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FOOD WASTE STATUS AND REDUCTION THROUGH THE CIRCULAR ECONOMY

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Abstract

Food waste and the circular economy are two major topics that the Earth's population should be concerned about. The circular economy has been discussed on a regular basis as a mechanism of better waste management through recycling, reuse, and recovery. As a result, this paper's aim is to reveal a comprehensive look at alternate solution implementations over the whole life cycle of any process, as well as the relationship between processes, environment, and economy. The research question is whether the circular economy is related to food waste, starting from the assumption that food waste can be prevented by applying the principles of circular economy. The findings show that the EU 28 contributes significantly to the global 1.3 billion tonnes of wasted food each year, while the cost of covering the 180 kg/capita of food wasted each year in the EU 28 raises up to 25% of the food products acquired, evidencing a massive monetization and a possible material overturn if this issue of reducing food waste is not properly managed. The relevance of the results consists in the fact that circular economy inspires new patterns and behaviors to consumers, assisting them in achieving greater sustainability. As a result, disposed food is no longer considered as a waste or energy recovery problem, but rather as an opportunity to enhance the overall system.

Key words**:** *circular economy, food waste, EU 28, disposal of food, household food waste*

INTRODUCTION

Over the time, food waste has significantly affected sustainability. This, combined with the consumption of meat and dairy products, is currently having a huge impact on the food systems.

Circular economy is part of the wider concept of green economy that implies fully reusable and recyclable material resources [20].

Food waste reduction is part of the European Union's Circular Economy Strategy, because of its three-dimensional importance determined through the impact over economic, environmental, and social aspects of any policy [38]. According to the European Commission (EC) [15], the goal of this strategy is to maximize resource efficiency by preserving the value of materials and expanding the product life cycle loop, to have an easier transition towards a circular economy (CE) that requires changes in technological infrastructures, business models and consumption practices in order to make this transition much easier [21].

The effects of human actions on the environment are causing significant worldwide challenges in our post-industrial era. These challenges necessitate a reconsideration of how we structure our economic and social relationships, which today appear to be bound by traditional technologies, lifestyles, supply chains, and organizational, regulatory, institutional, and political frameworks. The need for a transition to a circular economy has already been raised on the global policymakers' agenda, and it is already part of the strategic plans of established enterprises and sectors. Furthermore, significant issues persist for the actors involved in this change to overcome and make the required movement towards fully embracing the circulator economic model that represents the transition to sustainability [3].

The food sector, being one of the world's largest industries, is essential to the economies of many countries. Therefore, in the next 50 years, the increasing global population and food supply chain demands will determine a steep increase in food output [35].

Resources and environmental repercussions are sacrificed in vain when food is thrown away. Enhancing the usage of food produced and reducing waste are both necessary to fulfil the growing food demand in the face of threatening climate change effects and sustainability orientation [19]. In the products' route, from farm to fork, food waste occurs at every stage of the food chain. The last stages of the food chain, which include consumer-facing enterprises (hypermarkets, supermarkets, grocery stores, distribution facilities, restaurants; institutional food services) and residences, generate most of the food waste, especially in industrialized economies [13].

As people's living levels rise, businesses will change product proportions to accommodate customer psychology or remove large amounts of edible elements in the pursuit of high-quality items. As a result, vegetables, fruits, and other foods are thrown out due to their shape or expiration date, among other factors. Food waste is a major issue today, and it's becoming an increasing concern for many countries around the world. There has already been a lot of research done on food waste from the point of origin to the point of sale, and several restaurant management practices have established zero-waste policies [25].

Waste has become omnipresent around the globe, and natural resources are in higher demand than ever. Predictions indicate that about 80% of all materials and consumer items are discarded, and approximately 30% of processed food is discarded after it enters the food supply chain. The CE model promotes environmental conservation and social prosperity, as well as economic growth that is consistent with long-term development.

In this context, this piece of research has the objectives to reveal the relationships between food waste, environment, and economy, and, furthermore, to identify solutions for reducing food waste. It answers the question whether the circular economy is related to food waste. To achieve the research goals, a documentary study has been developed and statistical data have been introduced in econometric programs. The hypothesis tested in this article is that food waste quantities have increased in the last period, data evidencing the materiality of this issue transformed the topic of food waste into a global issue.

