

Food waste matters - The policy implications and sustainability of food waste practices

Questões de desperdício de alimentos - As implicações políticas e a sustentabilidade das práticas de desperdício de alimentos

Food waste matters - Las implicaciones políticas y la sostenibilidad de las prácticas de desperdicio de alimentos

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Ayobami Matthew Olajuyin

ORCID: <https://orcid.org/0000-0002-1733-6016>

American University of Nigeria, Nigeria

E-mail: doctorayobami@gmail.com; ayobami.olajuyin@aun.edu.ng

Hayatu Raji

ORCID: <https://orcid.org/0000-0001-7880-9481>

American University of Nigeria, Nigeria

E-mail: hayatu.raji@aun.edu.ng

Adaobi Iwu

ORCID: <https://orcid.org/0000-0001-7047-7160>

American University of Nigeria, Nigeria

E-mail: adaobi.iwu@aun.edu.ng

Helen Okunbor

ORCID: <https://orcid.org/0009-0008-9392-1779>

American University of Nigeria, Nigeria

E-mail: helen.okunbor@aun.edu.ng

Karis Albert

ORCID: <https://orcid.org/0009-0002-3192-9771>

American University of Nigeria, Nigeria

E-mail: karis.albert@aun.edu.ng

Adefunke Kafayat Olajuyin

ORCID: <https://orcid.org/0000-0001-8735-4167>

American University of Nigeria, Nigeria

E-mail: doctoradefunke@gmail.com

Adekunle Toyin Bamigbade

ORCID: <https://orcid.org/0000-0002-5878-2805>

Thomas Adewumi University Oko Kwara State, Nigeria

E-mail: adekunlebamigbade@gmail.com

Abstract

Food waste has grown in the last couple of years and is recognized by the general public, governments, education, companies, and Non-Governmental Organizations (NGOs) to cause greenhouse emissions and resource reduction. In the food supply chain, food waste is generated at all levels. The purpose of this article is to use information from various scholarly articles to analyze the determinants of consumer food waste and the key elements that facilitate or hinder food waste activities. Furthermore, we briefly discuss the contributions of various theories in understanding food wastage. This analysis shows that food waste needs to be understood and tackled with the views of different disciplines because it is quite complex. Understanding the reasons behind food waste production would aid in the creation of food waste preventive measures and sustainability.

Keywords: Food waste; Food policy; Sustainability; Food waste practices.

Resumo

O desperdício de alimentos cresceu nos últimos dois anos e é reconhecido pelo público em geral, governos, educação, empresas e Organizações Não Governamentais (ONGs) por causar emissões de gases de efeito estufa e redução de recursos. Na cadeia de abastecimento alimentar, o desperdício alimentar é gerado a todos os níveis. O objetivo deste artigo é usar informações de vários artigos acadêmicos para analisar os determinantes do desperdício de alimentos no consumidor e os elementos-chave que facilitam ou dificultam as atividades de desperdício de alimentos. Além disso, discutimos brevemente as contribuições de várias teorias na compreensão do desperdício de alimentos. Essa análise mostra que o desperdício de

alimentos precisa ser compreendido e enfrentado com as visões de diferentes disciplinas, pois é bastante complexo. Compreender as razões por trás da produção de desperdício de alimentos ajudaria na criação de medidas preventivas e de sustentabilidade do desperdício de alimentos.

Palavras-chave: Desperdício de alimentos; Política alimentar; Sustentabilidade; Práticas de desperdício de alimentos.

