

## **From Farm to Landfill: Uncovering the Environmental Consequences of Food Waste**

Over  $\frac{1}{3}$  of food produced in the US is never eaten. Food waste is the most common cause material that fills our landfills, creating extreme environmental impacts. At the same time, 11 million children claim to be s insecure which the USDA defines as, “a lack of consistent access to enough food for every person in a household to live an active, healthy life.” (Hunger, 2021) Food waste is one of the most critical environmental issues facing our country, tripling in the last fifty years.

Food waste significantly impacts the amount of greenhouse gasses emitted into our atmosphere. The United States signed the Paris Agreement in 2016 which aimed at reducing the increase of temperatures to 1.5 degrees above the pre-industrial levels. (United, 2016) This cannot be achieved without changes in the food system. If fossil fuels were completely halted, current trends in the food system would prevent the Paris Agreement’s goal. Food loss and waste contribute to over 8% of greenhouse gas emissions which equals 4.4 gigatons of CO<sub>2</sub>e annually. (U.S., 2022) Regretfully, although one of the driving factors in climate change, food waste is rarely discussed in the US.

Reducing food waste will not only help our environment but will also help feed our world’s population more sustainably. As the population increases by an average of .4% every year, food production continues to match the rising population. (U.S., 2022) Despite the abundance of resources in the US, food insecurity still exists and will affect 35 million Americans in 2023. Surprisingly, this insecurity is not due to food shortages, as research shows

that daily calorie surplus is up 1,050 to 1,400 per person. Surplus food from corporations and consumers, which amounted to 141 billion calories in 2010, could feed 154 million people for a year. This excess is well above the food insecurity rate estimated by the USDA. (Food, 2023) By decreasing our levels of food waste, we can decrease the need for more food production which can in turn lead to less deforestation, water pollution, and greenhouse gasses.

In 2015, the US announced its advantageous goal to reduce food loss and waste by 50% in 2030. (U.S., 2022) Although a step in the right direction, these efforts have not made significant progress in the past eight years. The U.S. The Environmental Protection Agency (EPA) prepared a report, aimed at educating policymakers on the extreme effects of major food waste in the US. They focused on the environmental footprint of food waste and the environmental benefits that can be achieved through food loss. Although the report was received well, no policy action was taken. The only federal initiative focused on curbing food waste is the *United States 2030 Food Loss and Waste Reduction Goal*. However, its impact has been limited, with a 4.8% increase in food waste observed since its launch in 2015. (U.S, 2022) With annual food waste now reaching a staggering \$161 billion, the question arises: How can we establish more effective policies to combat this issue?

Eight years ago the United States government recognized the dire need for food waste policy. In September 2015, they announced the *United States 2030 Food Loss and Waste Reduction Goal*. The advantageous policy aimed at cutting food waste in half by 2030. This policy was not only going to focus on the consumer level, but the retail as well. The United States had followed suit in its food waste policy as national governments representing over half the world population had previously adopted comparable food waste goals. After the *United States 2030 Food Loss and Waste Reduction* was adopted on a national level, states began to

initiate their programs. New Jersey, Oregon, and Washington all have established state goals to reduce food waste by half in 2023. California, Connecticut, Maryland, Massachusetts, New York, Rhode Island, and Vermont have all enacted organic waste recycling laws, which have reduced commercial waste sources significantly. An impressive  $\frac{2}{3}$  of the world's largest food corporations have also set FLW reduction targets more regulated than the national goal.

(U.S.,2022) With all of the statewide, national, and even global efforts being initiated to reduce food waste, why do we continue to overproduce and under-consume food? Despite the United States' commitment to the *2030 Food Loss and Waste Reduction Goal*, the increasing levels of food waste pose significant environmental challenges, necessitating a reevaluation of existing policies and the exploration of alternative solutions.

First, we must identify the problem, starting with the root, the supply chain. The food supply chain is called the cradle-to-consumer food supply. (Vitturi, 2020) This supply chain starts with primary production which includes the harvests of plants and animals. In this step, the main environmental inputs are land, pesticides, and fertilizer and 36% of GHG emissions are CO<sub>2</sub>. Next is the distribution and processing stage, where the main environmental input is water. In this step a staggering 91% of GHG gasses are CO<sub>2</sub>. Next is retail, where the main environmental input is energy and 32% of GHG gasses are CO<sub>2</sub>. Lastly, we have the consumption stage which only accounts for only 4% of total supply chain GHG gasses, but of which 87% of them are CO<sub>2</sub>. (Crippa, 2021) We must analyze each of these stages, to properly address how we can change food waste at the micro level.

The primary production stage is the biggest threat to sustainable land use in the US. Over 25% of all land in the United States is used for food production. (Crippa, 2021) This land use affects soil, air, and water quality. While agricultural land use has been relatively stable, global

projections suggest a need for further expansion of farmland. This poses a threat to the earth's biodiversity and ecosystems as well as contributes to greenhouse gas emissions. The United States also faces water stress, and many areas are already in a water-stressed situation due to the lack of freshwater availability.

