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DELVING INTO FOOD LOSS AND WASTE: REVIEW AND APPRAISAL OF LITERATURE

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Abstract

Food waste issues are discussed at various levels globally, nationally, regionally, and locally. Food waste is not only an economic crime but also an environmental and social one. Economically, it involves costs in the production and consumption of food and related products. Environmentally, food production utilizes natural resources such as water and energy, leading to various waste-related pollutants harmful to nature and humanity. Socially, many people in developing countries suffer from poverty, hunger, and malnutrition. Numerous national and international organizations are actively working to eradicate poverty, hunger, and malnutrition. The forthcoming years are expected to witness planetary crises impacting the entire world. Following the publication of global food waste reports in 2021 and 2024, scholars and researchers have focused their efforts on raising awareness about the causes and consequences of food waste issues. Against this backdrop, the authors aim to review and evaluate existing literature on food waste issues.

Keywords: food loss, food waste, literature review

I. Introduction

In a knowledge-driven society, knowledge grows rapidly, doubling and multiplying within short periods. Scholars, researchers, writers, and experts continually add new dimensions to knowledge through analysis, discussions, thematic studies, and research writings. Literature review plays a crucial role in research, providing a comprehensive background and identifying gaps for further investigation. It begins with problem selection, continues through research stages, and concludes with report writing. Reviewing literature helps identify research gaps, enabling researchers to make meaningful contributions. By surveying existing literature, researchers gain background knowledge, identify concepts, formulate hypotheses, select appropriate methodologies, and understand data sources and report structures. This ongoing task ensures that the proposed study is unique and contributes to existing knowledge. The literature review presented here is tailored to suite a study on food loss and food waste management from current to the past.

II. Review and Appraisal of the Literature

Hasan and Lateef (2024) explore global food waste, noting significant daily discards of edible food. They delve into innovative conversion technologies aiming to turn this waste into valuable animal feed, detailing methods like anaerobic digestion, insect-based conversion, and microbial fermentation. Environmental benefits, like waste and greenhouse gas emission reduction, are discussed. The review underscores the potential of these technologies for a more sustainable food system.

Global food systems' greenhouse gas emissions, largely from avoidable food waste, contribute significantly to overall emissions. Despite one billion people facing food insecurity, one-third to half of global food ends up in landfills daily due to negligence and unequal technology. Minimizing negative impacts during food waste management is crucial, yet existing strategies face challenges like methane emissions and pollution. Improved strategies, including education campaigns and advanced technologies, are emerging. However, broader impacts and factors like dietary preferences and income disparities complicate efforts **(NPJ Sustainable Agriculture, 2024)**.

Sahoo et al. (2024) highlight the significant issue of food waste, with up to one-third of food grown for human consumption being wasted, posing environmental and socio-economic challenges. In India, rapid urban expansion, modernization, and population growth contribute to increasing food waste output, making effective waste management crucial. The review focuses on the challenges, management strategies, and future perspectives of food waste management in India, emphasizing the need for

comprehensive characterization of food waste and improved waste management methods. Additionally, it covers government policies and rules aimed at managing food waste effectively in the country.

Mandal et al. (2024) highlight the global crisis of increasing food waste, valued at $1.2 trillion annually. They advocate for transforming waste into valuable products to improve food security, lower production costs, and promote environmental sustainability. Effective management of food waste can also reduce health risks and enhance bio-based fertilizer production, offering benefits for agricultural sustainability. By shifting towards bio-based fertilizers derived from natural resources, such as food waste, the adverse effects of synthetic fertilizers can be mitigated, supporting higher yields and soil fertility.

Pier, Paolo, Franzese (2023) delve into the global issue of food waste and loss (FWL) within current food systems, examining its impact on environmental sustainability and food security. They analyse scientific literature using social network analysis and bibliometrics, revealing a growing body of research since 2010. The focus has shifted towards proactive upstream strategies and policies to reduce waste, highlighting the need for interdisciplinary approaches to address FWL's significant ethical, environmental, social, and economic implications.

Alexander et al. (2023) studied a pilot project by the Circular Innovation Council in Canada, targeting source-separated organic waste and donatable food from industrial, commercial, and institutional sectors. With 53 participating businesses in the first year, the project diverted 230,637 kg of food/organic waste from landfills, providing 39,447 meals valued at $131,803.76. Long-term care/hospital facilities and grocery stores generated the most waste. The project also prevented 182,000 kg of emissions through food donation and 2,360,000 kg through waste diversion. Supporting dedicated food recovery and organics collection services for IC and I generators could significantly reduce greenhouse gas emissions and bolster emergency food systems.

Rauoof et al. (2023) highlight the significant challenge of food waste worldwide, especially in developing nations, impacting waste management processes. They stress the importance of collaborative efforts across the food supply chain to address this issue in alignment with Sustainable Development Goal 2. Sustainable food waste management technologies, including source reduction and advanced treatment methods, are crucial for converting food waste into valuable products like feed, biofuels, and biopolymers. The study suggests improving agricultural practices and adopting sustainable management approaches to enhance environmental conditions. However, traditional food waste reduction strategies have limitations in reducing greenhouse gas emissions and effectively treating food waste. The paper offers a comprehensive overview of theoretical and practical methods for preventing and minimizing food waste, along with an examination of the impact of COVID-19 on food waste behaviour.

Paraschivu et al. (2023) emphasize the global challenge of food loss and waste, which undermines food security and sustainability. They stress the need for concrete targets to reduce food loss and waste at different stages of the food supply chain, tailored to the specific circumstances of each country. The review synthesizes key data and literature on this topic to identify knowledge gaps and proposes multifaceted solutions. These include e-commerce platforms for marketing products, rethinking aesthetic standards for fruits and vegetables, promoting shorter value chains, improving packaging for fresh products during transport, and investing in agtech and biotechnology. Moreover, the authors advocate for consumer education to promote more efficient use of food and related resources. Food waste (FW) is a significant global problem, with around 20% of the world's food wasted across various settings. Recent years have seen increased international attention on FW due to its ethical implications and negative environmental effects. Urgent action is needed to address its economic, social, and environmental impacts. Various practices and methodologies have been adopted globally to manage FW effectively, aiming to work towards a Zero Hunger world. Assessing indicators like economic implications, environmental effects, and social considerations can guide suitable management approaches. FW stems from diverse factors, including personal behaviours, cultural norms, political structures, geographic challenges, and economic conditions. This chapter examines the causes of FW, discusses measures to reduce and prevent it, and provides an overview of global FW management practices, highlighting anaerobic digestion and FW composting as effective methods for producing biofuels and bioproducts.