Resumen

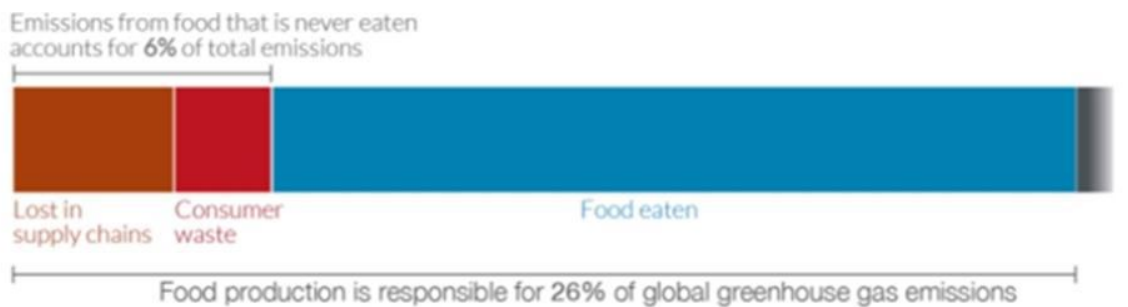
El desperdicio de alimentos ha crecido en los últimos años y es reconocido por el público en general, los gobiernos, la educación, las empresas y las organizaciones no gubernamentales (ONG) como causantes de emisiones de efecto invernadero y reducción de recursos. En la cadena de suministro de alimentos, el desperdicio de alimentos se genera en todos los niveles. El propósito de este artículo es utilizar la información de varios artículos académicos para analizar los determinantes de los desperdicios de alimentos de los consumidores y los elementos clave que facilitan o dificultan las actividades de desperdicio de alimentos. Además, discutimos brevemente las contribuciones de varias teorías en la comprensión del desperdicio de alimentos. Este análisis muestra que el desperdicio de alimentos necesita ser entendido y abordado con los puntos de vista de diferentes disciplinas porque es bastante complejo. Comprender las razones detrás de la producción de desperdicio de alimentos ayudaría en la creación de medidas preventivas y sostenibles para el desperdicio de alimentos.

Palabras clave: Desperdicio de alimentos; Política alimentaria; Sostenibilidad; Práticas de desperdicio de alimentos.

1. Introduction

Food waste is a process whereby the quantity or quality of food is reduced because of food supplier's actions (with the inclusion or exception of retailers, consumers, and food service providers) (Food and Agriculture Organization, 2020). As a result of food wastage, they affect the utilization of our resources like water, energy, climate, biodiversity, and land (Food and Agriculture Organization, 2013). As food waste affects our resources, it leads to a problem among the general public, governments, education, companies, and Non-Governmental Organizations (NGOs) (Schanes et al., 2018) due to lack of environmental sustainability (Kummu, et al., 2012; Licciardello, 2017). About 6 % of food waste accounts for greenhouse emissions (Figure 1). Hence, the requirements for necessary policy and ways to prevent wastage of our food to enhance sustainability.

Figure 1 - Greenhouse gas emission from Food (Adopted from our world data).



Source: Authors.

Analyzing food waste can be done by measuring the quantity of food wasted, per capita, by country, and where it occurs in the supply chain for different regions (Figure 2). As obtained from the Food Sustainability Index 2017, Australia, the United States, Turkey, Spain, and Japan have the highest food waste creation, which is 361kg, 278kg, 168kg, 165kg, and 157kg respectively. In contrast, Greece, China, India, Russia, and Colombia have the lowest food waste creation which is 44kg, 44kg, 51kg, 56kg, and 63kg respectively (Magnet, 2018). As of 2015, households were the largest contributors of the supply chain to food waste with 43%, this was followed by restaurants (18%), farms (16%), groceries and distribution (13%), institutional and food service (8%), and finally, manufacturers (2%). These statistics have had no relative change in the past years and the household sector remains the leading

contributor to food waste (Gunders & Bloom, 2017). Although private households have been the leading supply chain segment in food waste production, there has been little or no research done on this. Not overlooking the various research done on consumer food waste such as the article *Reasons for Household food waste with special attention to packaging* by Helen Williams which provides subtle knowledge on just one of the causes of household waste (packaging). There has been no research that gives a comprehensive review of the major causes of household food waste in society (Schanes et al., 2018).

Figure 2 - Share of food waste in post -harvest processes by region (adopted from our world data). Post -harvest losses are measured as the food lost from the farm level up to, but not, the retail. This includes handling and storage, food processing, transport, and distribution. It does not include consumer waste.



Source: Authors.

Therefore, we used information from various scholarly articles to analyze the determinants of consumer food waste and the key elements that facilitate or hinder food waste activities. We will also discuss the contributions of various theories in understanding food wastage as well as possible solutions and future research ideas. The information in this paper would make research easier as it provides collective information from various sources. It also helps to improve the efficiency and efficacy of policy initiatives and technological advances aimed at the production of food waste.