Primary production contributes significantly to the use of freshwater which reduces the availability of water for other purposes. Water use is categorized as blue water (from surface water and groundwater), green water (rainwater absorbed by plants or soil), and gray water (used for diluting pollutants). (Canning, 2020) The cradle-to-consumer food supply chain requires approximately 30% of US blue water withdrawals, primarily driven by the need for irrigation. (Food, 2023) Different food categories exhibit varying blue water requirements, with animal products often demanding more water, due to irrigation for animal feed. Blue water is extremely important in order to provide Americans with clean drinking water. Restrictions must be made to ensure water conservation.

Between 2004 and 2015, the food supply averaged 11,800 petajoules per year, equivalent to 11% of the total US energy consumption. (Wuebbles, 2020) Notably, the food processing and retail sectors each contribute about  $\frac{1}{4}$  of the total energy, while the consumption stage, primarily due to refrigeration and cooking, accounts for over  $\frac{1}{2}$ . Energy is a resource that is being used at every step of the cradle-to-consumer process, and currently only 15% of the energy being used is renewable. (U.S., 2022) Due to both of these stages using large amounts of non-renewable energy, a change must be made to correct their environmental impact.

Greenhouse gas emissions (GHGs) including carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and other synthetic chemicals contribute to global warming by trapping outgoing energy, particularly CO<sub>2</sub>. This is the main cause of increasing global surface air

temperature in the last 115 years. (Canning, 2020) Climate change impacts include increasing temperatures, changing precipitation, decreasing glaciers, rising sea levels, wildfires, and hurricanes. The Paris Agreement aims to limit temperature rise below 2 degrees Celsius, with 1.5 degrees preferred to prevent catastrophic consequences. This goal cannot be accomplished without addressing the growing impacts of the food supply system.

We must reduce food system emissions in the US. This is the only way to ensure sustainable food security for the growing population. The US cradle-to-consumer process produces greenhouse gas emissions at every level, although primary production is the largest contributor. Methane from fermentation and manure, nitrous oxide from fertilization, and carbon dioxide from land management practices represent about 39% of methane emissions and 80% of nitrous oxide emissions. (U.S.,2022)

In summary, the US cradle-to-consumer system puts tremendous pressure on limited natural resources and contributes significantly to climate change. Primary consumption is responsible for most of the pesticides, land, and water use, and greenhouse gas emissions. Energy use, on the other hand, is primarily dominated by the food processing and retail stage, followed closely by the consumption stage. Upon closer examination of each stage's impact on climate change within the food supply chain, one begins to question the rationale behind producing more food as a means to reduce emissions, especially when food waste presents a significant concern in the United States. In what ways has the American goal of reducing food loss and waste by 2030 failed to reduce food waste so far?

The US Department of Agriculture and EPA set a goal in 2015 to halve food waste by 2030, primarily through partnerships with private and community organizations. Yet many reports have yet to publish progress, meaning the industry has no specific mandate on food

waste. In 2010, 31% of food was wasted, and the federal government has been criticized for not investing more in addressing the issue. (U.S., 2022) Shannon Kenney, senior advisor for Food Loss and Waste Management in the EPA's Office of Research and Development, said few measures are being implemented to help reduce food waste. The government's plan to tackle food waste is expected to rely on public awareness campaigns, and Kenney expressed hope that new funding under the Infrastructure Plan or the Build Back Better Act can provide additional support. (Despite, 2021)

When addressing the *United States' 2030 Food Loss and Waste Reduction Goal*, the EPA states, "Working with USDA, FDA, and state and local partners, the EPA plans to secure action on the 2030 goal by working with leaders in the food system (e.g., private, government, non-profit, academia) to promote successful interventions and tools to advance the sustainable management of food." (Despite, 2021) The approach to reducing food waste relies heavily on public awareness campaigns and partnerships. While awareness is important, it may not be enough in the absence of comprehensive policies, programs, and incentives to drive behavioral change in the supply chain. Food waste is a multi-faceted problem involving different stakeholders from producers to consumers. Although there has been a shift in behavior towards food waste in the private sector, pledged goals are not being met. Shannon Kennedy states that corporations are using food waste goals as a performance activism technique, but have no intent of reaching these goals in the allotted time frame. (Despite 2021) The complexity of the issue may require a complex and comprehensive approach from the government, including stronger regulations than already enforced, incentives, and new technologies.

Government efforts to tackle food waste have been described as operating on a "shoe-string", meaning the project has not been adequately funded and resourced (Despite,

2023). Adequate financial support is needed to implement effective policies and campaigns. With the 2030 food waste target only 7 years away, food waste has increased by 4.8% since the policy's inception. Is this due to a lack of funding for the EPA to promote public awareness, or an inability to hold corporations accountable? The private sector has an important role to play in reducing food waste and contributing to sustainable development. Despite the complexity of the food chain, few companies manage it well, making them influential actors. Important parts of the global food supply chain are controlled by large farms, a handful of processing companies, and retailers.

