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FOOD WASTE IN GERMAN HOUSEHOLDS: A POLICY ANALYSIS

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By Carlie M. Vowell

A thesis presented in partial fulfillment of the requirements for completion
Of the Bachelor Arts degree in International Studies
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Abstract

This thesis examines the issue of food waste in Germany and proposes policy solutions for food waste in German households. The author analyzes the history and background of sustainability and food waste in Germany in order to recommend a change in policy. The author uses a literature review as the primary method for investigating food waste in Germany. The findings indicate that household food waste occurs due to a lack of planning, misreading food labels, misconceptions about food, improper food storage techniques, and a lack of awareness on the economic and environmental implications of food waste. Moreover, various demographic factors, such as income, household size, and age, along with psychological and social factors, influence household food waste. While current policies in Germany, such as the Too Good for the Bin policy, are making a positive impact on food waste prevention, policy change is needed in order to reach food waste goals, such as Goal 12 of the United Nations Sustainable Development Goals, which focuses on responsible consumption and sustainable development. The findings in this thesis lead to policy recommendations through the following means: education, economic instruments, laws and regulations, and technology. In order for the policy to be effective, food waste policies should be cost efficient and structurally organized.

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Introduction

The Problem

The amount of food the world consumes along with the amount of food that are wasted is an emerging and important topic. According to the World Food Program, 815 million people do not have enough food to live a healthy, active lifestyle, and almost 25% of people in developing countries are undernourished (World Food Program, 2017). Food waste contributes to this issue. Annually, 1.3 billion tons of food are wasted around the globe (“Key facts on food,” 2018). Many problems are associated with food waste including economic, environmental, and ethical factors. This thesis will focus on the issues surrounding food waste, the factors that cause food waste, and the importance of reducing food waste in Germany. Contributing to a large sum of food waste in the EU, Germany strives to reduce food waste substantially.

It is estimated that 1/3 of the food produced in the world is wasted or lost each year (“Key facts on food loss,” 2019). Food loss and food waste are often confused or used interchangeably. Distinguishing between food waste and food loss is important. The differences between food loss and food waste depend primarily on the supply chain. Food loss occurs before food waste, as it occurs during stages such as, harvesting, storing, transportation, and processing (Eise & Foster, 2018). Inclement weather has the potential to harm or damage crops, resulting in food loss. Produce falling out of the supply truck on route to the grocery store is also an example of food lost. Food loss occurs during harvest and postharvest. Food waste, on the other hand, occurs during the final stage of the supply chain. “This is any food that is discarded, for any reason, at places such as shops or restaurants, or school cafeterias, or, pretty commonly, in our homes” (Eise &

Foster, 2018, p. 135). Food waste is most predominantly seen in developed nations. Globally, the Food and Agriculture Organization of the United Nations reports that, annually, consumers from wealthier nations waste as much food as the entire net-production in sub-Saharan Africa (“Key facts on food loss,” 2019). Individual consumers from North America and Europe waste on average between 95 and 115 kg of food each year, while consumers in Sub-Saharan Africa and Southeast Asia tend to waste between 6 and 11 kg of food each year (“Key facts on food loss,” 2019). While both food loss and food waste present significant challenges to feeding the world, this thesis will focus specifically on food waste in Germany.

As mentioned, developed nations, in particular, contribute the most to food waste. The United States contributes greatly to global food waste. Economists at the United States Department of Agriculture (USDA), Economic Research Service estimate that food waste in the United States totals 29% of value, what the item is sold for or would sell for, and 33% of the calories that are delivered to retailers (Eise & Foster, 2018). This means that 29% of the total price of food items sold is wasted, and 33% of total calories are thrown away. Following North American and Oceania, Europe ranks second in food waste contribution (“Key facts on food loss,” 2019). According to Eurostat data, 89 million tons of food are wasted each year in Europe (Buchner, Fischler, Gustafson, & Reilly, 2012). This shows that, per capita, 180 kg of food are wasted annually. The European Commission divides food waste into four different categories: manufacturing, retail/wholesale, food service sector, and households (Buchner et al., 2012). The highest amount of food waste, 42%, occurs in households. Ahead of France and Italy, but following Great Britain, Germany contributes significantly to Europe’s total food waste.

In Germany, individuals produce 82 kg of food waste each year, which is equivalent to 12 full days of nutrition and altogether totals to 6.7 million tons of food waste (Buchner et al., 2012). While 6.7 million tons is less than many developed nations, considering Germany's role in environmental protection and sustainability, this is surprising. Of the wasted food, it is estimated that 65% of the wasted food could be completely or partly avoided (Rombach & Bitsch, 2015). Avoidable is defined as food that is still safe for human consumption at the time the food is thrown out, and partly avoidable refers to customer food waste habits, such as cutting off the crust of bread or the peel of an apple. Unavoidable food waste includes items such as egg shells and bones, which will not be considered in this study. In order to combat the issue of food waste in Germany, government bodies and political initiatives along with non-governmental organizations (NGOs) and individuals have taken a stand. Fighting food waste has become a significant social movement in Germany (McCabe & Lieberz, 2013).

The Significance of Combating Food Waste

Before looking further into food waste in Germany, it is important to understand *why* people should care about food waste. Food waste causes a variety of negative impacts on societies. Natural resources are used throughout the food chain in production, processing, transport, trade, and disposal. Food waste contributes greatly to greenhouse-gases (GHG). 19% to 29% of global anthropogenic GHG emissions come from the food system, emitting 9,800- 16,900 million tons of CO₂ annually (Venkat, 2011). If food does not end up being consumed, then natural resources have been wasted. Carbon and water footprints are negatively impacted by food waste. In Great Britain, for example, food waste contributes to 25.7 million tons of CO₂ emissions annually, and it is estimated

that food waste in households amounts to 6,262 million cubic meters of wasted water per year (Venkat, 2011). Lowering the need for production is important due to its negative impact on natural resources and the environment.

Furthermore, wasting food is an ethical issue (“Food Waste,” 2018). Food consumption patterns in industrialized countries affect hunger and rural poverty in developing nations (Bräutigam et al., 2014). Careless food handling in wealthy countries increases the global demand for food even more, which results in higher prices of staple foods on the world market, which further weakens the purchasing power of poor people in developing nations (Bräutigam et al., 2014). Already the growing demand for food is a challenge. Due to a growing population, it is reported that by 2050, food production will need to increase by 60% in order to meet the increasing demand for food around the globe (Alexandratos & Bruinsma, 2012). The growing demand for food strengthens the argument against food waste. If the amount of food waste is lowered, more food will be available to meet the demand for food, which, in turn, will lower the need for increased production. Ultimately, decreasing food waste has the ability to address many global food policy problems.

Moreover, food waste has additional large economic impacts. Household food waste contributes to high costs for collection, transport, separation, and treatment in waste management facilities (Bräutigam et al., 2014). Food waste also negatively affects individual consumers from a monetary standpoint. In the United States, it is estimated that individuals throw out \$390 worth of edible food per year (Bräutigam et al., 2014). A study conducted by the University of Stuttgart in 2012 estimated that households in

Germany throw away 6.7 million tons of food per year, which is equivalent to €230 of waste per person (“Too good for the bin,” 2015). The economic losses are evident.

Food waste negatively affects many individual and societal areas, which, in turn, means that action is needed to reduce global food waste. Food waste has negative impacts on the environment, presents ethical issues, and contributes to economic losses. Food waste is a problem, and behavioral change among consumers must take place before it can be solved.

Research Objectives and Research Question

The objective of this thesis is to examine food waste in Germany and the movement against food waste in Germany. The primary research question is, “What are the implications of food waste in Germany?” and its author attempts to answer it using a literature review. Chapter 1 develops a historical background of food ways in Germany. Chapter 2 provides the methodology. Chapter 3 presents the research findings of this thesis. Finally, the conclusion makes recommendations for future actions.

Chapter I: Background of Food Ways in Germany

Hunger to Abundance

The relationship between Germans and food is connected with a history of war and hunger. Recognizing the food ways, or the eating habits and culinary practices of a people or a region during a historical period, is an important element in evaluating food waste ("Foodways," n.d.). During World War I, Great Britain implemented a hunger blockade against Germany and used the naval forces to block imports of food into the country (Weinreb, 2010). This resulted in mass hunger and starvation throughout the German population (Weinreb, 2010). WWII was also an essential element in the development of food policy in today's Germany. During the war, the government insisted that if Germany lost the war, mass starvation would ensue. The government used food as a point of leverage, encouraging German's that success would yield to food abundance and prosperity (Weinreb, 2010). Hunger was a quotidian reality in the aftermath of WWII, causing food to become a valuable resource (Weinreb, 2010). In order to master the situation, the allied authorities introduced food rationing, which inadvertently limited food waste. Every morsel of edible food was consumed from 1945-1950 during the "Hunger Years." Moreover, organizations like the Food and Agricultural Organization (FAO) and the United Nations Children's Fund (UNICEF) stepped in to provide food relief, resulting in occupied Germany's dependence on foreign aid.