2. Methodology

The method used in this paper is a systematic literature review (narrative). This method was adopted as it is beneficial for scholars, researchers, as well as, practitioners. This is because it provides a reliable source of comprehensive information based on scholarly findings from a variety of research papers. It can also be used as a baseline for future research purposes.

Firstly, we obtained information from various research papers on the reason for food waste in households. But our research was solely limited to peer-reviewed journal articles written in English language and there was an exemption of gray literature for example policy statements, books, and government reports. By definition, gray literature is research that is not published or that was published in a non-commercial way.

The Google Scholar database was used as the basis of this research. The keywords used in the research for this paper were “food waste”, “household”, and “consumer.” These articles were sorted out manually and papers that were either not peer-reviewed literature or did not have a main focus on household food waste were not selected. Furthermore, references to the selected articles were checked and articles that were relevant to our focus were selected. This systematic literature review is based on the final list of articles.

2.1 Limitations

Data obtained from Europe was used in the analysis of the determinants of consumer food waste although the topic at hand is globally based. While this research aims to serve as a guide to demonstrate patterns in the occurrence of food waste, due to the lack of data from different countries specifically. Even though explaining, to a certain degree, differences in results based on country or culture are still limited because we don’t have all the countries listed. It can be an area for future research.

2.2 Analysis and bibliographic information

The tables below give a summary of authors and scientific journals that have published articles concerned with household food waste. From our research, we discovered that this area of research has been largely worked on by many authors in various journals. In Table 1, the author with the greatest number of publications was Brian Wansink, followed by Krista L. Thyberg and a variety of other authors. In Table 2, the journal with the most publications is the British Food Journal, followed by the Food Quality and Preference Journal and various other journals.

Table 1 - Top-10 authors (notwithstanding authorship) sorted by number of publications on consumer food waste.

| AUTHORS | NUMBER OF PUBLICATIONS |
|-------------------|------------------------|
| Brian Wansink | 7 |
| Krista L. Thyberg | 5 |
| Helen Williams | 4 |
| Sally V. Russell | 3 |
| Violeta Stancu | 3 |
| David Evans | 3 |
| Fazio Alessandro | 2 |
| Angela Meah | 2 |
| Paul Sparks | 2 |
| Donna C. Jessop | 2 |

Source: Authors.

Table 2 - Top 6 scientific journals classified based on the number of publications on household food waste.

| ACADEMIC JOURNALS | NUMBER OF PUBLICATIONS |
|------------------------------|------------------------|
| British Food Journal | 7 |
| Food Quality and Preference | 3 |
| Journal Of Consumer Behavior | 3 |
| Critical Public Health | 2 |
| Waste Management | 2 |
| PloS One | 2 |

Source: Authors.

3. Results: Explaining food Waste Behavior and Practices

In this section, we discuss the evidence provided by academic research on the reasons behind household food wastage. Firstly, we go through three highly referenced theories that sought relationships between various factors and food waste behavior. Then, we look into the views of individuals on food waste. We also present household food-related procedures that play a part in food waste production. Finally, we analyze the role of socio-demographic characteristics of food waste.

3.1 Theoretical perspective on food waste

Food waste behavior can be viewed through various theoretical perspectives. The perspectives that are going to be analyzed in this article include the theory of planned behavior (TPB), the theory of interpersonal behavior, and the social practice theory (Russell et al., 2017; Alexander 2020). The main theory this article focuses on is TPB which is commonly used to speculate and describe environmental behavior. While the other theory serves as a supplement. TPB indicates that behavior is specifically influenced by intentions. These intentions are influenced by (a) Subjective norms which consist of what other individuals expect of someone, who is relevant to the situation, to think about a particular behavior (b) Attitudes which are measures of an individual's behavior (c) Perceived behavioral control which measures a person's belief in their ability to carry out a certain behavior. All these come together to either facilitate or hinder one's behavior in a particular situation. That is to say if one feels that someone important expects them to behave in a certain way if the person has a good attitude to the behavior, and if they believe in their ability to carry out that behavior then their intentions to carry out that behavior grows dramatically and vice versa. However, a lapse in the TPB is the presumption that people make reasonable decisions (Russell et al., 2017).

