

MITRE | GALLUP®

THE STATE OF FOOD WASTE IN AMERICA

2023 REPORT

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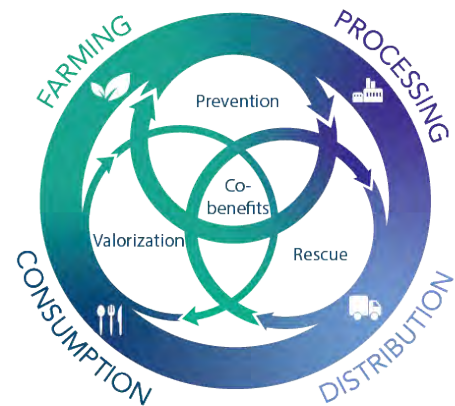
Since 2010, the FLPC has served partner organizations and communities in the United States and around the world by providing guidance on cutting-edge food system issues, while engaging law students in the practice of food law and policy. FLPC's work focuses on increasing access to healthy foods, supporting sustainable and equitable food production, reducing waste of healthy, wholesome food, and promoting community-led food system change.

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NATURAL RESOURCES DEFENSE COUNCIL

The NRDC (Natural Resources Defense Council) is an international nonprofit environmental organization with more than 3 million members and online activists. Established in 1970, NRDC uses science, policy, law, and people power to confront the climate crisis, protect public health, and safeguard nature. For over a decade, NRDC has built a body of research, tools, case studies, and strategic approaches for reducing food waste across the United States. NRDC works with key actors such as consumers and city, state, and federal governments to reduce food waste through policies and programs that work across the life cycle of food. www.nrdc.org



ReFED

ReFED is a national nonprofit working to end food loss and waste across the food system by advancing data-driven solutions. It leverages data and insights to highlight supply chain inefficiencies and economic opportunities; mobilize and connect supporters to take targeted action; and catalyze capital to spur innovation and scale high-impact initiatives. Its goal is a sustainable, resilient, and inclusive food system that optimizes environmental resources, minimizes climate impacts, and makes the best use of the food we grow.

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INTRODUCTION: THE SIZE OF THE PROBLEM

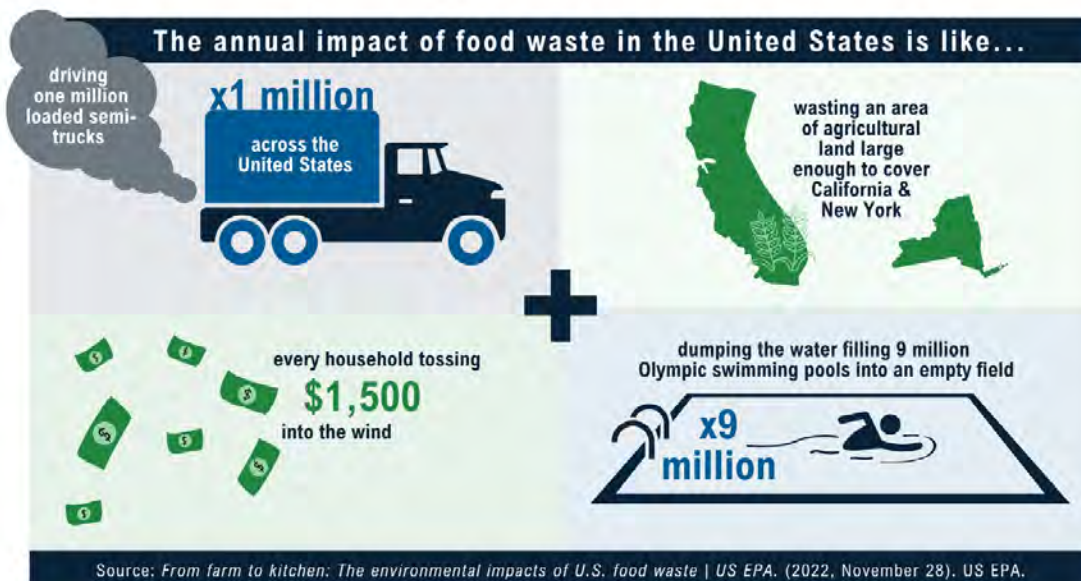
One-third of all food in America is wasted.¹ Food waste is a far-reaching problem with national and global consequences. As a major contributor to economic outcomes, food insecurity, and environmental strain, the waste and misuse of food resources leads to billions of dollars lost each year. Because of its impact, initiatives to reduce and repurpose this waste have the potential to positively contribute to the economy, environment and national security.

Because little insight was available about how much food is wasted at the household level, MITRE initiated a nationally representative survey of the United States with Gallup to better understand how and why people are wasting at home. The MITRE-Gallup State of Food Waste in America survey measured how much food was wasted in American households during a one-week period in July 2023. This data adds to prior reports published by experts in the field, including some of our partners, and builds on a knowledge base that

may enable positive changes in the way we purchase, use, and dispose of our food resources. The data can also help track progress against our national goal to reduce food loss and waste by 50% by 2030.²

Economic Impact

Food waste cost the United States an estimated \$310 billion³ in 2021.⁴ Most of this toll falls on consumers,⁵ with an average family of four spending at least \$1,500 annually on food that eventually ends up being wasted.⁶



Source: From farm to kitchen: The environmental impacts of U.S. food waste | US EPA. (2022, November 28). US EPA.