Businesses are beginning to realize that addressing issues such as poverty, inequality, water scarcity, climate change, and environmental degradation are not just human and environmental issues but also necessary to sustain businesses. Investing in sustainable development can open up new markets, create opportunities, and lead to long-term success. There is a growing awareness that economic growth must be separated from “irrational consumption and environmental degradation”. (Wwf, 2018) Although some companies have committed to the Sustainable Development Goals (SDGs) outlined in the *United States 2030 Food Loss and Waste Reduction Goals*, the call for urgent action still exists. The mandate for action should not only be a corporate social responsibility but also from shareholders. These shareholders must emphasize the need for consideration of factors beyond profits to help correct the food supply system. (Wwf, 2018)

In response to the critical issue of food waste and its environmental consequences, a three-pronged framework has been proposed. First, severe restrictions will be imposed on the public and private enterprises involved in the food supply chain. This includes federal, state, and local government agencies, as well as private companies involved in food processing,

manufacturing, and distribution. The aim is to introduce appropriate sanctions for non-compliance and to encourage the adoption of sustainable practices throughout the supply chain. If more than 15% of food is wasted, a fine will be placed on that company or sector. If under 15% of food waste is achieved, that entity will receive a tax break. This will promote sustainable food production and consumption.

Second, the policy framework aims to provide strategic efficiencies at various stages of the supply chain. Incentives will be introduced to promote sustainable land use in primary production, reduce reliance on pesticides and fertilizers, and promote precision of agricultural technology. Farms that are using sustainable farming practices will receive subsidies from the government to offset the cost of production. For the processing and retail stages energy efficiency benchmarks would be set. If a company is producing under an efficiency benchmark, they will be subject to fines and higher taxation. Any investment in sustainable energy will be tax-free and companies who use more than 70% sustainable energy will receive a grant from the government to offset operational costs. These policies would serve to promote renewable energy for commercial use. Certification programs would also be instituted which will allow companies with significant reductions in greenhouse gas emissions to be recognized.

Thirdly, new food redistribution incentives will be implemented. The new policy framework would protect businesses from liability when excess food is served and make donations to food banks and community organizations easier. Tax incentives will be offered to companies engaged in an efficient surplus food distribution system, including discounts on associated logistics, warehousing, and transportation costs. However, it's not always applicable to redistribute surplus food, emphasizing that merely increasing redistribution efforts cannot singularly achieve the goal of halving food waste by 2030. Comprehensive solutions are needed

to address both preventing the generation of surplus food and food loss and facilitating redistribution where feasible. Because of this, public awareness campaigns would also be launched to emphasize the benefits of all three policy solutions.

The rationale for this framework lies in the multidimensional effect. Stricter limits on carbon emissions directly address the carbon footprint of the food supply chain in line with global sustainability goals. Efficiency measures promote sustainable practices and lower energy use. Furthermore, food redistribution incentives not only reduce food waste but also reduce food insecurity by diverting excess food to those in need. While there may be potential objections like the cost incurred for businesses, long-term benefits, such as improved public perception, cost savings by the efficiency gains, and potential tax incentives, outweigh the upfront costs. Research continues to support the feasibility and financial benefits of sustainable practices, which aligns with global trends towards corporate social responsibility and environmental practices.

In conclusion, the analysis of food waste in the United States has revealed complex challenges that require immediate attention and strategic intervention. With more than a third of the country's food ending up in landfills, the environmental impacts are profound, contributing significantly to greenhouse gas emissions and waste. Despite ambitious policies such as the *United States 2030 Food Loss and Waste Goals*, progress has been slow, requiring reassessment of existing policies and calls for innovative solutions.

The proposed system provided a comprehensive approach to food waste management at each stage of the supply chain. An emphasis on strict emission limits for both public and private sectors addresses significant environmental impacts. From land-use efficiency in primary production to energy efficiency in manufacturing and retail, the policy framework aims to

encourage sustainable practices. At the same time, surplus food redistribution incentives not only prevent food waste but also address the dire issue of food insecurity. While there are challenges and setbacks, such as initial costs and resistance to change, there are long-term benefits of sustainability. Gains in business efficiency and livelihood in responsibility far exceed the challenges of implementation. This call to action extends not only to the government but to the private sector.

Going forward, it is important that food supply reform is not only a government responsibility but requires the cooperation and participation of all stakeholders. By balancing economic incentives with environmental and social responsibilities, the proposed program aims to pave the way for a more sustainable and equitable food future in the United States. The urgency of this effort is underscored by our limited resources and the growing need to address climate change. Through strategic policy measures and collective efforts, we can aspire to build a resilient and responsible food system that preserves both the planet and its people.

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2 Canning et al. (2020) combined three models (a diet model, an environmentally extended input-output model of resource use in the food system, and a biophysical model of land use for crops and livestock) to estimate resource use. The study examines only domestic production, excluding resources used to produce exports and resources used in other countries to produce food imported into the United States.

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