Latika et al. (2023) emphasize the global challenge of food waste, which contributes to resource depletion and air pollution. Approximately one-third of the world's food production is wasted throughout the food value chain. By highlighting food waste's impact on climate change and carbon footprint measurements, behavioural change can be encouraged. Repurposing food waste helps mitigate environmental pollution and reduces the carbon footprint of the food supply chain. Advanced waste management systems are needed to handle the large volume of waste generated and bridge the gap between production and management. Food waste biorefineries offer a sustainable, cost-effective solution for producing platform chemicals, biofuels, and other bio-based materials, thereby reducing environmental burdens. Recent technological advancements have made significant progress in addressing the food waste issue. Food waste (FW) threatens global food security, the economy, and the environment, exacerbating climate change, biodiversity loss, and pollution. According to the United Nations Environment Program (UNEP) Food Waste Index Report of 2021, food loss and waste rank as the third-largest source of greenhouse gas (GHG) emissions if considered a nation. This issue is particularly prevalent in South Asian countries. This study explores the FW-GHG emissions relationship in South Asian countries from 1990 to 2018. Through time-series cointegration and Granger causality techniques, the research finds a long-term connection between these variables in Afghanistan, Bangladesh, and Sri Lanka. Additionally, the Granger causality test suggests that FW significantly influences GHG emissions in Bangladesh, India, and the Maldives. Governments in these nations must develop strategies to minimize FW to foster sustainable development.

Demi (2023) focused on reducing food waste in New Zealand's public hospitals, aligning with Sustainable Development Goal (SDG) 12.3 to halve global food waste by 2030. The study analysed literature on food waste management strategies in hospitals

and evaluated their financial, environmental, and social impacts using the Food Recovery Hierarchy framework. A food waste audit at Dunedin Public Hospital quantified current organic waste, addressing waste prevention strategies, alternatives to landfill disposal, identification of most wasted food items, and quantification of greenhouse gas emissions from organic waste. Given organic waste's contribution to methane emissions and land use, reducing food waste has significant environmental, social, and economic benefits. This research aims to mitigate organic waste sent to landfills, reducing climate change effects and benefiting the environment, society, and economy.

Deconinck et al. (2023) analyse food supply chain resilience and its link to broader food system resilience. They note the resilience of food supply chains in terms of availability and affordability, with trade playing a key role in risk mitigation during domestic shocks. While some domestic policies aid in absorbing shocks, others exacerbate instability. The concept of food systems resilience extends beyond food availability and affordability to include broader objectives like livelihoods and environmental sustainability. The authors suggest policymakers adopt a holistic approach to resilience that anticipates various shocks and considers the environmental impacts of food systems.

FAO et al. (2023) report on global progress towards ending hunger (SDG Target 2.1) and all forms of malnutrition (SDG Target 2.2), estimating the number of people unable to afford a healthy diet. Highlighting the impact of conflict, climate extremes, economic slowdowns, and unaffordable nutritious foods, the report underscores challenges in meeting SDG 2 targets. Urbanization emerges as a significant trend, with food purchases increasing not only in urban but also in rural households, along with rising consumption of highly processed foods in peri-urban and rural areas. These shifts affect food security and nutrition differently across the rural-urban continuum. Aligned with the UN-endorsed New Urban Agenda, the report offers recommendations on policies, investments, and actions to address agri-food systems transformation under urbanization and ensure access to affordable healthy diets for all.

According to **You et al. (2022)** food loss and waste is crucial for meeting the goals of the Paris Agreement, as eight to ten per cent of total global greenhouse gas emissions stem from this issue. Despite this, few countries mention food loss and waste in their Nationally Determined Contributions to the Agreement. This review examines the global problem of food loss and waste and highlights opportunities for managing it to mitigate carbon emissions and beyond. Emphasizing the need for collaboration among stakeholders, the work discusses recent policy developments and the impacts of the COVID-19 pandemic on food loss and waste. It concludes by summarizing potential solutions to tackle this challenge. The global food system exacerbates sustainability challenges like climate change and resource depletion, mainly due to food loss and waste. About one-third of all food produced is lost or wasted, worsening health and environmental issues. This study suggests that repurposing food waste can help alleviate these problems. By implementing methods like composting, anaerobic digestion, or feed-making for food waste treatment, we estimate a potential reduction in carbon footprints by 614–1041 Mt CO2-eq compared to landfill disposal. This could offset the global food system's climate burden by 4.5–7.6%. Additionally, upcycling nutrients through soil-crop-based methods could reintegrate up to 6.6 Mt of nutrients into agricultural systems. Producing novel feeds could yield up to 155.6 Mt of alternative feeds for livestock, potentially replacing 41% and 9% of maize and soy in global livestock feed, respectively. This replacement can lead to cascading benefits, including land and fertilizer conservation and pollution mitigation, as evidenced by case studies in the United States and China.

Jürgens (2022) explores the relationship between food waste and grocery shopping behaviour in Germany, using regional data. Through quantitative surveys and multivariate analysis, the study identifies four distinct attitude groups related to household food management. These groups' shopping patterns closely match their attitudes toward food. The study also examines retail formats and food products as primary sources of household food waste, pinpointing specific product categories prone to waste and reasons for disposal. Fresh products emerge as the main contributors to food waste, with both alternative and conventional retail formats playing a role. By uncovering attitude and behavioural groups, the study reveals demographic structures not immediately evident, enabling targeted educational interventions beyond simplistic approaches.

Guglielmo (2022) highlights the alarming scale of food waste globally, with the United States alone wasting an estimated 103 million pounds annually. This waste not only squanders land resources but also consumes unnecessary energy and water, exacerbating climate change. Francis L. de los Reyes III emphasizes the need for systems thinking to achieve the UN's Sustainable Development Goal 12.3, aiming to halve global per capita food waste. Targeting key areas within the food system for waste reduction and exploring methods to convert food waste into energy are essential steps towards achieving this goal.

According to **FAO (2022)**, about one-third of the world's food production for human consumption is lost or wasted annually, representing a significant missed opportunity for improving global food security and efficient resource utilization. This chapter investigates the effects of food wastage, food security, and environmental quality on the economic growth of developing countries from 1990 to 2021, using the Method of Moments Quantile Regression (MMQR). The findings reveal that food wastage, limited food access, and environmental degradation negatively affect economic growth, while food availability and food security positively influence it. This study is the first, to our knowledge, to comprehensively analyse the global environmental impact of food wastage and its implications for food security and economic growth.