The division between West Germany (FRG) and East Germany (GDR) in 1949 cast a divide in the development of food policy as well. In East Germany, collective eating programs were utilized. Government-facilitated canteens were used to feed workers and school children, enforcing equality and fairness through food intake. Meanwhile, West Germany focused on family meals opposed to collective eating, with the intent of progressing toward a liberal democracy (Weinreb, 2010). The cancellation of government funded school lunch programs in West Germany caused families to eat with and provide for their children.

During the 1950s, West Germany experienced the Economic Miracle or *Wirtschaftswunder*, which created a growing economy, allowing consumers to buy more. The *Wirtschaftswunder* included almost three decades of continuous economic growth that propelled citizens into consumerism, restored their self-confidence, and ultimately rebuilt West Germany (Jaraus, 2018). With the ability to buy again, West Germans began indulging in excess foods, sweets, and alcohol (Jaraus, 2018). East Germany, on the other hand, remained focused on food for the purpose of "harmonious unity" (Weinreb, 2010). Concentrating on uniformity and equality, the East German society relied heavily on public canteens, which controlled the amount and type of food intake. While East Germany claimed to promote health and nutrition by overseeing canteens, West Germany focused on taste and pleasure from food as a method of distinguishing between a starving Third Reich and the new liberal democracy.

In 1989 the Berlin Wall fell, initiating the onset of reunification of West and East Germany. A highly satirical newspaper, *The Titanic*, published a photo of a young girl who crossed the border from East Germany to West Germany with a banana peel in her

hand, stating "My first banana" (Weinreb, 2010). While the newspaper exaggerated the situation, the people from the East were now readily exposed to the "luxuries" of the West. Bananas were used to symbolize economic prosperity, and due to West Germany's right to import bananas tax free, bananas were among the cheapest, most abundant fruits in West Germany, while they were absent from East German stores (Weinreb, 2010). Although access to bananas seems like a minute privilege, East Germans' excitement exemplifies the extent of the depravity they were facing. East Germans also treasured processed foods, as they were not plentiful in East Germany. The transition from hunger to abundance impacts Germany's food waste history.

Environmental Movement

It is essential to have an understanding of German history and the East/West division in order to assess the environmental movement in Germany today. The German environmental movement appears to be strong and successful. This is largely due to the many organizations, institutions, and protests that have surrounded this movement. The environmental movement in Germany began alongside the conservationist movement in the latter half of the 19th century (Rucht & Roose, 1999). Although the umbrella organization for nature conservation, Deutscher Naturschutzring (DNR), formed in 1950 in West Germany, the citizens did not show interest in environmental protection until later. Initiatives from local citizens who were worried about environmental degradation in their immediate neighborhoods in the 1960s spearheaded the rise of the environmental movement (Rucht & Roose, 1999). A series of protests and debates took place, thematizing issues such as overpopulation, exhaustion of natural resources, and pollution

(Rucht & Roose, 1999). These events, later labeled the new social movements, pathed the way for social change.

Although policies relating to the environment, such as the Energy Security Act of 1973, which restricted energy consumption and called for 'car free Sundays,' were implemented in West Germany, the people called for greater change ("History of Environmental," 2014). Policymakers began to take notice of the issues the citizens raised. With the UN's 1972 publication of "The Limits to Growth," a report on population growth; limited resources; and the increase in oil prices in 1973, it was evident to the people that fundamental societal changes must be made (Rucht & Roose, 1999). More than 1,000 groups united under the Federal Union of Citizens Initiatives for Environmental Protection (Bundesverband Bürgerinitiativen Umweltschutz: BBU) to combat environmental deterioration (Erk, 2013). Following the citizens' actions, policy makers began to make changes.

Following citizen action, policy makers began to take more notice in the environment, and conflict between capitalism and environmentalism arose. Economic growth, through means such as the increased usage of power plants and natural resources, was seen as incompatible to the protection of the environment ("History of Environmental," 2014). Because elites were divided on the topic, environmentalism pushed its way into the realm of politics as a mainstream issue. The main focus was to instill environmental regulations at the federal level. In 1972, the institutional change from federal states to the federal government began with the amendment of Article 74, Number 24 of the Basic Law, the German Constitution. "The constitutional amendment transferred the administration of legal regulations in the field of waste disposal, clean air

and noise abatement to the federal government" (Erk, 2013, p. 355). This forced environmental change in West Germany as a whole. This is also significant in the consideration of food waste, as food waste falls under 'waste disposal'. The fact that the federal government had the ability to enforce federal regulation on waste disposal exemplified the government's potential influence on food waste at the household level.

In the 1969 West German federal elections, politicians had little interest for the environment, but that changed significantly in the following decade. The three major parties, the Social Democrats (SPD), Christian Democrats (CDU), and the Free Democrats (FDP) began to address environmental concerns in their platforms and promise to implement environmental regulation (Erk, 2013). The CDU politician, Herbert Gruhl was one of the most significant environmental politicians in Germany. In 1975, he published his book, "Ein Planet wird geplündert- Die Schreckensbilanz unserer Politik" (A planet is plundered: The Balance of Terror of Our Politics), which became a bestseller and greatly impacted the environmental movement ("History of Environmental," 2014). Political interest in the environment was further exemplified by the founding of the Green Party in the 1980s. Initially the Green Party served as a radical, anti-party party. In 1983, however, it won national representation in the parliament. The Greens worked with other parties to establish the Federal Ministry for Environment, Nature Conservation, and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit: BMU) in 1986 (Erk, 2013). The Green Party has remained a relevant party, and as of 2017, the party represents 67 of 709 seats in the Bundestag ("Distribution of Seats," 2019").

Although East Germany did not have as much interest in environmentalism concerns, the concerns were, nonetheless, voiced by politicians, organizations, and individuals. Groups fighting for environmental protection were, however, suppressed. A Green Party, opposed to reunification, formed in East Germany in 1989 right before the fall of the Berlin Wall (Rucht & Roose, 1999). With reunification in 1990, Western ideas of environmentalism were further spread to the East. However, the environmental movement remained larger in the West than in the East (Rucht & Roose, 1999).

Germany has exemplified environmentalism progression. Environmental impacts in post-reunification Germany have been more visible than in other countries due to the fact that Germany is a highly industrialized, urban, populated country, and compared to other countries, most of the land area has been touched by civilization (Rucht & Roose, 1999). Other important milestones highlight Germany's trend toward environmental protection as well. In 1994, environmental protection was instilled as a priority in the German constitution. This mandated that the state protects the environment and the wellbeing of future generations. In 2002, a law was passed to phase out nuclear energy and move toward renewable energy, which was further promoted after the nuclear accident in Fukushima, Japan in 2011 (Scholz, Keijzer, & Richerzhagen, 2016). The German government continued to partake in environmentalism. As Angela Merkel, the chancellor of Germany, continued to support renewable energy, the German public continued to become more invested and involved in this area. Germany also partnered with other countries to promote environmentalism. Germany worked with France and Switzerland to head the Sustainable Development Goals (SDGs), which were adopted in 2015 by the United Nations as part of the 2030 Agenda for Sustainable Development

(Scholz, Keijzer, & Richerzhagen, 2016). In September of 2015, Merkel verbalized her commitment to developing the German federal government's involvement in the 2030 Agenda. "We in Germany will further develop our National Sustainability Strategy in the light of the 2030 Agenda" (Merkel, 2015). Merkel further exemplified this by representing Germany in the High-Level Group, started by Sweden, which seeks to implement the SDGs at all levels of society (Scholz, Keijzer, & Richerzhagen, 2016). It is also important to note that as a fairly rich country, Germany can "afford" environmental protection (Rucht & Roose, 1999). Ultimately, motivation and activism from citizens initiated a movement that remains powerful in Germany today. Political actors had no choice but to address the demands of the people and to support the environmental movement.

Activism from citizens has played an important role in positive environmental change and sustainability in Germany. The effects of activism are seen in the issue of food waste. In 2011, Valentin Thurn released a documentary entitled, *Taste the Waste*, which shocked audiences around Germany and created the anti-food waste movement (*Determination of discarded*, 2012). It is important to take a closer look at this film in order to better understand the onset of the food waste movement.

Thurn used *Taste the Waste* to raise awareness about food waste among German citizens. The film focuses on all areas of the supply chain. Through interviews with various Lidl supermarkets, Thurn discovers that foods, such as yogurt, are taken from the store shelves and thrown away approximately six days before their 'best before' date (Thurn, 2010). This is unnecessary waste, considering food is still safe to consume even after the 'best before' date. The 'best before' date pertains to freshness and quality, not to

safety. Although quality may be diminished, foods remain edible well past their 'best before' date. Thurn concludes that roughly every supermarket throws away 45 kg of food per day (Thurn, 2010).