Habits also play an essential role concerning food waste. This information can be considered significant being that the production and disposal of food waste is a habitual behavior (Russell et al., 2017). Just as habits, emotions play an essential role in food waste as suggested by the theory of interpersonal behavior. It is well known that emotions are significant in making decisions and have a huge ability to affect behavior although, not much is known about the extent to which emotions have an effect on individuals' pro-environmental behavior (Russell et al., 2017). There is evidence that negative emotions can positively affect the pro-environmental behavior of an individual. Likewise, positive emotions have also been shown to have an impact on said behaviors.

The third theory to be discussed is the social practice theory. This theory extends past human physiological factors like choice, attitude, and behavior by expanding the view on food waste production (Shove, 2020; Tiffany, 2021; Dahiya S 2018). The

difference between the psychological approach and social practices theory is that in social practice theory attitudes and practices are not causally related but rather an attitude can be structured by carrying out a practice (Schanes et al., 2018).

3.2 Understandings and perceptions of food waste

The end of any problem begins with the acknowledgment of the presence of the problem. People realizing that the waste of food is wrong, bad, or not environmentally sustainable is an important factor in the reduction of food waste. Studies have shown that most households associate food waste with negative emotions and this would serve as a strong drive towards our result to reduce food waste drastically because they would try to handle food better (Schanes et al., 2018).

3.3 Food-related household practices and routines

Research has been done concerning how food-related household practices and routines can lead to the generation of food waste. Psychological theories such as the theory of planned behavior give interesting perceptions to analyze our day-to-day food-related processes about food wastage in households. Household procedures like planning, shopping, storing, cooking, eating, and managing leftovers play a crucial role in the provision of food as well as the production of food waste. In this section, food items will be scrutinized (Wahlen & Winkel, 2017).

3.3.1 Planning

Planning plays a crucial role in the prevention of food wastage in the household. One can plan by checking the food store before shopping, making a shopping list, organizing meal plans before shopping, or by household members communicating with themselves about the food that is available in the house (Farr-Wharton, Forth, & Choi, 2014). These work efficiently to prevent food wastage or overbuying of food that is already available at home because when someone makes a shopping list before going to the grocery store, he/she is limited to buying food items that are on the list and are needed in the house. Moreover, these methods of planning do not always apply to those consumers who are very busy and have no time. So, they tend to buy food items that they already possess in their inventory. Which in turn leads to food waste in the household (Schanes, Dobernig, & Gozet, 2018).

3.3.2 Shopping

The majority of people go shopping with the mindset of buying the accurate amount of food items needed for their households. But they tend to end up buying more food items than needed. Providing more food items than necessary (overprovision) is one of the major reasons for surplus food. Reasons, why individuals provide more food items than necessary, are (a) the compensation effect, (b) the good provider identity, (c) differences in tastes, (d) time constraints (Evans, 2011).

Firstly, a good provider identity refers to someone's desire to be a good partner or a good parent. This is described as the wish to give plenty of food and also provide food that is believed to be proper. This identity moves beyond just the household; it can also be considered when it comes to treating guests. Because the notion of being a good host brings about providing plenty of food to the guests during various social occasions. The second reason is the differences in taste. In a household, everyone has different preferences. What one member of a household wants to eat doesn't necessarily correlate to what other members want to eat. To satisfy everyone's taste, more food items are bought thereby leading to food waste (Schanes et al., 2018). Next, the compensation effect happens when people know that the food, they eat is unhealthy, and to ease their guilt, they buy healthier food items that are perishable and would end up wasted (Schanes et al., 2018). Finally, time constraints are also a reason for overprovision because

when one is too busy to do proper planning before shopping, he or she tends to buy more food items than is needed (Schanes et al., 2018).

3.3.3 Storing

A potential way of reducing the production of food waste could be storing, arranging, and periodically re-arranging food products. This process is called systematic storage. During this process, food items can be reviewed and reutilized thereby, minimizing prospective waste. This is because it reduces the act of forgetting stored food items. As much as this process is assured to reduce food waste, a lack of proper understanding of the techniques to be used and limited space can affect it (Schanes et al., 2018).

Another way to reduce food wastage is to extend the shelf-life of the food items by storage techniques such as freezing. Although this is quite a powerful strategy, households have not yet discovered the strong relationship between storage techniques and the quantity of wasted food (Schanes et al., 2018).