Imana (2022) highlights that globally, over 1.3 billion tons of food are discarded annually, contributing to Food Loss and Waste (FLW) within the food supply chain (FSC). This wastage presents challenges and missed opportunities for farmers, consumers, and societies worldwide. Managing this food waste effectively can help address the hunger and malnutrition crisis. FLW not only squanders food but also depletes vital natural, financial, and human resources like arable land, water, energy,

fertilizers, capital, and labour. The combined impact of loss and waste undermines fundamental human rights, including access to a healthy environment and food security. The chapter offers insights into FLW prevention and generation in developed and developing countries, highlighting their adverse effects and implications for global malnutrition. It also presents viable solutions aimed at combating FLW to promote sustainable development. To achieve Sustainable Development Goal 12.3 of halving food waste and reducing food loss by 2030, addressing food security and environmental sustainability is vital. The food industry generates significant waste, especially in developed countries, with industries like fruit and vegetable processing, dairy, and meat contributing substantially. Methods such as fermentation, composting, and biofuel production can convert food waste into valuable products like biopolymers and biofuels. This chapter explores various waste types and their potential for valorization, discussing recent advancements and sustainable solutions to improve waste management.

Dietrich et al. (2022) highlight the significant threat posed by the global food waste crisis to food system sustainability and the planet. They identify multiple factors contributing to its generation, including changing perceptions of food value, consumption habits, and market constraints. The review explores cultural, religious, social, and economic factors influencing attitudes toward food and their impact on waste generation. Additionally, it discusses key drivers of food waste, such as profit-driven waste, convenience, labelling issues, and household waste. Strategies for waste reduction, including food recovery, waste-to-energy conversion, and efforts to curb consumer food waste, are also examined. The review emphasizes the importance of stakeholder collaboration to effectively address the food waste issue.

Thakali et al. (2022) emphasize the importance of managing food waste recycling to prevent contamination and build a sustainable food system. Their study evaluated source-separated food waste across different regulatory environments, finding physical contamination in over half of the samples and occasional detection of heavy metals and halogenated organics like PFAS. Pathogen screening revealed low levels of Salmonella and L. monocytogenes, while antibiotic-resistance genes were prevalent. Overall contamination levels were low, except for certain antibiotic resistance genes. Source type influenced contamination levels, emphasizing the need for tailored waste management strategies.

Anriquez et al. (2021) investigate the significant food losses occurring among farms and intermediaries in the Near East and North Africa region, focusing on wheat losses in Tunisia and tomato losses in Egypt. They explore why economic decision-makers tolerate such losses despite the common economic intuition suggesting that reducing losses would not outweigh the costs. In Tunisia, outdated and poorly adjusted harvesting equipment, particularly on smaller farms, contributes to wheat losses. Their analysis reveals that smaller farms experience relatively higher physical losses due to the lack of incentives to invest in equipment upgrades. Similarly, in Egypt, significant post-harvest losses of tomatoes, mainly cultivated by small-scale farmers, are observed. The study investigates the efficacy of plastic crates in mitigating losses compared to traditional palm crates, highlighting marginal benefits but uncertain economic feasibility due to narrow margins.

Kurthy et al. (2021) address the often-overlooked issue of food loss within the food industry. Their study, based on a primary survey of 175 Hungarian food processors, uses SPSS software for data analysis, alongside in-depth interviews and a workshop. They find that only half of the respondents maintain accurate records of food loss, with many considering it a natural aspect of their operations rather than a serious concern. Through cluster analysis, companies were grouped into two distinct categories, with larger companies demonstrating greater concern for food loss and implementing more accurate recording methods. Barriers to effective management include regulatory hurdles, limited markets for by-products, and insufficient collaboration along the food chain. The study underscores the necessity of regulatory changes to incentivize companies to minimize losses and optimize by-product utilization.

In **Julian's study (2021)**, it is highlighted that since the United Nations Food and Agriculture Organization (FAO) reported global food waste statistics in 2011, there has been a growing emphasis on measuring waste at consumer and retail levels. However, primary production losses have received less attention. To update our understanding, a systematic review of data sources was conducted, focusing on harvest and on-farm post-harvest stages. Specific datasets were analyzed, and ten commodity/region case studies were examined through stakeholder interviews and literature reviews to verify food waste estimates and gain insights from a farming perspective.

Canxi (2020) examines the global impact of food waste on Sustainable Development Goals (SDGs) and highlights country-level differences in embedded nutrients and environmental impacts. The study evaluates daily per capita food waste across 151 countries, finding that globally, the average person wastes around 65 kg of food per year, primarily comprising vegetables, cereals, and fruits. Significant amounts of essential nutrients such as vitamin C, K, and Zinc are also wasted, along with substantial contributions from meat, dairy, and eggs. Annual per capita food waste contains enough nutrition for 18 healthy diets for 18 days on average. Additionally, the study analyses environmental impacts, revealing embedded footprints of CO_2 emissions, freshwater use, cropland use, and nitrogen, and phosphorus use, with cereals, meat, and sugar being major contributors. The findings underscore the importance of country-specific waste reduction interventions to address the considerable variation in nutrients and environmental footprints embedded in food waste across different countries.

Armington et al. (2020) stress the need to move away from landfilling food waste, advocating for alternative treatment methods to generate energy and value-added products. They emphasize the importance of accurate data on waste volume and characteristics for developing effective treatment networks. Traditional estimation methods offer quick but limited snapshots, failing to capture seasonal and geographical variations in waste generation. Using empirical data from New York State, the study reveals that a small percentage of facilities contribute to the majority of food waste generated, with significant monthly and regional

variations. The findings highlight the inadequacy of static estimations for policy-making and call for improved methods to inform more robust policies.

Quested et al. (2020) explore the use of diaries to estimate household food waste (HHFW) and compare these estimates to more accurate data obtained from waste compositional analysis (WCA). The study analyses data from five studies and finds that diary-based estimates consistently underestimate HHFW, with underestimation ranging from 7% to 40%. This discrepancy is attributed to factors such as behavioural reactivity, misreporting, measurement bias, and self-selection bias. While diaries provide valuable insights into food waste patterns, the study emphasizes that they alone are insufficient for accurately monitoring HHFW trends or evaluating waste reduction interventions, highlighting the need for further research in this area.