While Thurn focuses heavily on food waste at the market level, he also looks at food waste among consumers. Through surveys and interviews, he finds that people are quick to throw away food due to the accessibility and abundance of food at supermarkets. People also assume that they waste very little food, and the average household does not appear to be aware of the food waste they are contributing. (Thurn, 2010). Consumers also admitted to being picky when shopping for produce. Farmers are forced to throw away potatoes that are too small or contain any dents. In fact, at one-point, EU law stated that bendy cucumbers could not be sold. When there was an attempt to repeal the law, the federal government of Germany fought to keep the law due to pressure from merchants and retailers (Thurn. 2010). Merchants and retailers acknowledge the fact that customers prefer 'perfect' produce. Aside from food quality, Thurn highlights the variety of products that consumers expect to find in markets. Nowadays, a bakery is filled with dozens of different bread options, while in the past only a few options were available. Additionally, any left-over bread could be frozen and sold the next day, which is also no longer acceptable (Thurn, 2010). Thurn gives examples of how food waste in countries of abundance negatively impacts food prices in poorer countries, by causing prices to rise (Thurn, 2010). The documentary clearly exemplifies the overall negative impact of food waste on a global scale.

It is vital to consider the elements in Thurn's film when looking at the anti-food waste social movement that has begun in Germany. By combining surprising facts and

shocking imagery, Thurn engages his audience and encourages them to be the voice of change. Ultimately, *Taste the Waste* made Germans aware of food waste.

Following Thurn's film, the issues of food waste began to receive attention from press releases, TV broadcasts, and public events. In response, several initiatives began to rise. The Federal Consumer Protection Ministry (Bundesministerium der Justiz und für Verbraucherschutz) launched the campaign, "Each meal (time) is precious" to enhance consumers' appreciation of food (*Determination of discarded*, 2012). "Food sharing" also emerged, propelled by a non-profit organization encouraging consumers to share uneaten foods that would otherwise go to waste. In order to gain a quantitative idea of food waste in Germany, the University of Stuttgart Institute for Sanitary Engineering, Water Quality and Solid Waste Management (ISWA) began researching food waste through a project that lasted from June of 2011 until February 2012.

In March 2012, the Minister for Food, Agriculture, and Consumer Protection (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz: BMELV), Isle Aigner, announced a nation-wide initiative to combat food waste in Germany (McCabe & Lieberz, 2013). This was the birth of the campaign "Too Good for the Bin," (*Zu gut für die Tonne*) whose goal is to inform Germans about how much food they throw away, why they throw it away, and how they can reduce food waste (McCabe & Lieberz, 2013). The study from the University of Stuttgart serves as the foundation of the campaign, which concentrates primarily on household waste (McCabe & Lieberz, 2013). With the goal of reducing food waste in Germany by 50% by 2020, the campaign produced a website, a mobile application, exhibitions, and pamphlets at supermarkets to inform consumers about how to plan for the grocery store, to better store food, to use

leftovers, and to use instinct rather than the "best before" date on packages when discarding food items (McCabe & Lieberz, 2013).

The BMELV has also paired with other organizations in order to make the Too Good for the Bin initiative more powerful. In conjunction with the Federal Association of the German Retail Grocery Trade it has implemented a nationwide initiative to teach consumers how to properly read dates on food labels. The BMELV also paired with the German project management agency, Projektträger Jülich, to establish regional competitions for the best and most innovative practices against food waste (McCabe & Lieberz, 2013). Additionally, the BMELV is working to connect the anti-food waste movement with the "buy local" movement, which encourages consumers to engage with local farmers and producers. Moreover, the BMELV hopes to establish more regulations and legislation reducing food waste (McCabe & Lieberz, 2013). Thus, what began as a grassroots movement is now being addressed at the federal level.

Context

When discussing the vitality of anti-food waste policy, it is important to reiterate the fact that households represent the largest portion of food waste in Germany.

Households are at the very end of the supply chain. This means that when household food is wasted, all resources used throughout the supply chain have been wasted as well.

The UN acknowledges and addresses food waste as an issue. The Sustainable Development Goals (SDG) includes food waste prevention within SDG 12, which focuses on responsible consumption and production. The Federal Chancellery of Germany is primarily responsible for implementing these goals, and representatives at the German state level hold positions in the State Secretaries' Committee for Sustainable

Development (Staatssekretärsausschuss für nachhaltige Entwicklung: SNE) (Scholz, Keijzer, & Richerzhagen, 2016). Because the SDGs have been addressed on a global level, within the UN, the issue of food waste is receiving even more attention in Germany. In fact, Germany's primary focus for SDG 12 is to reduce food waste (Scholz, Keijzer, & Richerzhagen, 2016). Every two years the Federal Statistical Office (Statistisches Bundesamt) presents a public report on the progress made in the SDGs (Scholz, Keijzer, & Richerzhagen, 2016). Political parties in Germany are also aware of food waste as an issue and strive to address it. The Social Democrats (SPD), Christian Democratic Union (CDU), and the Christian Social Union (CSU) formed a coalition agreement to focus on food waste throughout the entire value chain ("Shaping Germany's Future, 2014). This further emphasizes that the challenge of preventing food waste is known and broadly accepted in Germany.

Chapter II: Methodology

Using systematic literature review, this author evaluated food waste in German households and analyzed policies for reducing household food waste. The author gathered information using OneSearch. The author searched for articles including material and data on household food waste and waste prevention strategies, focusing on Germany. The resources selected for this analysis provide knowledge on the implications of food waste, reasons for food waste, actions to combat food waste, and recommendations for decreasing household food waste. The data focuses on Germany, other countries in the European Union (EU), and countries developmentally comparable to Germany, such as the United States. Considering the abundance of literature on food waste, this research design allows for a comprehensive data collection.

The author's sources range from scholarly peer reviewed journal articles to government reports and food waste policies. The data collection procedure includes: (1) search in OneSearch, (2) filter responses for peer-reviewed and articles published, (3) examine titles and article descriptions for relevant content, i.e. effect of, impact of, survey of, policy for, approach to, etc. household food waste, and (4) select articles with diverse content that conclusively provide an overarching view on food waste at the household level. The indicator words used to search include: *food waste, food waste policy in Germany, food waste policies, food policy history Germany, food waste prevention and*

food waste EU. In the process of filtering the data, the indicator words produced 1,062 results.

In order to limit the amount of data, the author further filtered the sources for those published within the last five years. This yielded 684 sources. The author evaluated the sources by focusing on particular themes and elements of food waste and food waste prevention and policy. The author identified these themes by reviewing the article titles and dates; reading the article abstracts when present; and by noting key words, such as *prevention, policies, facts, studies, statistics, and measurements*. The data was narrowed down further to include information that highlighted food waste in German households and presented current and comparable food waste studies and policies.

By concentrating on the indicator words and reducing the amount of data into more detailed, relevant classification, the author could sift through and organize the findings and present an articulate, unified review of food waste in German households.

Chapter III: Findings

The prominent research findings in this thesis encompass the reasons for food waste, actions against food waste, and current food waste policies. The findings will be used to recommend and evaluate food waste policy in Germany.

Reasons for Food Waste

Lack of Knowledge

The various causes of food waste tend to stem from lack of consumer knowledge. Often, consumers overestimate the amount of food they prepare, resulting in "left overs," which are later discarded (Buchner et al., 2012). Consumers frequently do not know what to do with miscellaneous or left-over ingredients, so they throw them out. In the UK, for example, 4.4 million tons of the total 7.2 million tons of household food waste consists of food and drinks that are still edible (Buchner et al., 2012). Another issue occurs during the food consumption stage as well. Consumers throw away food that appears to be deteriorated or no longer edible. Germany faces challenges with regard to food appearance. Germany needs to work on increasing the demand for "ugly" food. The mentality of perfect produce must be overcome in order for consumers to be satisfied with "ugly" food and decrease food waste (Evans & Nagele, 2018). Food labeling misunderstandings also contribute to the waste of edible food in the household.

According to a 2018 study conducted by the European Commission, up to 10% of the 88 million tons of food waste generated annually in the EU is due to date marking (European

Commission, 2018). Many consumers do not know the difference between "best if used by" and "use by dates." "Use by dates" are relevant to safety concerns, while "best if used by" dates only relate to food quality (Buchner et al., 2012). This means that foods that surpass their "best if used by" date may not be as fresh but are safe to eat. Without this information, consumers discard edible food. Lack of knowledge contributes to food waste. Consumers lack knowledge in handling leftovers, in food quality, identification, and in understanding food labels. Additional factors that contribute to food waste include improper food storage, due to not reading instructions properly, and inadequate preservation techniques. Lastly, consumers lack awareness of the negative impacts of food waste on the environment and the economy (Buchner et al., 2012).

Lack of Planning

Lack of planning also contributes to food waste. A study by Carolin von Kameke and Daniel Fischer explored the potential effects of "nudging" in preventing household food waste. Nudging was defined as "the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentive" (Kameke & Fischer, 2018, p.33). One hundred and one Germans partook in a survey containing questions to predict their outlook on nudging in food waste prevention. According to Kameke and Fischer's study, faulty planning of food purchases is the primary cause of household food waste. "This is because food purchases occur at the beginning of the consumer food handling process and hence hold the most potential to reduce surplus food purchases and thus have an effect on food security and alleviating environmental pressure from surplus food production" (Kameke & Fischer, 2018, p. 33). Planning of food purchases includes meal planning, usage of a shopping list,

and supply checking. In the United Kingdom, for example, 40% of household food waste stems from the preparation of a disproportionate amount of food due to lack of meal planning and excess purchasing (Zhang, et al., 2018).