3.3.4 Cooking

The effect of cooking on food waste is the problem of cooking food that is more than sufficient for the household. Families tend to cook food that is often too much and cannot be consumed, which leads to the throwing away of these foods. This can be prevented by adding accurate portion control as a cooking skill. These skills help whoever is cooking to know the right amount of food to prepare for their household and reduce waste. Another way is by using just the available food items in the inventory at home to cook. This leads to the production of new food recipes and reduces waste. But this preventive method becomes a barrier when household members do not like new recipes (Schanes et al., 2018).

3.3.5 Eating

There is a relationship between eating practices and the production of food wastage which has not been fully explored. Some studies have shown that households with fewer children or no children at all will produce less food waste because children's eating patterns and food bias cannot be predicted. However, the unforeseeable nature of children regarding their eating patterns and biases is also the same for adults. Reports show that individuals who spend more money on eat-outs tend to generate more food waste and this is done with less guilt as compared to someone who doesn't. This eating pattern in an adult is unpredictable because it can be a result of an unexpected hangout invitation which leads to food being left on the plate / wasted (Schanes et al., 2018). Parizeau et al. (2015) showed that households on specialized diets such as vegetarians are more likely to reduce food waste. It has also been reported that some individuals have a clash between the want to finish the food on the plate to avoid food wastage and the want to have a slim figure by eating less (Schanes et al., 2018).

3.3.6 Managing leftovers

The most efficient way to curb the wastage of food at the household level is by recycling leftovers. Households who reuse their leftovers by eating them tend to produce less waste than those who don't. However most households do not adhere to this because they are more concerned with the safety and durability of the leftover food. Besides, eating leftovers is most times associated with the feeling of sacrifice and saving for the interest of the family. Moreover, giving children leftover food comes with a belief that one does not properly care for the children. Also, most people don't enjoy eating the same type of food continuously or they don't eat foods that have been microwaved thereby believing that it has lost their freshness and quality. Other reasons can be because

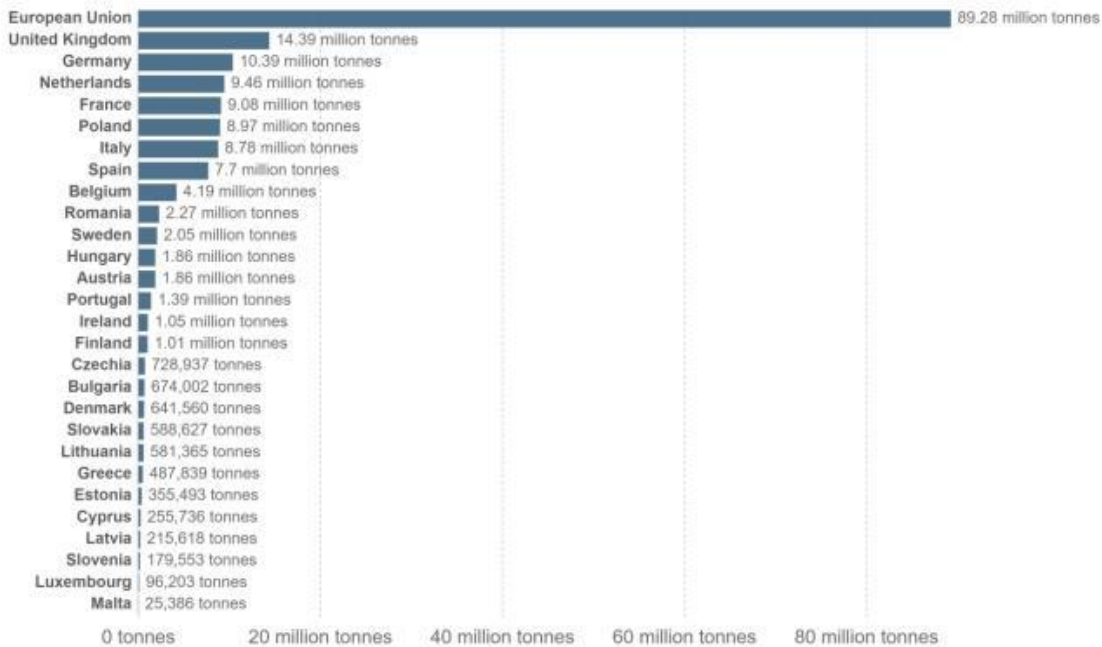
using the leftovers to make new meals is time-consuming, leftover foods stored in the fridge are often forgotten, and procrastination. All these eventually lead to the throwing away of leftovers causing an increase in food waste at this level (Schanes et al., 2018).