Rohini et al. (2020) stress the global imperative of reducing food loss and waste, crucial for poverty alleviation, hunger eradication, and the preservation of agricultural resources. Human-induced food waste affects wildlife ecology and community dynamics, with causes spanning production, processing, retailing, and consumption stages. In low-income nations, losses occur mainly during production, while in developed countries, excessive consumption leads to an average of 100 kilograms of wasted food per person annually. Factors like quality standards, poor planning, over-buying, and excessive cooking contribute to this waste. Food waste has extensive effects, including biodiversity loss, water waste, and land degradation, along with contributing to global warming and greenhouse gas emissions. While some methods of utilization offer benefits, others, like hunger, pose negative consequences. The food industry can innovate by repurposing food waste to develop new products, adding value and improving nutrition to combat global malnutrition. Mitigation strategies include prevention, optimization, recycling, recovery, and proper disposal, with governments encouraged to implement schemes and mobile applications to reduce food waste.

Geeta et al. (2020) explore reducing the environmental impact of food systems by addressing food loss and waste (FLW), amidst the challenge of meeting the anticipated caloric and nutrient requirements of a population expected to grow by 3 billion individuals within the next three decades. They acknowledge the impressive performance of the global food system in ensuring caloric sufficiency despite starting with a population of 1.6 billion in 1900, achieved primarily through enhancing yields of staple crops. However, they highlight that this trajectory is no longer viable or sustainable.

Freire and Soares (2020) emphasize that food loss and waste lead to approximately USD 750 billion in economic losses annually worldwide. In developing countries, post-harvest loss estimates vary widely, reaching up to 50% or more in some regions. According to the Food and Agriculture Organization of the United Nations (FAO), 54% of these losses occur at the initial production stage, mainly during post-harvest handling and storage, while 46% occur during processing, distribution, and consumption stages. Consumers often discard food shortly after purchase due to perceived quality deficiencies, such as appearance and taste. This highlights the pressing need for increased research efforts to globally reduce food loss and waste, which would enhance food supplies, reduce production costs, and alleviate environmental impacts associated with food waste.

Mak et al. (2020) introduce the theory of planned behaviour (TPB), a psychological model comprising three key constructs—attitude, subjective norms, and perceived behaviour control—that shape individuals' intentions and actions. These constructs reflect individuals' perceptions and beliefs about their behaviour. The chapter explores TPB's theoretical foundations and its modern application in predicting food consumption patterns and promoting safe food handling and waste recycling in households and commercial settings. This highlights TPB's practical value in understanding food waste recycling behaviours across different stakeholders.

Redlingshöfer et al. (2020) explore the integration of uneaten food into sustainable food systems. Despite the recognition of waste hierarchies like the European waste hierarchy and the 3R approach in OECD countries, their food application is limited. Through a literature review, the authors assess the effectiveness of the food waste hierarchy in resource efficiency and environmental impact reduction. They find that while the hierarchy aligns with reducing greenhouse gas emissions, adjustments are needed for other environmental impacts. Moreover, assessments of food waste prevention are insufficient despite being a priority. Recent research offers decision criteria for managing food waste based on food characteristics, but various barriers hinder prioritization. The authors propose shifting from the current "waste approach to food waste" to a more holistic "food approach to food waste" in research and policy to better address environmental concerns.

Pelt et al. (2020) collaborated with French local authorities to devise a strategy for reducing household food waste. They tested three interventions: an information-focused approach, a diary-based awareness method, and a dissonance-based strategy. Assessments included pre- and post-intervention compositional analyses of food waste, with follow-up evaluations five weeks later. Results showed the dissonance-based intervention as the most effective in the medium term, highlighting the complexity of behavioural changes required for reducing food waste.

Wunderlich (2020) discusses global food loss and waste (FLW) highlighted by the Food and Agriculture Organization of the United Nations (FAO). FLW ranges from 40-50% for root crops to 30% for cereals, occurring at various stages of the food supply chain (FSC). While initial production stages primarily face loss, waste is prevalent among retailers and consumers, significantly impacting the environment through resource depletion and increased greenhouse gas emissions. A 2017 report by the Natural Resource Defense Council in the US underscores substantial land, water, and energy usage in food and agriculture. This paper stresses the importance of addressing FLW's impact on natural resources to preserve environmental integrity and biodiversity. It advocates for green food supply chains with sustainable production practices to tackle FLW in the US, recognizing its dual impact on the environment and food supply chain sustainability.

Hadi et al. (2020) conducted a literature review to assess research trends on food loss and waste from 2009 to 2018. They analyzed sixty scientific articles using online platforms like ProQuest, Elsevier, and Google Scholar with keywords 'Food loss and food waste'. Findings showed a rising trend in research from 2011 to 2014, peaking in 2014 with seventeen articles and hitting a low in 2011 with only one article. Quantitative methods were more prevalent, with thirty-four articles using them compared to twenty-six employing qualitative methods. The authors advocate for more research using qualitative methods to gain deeper insights into food loss and waste.

Lombardi and Costantino (2020) highlighted the significant challenge of food waste (FW) on Earth, emphasizing ethical, social, economic, and environmental impacts. The UN's Agenda for 2030 aims to reduce FW by 50% by 2030, but concerns exist regarding achieving this goal due to strategies focusing more on logistics/marketing than social aspects, hindering the potential benefits of social network reconfiguration in food redistribution. The study explores how social innovation models, exemplified by the Avanzi Popolo 2.0 project in Italy, can enhance FW reduction by fostering new relationships among stakeholders and engaging non-traditional actors, emphasizing community-building and social capital in local food redistribution networks to address FW reduction effectively.

Teigiserova et al. (2020) examined the gaps in food waste prevention within the circular economy framework by clarifying terminology and categorizing food waste types. The study emphasizes the importance of clear definitions for sustainable food waste management, introducing a matrix with six distinct categories. The proposed updated food waste hierarchy pyramid includes a new category for material recycling to align with future circular bio-economy practices, while also discussing nutrient and energy recovery, circular economy frameworks, and EU policies on food waste.

Sosna et al. (2019) explore household food waste in rural West Bohemia, Czech Republic, aiming to fill a gap in understanding within rural contexts. Through waste composition analysis and ethnographic research spanning 2013-2014, they characterize food waste, estimate its financial value, explore household variations, and interpret local perceptions. Findings show low edible food wastage (7.9 kg per capita per year, equal to 13.5 EUR) with significant household variation. Rather than offering a singular explanation, they emphasize the complex factors shaping food-related practices, framing local disposal practices within the concept of thrift. They argue that thrift encompasses economizing, moral discourse, and social dynamics, influencing value exchange.

