FOOD WASTE AND POSSIBILITIES OF MANAGEMENT: A REVIEW

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ABSTRACT
Rapid increment in the population can be directly connected with the rapid increase in the generation of waste. Mismanagement of solid waste can cause adverse environmental impacts, socio-economic problems and can pose risk to the public health. Enumerating the current scenario food waste is increasing from time to time, be it the waste generated through the supply chain, institutions, or households, a lot of natural resources are going to waste, and this worsens the situation if not disposed of properly can create an adverse effect on the environment itself. This paper tries to understand food waste which can help the researchers and authorities responsible for waste management to bridge the gaps and lacunas present in the existing systems.

Keywords: Waste Management, Food Waste, Solid Waste, Environment

INTRODUCTION
Human activities either directly or indirectly can have a profound impact on the type and quantity of the waste being generated (Kumar et al., 2016). India is the second most populous country in the world with a population of approximately 1.27 billion people (Jaipur City Population 2023 | Literacy and Hindu Muslim Population, n.d.). In terms of land area it is the seventh largest country in the world with an area of 3.200 million sq. km. ("World Food Agric. – Stat. Yearb. 2022," 2022). Adding to the economic growth and development, standard of living, and urbanization an increasing trend was observed in terms of the complexity of the type of waste being generated (Sonawane & Sharma, 2019).

Food waste is the term that is collectively used for the edible and inedible parts of food which are thrown away or not consumed (Kaur et al., 2020). In other words, food waste can be defined as leftover foods or foods that have been left to spoil along with edible portions, and the foods that have been discarded for a variety of reasons (Bernstad, 2014; Hanssen et al., 2016; Stenmarck et al., 2016). In recent years food waste is segregated as "avoidable," "partially avoidable," and "unavoidable." However, the definition of food waste varies by country and culture. For example, while animal offal is considered food in some cultures, it is considered food waste in others and is discarded as a result.

Personal habits contribute to partially avoidable food waste. Bread crusts and apple peels, for example, which may not be appealing to some people, end up being wasted (Munthe Vice President et al., 2011). In contrast, food waste generated during preparation, such as peels, bones, and shells, is referred to as unavoidable food waste (Bernstad Saraiva Schott & Andersson, 2015). Avoidable food waste accounts for a large proportion of household food waste, accounting for between 35% and 60% in advanced economies (Hanssen et al., 2016).

Food waste definitions are not universally accepted, making it difficult to study and quantify food waste. Various classifications are generated based on the materials used, the methods of production, and management approaches. Food loss, food waste, biological waste, and kitchen waste are all synonymous terms that have been used interchangeably. Furthermore, the same terms are frequently used but with different meanings (Thyberg & Tonjes, 2016).

The main objectives of the present study are to identify the gaps between existing works of literature and propose prospective research in food waste scenario and possibilities of management. Subsequently, to promote research in the field of food waste, we reviewed the existing literature and accumulated learning on the topic, so that future researchers can develop upon them and further enrich the area.

METHODOLOGY
We intended to conduct a critical and comprehensive synthesis of the accumulated knowledge about the food waste scenario and management options. To achieve the study's broad goal, we used the systematic literature review (SLR) method. SLR is a secondary research method that originated in medical science but is now widely used in social science and management (Bavik, 2020; Mariani et al., 2018; Seth et al., 2020).

We propose reviewing studies on food waste scenarios and possibilities of management. In addition, we distinguished the difference between food waste, food waste scenarios, and possibilities of food waste management previously, some studies used the terms food loss and food intake interchangeably with "waste" (Betz et al., 2015). Many academics, however, have classified them as two various concepts. They defined food

loss as food that went to waste during the initial stage of the process. Food waste is defined as food lost at the end of the food supply chain (Parfitt et al., 2010). According to our understanding, food loss refers to food that initially leaves the supply chain. However, food waste refers to food that is not consumed.

DISCUSSION

Food waste data in India
Food waste reduction benefits both people and the environment by increasing food security, addressing climate change, saving money, and reducing pressures on land, water, biodiversity, and waste management systems. However, this potential has been woefully underutilized to date. This possibility may have been overlooked because the true scope of food waste and its consequences are not well understood. Global estimates of food waste have relied on the extrapolation of data from a small number of countries, which is frequently based on old data. Few governments have reliable data on food waste to justify and prioritize their efforts (Annual Report 2022 | UNEP - UN Environment Programme, n.d.).

