covid-19

- *Food Security*

One of the main concerns highlighted during Covid-19 pandemic regards "food security", which describes a situation in which "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (Barrett, 2010). Food security is composed by three main components (availability, economic and physical accessibility and acceptability), and its main limits are related to food provisioning disruption (*food system failures*) which occurs often at retail food store, but also in schools, food service institutions, restaurants or deliveries (Chodur et al., 2018; Lagioia et al., 2020). Furthermore, several food supply chain failures spread, in terms of production failure and processing, wholesale, distribution and retails disruption.
The possible effects of available food decrease during pandemic are difficult to specifically predict. However, it is expected that food limitation or lack (accessibility) will cause severe and negative consequences on society all over the world. Moreover, food system is characterized by high levels of interdependencies between multiple systems (such as water, energy, workforce), and a fundamental property of interdependent networks is that failure or degradation in one system may cause the failure of other dependent systems (Buldyrev et al.

2010). This deep interconnection makes food system vulnerable and its resilience is fundamental, so all possible efforts must be done to improve against this and other hazards. Thus, food security is facing new challenges and FAO (2020a) has proposed a "battle plan" for ensuring global food supplies during this pandemic, highlighting the importance of coordinated international policies, global food trade and domestic markets. Governments should take care of children missing school meals and parents losing their jobs, which means reduced incomes. Moreover, global food trade should keep going, since several countries depend on imported food and are vulnerable to slowing trade volumes, without underestimating the key role of domestic markets and smallholder farmers.

- *Food waste*

Covid-19 pandemic represents a high-risk factor for food waste mainly related to the entire countries' lockdowns. It has "stopped" all the outdoor food consumption typologies. Company and school canteens, leisure (bistro, restaurants, pubs, café) and hospitality facilities (e.g. hotels, resorts) have been closed. The consequence is a drastically increase in food waste along the whole food supply chain, from agricultural to consumption stage.

In terms of agricultural production, growers and farmers are facing a massive surplus of highly perishable items, such as fruits and vegetables, and impressive quantitates of fresh milk have been dumped, due to the sudden demand breakdown by the food service (FAO, 2020b). It has been estimated that the U.S. loss, from March to May, would exceed $1.32bn. The huge surplus of primary products (fruits, vegetables, dairy products), mainly due to a "disconnection in the food chain", cannot be absorbed by retail, with the consequence that a huge amount of fruits and vegetables go unharvested and perish on field. Moreover, extraordinary quantities of milk surplus have not been processed, flooding agricultural fields and industrial plants discharges (National Sustainable Agriculture Coalition, 2020; Nicola et al., 2020)

At distribution stage, due to the mandatory closure of catering (e.g., restaurants, pubs, pastry shops) and hospitality activities (e.g. hotels, resorts), in the first weeks (table no. 1) of lockdown the Italian large-scale distributions (GDO) registered higher values than those recorded in the same period of 2019 (17/02-29/03).

Table no. 1 Italian food distribution trends during Covid-19

Week	South Italy	Central Italy	Northwest Italy	Northeast Italy
17/02-23/02	+6.06%	+4.38%	+11.20%	+9.66%
24/02-1/03	+15.8%	+12.8%	+9.9%	+12.8%
2/03-8/03	+20.9%	+12.9%	+7.9%	+7.5%
9/03-15/03	+28.4%	+16.8%	+18.6%	+10.1%
23/03-29/03	+6.3%	+0.4%	+0.1%	+7.0%
Average value	+15.5%	+9.45%	+9.54	+9.42

Source: Personal elaboration by authors based on Nielsen, 2020b

In Italy, several differences have been recorded from North to South of Italy, where an average increase of respectively +9.5% and +15.5% has been registered. However, the highest increase has been performed in the eCommerce, where the purchase of consumer products increased of an average of than +100%, from +56% in the first week to +162% during the last one (Coldiretti, 2020; Nielsen, 2020a, 2020b). The main reasons of such increase are

represented by the "stock-effect", which is due to the fear of not finding food in the mid-long term, and the "I-stay-at-home-effect". Thus, high volumes of rice, canned food, tomato derivates, pasta, flour and yeast have been purchased, but also frozen and "comfort food" (Nielsen, 2020a). To this extend, food manufacturing has faced an increased food demand of approximately 60-70%, adapting processes management and acting improvements in logistics to speed up the flow of good to the stores (Federdistribuzione, 2020). The high volatility in food purchase, both between regions and also within the same geographical area, has made food provisioning quite unpredictable, with strong consequences in the food chain.
At final consumption, food waste during Covid-19 occurs only at-home, being closed all food service facilities. Since the highest amount of food waste occurs at-home (more than 50%) (Moller et al., 2014; Stenmarck et al., 2016; FAO, 2019b), the increase in domestic food consumption inevitably produces a higher amount of food waste. A report produced by National Geopgraphic (2020) in collaboration with the Food and Environment Reporting Network has stated that people are cooking more at home, producing more tonnages of food waste than usually.