Busetti (2019) evaluates Italy's recent food waste policy changes, particularly the allowance of donating food beyond its best-before date (BBD) and streamlined donation procedures. Using realist synthesis methodology, the article assesses these measures, challenges their assumptions, and offers insights into their operational dynamics. Findings reveal the minimal impact of bureaucratic hurdles on donation costs, varied responses from donors and food rescue organizations, and the importance of considering charitable organizations' capacity and preferences. Additionally, the analysis highlights reputational risks constraining both the supply and demand for food beyond its BBD, despite legal provisions encouraging donation.

Tolulope et al. (2019) highlight food waste as a significant global issue, spanning various stages of the food value chain. The paper emphasizes the need for collective efforts to transform waste into valuable resources, serving as an introductory overview of the global problem of food waste.

Lemaire and Limbourg (2019) provide a literature review on food loss and waste management systems, aligned with UN Sustainable Development Goal 12. Their comprehensive overview includes concepts, causes, solutions, and research challenges. They propose a new classification system for causes, solutions, and research challenges. Solutions discussed range from awareness campaigns to supply chain redesign and efficient disposal methods. The review suggests research directions like standardized data collection, analysis of consumer behaviour, and the role of packaging in waste reduction. FAO data is cited to underscore the significant environmental impact of global food waste, including land use, water consumption, and greenhouse gas emissions.

Urrutia et al. (2019) propose a novel approach to understanding consumer food waste by examining underlying motivations rather than solely focusing on individual behaviours. Their study conducted in Ontario, Canada, integrates broader policies concerning food accessibility and insecurity. Utilizing a visceral-material framework, data from thirteen households reveal intricate drivers of food waste, including spatial food access disparities and complex relationships with food stemming from past experiences. The study underscores the need to address systemic issues alongside individual behaviour modification efforts to effectively reduce household food waste.

Shriram (2019) emphasizes the significant food waste generated by the global food industry annually, which amounts to about one-third of all food produced. In India alone, this waste reaches about 40%, equivalent to an estimated Rs. 50,000 crores annually. Various sources contribute to this waste, including agricultural residue, processed food, fruit and vegetable processing, marine food, dairy processing, meat and poultry, and the hospitality sector. However, the author highlights the potential for repurposing food industry waste into valuable byproducts, such as livestock feed, bioenergy, fertilizers, and nutraceuticals.

Li et al. (2019) highlight the global focus on food losses and waste (FLW), driven by initiatives like the United Nations Sustainable Development Goals Target 12.3. Despite increased research, gaps persist in FLW quantification due to data deficiencies and limited coverage. Their analysis reveals a concentration of studies in industrialized nations, with many relying solely on secondary data, leading to uncertainties. They observe that per capita food waste tends to rise with increasing per capita gross domestic product. The authors stress the urgent need for more comprehensive studies, especially in emerging countries, to inform policy-making and mitigation strategies addressing FLW's environmental impacts.

Busetti (2019) examined how Italy's recent food waste policy changes, including allowing donations after the best-before date and simplifying donation bureaucracy, have been supported by food waste experts to boost donations. Using realist synthesis, the article evaluated these measures, revealing the minor role of bureaucracy in donation costs, varying responses from donors and organizations, and the need to consider charities' capacity and preferences when increasing donations, while also uncovering reputation risks limiting the supply and demand for post-best-before-date food despite legal support for donations.

Dal Magro and Talamini (2019) highlight the paradox of global food production is sufficient to meet the caloric needs of the population, yet 821 million people suffer from malnutrition. They stress the importance of combating food insecurity effectively, with food loss and waste exacerbating the problem. Utilizing a methodology by Oelofse and Nahman, they quantify food loss and waste (FLW) in the Brazilian food supply chain. They found an annual average of 82,200 tons of FLW between 2007 and 2013, representing 42% of the average national food supply for the period. On average, this amounted to 427 kg/inhabitant/year, with the edible portion being 327 kg/inhabitant/year. The authors emphasize the need for specific studies to quantify and address FLW throughout the production chain to tackle this issue effectively.

Schanes et al. (2018) note the increasing attention to food waste by policymakers, organizations, and academics due to concerns about food security and environmental impacts. They focus on consumer food waste at the household level, reviewing empirical studies to identify factors influencing waste generation. The analysis underscores the complexity of food waste and advocates for integrating diverse disciplinary perspectives. Mapping these factors aids in understanding household practices and developing prevention strategies. Finally, they connect identified factors with policy, business, and retailer options.

Berja (2018) highlights the significant issue of food losses and waste (FLW) in the Near East and North Africa (NENA) region, where roughly one-third of globally produced food is lost or wasted. Despite lacking precise data on food waste in NENA, FLW levels vary across countries and food types, with postharvest losses being particularly notable. FLW amounts to 34% of the food supply in the region, threatening food security, depleting resources, and contributing to greenhouse gas emissions. Addressing FLW is essential for enhancing the sustainability of the food supply chain and achieving food security in NENA.

Conrad et al. (2018) emphasize the global need to enhance diet quality while minimizing environmental impact. Previous studies have primarily focused on limited sustainability indicators without considering food waste. To fill this research gap, the relationship between food waste, diet quality, nutrient waste, and sustainability measures was investigated using data from various US governmental sources. The findings reveal that US consumers waste significant amounts of food daily, leading to substantial cropland utilization, highlighting the importance of addressing both diet quality and food waste simultaneously to promote sustainable practices.

Aragie et al. (2018) stress the importance of reducing food losses and waste (FLW) in developing countries to close the food requirement gap. This study focuses on ten agrarian countries in Africa to assess the extent of FLW across different stages of the food supply chain (FSC) and by food type. Using data primarily from the Food and Agriculture Organization's Food Balance Sheets (FBSs), the study reveals that these countries lose about 28% (641 kcal/cap/day) of the current calorie intake due to FLW. Production and post-harvest handling stages contribute the most significant shares of total losses, accounting for 38% (244 kcal/cap/day) and 34% (218 kcal/cap/day) respectively. Recovering avoidable losses and waste could increase farm incomes by 20%, highlighting the inefficiency and unsustainability of current practices in these countries.