3.4 Socio-demographic characteristics

Although socio-demographics such as household size, age, and income show a correlation with food waste, socio-demographic characteristics cannot be singled out as a variable that explains the production of food waste, unlike other commonly referenced models. That is to say that they cannot be made into a simple model with strong predictive power (Schanes et al., 2018). In the analysis of an experiment conducted by Violeta Stancu, it was found that socio-demographic determinants such as smaller household size, older consumers, and lower income would lead to less food wastage (Stancu et al., 2016).

Another socio-demographic determinant of food wastage was seen to be awareness. Although there are different forms of awareness with respect to food wastage, the two types that were looked at were the awareness of economic consequences and the awareness of environmental and social consequences. Psycho-social factors are more related to the latter than the former whereas the reverse is the case for food-related routines and household skills. That is, factors such as leftover reutilization, shopping, household skills, etc. are linked strongly to awareness of economic consequences while only leftover reutilization is weakly linked to awareness of environmental and social consequences. It should be noted that awareness of economic consequences has a stronger negative relationship than awareness of environmental and social consequences of food waste (Stancu et al., 2016). Geographical locations such as urban and rural areas have also been looked at in some studies as socio-demographic determinants in which urban dwellers are said to generate more food waste (Figure 3). However, there has been no noteworthy association between living in an urban area and self-reported food wastage behavior (Schanes et al., 2018).

Figure 3 - Food waste by country in the European Union (Adopted from our world data). Annual food wastage across the supply chain in the European Union measured in tonnes per year.



Source: Authors.

4. Discussion: Key Leverage Points for Household Food Waste Prevention

Our goal is to achieve the twelve sustainable development goals (SDGs) and to reduce per capita food waste by half on the level of the consumer in the supply chain. This goal is to be met by 2030 and it would be achieved through a combination of measures in a complex approach. Although not focused on recent approaches, a consistent policy structure is needed. In the following section, we deliberate on the use of mobile applications, basic policy measures, and potential actions that both producers and retailers can adhere to curb food wastage at the household level (Schanes et al., 2018).

4.1 Policy initiatives

Policies aimed at preventing food waste should focus on the situation or activities that bring about food waste. These policies should be informed by the determinants of waste production. Policy approaches should be directed at both the psycho-social and the logistical reasons behind food waste creation. That is to say, in the bid to reduce food waste creation, different policies have to be used simultaneously to address the different reasons behind this problem and also different parts of the population (Thyberg & Tonjes, 2016). Three important aspects should be incorporated to create this food waste prevention policy pack. These keys include values, skills, and logistics. When referring to values, in this case, one is talking about the making of policies that focus on the perceptions, motivations, and values regarding food waste. These types of policies should tackle the concerns and consequences of food waste. Such concerns include the negative economic and environmental consequences and the aftermath feeling of guilt which may result from food wastage (Thyberg & Tonjes, 2016). Examples of value policies are a campaign that educates people on the advantages of food waste prevention and how environmental and social altruism is very important (Wilson, 1996). One way to help the value policy flourish is to make food waste quantities known to the public (Thyberg & Tonjes, 2016).

Another one of the key components includes skills. This focuses on giving people the skills and tools that would aid them in food waste management and prevention. Such skills include food planning, shopping, and storage skills. These skills would enable consumers to apprehend food safety better and work towards achieving it. (Thyberg & Tonjes, 2016) (Schanes et al., 2018).

Logistics is the final key component that should be incorporated in the making of food waste prevention policies. Logistical advancements that could be made include improvements in food packaging to better protect the product from damage, bringing about increments in the eating time of students, enablement of different means and platforms for easy food redistribution, etc. (Thyberg & Tonjes, 2016).

Food waste prevention policies are a good way to drastically reduce the quantity of food waste on the household level. However, the policy practices may not be well received by the consumers and may not come cheap (Thyberg & Tonjes, 2016).