In fact, purchasing excessive amounts of food or taking advantage of sale items causes consumers to have more food than they will use. Because of this, the French Environment and Energy Management Agency stresses the importance of strictly monitoring the rising phenomenon of bulk distribution (ADEME, 2011). By limiting access to bulk food products, consumers purchase smaller quantities, decreasing the amount of potential food waste.

Consumer Habit

Other reasons contribute to food waste as well. According to a qualitative research project conducted by the Waste & Resources Action Program (WRAP) in the United Kingdom, personal choice and lifestyle as well as personal value of food are reasons for individual food waste (WRAP, 2006). Through personal choice and individual lifestyle, some individuals are accustomed to not finishing their plates and throwing out what remains. This is especially true about children. Others, for example, may hurriedly eat half an apple on their way to work and throw the rest away. Personal value of food contributes to this, which is shown to be decreasing, due to the industrialization within the agriculture and food sector. It has become normal that machines produce the majority of food items. Consumers are more disconnected from the food they eat than ever before, which results in lack of knowledge about the origin of food, how it is produced, and what it contains (Kranert, et al., 2012). When consumers become accustomed to not thinking about the food they eat, consumers do not feel guilty

or even conscience about how much they waste. Increasing consumer awareness is an essential factor in combating food waste.

Food waste stems from both physiological factors, such as the motivation and willingness to act, and social factors, like one's daily home routine. Studies have shown that a gap between knowing food waste has negative implications and actively changing food waste habits is evident (Schanes, Dobernig, & Gözet, 2018). This is not stating, however, that physiological feelings such as concern and guilt do not play a positive role in the reduction of food waste. It simply means that sometimes these emotions are not followed by preventative actions. “Social practice theories account behavior to wider facts deemed beyond control of the individuals, which are reflected in the organization and temporal nature of everyday routines” (Schanes, Dobernig, & Gözet, 2018, p. 981). Human behavior is largely affected by mindless routine. Simply being aware of food waste is not enough to cause consumers to combat food waste. More serious alterations in consumers' routine and life practices must occur in order for individuals to commit to fighting food waste. These factors must be taken into consideration when analyzing food waste policies.

Socioeconomic Status

A majority of consumers in richer nations have never experienced food shortage and are, therefore, less consciousness about the amount of food they are throwing away. The Barilla Center for Food and Nutrition and The Economist Intelligence Unit study mentions the detrimental effect of food waste on consumer income, stating that food waste in the UK is estimated to be worth 19.7 billion US dollars (Murray, 2018). Meanwhile, people in poorer nations preserve what is available to them. It is also

important to note that some data combines food waste and food loss into one category, leading to misunderstandings. While many developing nations rank high in combined categories of food waste and food loss, this is primarily due to food loss, which plays a larger role in developing nations than food waste (“Key facts on food loss,” 2019). Lack of technology, poor infrastructure, insufficient storage, and deficiencies in transportation and processing cause low-income countries to lose more than 40% of agriculture before it reaches its retail location (“Key facts on food loss,” 2019).

Differences in socioeconomic status also affect the amount of food waste produced on a national and individual level. Industrialized countries have a surplus supply, which influences consumers to buy and consume much more food than necessary (WRAP, 2006). Studies have shown that food waste is highest in consumers who shop in large supermarkets as opposed to small shops and local markets (Jörissen, Priefer, & Bräutigam, 2015). As seen in the United States, super markets are filled with an endless supply of items. There are multiple brands of the same or similar items, and it is unlikely that the supermarket will ever be short on produce. While the average German supermarket does not have the vast amount of supply and brand variation that U.S supermarkets like Walmart have, German supermarkets are, nonetheless, fully stocked. This permits consumers to over-shop and purchase unnecessary items. In fact, retail stores purposely overstock product displays under the assumption that, “customers buy more from brimming, fully stocked displays, preferring to choose their apples from a towering pile rather than from a scantily filled bin” (Gunders, 2012, p. 10). Access to food influences customer decision as well. Easy access to food supplies correlates to an increased frequency of shopping, which appears to have a positive impact on food wasted

(Jörissen, Priefer, & Bräutigam, 2015). In working to limit food waste, the availability of food can impact consumer food purchasing decisions.

Other Demographics

Various other demographics impact the amount of food wasted as well. A 2014 Waste and Resource Action Program (WRAP) study showed that household size plays a large factor in the amount of food waste generated. It is not surprising that the amount of food waste increases as the number of occupants in a household increases. However, it is noteworthy that the amount of waste per person was higher in single occupancy households (WRAP, 2014). This can be attributed to a larger amount of prepared and purchased food not being consumed in single occupancy households. Data also shows that people who live alone tend to buy more food per person than larger households. People in single households are often times roped into buying larger quantities of items that will go unused because of a better price value (WRAP, 2014).

Age also plays a role in the production of food waste. Studies show that older people produce less food waste than younger people (Lea & Worsley, 2008). Older people tend to be more conscious of food they use and are more experienced with proper food preparation quantities. A study in Germany showed that the war generation and their children are particularly conservative when it comes to food waste (Glanz, 2009). They learned the importance of properly storing foods and cooking with leftovers due to the scarcity of food during and immediately the after war (Glanz, 2009). Today's children tend to waste a significant amount of food simply because they do not finish their meals, and they often cause parents to buy more food than necessary. Yet the age group between 18 and 34 is shown to waste the largest amount of food (WRAP, 2014). Generally, people

in this age range have less practice when it comes to food management skills and are more likely to prepare too much food and let food expire. Based on the few examples provided, the complexity of pinpointing the grounds for food waste is evident. Various circumstantial factors go into determining the reasons for food waste, which emphasize the complexity of combating food waste.

Source of Food Waste

The study conducted by the University of Stuttgart ISWA collected a variety of data on food waste in Germany as exemplified by figure one and two exemplify the study's findings.

Verteilung der Lebensmittelabfälle nach Bereichen der Nahrungsmittelkette (Median) [t/a]

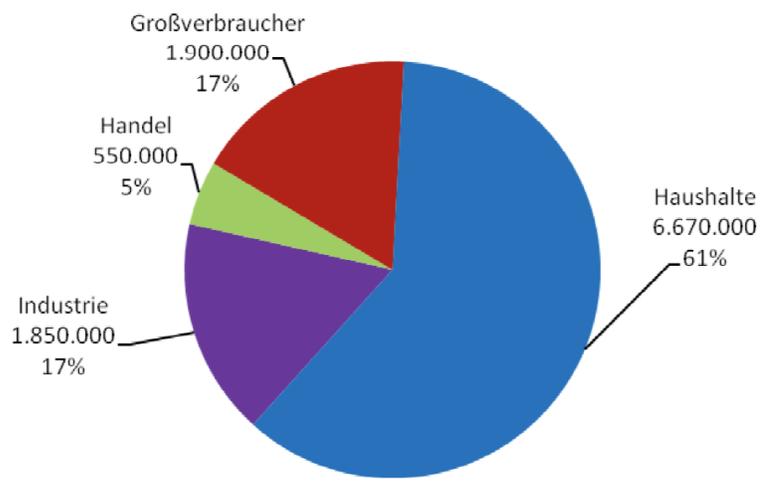


Abbildung 6: Verteilung der Lebensmittelabfälle nach Bereichen der Wertschöpfungskette für Lebensmittel

Figure 1: Division of food waste in sectors of the food chain. The highest percentage of food waste is seen at the household level: 61%.