In the past few years there is an increased interest in food waste and abundant literature on the topic. The researchers [22, 26, 28, 33] were preoccupied by the legal framework of food waste, its hierarchy, reduction, donation, animal feeding and so on.

The increasing popularity of the topic of circular economy is also observable in the academic literature. In the last couple of years an increasing interest has been marked in various related aspects of this topic, including its implementation [10]. The paper's topic has its origins in industrial ecology, a concept that targets collaboration between the private sector and various production mechanisms [12].

Industrial ecology is also presenting the direct benefits of waste recycling through diverse linkages in various industrial collaborative projects [1].

Discarded food is common throughout the entire supply chain, even though it has all the properties to be edible for human consumption. Estimations account up to 30% of worldwide food production being wasted [18], fact that is significantly impacting the actual food systems that are already raising different uncertainties related to environmental boundaries as landfill still represents a used method for waste disposal in various states, resulting in chemicals known as contaminants (leachate, methane, and other greenhouse gases), whereas methane has more than twenty times negative impact than carbon dioxide. This resource resulting from landfilled food, isn't properly used as it could be valued through valorizing its heating and cooking properties [33]. Reduced or fully eliminated discarded food will result in an

improved food system [27] and improve food security and smart resource use.

The shifting of laws and regulations is pushing a reduction in the amount of trash that is generated, and it is encouraging the development of an economy based on biomaterials. This because these processes produce products and materials in a way that is more circular and sustainable. In addition, exhaustive research on the recovery of different products is required to address the present issues facing food waste biorefinery, bioeconomy re-engineering of food waste. Accordingly, different methodologies look at the current state of the art regarding biorefineries that process waste from food production. A critical analysis of recent research that has concentrated on food waste biorefineries that are used to produce biofuels, platform chemicals, biopolymers, bio-based fertilizers, bio-based enzymes, proteins, and other bio-based compounds and materials, is presented. In addition, an evaluation of the process of shifting from a linear economy to a more circular economy by meeting the objectives of sustainable development has been carried out. The technological obstacles that must be overcome to implement a zero-waste policy are explained, and various scenarios are analyzed [41]. The integration of processes that produce products and materials in a more circular and sustainable fashion is the only scenario for food waste valorization that will allow for the achievement of the sustainable development goals. This is because it is the only scenario that will allow for the valorization of food waste. There is no other way to salvage value from food scraps but this one.

Worldwide waste challenges can't be solved through an unequivocal direction, therefore the impossibility of having a common action framework on waste management throughout industries, states, and people. Legislated action points have been undertaken regarding generation and management of waste to provide some wider solutions, such as the Directive 2008/98/EC of the European Parliament that aims at diminishing harmful effects of human health and environment.

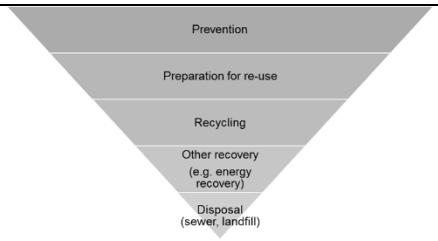


Fig. 1. Waste hierarchy
Source: Adapted from European Commission [16].

The directive of the European Parliament has highlighted the importance of prevention and reuse (material or energetical) of waste. As presented in the above figure, the directive is also establishing the hierarchical importance of all waste management stages, once again discrediting landfill disposal.

Food waste is more often presented as a global challenge, its conceptual framework is described in Figure 1. Authors [36] have adopted the EU waste hierarchy framework and adapted it across the entire food supply chain; double categorization was necessary to distinguish what can be recovered as part of the food excess, action situated at the waste prevention stage in the initial hierarchy. This novel definition is also including edible materials that reach the end-stages of the food supply chain.

Efficient management is mandatory as surplus of food is often the straightest solution for improving food insecurity. Food surpluses would have to be better integrated into a redistributive system and could be part of diverse food waste treatments such as donations, animal food or anaerobic digestion.