Cerda et al. (2018) review the challenges associated with food waste composting and assess the quality of the resulting compost. While progress has been made in areas like composting microbiology, there's a need for enhanced process monitoring. The study thoroughly examines issues such as impurities in food waste composting and discusses environmental impacts such as greenhouse gas emissions and odours. Additionally, it delves into the use of food waste compost for soil bioremediation.

Van der Werf and Gilliland (2017) conducted a systematic literature review on food losses and waste (FLW) across the food supply chain in developed countries. They analysed 55 estimates from various studies, revealing that consumption-stage food waste accounted for 43.6% of the estimates, averaging 114.3 kg per capita annually. Total FLW averaged 198.9 kg per capita per year. The review identified variability and inconsistent trends across variables like scope, geography, and methodologies. North American estimates showed higher consumption-stage food waste compared to European ones. Indirect estimates were notably higher than direct measurements. The authors advocate for further research to develop a customized, weight-based, and statistically sound methodology for directly measuring FLW to improve accuracy and precision in estimates.

Paritosh et al. (2017) highlight the pressing issue of global food wastage, driven by population growth. They stress the urgent need for standardized waste management practices to mitigate environmental pollution, health risks, and land scarcity. Anaerobic digestion emerges as a promising solution, offering eco-friendly energy and nutrient production to meet increasing energy demands. The authors provide a concise overview of anaerobic biodegradation approaches for food waste, including co-substrates, environmental factors, microbial populations, and available computational resources for research in food waste management.

Alexander et al. (2017) explored how losses throughout the food system impact meeting the nutritional needs of the global population sustainably. Inefficiencies in agricultural production and consumer behaviour contribute to these losses. The study evaluates losses across different stages to enhance understanding of overall food system efficiency. Results show that addressing consumer behaviour, such as reducing animal product consumption, can significantly improve food security for the growing global population.

Richter and Bokelmann (2016) surveyed top German food industry firms to gauge their views on food losses. They found it's considered important, especially among confectionery companies, but consumer communication about these efforts remains minimal. However, there's increasing interest in tackling food losses, particularly among meat and fish companies. Companies in the confectionery and fruit/vegetable sectors are open to more consumer engagement, especially if interest grows. Effective reduction of food losses hinges on robust communication and collaboration throughout the supply chain, emphasizing consumer involvement, which could confer competitive advantages and leadership in the industry.

Chalak et al. (2016) emphasize the substantial waste in the food supply chain, with 35% lost at the consumer level. Household food waste, varying between developed and developing countries, forms a significant portion of overall waste. Their study across 44 countries of varying incomes explores the impact of legislation and economic incentives on household food waste generation. Findings suggest that well-defined regulations and policies are more effective than fiscal measures in reducing household food waste.

Graham-Rowe et al. (2014) found that household food waste in the UK is substantial and avoidable, with significant environmental impacts. Their study, based on interviews with 15 UK household food purchasers, identifies two main motivations for waste reduction: concerns about waste and a desire to align with social norms. The importance of food management skills in waste reduction is emphasized. Barriers include perceptions of being a good provider, inconvenience, low prioritization, and a sense of exemption from responsibility. Negative emotions like guilt, frustration, and embarrassment play a significant role in influencing both motivations and barriers to waste reduction, suggesting potential conflicts in personal goals.

Bräutigam (2014) stresses the urgency of reducing food waste due to its ethical, ecological, and economic implications, as echoed by the European Commission's target to halve food waste by 2020. Understanding the reasons and scale of food waste generation across the food supply chain is crucial for effective prevention measures. This mini-review provides an overview of available data on food waste generation in the EU-27 and evaluates their reliability against the author's model calculations. These calculations, based on a methodology developed for the Food and Agriculture Organization of the United Nations, offer insights into food waste generation for each EU-27 member state, categorized by stages of the food chain and product groups. However, variations in results based on data sources and assumptions underline the need for further research to improve data quality for monitoring and managing food waste.

In their study, **Dung et al. (2014)** highlighted the lack of attention towards the value of food waste due to insufficient policies and laws. They reviewed food waste management for bioenergy production, collecting data from 21 countries and calculating bioenergy potential using innovative methods, suggesting appropriate strategies and policies for sustainable development in food waste management.

Stefan et al. (2013) investigated the factors influencing food waste generation in households through a survey of 244 Romanian consumers. They found that planning and shopping behaviours strongly predict food waste, influenced by moral attitudes and perceived control. This suggests that efforts to reduce food waste should prioritize providing consumers with the skills and resources to manage their food-related activities effectively.

Beretta et al. (2013) stress the need to minimize food losses across the food value chain for improved efficiency. Their study in Switzerland covers various stages, including production, processing, and households, identifying critical areas and causes of losses. Using mass and energy flow analysis, they find that nearly half of the total calories produced are lost, with half of these losses preventable. Specifically, households, processing, and agricultural production contribute the most to avoidable losses, with households responsible for almost half of total avoidable losses.

Schneider (2013) highlights the importance of research on food waste prevention, noting an increasing number of reports and scientific papers on the topic. The paper aims to summarize international research on food waste prevention across different countries and segments of the food supply chain, with a focus on English-language publications. While ample information is available from regions like North America and Western Europe, there's a lack of English-language publishing on food waste in other regions. Agricultural aspects are well-covered in most developing countries, but household waste is primarily studied in industrialized regions. Some topics, such as methodology, definitions, logistics, wholesale, and redistribution, remain insufficiently targeted.

Melikoglu et al. (2013) address the global issue of food waste, emphasizing the substantial economic impact associated with billions of dollars wasted annually by developed economies. The repercussions of food waste extend to landfill sites, where anaerobic digestion converts it into harmful greenhouse gases, contributing significantly to climate change. Forecasting a rise in food waste over the next 25 years, especially in Asian countries due to economic and population growth, underscores the urgency for addressing this critical issue on a global scale. The study highlights the significant energy loss resulting from food waste dumped in landfills, with calculations revealing that this energy loss is equivalent to a substantial percentage of energy consumption in various countries and industries.