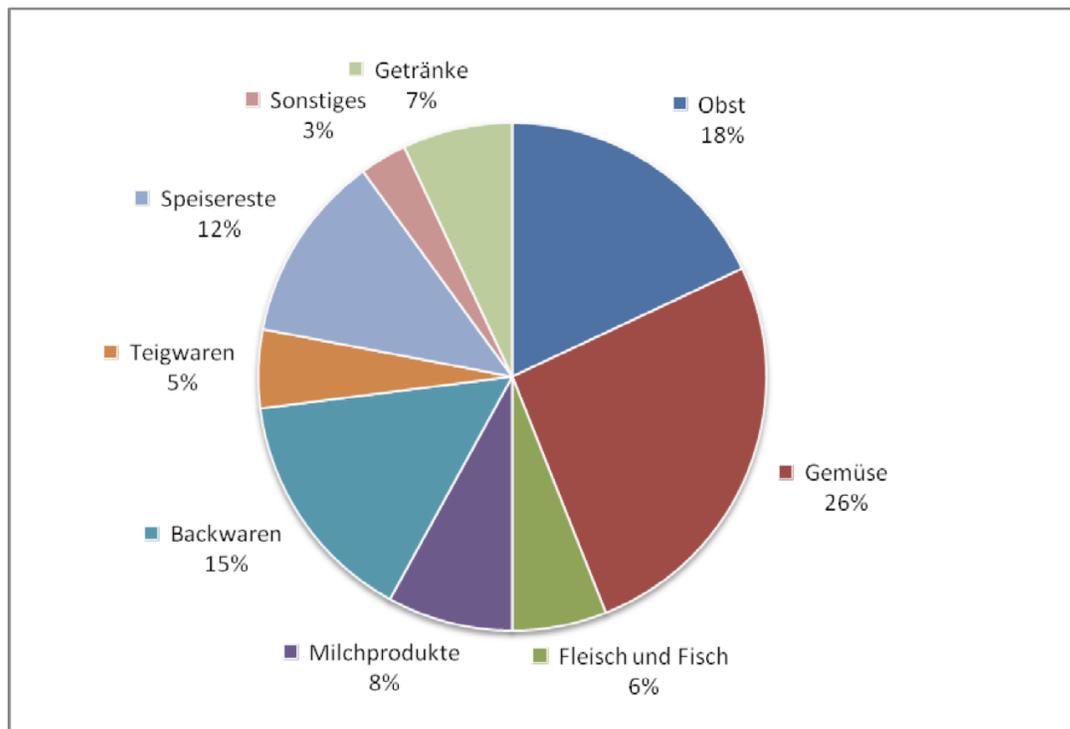


Abbildung 8: Zusammensetzung der vermeidbaren und teilweise vermeidbaren Lebensmittelabfälle aus Haushalten in Deutschland nach Produktgruppe (Masseprozent)

Figure 2: Avoidable and partly avoidable food waste in German households divided into sectors. Vegetables and fruits contribute greatest to household food waste: 26% and 18%.

Figure 1 identifies households as the heart of food waste. As Figure 2 depicts, the majority of household food waste comes from fruits and vegetables, 44%. Other food waste studies conducted in Ispra, Italy, and Karlsruhe, Germany, have identified the highest percentage of food wasted in fruits and vegetables and bread and cheese, totaling more than 40% (Jörissen, Priefer, & Bräutigam, 2015). Therefore, food waste prevention should concentrate on fruits and vegetables in consumer households.

The economic state of a nation also plays a role in the amount of accumulated food waste. As exemplified by Greece, economic recessions lead to a decrease in food waste due to the value placed on saving money (Schanes, Dobernig, & Gözet, 2018). While economic recessions cannot be instilled to encourage countries to act against food waste, implementing a better understanding of the connection between food waste and saving money could be useful. Moreover, evidence yields that concerns for the environment do not highly motivate individuals to pursue food saving strategies (Schanes, Dobernig, & Gözet, 2018). Environmental concerns tend to revolve around global warming and the preservation of natural resources (Albeliotis, Lasaridi, & Chroni, 2014). This is in part due to the lack of knowledge about the harmful impacts of wasting food, such as the production of greenhouse gases. The level of environmental concern varies among age groups. A study in the United States showed that younger people are more concerned with the financial dimensions of food waste, while older people show more concerns about the social and environmental consequences (Blichfeldt, Mikkelsen, & Gram, 2015).

Actions Against Food Waste

The negative effects of food waste are recognized on a global level. In recent years, governments have worked to improve food sustainability. The European Union is a prime example of governments working to end food waste. In 2012, the European Union started the FUSIONS campaign (Food Use for Social Innovation by Optimizing Waste Prevention Strategies) that worked to develop a Common Food Waste Policy for the EU and reduce food waste by half by 2020. Although efforts to halve the amount of food waste in the EU have been extended until 2030, the EU has been working consistently on

fighting this battle. In 2015, the European Commission organized the Fight Food Waste, Feed the Planet conference at Expo Milan in order to share information and discuss action plans among policy makers, stakeholders in the food chain, and consumers (“EU actions against,” 2018).

The United Nations has encouraged the EU to take a stand against food waste. The 17 Sustainable Development Goals of the UN include the better management of food waste in order to feed the one in nine people around the globe who are undernourished (“Goal 2: Zero Hunger,” 2019). Decreasing food waste is essential in feeding the world’s rising population and providing food for those who are food insecure. The EU is striving to lead this initiative. In these efforts, the EU established the EU Platform on Food Losses and Food Waste in 2016 (“EU actions against,” 2018). In 2018, the Revised Waste Legislation was adopted, which calls on member states to reduce food waste at each stage of the food chain, monitor food waste levels and report back on progress made in order for the EU to develop a common methodology to measure food waste in the EU by 2019 (“EU actions against,” 2018). The revised legislation will encourage member states and actors in the food chain to collaborate and decide what the best measures are to combat food waste in the EU.

The fight against food waste can be seen at national and local levels as well. In 2015, France became the first country to ban edible food waste from supermarkets, requiring stores to donate edible foods to charities instead (McCarthy, 2016). France is becoming a model country for food sustainability. The budding interest in food waste has led to an increase in research. Governments and private organizations around the world are conducting a greater amount of research on the amount of food waste in individual

countries and areas. Research is an important factor in combating food waste, and it is essential that countries are given quantitative evidence of food waste in order to better understand their role in the issue. Studies motivate individuals and governments to take a stand on issues, like food waste. One significant study, which will be discussed later, was conducted by The Economist Intelligence Unit and the Barilla Center for Food and Nutrition Foundation.

Current Policies

Current policy approaches predominately revolve around raising awareness and providing information to influence attitudes and educate others about food waste. This is exemplified through Germany's Zu Gut für die Tonne (Too Good for the Bin) initiative that was implemented by the Federal Government in Spring of 2012. The importance of the Too Good for the Bin initiative is that it is one of the recommended policy options suggested by the European Commission. According to a study conducted by the Commission, the German initiative is one of the three most successful initiatives in the EU (European Commission, 2010). This government initiated, broad educational campaign aims to set standards for future food waste initiatives. Too Good for the Bin has the potential to guide food waste legislation at the EU level. It is also important to consider that the Federal Government of Germany acts more as a promoter of the initiative than an acting provider. With a more direct role, the Too Good for the Bin policy could yield further success.

In order to combat the estimated 82 kilograms of food that is wasted by each person every year, the Too Good for the Bin initiative was launched as an information campaign against the disposal of food (“Initiative gegen Lebensmittelverschwendung,”

2019). The campaign includes a website with tips regarding food storage, food labeling, facts about food waste, and recipes for leftover foods. The initiative also produced the mobile application, *Zu gut für die Tonne!* (Too good for the Bin), which includes more than 600 recipes from star chefs and prominent cooks (Korte, 2018). The app allows the user to enter leftover ingredients, which will then be used to produce a simple recipe containing the leftover ingredients. Example recipes include black tee yogurt, avocado dip, broccoli soup, banana curry, and bread pudding. The app also includes a section to generate shopping lists, the 10 golden rules for preventing food waste, and safety and health information regarding specific food items. For example, the app tells users that apples are best stored in dark, dry places around 4 degrees Celsius (the refrigerator is best), and apples are typically good to eat from 3 to 5 months after purchasing or 6 to 12 months if stored in the freezer (Korte, 2018). The simplicity and transparency of the app make it a useful element in the Too Good for the Bin campaign.

Germany's Too Good for the Bin program is unique compared to other food waste policies because it is an educational policy tool found at the governmental level, which is not a common trend among countries and food waste policy. As the primary campaign for food waste in Germany, the success of Too Good for the Bin has been documented. Federal Minister Aigner claims that, "the campaign Too Good for the Bin is a great success. We have hit a nerve with our initiative. The response is overwhelming and has triggered numerous activities throughout Germany. I am pleased with the many positive responses from companies and institutions as well as all the citizens who participate in the action. We have come up with many good ideas for reducing food waste, which we are now implementing step by step" ("Initiative gegen

Lebensmittelverschwendung,” 2019, p. 1). The positive effects of the initiative have been seen in industries, academia, various public institutions, and homes. Many hospitals, schools, and companies have come up with new ways to handle leftover food, which are influencing behaviors in the home as well (“Initiative gegen Lebensmittelverschwendung,” 2019). For example, Restlos Glücklich, a restaurant in Berlin, uses leftover foods from markets, supermarkets, and farmers to serve its customers (Deutsche Welle, 2017). Furthermore, the mobile application has received more than 800,000 downloads (Korte, 2018). Too Good for the Bin has increased enthusiasm and awareness for food waste; however, no measurement tools have been used to evaluate whether or not food waste has decreased since the onset of the initiative. This prevents the success of Too Good for the Bin from being accurately appraised.