Organic waste reduction is becoming an increasingly important concern of businesses, organizations, governments, etc. due to the scandalous amount of food being brought from the field to the table. The aim is to prevent overproduction and the oversupply of food beyond what is needed for human consumption at all stages of the food value chain.

Retail also includes the avoidance of excess food [36]. Food waste can be easily reduced by managing inventory to minimize excess while maximizing shelf replenishment and warehouse life.

Sharing food to those in need through donations is more at hand in current times as

food networks can contribute to offering working systems, enhancing the continuous work into sustainably assisting the efforts towards ensuring the food security and safety.

Developing countries are facing difficulties in fully implementing the anaerobic digestion due to technical difficulties, insecure operations, and insufficiently enough waste management [34].

One example of smart alternative energy source is the biogas resulted from anaerobic digestion that is substituting the fossil fuels, making this resource a viable combustion alternative [29]. Resulted heating could become a temperature maintainer and if it is used in electricity generation, could also input the public grid [31].

Through different schemes, companies could create strategies to face businesses challenges by starting up new CE models so that bigger profits will appear for example by making use of by-products.

With around a third of all food produced for human consumption being lost or wasted [18], the use of this material has the potential to dampen demand for land.

As the concept of circular economy itself is based on the waste collection and fully elimination of debris [11] including food waste, an important aspect that current research piece is tackling through the following parts.

Current food waste situation

The generator sources of the wastes described below are attributed to both production and consumption activities. These datasets refer to as waste, to any substance or object that is discarded or is intended-required to be discarded as defined by Eurostat. In order to fully understand the food waste generation phenomenon, several databases have been interrogated at a total EU 28 level and by each member state in order to design an empirical analysis.

Food waste is a major economic, social, and environmental problem. Food waste management and reduction is a strategy to reduce production costs and maximize the food performance of the system, promote food and nutrition security, and contribute to a greener food system. Food demand management, including waste minimization, is an important aspect of developing sustainable food systems to accommodate the world's increasing population [32].

One third of the world's food output, or over 1.3 billion tonnes, is discarded annually. Researchers measured that even in Australia food waste is representing a major issue, residents generating in 2014-2015 around 3.1 mt of wasted food, resulting around 133 kg for each person. In the current world that is focusing on climate change and looking deeper in possible environmental crisis, wasted food generated by households is seen not just as a loss of finite energy and water, but also as an environmental issue due to emissions and toxic waste from deteriorating food waste in overburdened municipal landfills [43].

Food waste management integration, on the other hand, could have an influence on both municipal solid waste and liquid waste systems in terms of collecting, distribution, processing, and placement. Consequently, trying to divert food waste could relieve the load of solid waste intervention, potentially reducing adverse environmental effects from waste disposal in landfills or incineration, reducing energy use and greenhouse gas emissions from waste transportation, and reducing genetic disorder vectors [44].

The integrated resources and consequences that occur along the supply chain that brings food to customers' tables are included in the external impacts of food that is wasted (or consumed). In plenty of other words, thrown out food wastes resources and has unintended environmental implications. Food waste at later stages in the supply chain (i.e., at the retail and consumer levels) has accumulated more integrated asset use and affects than end up wasting at prior stages of production, and as such strategies to reduce waste at all these later stages are especially essential for the sustainable development and a great stage for circular economy [9].

Food supply chain sustainability is dependent on resource conservation, particularly water and energy preservation, while also food waste reduction and environmental quality implications. Beyond the manufacturing of

raw materials, the section of the food industry in industrialized countries consumes around 80% of the total energy required to distribute and prepare food for human consumption. Furthermore, these same sections of the food chain require a large quantity of fresh water, and well over 20% of the food is lost after delivery to the customer. Every market and procedure assessment is necessary for a comprehensive method for enhancing the food supply system's sustainability [24].

In order to decrease the food insecurity through reducing wasted food it is mandatory for all stakeholders to better collaborate across the chain, to provide comprehensive agricultural solutions and smartly resolve any supply-demand bottlenecks [37].