Hultman and Corvellec (2012) examine the challenge of food system sustainability, focusing on uneaten food. They discuss the advocacy of waste hierarchies like the European waste hierarchy and the 3R approach for managing food waste in OECD countries. However, their review finds inconsistent implementation of these hierarchies for food. They identify four insights: effectiveness in reducing greenhouse gas emissions, underrepresentation of food waste prevention in literature, decision criteria for food waste management based on food characteristics, and barriers hindering prevention efforts. They call for a "food approach to

food waste," prioritizing prevention and resource efficiency in research and policy. Food is lost or wasted throughout the entire supply chain, from primary production to final household consumption. In low-income countries, food is lost mostly during the early stages of the supply chain as a result of limited harvesting techniques, inadequate storing and cooling facilities, unfavourable climatic conditions, poor infrastructure and insufficient processing, packaging and marketing systems **(FAO, 2012; Lang and Rayner, 2012)**.

Buzby and Hyman (2012) reveal the economic impact of food loss in the United States, drawing from data from the US Department of Agriculture. Their analysis finds that in 2008, food loss at retail and consumer levels reached $165.6 billion. The top contributors were meat, poultry, and fish (41%); vegetables (17%); and dairy products (14%). On average, each person wasted about 124 kg (273 lb) of food, valued at $390 annually. This represented nearly 10% of average food spending per consumer and over 1% of average disposable income. The study underscores the importance of these findings for industry, government, and consumer awareness and discusses potential large-scale approaches and incentives to reduce food loss in developed countries.

Evans (2012) offers a sociological perspective on household food waste, challenging the idea of a throwaway society solely based on waste volume. Through ethnographic examples, it explores how social and material factors shape the transformation of "food" into "waste" in households. The analysis delves into household food provisioning routines, the social dynamics of family meals, and the socio-temporal aspects of food practices. These insights suggest that sociological frameworks focusing on home consumption, material culture, and everyday life can inform public and policy discussions on the origins and impacts of food waste.

Buzby and Hyman (2012) conducted a study on food loss in developed countries, particularly in the United States, using data from the US Department of Agriculture. They estimated the total value of food loss in 2008 at $165.6 billion, with meat, poultry, and fish being the top food groups affected. The study suggests that food loss is a significant issue, impacting household food expenditures and disposable income, and highlights the need for awareness and strategies to reduce such losses.

The **FAO (2011)** study highlights the extensive losses throughout the food chain and identifies causes and prevention strategies. It estimates that globally, about one-third of food produced for human consumption is lost or wasted annually, amounting to approximately 1.3 billion tons. These losses squander valuable resources and contribute to unnecessary greenhouse gas emissions. Losses occur across the supply chain, with significant wastage in consumption in medium- and high-income countries and early stages in low-income countries. Per capita food waste is substantially higher in industrialized regions compared to developing countries. In low-income nations, losses stem from financial, managerial, and technical limitations, impacting smallholder farmers' livelihoods. Strengthening food supply chains in developing countries requires investments in infrastructure, transportation, and industry, along with promoting farmer organization and diversification. In medium/high-income countries, consumer behaviour and coordination issues contribute to waste, with quality standards and expiry dates exacerbating the problem. Raising awareness among stakeholders and finding alternative uses for surplus food is crucial for waste reduction. Data gaps underscore the need for further research, particularly in regions facing food insecurity. Addressing food loss is vital for global food security, with the potential to enhance efficiency across the entire food chain amid growing demand and limited resources.

Dahlén and Lagerkvist (2010) investigated household responses to weight-based billing for waste collection, aiming to inform waste management policies. They examined available data on weight-based billing in Swedish waste collection statistics, explored reasons for its implementation by local authorities, and assessed its local-level impacts. Municipalities with pay-by-weight systems collected 20% less household waste per capita, but the study found no clear correlation with increased recycling rates. Despite perceived benefits by waste management professionals, conflicting strengths and weaknesses were observed with weight-based billing.

Cuéllar and Webber (2010) estimated the energy content of wasted food in the United States by calculating the energy intensity of food production across various stages. They found it to be 8080 +/- 760 trillion BTU in 2007. Based on the approximate 27% of edible food wasted in 1995, they estimated that about 2030 +/- 160 trillion BTU of energy were embedded in wasted food in 2007. This accounts for about 2% of the nation's annual energy consumption, underscoring its significant impact compared to other energy initiatives. The authors recommend improving nationwide estimates of food waste and updating energy consumption data for food production to enhance accuracy.

Parfitt et al. (2010) review global food waste in light of feeding a population of nine billion by 2050. They discuss various definitions of food waste in complex food supply chains and note a lack of consistent data, particularly regarding post-harvest losses in developing countries. Current global losses cannot be accurately quantified due to outdated data collection methods. Limited information suggests higher losses at immediate post-harvest stages in developing countries and for perishable foods globally. In affluent economies, post-consumer food waste is the primary concern. Interviews with food supply chain experts underscore the magnitude of the issue, potential efficiency improvements, and challenges in changing consumer behaviour to reduce waste.

Joseph Langley et al. (2010) brought attention to the urgent necessity for reforms in waste management, which has been underscored by media coverage. With costs on the rise and European regulations pushing for waste reduction, industries are increasingly held accountable for their products' waste. Efforts are underway to decrease both general waste and food waste going to landfills, driven by various factors like media coverage, financial pressures, political mandates, and environmental concerns. However, to gauge progress effectively benchmarks for the current composition and scale of both types of waste are essential. While methods exist for measuring general waste composition, there's limited prior work on food waste composition. This paper discusses the importance of analysing food waste composition, evaluates different measurement methods, presents results from one specific method, and suggests improvements.

In their investigation, **Kumar et al. (2010)** studied the co-composting of food waste and green waste with low initial carbon-to-nitrogen ratios using an in-vessel lab-scale composting reactor. By applying central composite design (CCD) and response surface method (RSM), they determined that the optimal moisture content for this process is 60%, with a C/N ratio of 19.6 leading to a significant reduction of 33% in total volatile solids (TVS) over 12 days, and a second-order equation provided a good model fit for TVS reduction. Furthermore, the resulting compost met the standard germination index for white radish seed, indicating its suitability as a soil amendment.

David Baker et al. (2009) found that Australian households discard over $5 billion worth of food annually, surpassing expenditures on digital equipment and even the cost of running the Australian Army. Their survey of 1,603 main grocery buyers across Australia revealed that food waste correlates with household income and size, with higher-income households wasting more and larger households wasting less per person. Financial savings emerge as the primary motivator for reducing food waste, outweighing environmental considerations. Better planning during grocery shopping is identified as a key strategy for waste reduction, although retailers incentivized by sales volume pose a significant barrier. Government action and public awareness campaigns are crucial for addressing this issue, as household waste is expected to rise without substantial policy changes.