Due to a lack of precise, universal data on food waste, it is important to look at official, government data that most closely represents food waste measurements. Although the European Commission does not yet measure food waste, the Commission has long-standing measurements of municipal waste. The Commission defines municipal waste as waste collected by or on behalf of municipal authorities or directly by the private sector, in which the majority of the waste originates, from households followed by offices, commerce, public institutions, and selected municipal services (Eurostat, 2019). Food waste is included in municipal waste, so this indicator can serve to identify varying levels of food waste among EU countries. The Eurostat data shows that in 2017 the EU as a whole produced 487 kg of municipal waste per capita. Meanwhile, Germany produced 633 kg of municipal waste per capita, a quantity that only Cyprus, Denmark, Norway, and Switzerland surpassed (Eurostat, 2019). Although municipal waste is not a

synonym for food waste, the indicator is important due to the fact that no government official EU data on food waste exists. The Eurostat data on municipal food waste also shows that, with the exceptions of 2011 and 2012, the amount of municipal waste has been increasing in Germany since 2006. In 1997, however, Germany experienced its highest level of municipal waste with 648 kg per capita (Eurostat, 2019). Based on these statistics, waste, with the inclusion of food waste, is a clear issue in Germany, especially when compared to other members of the EU.

The Barilla Center for Food and Nutrition along with The Economist Intelligence Unit has also attempted to measure food waste. They created the Food Sustainability Index (FSI) as a model to analyze the sustainability of national food systems and establish a system for measuring progress. The FSI aims to achieve Sustainable Development Goals by ranking countries with the purpose of monitoring and identifying the main challenges facing the global food system (Blair, 2017). The FSI focuses on three pillars: sustainable agriculture, nutritional challenges, and food loss and waste. The 2018 report analyzed 67 countries, an increase from 34 countries in 2017. In order to most accurately measure the level of food sustainability in various countries, the FSI divided countries up by income according to the World Bank. Germany ranks among the 35 high-income countries, so I will focus on this group. In the 2018 FSI, France takes first place overall and in the category “food loss and waste,” producing the least amount of food waste among the 35 countries (Murray, 2018). Germany, with a score of 71.2, is ranked 15th overall, following countries such as, Argentina, Croatia, and Poland and 20th in the category “food loss and waste” following countries like Poland, Italy, Portugal, and the United States (Murray, 2018). Perhaps Germany should look towards France's anti-food waste

mechanisms and model its policies after France's policies. Moreover, in the "food loss and waste" section, consumer waste is second only to post-harvest waste for the greatest contributor to overall food waste (Murray, 2018). This emphasizes the significance of waste generated at the household level.

As identified, it is essential to change consumers' thoughts and behaviors toward food waste. While policy makers are seeking to change policies in regard to food waste, it has not been enough. The FSI includes an indicator that measures the quality of policy response to food waste with regards to legislation, voluntary agreements, market-based instruments, strategies, prioritization framework, and private institutions, and Germany is not among the top 10 performers listed in the report (Murray, 2018).

Chapter IV: Discussion and Conclusion

Recommendations

Uniform Food Waste Measurement

Organizations around the world are beginning to take action against food waste, yet, more scientific research is needed. In order to advance the issue of food waste, quantitative information is necessary, which in return requires proper quantitative measuring tools to avoid unclear or vague objectives. This situation makes it challenging to evaluate and develop concrete measures needed to establish the goal of reducing food waste (Johansson & Corvellec, 2018). Although research projects, such as the study conducted by The Economist Intelligence Unit and the Barilla Center for Food and Nutrition Foundation exist, no precise, commonly accepted data is currently available. This is due to varying definitions of food waste and loss, designs and scopes of investigation, and to various methods for research and data collection. For example, a study conducted by Noleppa and Carlsberg estimates that each year 39% of food waste in Germany stems from households. Of this food waste, 70% or 5 million tons, which is equivalent to 62 kg per capita, is seen to be avoidable (Noleppa & Carlsberg, 2015). Meanwhile, Kranert et al. (2012) claims that German households produce 65% of total food waste, which equals between 71 kg and 92 kg per person (Kranert et al., 2012). Other studies, like the Safe Food study conducted by Cofresco, indicate that consumers estimate that they throw away 6% of their food, but the study's data shows that they

throw away 21% of their purchased foods (Cofresco, 2011). Although not in exact statistical accordance, these studies highlight food waste as a crucial issue in German households. This means that effective strategies to combat food waste should focus on the consumer level. However, in order to spread awareness and educate others on food waste, it is essential to establish valid and reliable data.

A field study conducted in eastern Haifa Israel worked to measure household food waste through a method called the "Daily Family Waste Collection." The waste of 192 households and 634 individuals of all ages and genders was measured on a daily basis. The elements of the study included capturing food waste at the point at which it enters the waste stream; collecting waste samples at the doorstep; using individual households as sampling units; and collecting and sorting waste daily (Elimelech, Ayalon, & Ert, 2018). The field test showed that measuring individual household food waste is not only feasible, but also yields results that reflect general behavior. Carrying out replication studies across EU cities and countries would provide more accurate, unified household food waste data. This data could be compared and analyzed at the EU level, which would lead to more effective food waste policies.

Education about Food Waste

Studies show that household food waste often results from a lack of consumer knowledge. As mentioned, the European Commission found that 10% of food waste occurs due to a misunderstanding of food labels (European Commission, 2018). Moreover, a study in the UK found that consumers improperly plan meals. The study concluded that 40% of household food waste stems from the preparation of a disproportionate amount of food due to lack of meal planning and excess purchasing

(Zhang, et al., 2018). Buchner, Fischler, Gustafson, and Reilly, suggest that if consumers were aware that wasting 22,000 tons of meat means wasting 127 million cubic meters of water, emissions equal to 9.8 million tons of carbon dioxide, and environmental resources equivalent to 8,360 hectares of land, they would reconsider their behavior (Buchner et al., 2012). In order to reduce household food waste, consumers must become educated on how to prevent food waste and on the implications of food waste.

Education Strategies

As reported, the University of Stuttgart found that the majority of household food waste comes from fruits and vegetables. Knowing this, policy makers should concentrate the education about food waste on these specific categories of foods. The researchers from this study recommend that the first step in preventing household food waste is to raise awareness via media campaigns and online platforms as well as acknowledge innovative ideas against food waste and conduct food waste management competitions (“Determination of discarded,” 2012).

Furthermore, cooking plays a large role in food waste. Developing cooking skills will allow for a better idea of proper portion sizes and using smaller plates will induce consumers to put less food on their plates, leading to less food waste (Schanes, Dobernig, & Gözet, 2018). Teaching others how to cook, how to properly read food labels, how to store food, and how to manage leftovers are essential factors in reducing food waste. Widespread education can be accomplished through educational campaigns with the addition of mobile applications.

Taste the Waste

Taste the Waste, the documentary that primarily sparked inspiration for lowering food waste in Germany, was the first major project to educate Germans on food waste. In the documentary, Thurn includes several suggestions for cutting back on food waste. He recommends that food waste, specifically bread, be used as an energy source, or like in Japan, food waste could be transferred to animal feed. Currently, the EU prohibits leftovers and waste from being used as animal feed, due to the fear of Bovine spongiform encephalopathy (Mad Cow Disease) from the shortened food chain. However, the Japanese methods have not led to an increase in BSE (Thurn, 2010). Using food waste for animal feed provides an efficient, effective solution for dealing with excess food waste. Altering EU policy to allow leftovers and waste to be used as animal feed would allow Germany to sustainably deal with food waste.

Thurn ends his film by discussing the disconnect between people and the food they eat. Today, few people pay attention to or appreciate the food they consume. People do not know where or how their food is made and, therefore, have no respect for the food they consume. If consumers knew that Farmer Gray down the road worked hard to produce enough corn for the community this year, the consumer might be more careful about simply throwing the corn out. Personal choices and lifestyle along with personal value of food are areas that must be addressed in order to better educate consumers on how they should treat their food. Thurn suggests educating children on how food is made from start to finish as well as initiating community round tables to invite those desiring to learn more about food (Thurn, 2010). The German government should include food waste

awareness in school curriculum and continue to push educational campaigns at national and local levels.

In the film's conclusion, Thurn tells his audience to simply buy less food and to eat all the food they purchased (Thurn, 2010). German grocery stores should implement measures that encourage consumers not to overshop. *Taste the Waste* served as an important tool in launching consumer awareness of food waste.

Too Good for the Bin

As mentioned, Germany's educational campaign, Too Good for the Bin, has the potential to guide food waste legislation at the EU level. Similar educational campaigns have been introduced around the world. The Environmental Protection Agency in Ireland launched the campaign Stop Food Waste (Pope, 2018). The Love Food Hate Waste campaign in the UK includes a mobile application that is very similar to the Zu gut für die Tonne app used for the Too Good for the Bin initiative. The Love Food Hate Waste campaign claims to have reduced food waste by 137,000 tons since 2007 (Kranert, et.al., 2012) Also, television and movies, such as *Taste the Waste*, have been successful educational tools in delivering food waste information. The German government and private organizations should continue to push, support, and enrich such educational campaigns.

Food Sharing

Other mobile applications aim to reduce food waste by encouraging consumers to re-distribute their household food surplus. In Germany, this can be done through the "Food Sharing" initiative. In Britain, the app "OLIO" allows neighbors and local businesses to share food more conveniently. Other food sharing initiatives are "Food

Sharing" in Austria, "Next Door Help" in Italy, and "Yo No Desperdicio" in Spain. While receiving food from donors via online applications is intended to reduce food waste, the rate of success is questionable. According to studies, consumers continue to report numerous concerns regarding the safety of food sharing and an absence of trust in the donator (Lazell, 2016). While sharing food has not yet become fully acceptable socially, as awareness about food waste rises and societal developments occur, its potential remains.