After the introduction, the literature review reveals the main streams of ideas about food waste and circular economy presented in scientific papers.

Then, the data about food waste are presented and analyzed, being discussed further as compared to the findings of other researchers. Finally, conclusions are drawn in the last part of the paper.

MATERIALS AND METHODS

As stated by [4] and [14] the EU 28 countries household food waste is more significant than the rest of the food supply chain, shrinking households' quantities of food waste could be seen as considerable effort towards reaching the EU targets for reducing food waste.

An important part of the following analysis will also be focusing on representing food waste through the importance that it pays in the process of fully transitioning the economy to a circular one. Biowaste, as stated by the data collectors (Eurostat in this paper's case), includes among others, food and kitchen waste from processing entities, offices, restaurants, retails and households as described by the Implementing Decision 2019/1004/EC and 2019/1885/EC.

Europe was the first continent to make strides toward minimizing and eliminating food waste as part of efforts to establish rules and strategies for the sustainable production of materials and chemicals. The legislation and restrictions prompted many businesses to rethink their methods of production, and they began transitioning towards technologies that were more environmentally friendly as a result. Therefore, accelerating the achievement of the sustainable development goals can be accomplished by transforming food waste into biofuels, bio-based fertilizers, bio-based enzymes, chemicals, proteins, and other bio-based compounds and materials. In addition, it has the benefits of (i) achieving the goals of zero waste generations; (ii) reducing or eliminating problems associated with waste management; (iii) reducing or eliminating costs associated with waste management; (iv) contributing to the sustainable production of materials and chemicals; and (v) fostering a circular bioeconomy. Consequently, the utilization of environmentally friendly technology for the recuperation of more valuable goods from food waste contributes to the reduction of environmental concerns [34].

Food waste results in a sizeable quantity of societal and environmental expenses; hence, the recovery of this resource has the potential to have a big and overwhelmingly beneficial effect on both society and the natural world. In developed nations, food waste is related with the actions of consumers, whereas in underdeveloped nations, it is associated with a lack of technological capabilities. consumer behavior is to blame for food waste in developed nations.

Fig. 2. Circular loops concerning the use of the technology "compost" for recycling household food waste

Source: Edited by the authors from [3].

According to a survey published by the "US Department of Agriculture," over 30 percent of food is wasted at the consumer and retail levels each year, which amounts to about 66.5 million tons and results in a financial loss of USD 161 billion [5].

Food waste across the supply chain in current practices, in the decreasing order of the added value, are ending as animal feed, composting, incineration or landfill.
Cost effectiveness comes from the route of completely reusing the food scraps in the animal feed processing processes [29].

RESULTS AND DISCUSSIONS

Food waste has been recognized as a worldwide issue with global ramifications due to its ecological, socioeconomic, impact, necessitating a revolution in governmental measures.
The agri-food supply chain's transformation to a Circular Economy will necessitate adequate support structures.
Worldwide, one-third of all food is thrown away, resulting in by-products that might be recovered and reintroduces in the commerce. In the low - carbon economy, analyzing the accessibility of recycled products and identifying the various conversion systems qualitatively and quantitatively is critical for the change to take place.
Able to fully recover and using this irreversible green waste percentage might be regarded a new method of resource extraction capable of decreasing non-renewable reserve reduction. As a result, vegetative biomass may be converted into petroleum products [40].

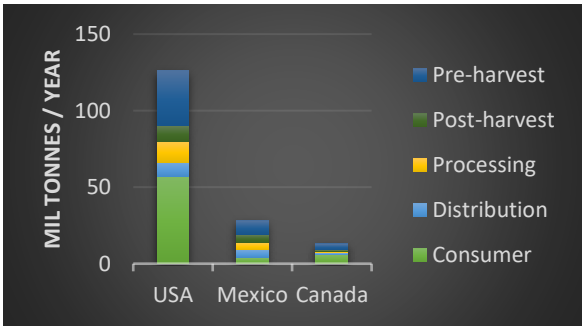


Fig. 3. North America food loss and waste estimates across the supply chain
Source: Edited by the Authors from The European Commission [16].