4.2 Business and retailer solutions

Businesses and retailers can curb household food waste in various ways, but we will be stating three main solutions in this section. They include food packaging, date-labeling on foods, and retailer's options to reduce household food waste.

4.2.1 Food packaging

The shelf-life of a food item mainly depends on how it's packaged. The packaging of a food item plays a major role in preserving it and retaining its quality. However, this sole purpose is not being met because 30% of food items produced around the world are wasted due to poor packaging (Wohner et al., 2019). Although, improving the efficiency of packaging can help increase the shelf-life of food items and reduce food waste. But how can this be achieved? Recently, some technologies have been discovered

that could help improve packaging like Modified Atmosphere Packaging (MAP) and Multilayer Barrier Packaging (MBP). Modified Atmosphere Packaging is the most notable technology that is used. This technology aims to modify the atmosphere present in the package using the interaction between the rate of respiration and the movement of gases in and out of the package. Other ways can be by making packages that are re-sealable and easy to empty. Lastly, the government can also provide incentives to producers to encourage them to improve their packaging using these technologies (Schanes et al., 2018).

4.2.2 Date-labelling

Date-labeling is another problem surrounding household food waste. This is due to the lack of knowledge of the consumers about what the date labels mean. There is a common confusion among consumers regarding the difference between the minimum durability date and the expiry date. They have no idea that the expiry date is two dates: the “use by date” and the “best before date”. The best before date simply means the date of the minimum lifespan of the food item. Which is the date that the food still maintains its quality (texture and flavor) (Wohner et al., 2019). This means that food items can still be consumed after it has passed their best-before date. But in the case of perishable foods like tomatoes and pepper a use-by date is used instead. And after the use-by date has been exceeded the food is not advisable to be consumed. Moreover, this problem can be solved using a technology called the Time-Temperature Indicator (TTI). This measures the time-temperature-dependent changes in the temperature of the food item since it was produced (Schanes et al., 2018).

4.2.3 Retailers Options

Retailers also play a role in the reduction of food waste in the supply chain. They can do this by reducing bulk purchases and also not selling regular food items at discounted prices. Some retail outlets have begun to take precautions that could help reduce food waste at their level. As of 2010, retail outlets like Sainburys and Tesco have started a campaign called “Buy One Get One Later” to help curb household food waste (Schanes et al., 2018). Finally, a reduction in food waste at the retail stage can bring a drastic change in the vision to reduce household food waste.

4.3 Mobile applications

A potential tool that would aid in reducing food waste is technology. Few applications are available and provide practical ways in which one can extend shelf-life, food supply knowledge, planning, and grocery shopping education and recipes which one can use leftovers to create. Such applications include the British app “Love your Leftovers” and the German app “Zu Gut für die Tonne” (Yalvac et al., 2014).

Another way technology can serve as a key tool in this goal of consumer-level food waste consumption is to create an online platform in which surplus food, which is still in good condition, can be sent out to other people who need it. A good example of such an app would be the British app “ÖLIO” which links nearby people and local businesses for food redistribution. Although this is a good technological tool, food redistribution through smartphone applications is not as simple as it seems. Due to this, it is not yet generally accepted by individuals worldwide (Schanes et al., 2018). Other applications include Kitche App Tutorial, Food for All, Too Good To Go, and Misfits Market etc.

5. Conclusions

The aim of this paper was to use information from various scholarly articles to analyze the determinants of consumer food waste and the key elements that facilitate or hinder food waste activities, discuss the contributions of various theories in understanding food wastage, and sustainability of food waste practice. From our analysis, it was shown that there is a widespread concern in households regarding food wastage. There is evidence that negative emotions and feelings of guilt can positively affect the pro-environmental behavior of an individual. Likewise, positive emotions have also been shown to have an impact. It is recommended that more awareness is created for the people to know how to manage their food waste and also their resources to enhance sustainability. Other mobile and computer-based applications that can enhance sustainability and reduce food waste should be created and given free access to the public.

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Authors' contributions

All the authors contributed to the preparation of this paper. IA, OH, and KA were responsible for the first draft of the article. AMO, HR, AKO, OOB, and ATB made substantial contributions to manuscript data analysis, AMO conception, and design and participated in its critical review and final editing. All authors read and approved the final manuscript.

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