Kosseva (2009) highlights the significant food waste issue in the United States and the United Kingdom, with billions of kilograms lost annually, costing billions of dollars and emitting substantial CO2. Major contributors to this waste include the fruit-and-vegetable/olive oil, fermentation, dairy, meat, and seafood industries. The chapter focuses on trends in food waste processing technologies over the last 15 years, covering recovery of added-value products, food waste treatment technologies, and sustainable food chain management. It also summarizes recent research on user-oriented innovation in the food sector, emphasizing the circular structure of a sustainable economy.

Adhikari et al. (2009) discuss the implications of accelerated urbanization and increased economic activity, which have led to a 35% rise in Urban Food Waste (UFW) generation from 2007 to 2025. The paper explores the benefits of implementing onsite composting and anaerobic digestion as alternatives to landfilling for recycling UFW and reducing handling costs. In Asia and Africa, these solutions could potentially reduce municipal solid waste (MSW) mass by 43% and 55%, respectively, allowing cities to manage a significant portion of their MSW. In North America and Europe, such practices could help mitigate earth-warming trends.

Nellemann (2009) highlights a UNEP report warning that environmental breakdown could result in up to 25% of the world's food production being lost by 2050 without action. It's the first UN summary outlining how climate change, water stress, invasive pests, and land degradation could impact global food security and prices. The report emphasizes the necessity for more sustainable food production methods, suggesting recycling food waste and fish discarded into animal feed as a solution. Additionally, it underscores the importance of improving food energy efficiency, an area that has received insufficient attention compared to efforts in the traditional energy sector.

Adhikari et al. (2009) investigated the effectiveness of three bulking agents in composting the organic fraction of municipal solid waste, aiming to recycle waste into a safe, nutrient-enriched soil amendment while reducing greenhouse gas emissions and leachate. The bulking agents, including chopped wheat straw, chopped hay, and pine wood shavings, were mixed with food waste and composted for 10 days. Temperature and pH trends were observed during composting, followed by maturation in vertical barrels for 56 days to assess mass loss, nutrient content, and decomposition level. Chopped wheat straw and chopped hay achieved thermophilic temperatures and showed well-decomposed compost with nutrient-rich content after maturation. In contrast, pine wood shavings produced less decomposed compost with visible wood particles, although all bulking agents yielded compost suitable for soil amendment.

Adhikari et al. (2008) characterized food waste (FW) and locally available bulking agents (BA) to optimize compost recipes. They measured FW characteristics from a Montreal restaurant, a community kitchen, and households over the summer. Various BA were assessed. Wheat residue pellets showed the highest moisture adsorption capacity, followed by chopped straw. Some BAs exhibited balanced C/N ratios and neutral pH values. The study highlights the need for compost facilities to accommodate seasonal variations of up to 50% by volume based on FW characteristics and production rates.

Chang and Hsu (2008) aimed to develop a method for predicting key parameters in the composting process of synthetic food waste, including composting time, temperature, pH values, CO2 evolution, and material losses, based on protein and fat weight fractions. Experimental results confirmed that the final products of all runs met maturity criteria. Quadratic equations derived from multi-regression analysis allowed for quick estimation, and testing with real kitchen waste showed reasonable agreement between experimental and predicted outcomes.

Blair and Sobal (2006) redefine "luxus consumption" as food waste and overconsumption, linked to health issues and resource strain. They estimate its prevalence and environmental impacts in the US using food supply, agricultural, and environmental data. Between 1983 and 2000, US food availability increased significantly, demanding 0.36 hectares of land and fishing area per capita, with notable rises in high fructose corn syrup (HFCS) consumption, particularly in carbonated beverages. For instance, sweetened soda consumption led to substantial soil erosion. Diet soft drinks also posed environmental concerns due to energy-intensive plastics production and HFCS manufacturing.

Engström and Carlsson-Kanyama (2004) stress the importance of reducing food losses to tackle hunger and ecological impacts. Their study, focusing on four food service institutions in Stockholm, Sweden, found that around one-fifth of the food is

lost, with plate waste comprising the largest portion at 11–13% of the food served. These losses hold significant economic value, with the land area equivalent to 1.5% of Sweden's cultivated land needed to produce the lost food. The study highlights the substantial economic and environmental consequences of current food loss levels and calls for further research to accurately assess levels, develop prevention strategies, and guide policy decisions. Managing food losses across the entire food system, from production to consumption, is essential for efficient resource use and hunger alleviation.

Engström and Carlsson-Kanyama (2004) highlighted the importance of reducing food losses to address hunger and minimize ecological impacts. Their study on food losses in Stockholm's food service institutions revealed that approximately 20% of food is lost, with plate waste accounting for the largest portion at 11–13%. The findings suggest that the economic and environmental repercussions of current food loss levels are noteworthy, emphasizing the need for further research to estimate levels accurately, develop prevention strategies, and determine policy implications.

Fehr, Calçado, and Romão (2002) investigated food waste in Brazil, identifying management failures in the food lifecycle leading to low landfill diversion rates. They found 16wt.% of fruits and vegetables lost before consumption, 9wt.% of household garbage as food waste during consumption, and 72wt.% of collected household waste as biodegradables after consumption. They proposed administrative measures and tested solutions to reduce waste by 50% at the wholesaler and retailer levels. They advocated for divided garbage collection, showing it could potentially divert 100% of biodegradables and 77wt.% of all household waste from landfills.

III. Summary

The research findings outlined above unmistakably highlighted the necessity for conducting an in-depth investigation into the management of food waste and food loss across various sectors, encompassing household agriculture, commercial enterprises (such as restaurants and hotels), industrial settings, social institutions, and service providers. It is evident that in all sectors of the economy, there is a significant presence of either food production or consumption activities. At both the production and consumption stages within the various economic sectors, substantial amounts of food waste and food loss are generated, leading to a pressing need for a comprehensive examination of Food Waste Management strategies. This calls for the involvement of diverse experts and stakeholders from different fields, including economists, social scientists, food scientists, and policymakers, to collectively address the complex challenges associated with food waste and loss. The multifaceted nature of this issue necessitates a collaborative effort from various think tanks and professionals to develop effective solutions and policies that can mitigate the detrimental impacts of food waste and loss on both the economy and the environment. By fostering interdisciplinary collaborations and leveraging the expertise of individuals from different backgrounds, innovative approaches can be formulated to tackle the intricate problem of food waste and loss management effectively.

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