In order to validate the research hypothesis, the empirical structural data analysis has been chosen as the main method through multiple visual correlations and descriptive statistics. The dataset has been obtained from open-source international sites such as Eurostat and other UN databases.
Figure 3 illustrates the food loss and waste in North America, showing that the food is largely wasted to consumers, rather than in other stages of the supply chain.
According to Figure 4, those averages of the food waste percentages across multiple research papers, regarding food waste in European Union are generated throughout the whole supply chain. The most significant impact comes during the consumption phase that accounts more than the food wasted in the primary production and processing stages.

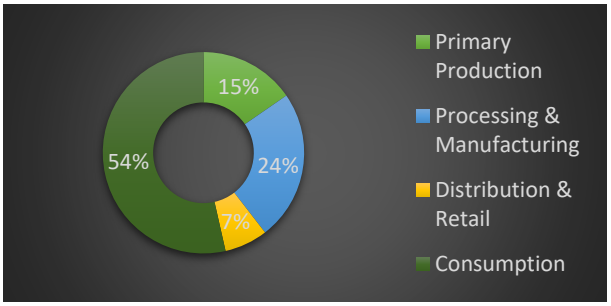


Fig. 4. EU 28 Food waste obtained split by supply chain actor presented as an average from multiple studies
Source: Edited by the authors from [6, 25, 26].

This fact that is not only applicable for the EU 28 countries as seen in the below worldwide representation where the consumption part takes most of the space in the food wasted across the supply chain, idea that is also represented in the following analysis.

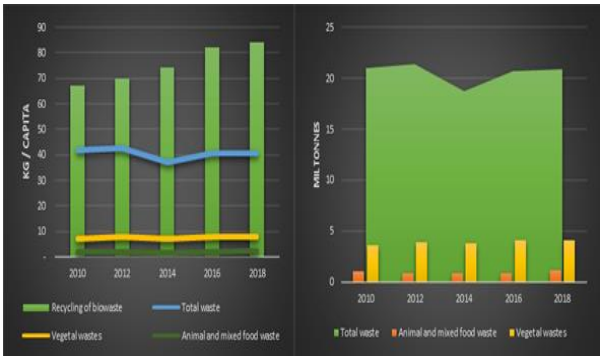


Fig. 5. (Left). EU 28 Agriculture, forestry and fishing food waste (vegetal; animal and mixed food waste) out of total waste compared to the recycling rate of biowaste (Right). EU 28 Agriculture, forestry and fishing waste structure (vegetal; animal and mixed food waste out of total waste)
Source: Edited by the authors from Eurostat [17].

As seen in Figure 5 (left), the kilogram per capita of biowaste recycled is significantly higher than the food waste generation rates for both vegetal and animal sector. The statistical indicators are separately analyzed in Table 1. The Figure 5 on the right side presents the effective waste materiality across EU 28 agricultural production stages.

We can clearly distinguish that animal and mixed food wastes are an insignificant part of the total wastes, for example in 2018, this category accounted 6% of total waste, a 16% increase over 2010, but taking vegetal wastes together with animal and mixed food waste then, on average, these two categories make up almost a quarter of the total wasted amounts across the studied period.

When considering agriculture, forestry, and fishing's food waste, it automatically ties back to a special stage in the supply chain, this specific stage where agriculture could be mapped against is definitely – Primary production, pre-harvest and post-harvest, stages that also include initial storage and freight. Possible wasted quantities in the vegetal/crops sector include non-harvested edible products, products that are edible but left on-field, harvested products not commercialized, rotten harvest, fruits or vegetables harmed by processing equipment, spilled substances, damaged products due to inappropriate handling and storage. Thinking about the animal production, most food waste along the limited supply chain, in the production stage, relates to directly discarded fish or other foodstuff and another contributing factor to the food waste's number may be caused, due to precarious storage and freight [39].