Under Sustainable Development Goals, SDG-12 specifically 12.3 deals with food waste, captures a commitment to halve food waste at the retail and consumer level, as well as reduce food loss across supply chains. The food waste index report (UN, 2021) aims to advance SDG 12.3 progress in two ways. First, it presents the most comprehensive food waste data collection, analysis, and modeling to yield a new global food waste estimate. Second, to track national progress toward 2030.

Food waste sources
Food waste occurs throughout the production process, from the farm to distribution to retailers to the consumer. Losses from mold, pests, and insufficient climate control are among the most looked upon causes. Apart from those losses from cooking and intentional food waste also plays a crucial role in terms of the circular economy. The waste is classified differently depending on where it occurs, i.e., whether food loss occurs before the food reaches the consumer as a result of problems during the manufacturing, storage, processing, and distribution stages or from the consumer's end. Food waste is food that is fit for consumption but is discarded consciously during the retail or consumption phases (Food Waste Activities | USDA, n.d.). Identifying several stages of the supply chain where food waste is generated (e.g. Manufacturer, retailer, etc.) and assessing the edibility of the waste can help the avoidable (edible parts of the food), unavoidable (inedible parts of the food, such as bones, fruit skin, and so on), and possibly avoidable (food that some people would have eaten and others do not, such as bread crusts and potato skins) food wastage (Bridgwater, 2012).

Further classification of food waste at the household level can be marked as cooked/uncooked, unpackaged/packaged food waste (when waste is packaged, it is also sorted as opened/unopened packaging), and based on the reason for disposal (Bernstad Saraiva Schott & Andersson, 2015).

Food waste has far-reaching consequences, both nationally and globally. In the United States, up to 40% of all food produced goes uneaten, and approximately 95% of discarded food ends up in landfills. At 21%, it is the most significant component of municipal solid waste. Over 38 million tonnes of food waste was generated in 2014, with only 5% diverted from landfills and incinerators for composting. Methane, a powerful greenhouse gas that contributes to global warming, is produced when food waste decomposes. One-third of all food produced is thrown away uneaten, putting an additional strain on the environment. It is estimated that cutting food waste by 15% could feed over 25 million Americans each year (O'Donnell et al., 2015).

Apart from all these reseasons personal preferences can also be traced to be responsible for almost 14% of the avoidable food waste (580,000 tonnes). The majority of this (530,000 tonnes) was attributed to fussy eating, with beverages and meals contributing the most, followed by dairy and eggs, fresh fruits and vegetables, salads, and baked goods (Bolos et al., 2022).

Reasons for Food Waste
Food waste is one of the most difficult problems that humanity is currently facing on a global scale. Food systems are currently extremely inefficient: it is estimated that one-third to one-half of all food produced is lost before reaching a human mouth (Global Food Waste Not, Want Not., n.d.).

Food waste is primarily caused by financial, managerial, and technical constraints on harvesting, storage facilities, refrigeration in poor weather conditions, infrastructure, packaging, and marketing systems in low-income countries, whereas it is primarily caused by consumer behavior and a lack of coordination among various supply chain actors in middle/high-income countries. Food is wasted as a result of quality standards, which reject food items that are not aesthetically perfect. Excessive purchases and expiration dates, combined with consumers' careless attitude, result in large amounts of waste at the consumer level (Gustavsson et al.,

2011). Food waste is increasing as a direct result of overproduction, mismanagement, and human behavior. In the United Kingdom, for example, a lack of robust consumer data limits the ability to understand and address food waste, as well as the adoption of long-term sustainable prevention strategies (Facchini et al., 2018).

Food waste generation at the household level, as highlighted by several authors, is a highly complex and multifaceted issue motivated by a variety of reasons and types of behavior. Families' attitudes toward waste prevention are generally ambivalent, with conflicts arising between good intentions to reduce food waste and personal preferences for food safety, taste, and freshness. According to food waste studies, people over the age of 65 spend less, and families with children waste more food. Furthermore, overprovision, systematic storage, misinformation about food expiration dates and date labels, as well as a dislike of food waste, are all important reasons for the disposal of excess food (Schanes et al., 2018).

Expired foods, food leftovers, food misuse, lack of awareness, label mixing, and inappropriate storage conditions are the main causes of food waste, while food losses are caused by a lack of fertilization of plantations, imprecise application of agrochemicals, incorrect post-harvest handling, adverse weather conditions, a lack of technology, improper transportation and logistics, and inoperative packaging in food maintenance (de Moraes et al., 2020).