In fact, a more comfortable food sharing option, the community refrigerator, debuted in Spain in 2015 and made its way to Auckland, New Zealand. The idea behind it is to "Take what you need. Leave what you don't, " and by so doing reduce food waste by sharing excess food with those who need it (Chapman, 2017). The solidarity fridge located in Bizkaia, Spain, saved 200 kg of food in the first month ("What is a Solidarity," 2015). The fridge successfully collected 30 full days of nutrition, an impressive amount. The Food Sharing initiative in Germany installed 25 community refrigerators (Fairteiler Kühlschranks) in Berlin. Originally, the community refrigerators yielded success; however, later in 2016, the city declared them as a health hazard, and authorities classified them as businesses, which meant they had to comply with EU regulations about the terms of traceability, liability, and food health and safety (Osborne, 2016). New policy, however, should alter EU regulation in order to support food sharing efforts. For example, policies could be altered to offer less strict health and safety regulations for food sharing programs. Regulation could allow for products containing "best by" dates to be included in the community fridges and forbid products with "sell by" dates, protecting consumer health and safety. EU regulation could also require periodic quality control

check-ins by Germany's Federal Office of Consumer Protection and Food Safety (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit: BVL) to ensure that food sharing practices are following the proposed regulations.

Economic Instruments

Food waste reduction can be solved with various policy tools, including economic instruments. Consumers can be encouraged through taxes, fees, and subsidies to reduce their personal food waste. An example of an economic-based policy is the "Pay-As-You-Throw" (PAYT) approach, which has been implemented in various communities in different countries, such as the United States, Sweden, Canada, Japan, Taiwan, Korea, Vietnam, and China (UNEP, 2014). Through PAYT households are charged based on the amount of household waste, including food waste, in weight, volume, or number of trash cans that they throw away. Typically, residents are charged through property taxes or a fixed fee. This encourages individuals to produce less waste and partake in recycling and composting (Schanes, Dobernig, & Gözet, 2018). In Sweden, some municipalities use separate bags or containers for the collection of food waste, which produces less mixed waste, allowing for easier waste separation (Andersson & Stage, 2018).

Analyzing PAYT and similar systems, research has found that weight-based tariffs tend to be more successful because consumers think about each additional wasted object as adding to their tariff (Andersson & Stage, 2018). In France, the community of Ribeyvillé experienced a 55% reduction in residual household waste between 2000 and 2010, with the implementation of PAYT (ADEME, 2011). One year after introducing a food waste tariff, households in Sweden reduced food waste by 18 kg annually, and after three years food waste was reduced by 32 kg per household (Andersson & Stage, 2018).

However, despite the fees and their success, surveys show that a significant majority of Swedes work to reduce waste and recycle because of moral standards (Andersson & Stage, 2018). Overall, PAYT has produced positive results regarding the reduction of household waste; yet, more evidence is needed in order to show the effectiveness of taxes or fees on waste reduction (Schanes, Dobernig, & Gözet, 2018).

Laws and Regulations

The addition of regulations, such as laws, standards, and mandatory restrictions, can also be used as policy tools. In France, the National Pact against Food Waste, enforces eleven measures to reduce food waste by 50% by 2025 (Mourad, 2016). These measures include, a national day against food waste, education about food waste in agricultural high schools, improved knowledge about the legislative and regulatory framework relating to ownership and liability in the area of food donations, measures against food waste in waste prevention programs, inclusion of food waste measurements as part of Corporate Social Responsibility, an advertising campaign against food waste, and the systematic replacement of the existing “expiration date” on the label with “to be consumed preferable by” (Malvezin, 2015).

Eliminating food and safety standards that do not protect consumer health is also a potential effective regulatory instrument that should be considered. For example, the "sell-by date" could be removed from many products, such as cereals and canned or frozen foods, without causing harm to the consumer while simultaneously reducing food waste. Clarifying the "best before" date is also essential. Milk, for instance, is safe to drink several days past its “best before” date. A 2018 study published by the European Commission declared that 10% of the 88 million tons of food wasted in the EU is due to

date marking (“EU actions against,” 2018). This issue is exemplified by German regulations. In Germany, it is illegal to donate foods that have passed their "use by" dates; however, foods may be donated if they have passed their "best before" dates. Confusion between these two labels leads to excess food waste (Baglioni, Pieri, & Tallarico, 2016). In Denmark, it is legal to sell expired food as long as the customer is aware the food has passed its expiration date and the food shows no sign of health risks. In fact, multiple supermarkets specializing in the selling of expired goods operate successfully in Denmark (Copenhagen, 2016). The products are donated by import-export companies, local supermarkets, and producers and are sold at nearly half the price of typical grocery stores (Copenhagen, 2016). A similar grocery store in Pudsey, in the UK, has also seen a success. If consumers are willing to look past food labeling dates and overlook foods with minor blemishes, food waste could be reduced. As of 2018, the Real Junk Food Project in the UK, opened a short-term pop-up supermarket with foods past their "best by" dates. The food that was not purchased was used to make the meal for a charity event. The purpose of this project was to encourage consumers not to throw out food at home if its "best by" date has passed (Sheerin, 2018). Furthermore, the lack of transparency in food labeling can be solved through unified labeling definitions. As of 2018, the European Commission is working to simplify date labeling and to promote a better understanding of food labels (“EU actions against,” 2018).

In Italian legislation, an expiration date is defined as, "the date which replaces the ‘best before’ date in the case of foods, which are highly perishable from a microbiological perspective,” and “may not be supplied or consumed after this date because of the risk it involves" (Vaqué, 2017). Meanwhile, the "best before date" is

defined as "the date until which a food product preserves its specifications if it has been stored correctly. The law also stipulates that foods which have passed this date may be donated under Article 4 provided that the packaging is intact and storage conditions are suitable" (Vaqué, 2017). Providing and promoting distinct food label definitions clears up confusion among consumers.

Technology

Using policy as a tool to incentivize scientists and food producers to create and establish enhanced packing solutions that would increase the lifespan of food products should decrease food waste (Schanes, Dobernig, & Gözet, 2018). Various technological advances, such as multilayer barrier packaging and modified atmosphere packaging, have been created to do just this. Modified atmosphere packaging, for example, changes the atmosphere inside of the food package by using a natural interaction between the respiration rate of the product and the transfer of gases through the packaging material (Oliveira, et al., 2015). Technology like this increases the lifespan of food products.

Technological innovations in labelling to produce accurate expiration dates would also be beneficial in preventing food waste (Schanes, Dobernig, & Gözet, 2018). At the Massachusetts Institute of Technology, researchers have used nano materials to detect amines that are emitted as food deteriorates. This finding could allow for "smart packaging," which would provide more accurate, precise information on the food's quality and expiration date (Murray, 2018). This would combat date-labeling confusion and prevent consumers from throwing away edible foods. Another prevailing tool is RFID technology. RFID tags include sensors that are fixed in fresh produce, and they allow retailers to know whether or not the proper temperature has been maintained

throughout the foods' journey. If temperature fluctuations have diminished the produces' shelf life, supermarkets can discount it in order to sell it more quickly (Murray, 2018).

Additionally, the company Winnow has developed "smart meter" technology. When the smart meter is attached to waste bins, it measures and monitors the amount of food waste in the bin. When the food or meal that has been thrown away is entered into the smart meter, the smart meter provides insight on the dollar amount of wasted food (Murray, 2018). This allows consumers to become more aware of which foods they waste the most and the economic implications of food waste. Currently the smart meter technology is being used predominantly in restaurants; however, the device can work in households as well. The smart meter provides simple data so that consumers can easily identify which habits they need to change.

Technologies that effectively aid in the breaking down of food could also serve to combat the negative environmental impact of food waste. Through anaerobic digestion, food waste can be turned into biogas, a source of clean, renewable energy. Organic matter in food waste is particularly fit for anaerobic microbial growth, and food waste is thought to be one of the best possible energy sources for renewable energy production through anaerobic treatment (Zhang et al., 2014). In fact, biogas digesters have already begun spreading throughout Europe. As of 2014, almost 9,000 biogas digesters were present in Germany (Murray, 2018). Zhang et al. recommend additional research on anaerobic digestion to improve the economic performance of anaerobic digestion and food waste (Zhang et al., 2014). The research group also suggests the government should centralize food waste for large scale anaerobic digestion plants (2014).