As seen in Figure 6 (left), the kilogram per capita of biowaste recycled rate is no longer more significant than the generative rates, in both vegetal and animal sector for households, with numbers that are on average up to 5 times more significant to the recycling rate of biowaste, indicating that households-final consumers' efforts are incomparable to discarded amounts, the statistical indicators are separately analyzed in Table 1. The right-hand side part of Figure 6 is presenting the effective EU 28 food waste at this level of the food supply chain.

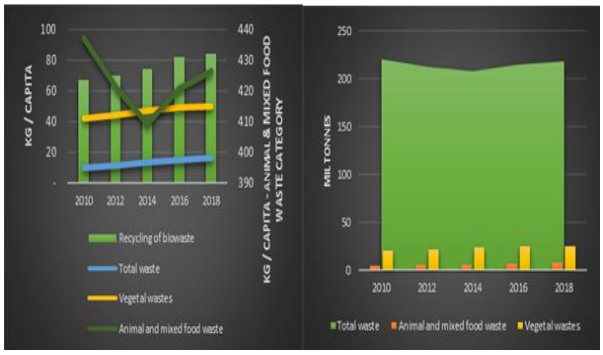


Fig. 6. (Left). EU 28 Households food waste (vegetal – left vertical axis; animal and mixed food - right vertical axis waste) out of total waste compared to the recycling rate of biowaste (Right). EU 28 Households waste structure (vegetal; animal and mixed food waste out of total waste)
Source: Edited by the authors from Eurostat [17].

Table 1. Descriptive statistics for EU 28 food waste from Agriculture… and households

Sector/Variable Fig 5 & 6	Recycling of biowaste kg/capita	*Households*		
		Total waste kg/capita	Vegetal wastes kg/capita	Animal and mixed food waste
Min	67 (2010)	9.7 (2010)	42 (2010)	409.3 (2014)
Max	84 (2018)	16.5 (2018)	50 (2018)	437.1 (2010)
Average value	75.4	13.1	46.4	422
Var newest/oldest	25%	70%	19%	-2%
Std Dev	7.4	2.7	3.3	10

Sector/Variable Fig 5 & 6	*Agriculture, forestry and fishing*		
	Total waste kg/capita	Vegetal wastes kg/capita	Animal and mixed food waste
Min	36.8 (2014)	7 (2010 & 2014)	1.7 (2016)
Max	42.4 (2012)	8 (2012, 2016, 2018)	2.2 (2018)
Average value	40.4	7.6	1.8
Var newest/oldest	-2%	14%	14%
Std Dev	2.1	0.5	0.2

Source: Edited by the authors based on the results.

We can clearly distinguish that animal and mixed food wastes are an insignificant part of the total wastes, for example in 2018, this category accounted 4% of total waste, seeing an increasing trend over the years with a 74% increase over 2010. Even when considering

taking vegetal wastes together with animal and mixed food waste then, on average, these two categories make up just 14% of the total wasted amounts across the studied period.

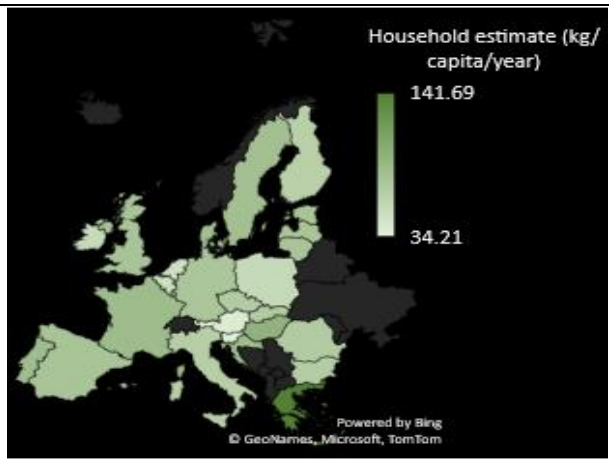
As presented in a 2020 study, the average yearly carelessness across the food supply chain is an important contributor to the yearly 1.3 bn tonnes of wasted food at a global level, while in the EU 28, the costs to cover the 180 kg/capita of food wasted each year, raises up to 25% of the food products that households acquire, revealing a huge monetization and a possible material overturn if this issue of reducing food waste would be properly managed [2].