According to Lag-Brotons et al., (2020), climate change and food waste issues are caused by the over-exploitation of natural resources and the increasing generation of solid and food waste. For them, political action to return lost natural resources within planetary limits is critical to ensuring human well-being, resulting in a closed-loop system that preserves the value of raw materials and food waste within a sustainable economy.

Roughly one-third of food produced for human consumption is lost or wasted globally, amounting to approximately 1.3 billion tonnes per year. This inevitably means that vast amounts of resources used in food production are wasted, and that greenhouse gas emissions caused by food production that is lost or wasted which means it is discarded even if it is still fit for human consumption (Gustavsson et al., 2011).

In the industrialized world, significant losses occur early in the food supply chain. Food is mostly lost in low-income countries during the early and middle stages of the food supply chain; much less food is wasted at the consumer level. Overall, the industrialized world wastes far more food per capita than developing countries. We estimate that per capita food waste in Europe and North America is 95-115 kg/year, while it is only 6-11 kg/year in Sub-Saharan Africa and South/Southeast Asia (Gustavsson et al., 2011).

Food losses and wastes are indirectly accompanied by a wide range of environmental impacts, such as soil erosion, deforestation, water and air pollution, and greenhouse gas emissions that occur during the processes of food production, storage, transportation, and waste management, due to the resource-intensive nature of food production (Mourad, 2016). Scenarios for Europe show a significant potential for lowering emissions by reducing food waste (Rutten et al., 2013). Food waste is increasingly recognized as an urgent issue among governments, businesses, NGOs, academics, and the general public as a result of these growing environmental, social, and economic concerns. As a result, there is a growing body of evidence on the amount of food wasted and the associated emissions along the food production-consumption chain (Beretta et al., 2013; Edjabou et al., 2016).

Given the high levels of food waste at the household level, preventing food waste at the final stages of the supply chain is critical to preventing further climate change (Parfitt et al., 2010). However, there is still a scarcity of field research on consumer-generated food waste in the context of private households. Despite an increasing number of studies, little is known about the factors that influence consumer food waste and the underlying factors that encourage, drive, or impede food waste behaviors and practices (Graham-Rowe et al., 2014). A closer look at households reveals that the issues of food waste and sustainable food practices are multifaceted (Plessz & Evans, 2016). Food waste in the world currently accounts for approximately one-third of all food produced for human consumption; each year, approximately 1.3 billion tonnes are lost or simply wasted.

Food waste causes enormous losses in a variety of countries, both developed and developing. It is estimated that 670 million tonnes of food are wasted in developed countries, while, 630 million tonnes of food are wasted in developing countries, with tubers, vegetables, and fruit wasting the most food (UN, 2021).

Solutions for Tackling Food Waste

The first concept generated to tackle cooked food waste was by donating the excess food to the "food banks". Food banks further distribute the food before it goes stale to charities or to potential recipients who are in need (Mourad, 2016).

Composting is recently gaining attention at the household level. Organic waste composting is a process where the organic waste is put into composting, for example vermicomposting. In the process of vermicomposting earthworms being voracious eaters, consumes huge heaps of organic waste and turn it into vermicompost, which has many beneficial nutrients and minerals helpful for enriching the soils (Trehan et al., 2014). The composting process also helps to suppress the harmful diseases and pests which are resulted from the landfills. This also reduces methane production. Some of the other forms of composting include, vessel composting which is mainly used for crop residues and agro-industrial by-products. Windrow composting for the garden wastes, such as leaves, garden clippings, grass cuttings, pruning waste, etc, along with the mixture of household food waste.

Anaerobic digestion is a process where food waste is treated in such a manner that the energy from the waste is recovered in the form of methane extraction which in terms can be used for combustion purposes. The only disadvantage is that anaerobic digestion needs to be performed in controlled conditions, and should be carefully handled to prevent gas leaks (Jain et al., 2018).

Apart from all the types of food waste management techniques one of the first and foremost things consumers need to get to is their role in the generation of waste. Waste generation is a continuous process and can not be stopped with whatever measures we take, but the core concept is how much waste is being generated and how you choose to manage the waste.

CONCLUSION

To conclude food waste can be defined in a variety of terms for a variety of items, but the major concern is how one tackles the issue with consciousness. Suggestions from the literature studies show that more research on different policies should be explored and consumers should be educated regarding food waste management strategies. Studies can be encouraged on the improvement of the shelf life of foods to minimize the handling and transportation of waste in the supply chain. As consumers and manufacturers are the two key ends to food waste they should be thoroughly educated and motivated to bring out change in the future generations.

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