Past lessons and future directions for food consumption during Covid-19

In such context, FAO (2020c) has proposed an educational-engaging package to educate people to value food and reduce its waste, giving value to past and present experiences to raise awareness and suggest solutions to reduce food waste at-home. Moreover, Banco Alimentare (2020), an Italian foundation which fights against food waste since 2014, has reported some suggestions for a healthy and balanced food expenditure. Among these pillars, one of the main suggestions is represented by food purchase and meal planning, which could at the same time: a) implement a safe and healthy nutrition; b) help in respecting the rules of social distancing and quarantine; c) reduce the amount of food waste at final consumption.
The starting-point to understand how to reduce food waste is represented by the comprehension of its principal causes. According to literature (WRAP, 2009; Barilla Center for Food and Nutrition, 2012; Papargyropoulou, 2014; Van Geffen et al., 2016; Ravandi and Jovanovic, 2019), food waste is not only the consequence of food disposal and natural events but is the sum of wrong human behaviors during time. Among the principal causes, overproduction and overcooking represent the main reason for "leftovers" generation. Moreover, food waste is caused by wrong interpretation of food label (e.g., mistake between "best before" and "use-by"), lack of cooking skills (e.g. food burned or damaged during preparation), bad food storage according to climate and temperatures and limited knowledge on leftovers and waste management. Of course, such phenomenon depends on socio-demographic variables (e.g. age, gender, income and educational level, country, culture and traditions).
Thus, several individual actions have been suggested by national and international institution (FAO, 2020c; GOV.UK, 2020; Ministry of Health, 2020) and are summarized in table no. 2. Moreover, suggestions against food waste have been recorded also on *social-media* such as Instagram (United Nations Environment Programme, 2020), where people are sharing receipts demonstrating how to make great meals from what is at-home. Such experience could represent an interesting way to understand limits and opportunities of domestic consumption.

Table no. 2 Tips to reduce food waste at-home during Covid-19

Tips during Covid-19	Description
"*Ask for smaller portions*"	Reduction in portion sizes represents one of the crucial steps towards edible and safe leftovers generation, since it is generally assumed that leftovers in people's plate are no more edible.
"*Love your leftovers*"	Leftovers should be reused for further meals or as ingredients for other preparations but should be put in fridge or freezer.
"*Shop smart*"	Shopping planning helps in better ingredients choice and in meals organization, avoiding over-purchase, overcooking and leftovers.
"*Check your fridge*"	Fridge maintenance regards essentially its temperature. Food needs to be stored between 1 – 5°C to preserve freshness and quality.
"*Practice FIFO: first in, first out*"	Food storage and food rotation are related to fridges organization. It is essential to place new products on the back and old ones ahead.
"*Understand dates on your food*"	Food label comprehension must be clear: "use-by" indicates that food is not safe to eat anymore, while "best before" indicates that food has decreased its quality (smell, taste, texture).
"*Turn waste into compost*"	Compost production represents one important added-value solution for both inedible and unavoidable food waste (e.g. skins and scraps), both for its economic and environmental implications.
"*Sharing is caring: give to help*"	Surplus donation to charities or needing people reduces food waste production, but food safety must be ensured.

Source: Personal elaboration based on Amicarelli et al., 2020; FAO, 2020c and Ministry of Health, 2020

Conclusions

After having traced the main factors affecting food security and food waste during Covid-19 pandemic, the authors have observed what happened in the last six weeks of lockdowns in terms of food security and waste. There are no data available to make a comparison between "before" and "after", mainly because we are still dealing with Covid-19. The sanitary emergency is the goal to overcome and the social-economic catastrophe is the risk to avoid. This means that it will be necessary a long time to by-pass and to learn to cohabit with it. The authors voluntarily have decided to title this section "final remarks" rather than "conclusions" because, at the moment, there are no conclusions but reasonable considerations.

FAO (2020b) reassures that "globally, there is enough food for everyone", so there is no "need for the world to panic", but it does not mean that there are no problems. One of the three food security components is guaranteed (availability), the problem is to manage in the next months the other two (economic and physical accessibility and acceptability). The food supply chain is a complex system involving producers, consumers, agricultural and fishery inputs, processing and storage, transportation and marketing closely interconnected. As just mentioned before, the disruption of one of them might determine the stop and/or the collapse of the entire system (food system vulnerability). It is necessary that business managers and policy makers cooperate, with hard work, to make possible that food system will return to its desired (or original) state after being stressed by Covid-19 (food system resilience). In this last consideration it is included the opportunity offered by Covid-19, because society is facing

a cruel "stop" and we cannot lose the chance to start again based on all we have theorized and partially applied in terms of sustainability and circular economy approach.

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