As in the following part of the study, the United Nations Environment Programme database would be used to drag some EU 28 remarks to reinforce the already mentioned bullet points from the above data analysis. It was stated in the respective study that generated household food waste is similar within a specific country's regions, despite income levels, a remark that diverges from the other conclusion that food waste at the consumer stage is significantly higher in developed countries while developing countries encounter food waste during other different supply chain stages, as production, storage and logistics [42].

It is also important to be reminded that previous food waste estimates have resulted in a different manner (more than double) this time around when looking at the household values, compared to FAO's 2011 value ranges [23].

In Map 1, using UNEP's data, household food estimates clearly overrun the above-mentioned food waste data from Eurostat, indicating that clearly animal and mixed food waste together with vegetal wastes do not include all the facets of food wasted across EU 28.

From this map, one can notice the value sitting around the mean with a couple of countries doubling the average of 75 kg/capita/year across the Union, with 141.69 kg/capita/year (Greece) and 129 kg/capita/year (Malta).



Map 1. EU 28 country food waste estimates by state – households Source: Edited by the authors from UN Environment Programme Food Waste Index Report 2021 [42].

The top 5 minimum wasted amounts are recorded in Ireland, Netherlands, Belgium, Austria, and Slovenia. An aspect that is not overseen in this figure is the total food wasted quantity, measured in tonnes/year, absolute indicator that has Germany in the first place with 6.2 mil tonnes/year, France with 5.5 mil tonnes/year and the UK with 5.2 mil tonnes/year.

Prospecting the food wasted in the services sector of this industry, what can be seen in Map 2 is the fact that on average, around 25 kg/capita/year of food is wasted, highlighting that it equates 30% of the food wasted by households. Ireland comes first in the food services food wasted with almost 60 kg/capita/year while the lowest of the sector is recorded by the UK 16.5 kg/capita/year.

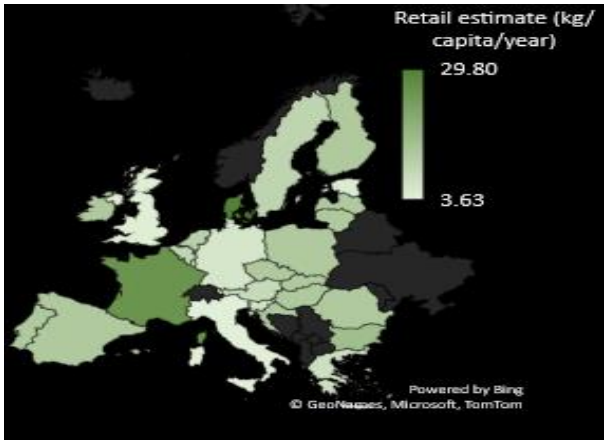
Map 2. EU 28 country food waste estimates by state – food service
Source: Edited by the authors from UN Environment Programme Food Waste Index Report 2021 [42].

In terms of absolute amounts, the same 2 countries sit at the top of the chart, Germany with 1.7 mil tonnes/year generated food waste from the food service sector and France with 1.5 mil tonnes/year.

In the retail sector, food waste records the lowest values across the three sectors mentioned earlier (Map 3), Denmark recording the highest value of food wasted, around 30 kg/capita/year, followed by France (25.6 kg/capita/year) and Bulgaria (15.6 kg/capita/year).

This sector weights 16% on average of the food wasted by households. Quantitatively, France retail sector wastes 1.6 mil tonnes/year, followed by Spain 0.6 mil tonnes/year and Germany 0.5 mil tonnes/year.

When thinking about the need of innovation and research in the food supply chain to reduce the food that is wasted, is obvious that wiser investment in smart technologies could minimize the waste effect and even using these discarded materials in any recycling processes should generate a better anti-food waste promotion scene.



Map 3. EU 28 country food waste estimates by state – retail estimate

Source: Edited by the authors from UN Environment Programme Food Waste Index Report 2021 [42].