Cost Efficiency

Cost should be considered when looking at anti-food waste strategies. Policy makers must be attentive to costs versus benefits in the policies they suggest. A publication in the *Natural Resource Journal* concludes that implementing composting facilities and other alternative waste facilities is too expensive and complicated compared to the benefits. For example, a new law in Vermont, USA requires citizens living within a 20 mile range from a certified organic waste facility to dispose of food waste at that facility. It is important, however, to note the costs of administering such facilities. It is estimated that solid waste composting systems cost \$50 per ton to operate, which is much more expensive than solid waste management systems (Evans & Nagele, 2018). Moreover, such composting facilities must also be easily accessible to consumers. Composting facilities present many difficulties, while inculcating federal food labeling requirements and education programs are easy and effective (Evans & Nagele, 2018). An education program implemented in the United Kingdom, for example, proved to be successful. Because of the program's education methods, data showed a 24% decrease in avoidable food waste between 2007 and 2012 (Evans & Nagele, 2018).

Coordination in Policy Implementation

Effective food policies should be clearly organized on all level of policy implementation. In 2015, the United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA) announced the goal of decreasing food waste and food loss by 50% in the United States by 2030. These organizations implemented five action levels: source reduction, feeding hungry people, feeding animals, industrial uses, and composting (Evans & Nagele, 2018). However, because of unclear definitions

and measurement complexities found within these categories, along with the exclusion of consumer participation, these federal initiatives failed. It is important that policy changes implemented at the federal level be clear, inclusive, and easy to implement. The European Union and Germany must keep this in mind when altering food waste policies.

Limitations

Measuring Food Waste

Accurately measuring food waste presents a challenge. Studies considering the scale, causes, and impacts on food waste have been conducted in a variety of countries in the European Union. Currently, national surveys are available for the Netherlands, Denmark, Great Britain, Norway, Finland, Sweden, Portugal, France, Italy, Austria, Germany, and Switzerland (Jörissen, Priefer, & Bräutigam, 2015). A variety of sources including universities, NGOs, industrial companies, and international and European organizations are responsible for collecting this data. The studies, however, used a variety of methods, such as surveys, interviews, kitchen diaries, waste composition analyses, and calculations based on statistical data on food supply or municipal waste (Jörissen, Priefer, & Bräutigam, 2015). The diverse range of methods produces results that vary in their accuracy. For example, individuals are more likely to underestimate the amount of food they waste during an interview due to the tendency to give “socially acceptable” answers. Studies that rely on kitchen diaries typically focus on a smaller sample size, which leaves room for inaccuracy. While waste composition analyses tend to produce the most precise results, because of inconsistent definitions and a lack of an internationally standardized collection method, the results are not consistent with one another and do not provide reasons for the wasted food (Jörissen, Priefer, & Bräutigam, 2015).

As a member of the EU, Germany works hand in hand with the EU to deal with environmental issues and initiatives. As mentioned, in order for the EU to tackle the issue of food waste at the supranational level, accurate data is necessary. Due to the lack of harmonized data and methodologies for analyzing household food waste, comparisons of results from studies and initiatives at national levels are difficult to be made (Bräutigam, Jörissen, & Priefer, 2014). This means, for example, that the success of the Too Good for the Bin initiative cannot be measured accurately in comparison to other EU countries, which causes confusion about the policy's viability throughout the EU. If the Too Good for the Bin produced positive results, the initiative could be confidently implemented throughout the EU. At the EU level, legislative measures have been taken in order to reduce food waste. The 2008 revision of the EU Waste Framework Directive required that member states adopt waste management strategies by 2013, which are to be evaluated every 6 years (Secondi, Principato, & Laureti, 2015). This led to the creation of over 100 food waste initiatives, including the initiatives seen in Germany. However, the inability to measure the success of such initiatives makes them problematic.

It is also difficult to trace all signs of food waste. Food that goes down the garbage disposal, is fed to a pet, or is composted, is likely left uncalculated. Ultimately, the difficulties present in calculating food waste are evident. Again, a collective approach to measuring food waste is necessary. However, even with a lack of precise data, it is evident that food waste is abundant and is a predominant issue.

The Effect of Non-Government Actors

In Germany, many non-government actors, such as The Food Sharing Initiative, have taken action against food waste. Public, non-governmental actors play a strong role

in influencing food waste prevention. While many non-government programs have experienced success, giving the market the power to influence food waste prevention leads to unclear waste effects and a lack of control regarding the food waste measurements (Johansson & Corvellec, 2018). For example, like in Germany, many private actors have stepped up in the United States to reduce food waste. Private food policy councils (FPC) exist in 45 states and the District of Columbia (Evans & Nagele, 2018). FCPs focus on various efforts included in the area of food policy, advocacy, and education. However, non-governmental organizations, such as FCPs, have been seen to unintentionally increase food waste, and they face many barriers in the effort to effect policy, due to limited resources, influence, and skill compared to public counterparts (Evans & Nagele, 2018). Therefore, the prevention of food waste should not depend solely on non-government actors and such organizations should be monitored and appropriately guided by the government.

Policy Coordination

Properly installing specific policies from the federal level in Germany is also important. Étienne Le Roy, from the French Environment and Energy Management Agency, attributes France's success in waste prevention to government support: "In our experience with a variety of schemes we have very clearly seen that prevention plans and programs will bear fruit only if elected officials are truly involved and push the project. Working with a prevention plan or programs manager, the role of elected officials is to mobilize their own staff as well as residents and project partners to ensure success. Their constituents are sure to attribute the major economic and social benefits of this success to their elected officials- a win-win solution!" (ADEME, 2011).

Regardless of the type and amount of policy changes, the implementation of such policies is most important. The German federal government must work with its 16 federal states in order to compose a set of cohesive policies against food waste. The coordination between the federal state and state levels presents a challenge. The German federal government should focus on "top-down" initiatives while simultaneously supporting and encouraging "bottom-up" actions by the states, cities, and local communities, along with different societal actors (Scholz, Keijzer, & Richerzhagen, 2016).

Conclusion

Food waste impacts economic, environmental, and social aspects of society. Household food waste contributes the most to food waste; therefore, it is in the hands of the consumers to combat food waste. In Germany, each individual produces 82 kg of food waste every year, totaling 6.7 million tons of household food waste (Buchner et al., 2012). To promote a sustainable future, food waste policy must be effective. In order to promote sustainable development, the United Nations developed the 12 Sustainable Development Goals. Sustainability should be referred to as development “that meets the needs of the present without compromising the ability of future generations to meet their own” (WCED, 1984). Food waste must be decreased in order for German society and the world to continue functioning at high environmental, economic, and social levels and to ensure a stable future for generations to come.

The most efficient methods in decreasing food waste are policy tools such as: education, laws and regulations, economical instruments, and technological innovations. Consequently, the strongest policy plan will encompass these four policy instruments. To properly evaluate food waste, a uniform food waste measurement strategy must also be

put into place. Such a measurement tool should be depicted at the EU or the global level, through the UN. Germany, therefore, should concentrate on implementing policy tools that fight food waste through education, laws and regulations, economic instruments, and technological innovations.

The German federal educational campaign, Too Good for the Bin, includes aspects found in other successful educational campaigns, such as the UK's Love Food Hate Waste Campaign. Taking measures to teach consumers about grocery shopping planning, cooking techniques, proper food storing, how to read food labels, and the environmental and economic impacts of food waste, will create more food-waste conscious consumers. The government should work to continuously promote this campaign along with the campaign's app, Zu gut für die Tonne. Further marketing, expansion, and constant updating of this program will allow more Germans to become educated about food waste, promising a greater impact on the battle against food waste. Furthermore, an educational campaign is relatively low in costs, making the benefits of such an initiative outweigh the financial implications.

The addition and/or alteration of laws and regulations also serve as effective means to combat food waste. In order to lower household food waste, more flexible restrictions should be given to food sharing initiatives. This will lessen the complications to partake in food sharing and will encourage food sharing between consumers. Regulations should also be altered in the case of food donations, allowing all edible food to be donated. In addition, food labeling regulations should be clear and consistent in order to diminish the confusion that current food labels create. Food labeling regulations should be distinctively defined and implemented throughout the entire country.

Confronting food waste legislation will establish unified, legal change that is necessary in decreasing food waste at a national level.

Moreover, economic instruments have been successfully implemented in other countries, so using economic means to fight German food waste is also a good idea. Charging households based on the amount or weight of food waste they produce could be a very influential policy tool. By implementing a tax on household food waste, consumers will become more aware of the food they waste and will work to decrease their household's food waste.

Technological advancements and implementations have the potential to positively impact food waste as well. Technological tools can be used to better identify a product's true expiration date and to create packaging that extends the shelf life of foods. Technology can also be used to turn food waste into energy through the use of biogas digesters or to measure and analyze food waste in one's trash can. Through innovations like these, the amount of food waste will decrease. As technology has great potential in fighting food waste, the German government should establish research grants for this purpose.

The fight against food waste is no easy feat. Germany continues to work towards meeting SDG 12. The current Too Good for the Bin policy in Germany has spread food waste awareness; however, further action must be taken in order for Germany to meet its sustainability goals. Policies that encompass the educational, technological, economical, and regulatory necessities in limiting food waste must be implemented. The largest portion of food waste stems from household food waste, which is why policies focusing

on the consumer level will be most impactful. By decreasing household food waste, Germany will reap financial, environmental, and social benefits.

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