Interestingly enough, the researchers have also noted a couple of reasons why the food is still wasted in companies' cases, despite the phenomenon still continuing to exist and even grow, such rationale of keeping food waste levels intact are marked by limited perspectives as [2]: reducing food waste could generate a larger cost than a clear benefit; prolonged investments pay-back; as investments require resources, business priorities don't necessarily have to be towards reducing wasted food; if there is extra food supply, the inexistence of a ready market could further cause wastages by the time the new market is established.

Strategic initiatives target food losses and aim at increasing efforts towards food waste reduction in a direct way while others come as an indirect result of consumers' behavioral change in the long run. Essential supply chain measures such as stock flow and shelf life are mandatory to be implemented to exclude unnecessary loses. Any approach oriented in solving this problem is required to be affordable and specifically applied therefore implementation itself is a fast-paced process mitigating long term profit losses [30].

In the anaerobic digestion process, the food is converted into biogas through bacteriological micro activity, process that generates both thermal and electrical energy offering wide applications in diverse sectors [7]. Different from other food waste elimination methods such as composting or incineration, anaerobic digestion besides the energetical recovery is also causing lesser environmental harm from the resulting greenhouse gases [8].

CONCLUSIONS

The paper analyzed the food waste worldwide and possible solutions for reducing it. A final answer to the research question is that food waste is related to circular economy, the latter being considered as a solution in fighting food waste. The hypothesis established at the beginning of the research, that food waste quantities have recorded increased numbers has been validated and even academic literature interest over this topic has constantly increased.

Worldwide economic agents will gain competitive advantages if the traditional economic modal would be converted to the circular one, from a consumption-oriented to reintroduction-oriented solutions because of waste reduction, recycling and reusage, implying improved performance indicators such as productivity, unit cost efficiency and profit. Significant production modernization

might come at hand when environmental concerns will be introduced in the production function, this will allow the sustainable development across industries and will generate an enhancement in competitiveness, innovation, labor market, social inclusion, and general well-being.

As food waste is generated from farmers to final consumers, composting represents a valid opportunity for economic and productive valorization, the resulted chain piece closes the composting loop. Data is pointing towards increased wasted amounts in households, while businesses stocks' efficiencies signal decreased food discarded. The businesses interest in keeping the consumers' levels up is understandable as a significant reduction in people's own food supplies shelfing would instantly mark reducing shopping frequency, thus decreasing revenues.

Purchasing promos are known to cause households oversupply that effectively result in increased wasted food; therefore, consumers should pay more attention on correctly evaluating family's food products needs to do the food stock replenishment in an efficient manner.

Evaluating wasted food increased trends and adverse forecasts, there could be found some favorable scenarios that could amend consumers' wasted quantities and not impact retailers' outcomes; on one hand any consumer should mind food spends and aim for overall savings just through a slightly better food purchasing habit, storage and usage; and on the other hand get retailers to broaden their business opportunities through implementing discarded food collection through various methods in order to introduce the picked up foods into any valorizing chain towards composting or energetical use.

The new model of consumerism and lifestyle adopted in this decade by the society has a multitude of economic and ecological implications. The minimization of wastage is the primary goal of the globally stated transition to a Circular Economy model, both from a corporate and scientific standpoint. Food waste is extremely significant because, in conjunction to technical and economic factors, it involves social and cultural factors. Wasted food can be reduced, and lost portions can be recovered, which might offer food to vulnerable communities. Also, it can be exploited and used to recover a variety of energy and resources, including biofuels, chemicals, and bioplastics, among many other products.

As natural resources continue to be pressurized due to emerging markets development, population and income growth, the traditional economic model, as previously stated, that is based on consumption, will need to revamp to one that is established on sustainable consumption and production patterns, enabling economic growth without any environmental costs.

Circular economy is ultimately the valid reason to accelerate proper waste management implementation and to close the life cycle loop for each process and their interactions between each other.

The scope of future research could be focusing on food waste reduction methods and what could be effectuated.

Current results are aiming in raising awareness for final consumers on the change importance of both production and consumption patterns.

Increased attention needs to be offered to the environmental side of the economy, an opportunity that needs to be expanded and intensified is the public funding aiming at supporting the circular economy.

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