For context, in 2021, households in the lowest income quintile spent an average of \$4,875 on food (representing 30.6% of their income),⁷ while households in the highest income quintile spent an average of \$13,973 on food (representing 7.6% of income). Today, inflation and the rising cost of food impose huge burdens on many Americans. In fact, Americans worry more about food costs⁸ than any other expense.

Food Insecurity Impact

Food insecurity affected 13.5 million U.S. households in 2021.⁹ Reducing consumer food waste lowers food demand and production, which, in turn, ultimately lowers food prices.¹⁰ Lower food prices allow food-insecure households to purchase more food with limited funds.

Environmental Impact

Food waste also carries environmental consequences that go well beyond the tons of organic material piling up in our landfills. The production of food places an enormous burden on our planet and natural resources. The illustration below, which is based on Environmental Protection Agency (EPA) 2021 estimates,¹¹ illustrates

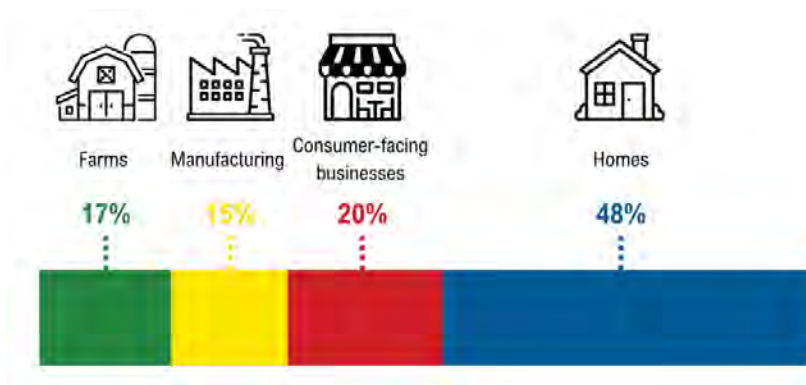
the demand on U.S. resources that go into the farm-to-kitchen production of food that is ultimately wasted in the United States every year.

Food Waste Measurement

Many countries, including the United States, have pledged to reduce food waste by 50% at the retail (e.g., grocery stores, restaurants), food service, and consumer household/residential (e.g., individuals, households) levels by 2030.¹² To reduce food waste, it is critical to track and measure that waste.

Without accurate and representative data, not only are we unsure of the nature of the very issue we seek to address, but we have no way to assess the impact of initiatives to reduce food waste. Therefore, valid and reliable data on the problem is a key part of understanding and documenting the scale and scope of the issue, making acquiring this data vital to all efforts targeting food waste reduction.

Our food makes a long journey from fields and pastures to our tables and landfills, and waste occurs at every step along the way. Nearly half of food waste occurs in the home,¹³ which is why the MITRE-Gallup food waste survey focuses on household food waste.



Where's the Waste?

Food is lost at all levels of the food supply chain, from going unharvested on farms, being rejected by grocery stores for imperfections, spoiling on buffet lines, to shriveling in the fridge. Nearly half of waste occurs in the home, making it crucial to better understand and reduce household waste.



“

One of the many challenges facing the municipalities starting food waste reduction campaigns is that they don't have resources to do evaluation. The vast majority don't know if their campaigns are changing attitudes, behaviors, or food waste. There is a big gap in these campaigns because we don't know if they're working.

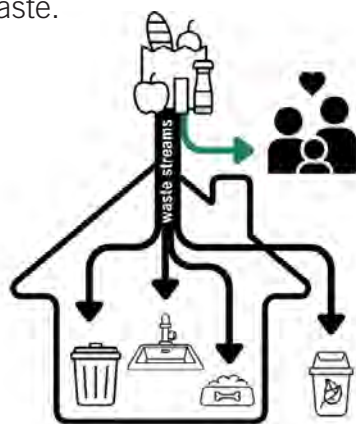
Claudia Fabiano, Environmental Protection Agency

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RESULTS OF THE MITRE-GALLUP SURVEY

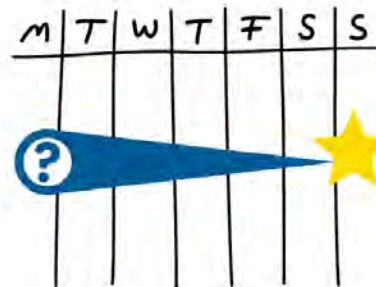
MITRE and Gallup conducted this nationally representative survey of 9,259 American households to better understand the state of food waste across the United States and raise awareness about factors that can help reduce it. This is the largest known representative study of food waste in the United States and, as such, illuminates Americans' behaviors, attitudes, and knowledge about food waste.

In this survey, household food waste was defined as any food disposed of at home via the trash bin, drain, garbage disposal, compost, or animal feed. Some established definitions of food waste focus on edible food, while others include food scraps: parts of food items that are not usually eaten, such as bones, eggshells, and pits.¹⁴ In this study, we additionally ask Americans about inedible food scraps as a separate category, to allow us to examine food waste amounts with and without that category. Unless otherwise specified, all findings in this report focus on edible food waste.



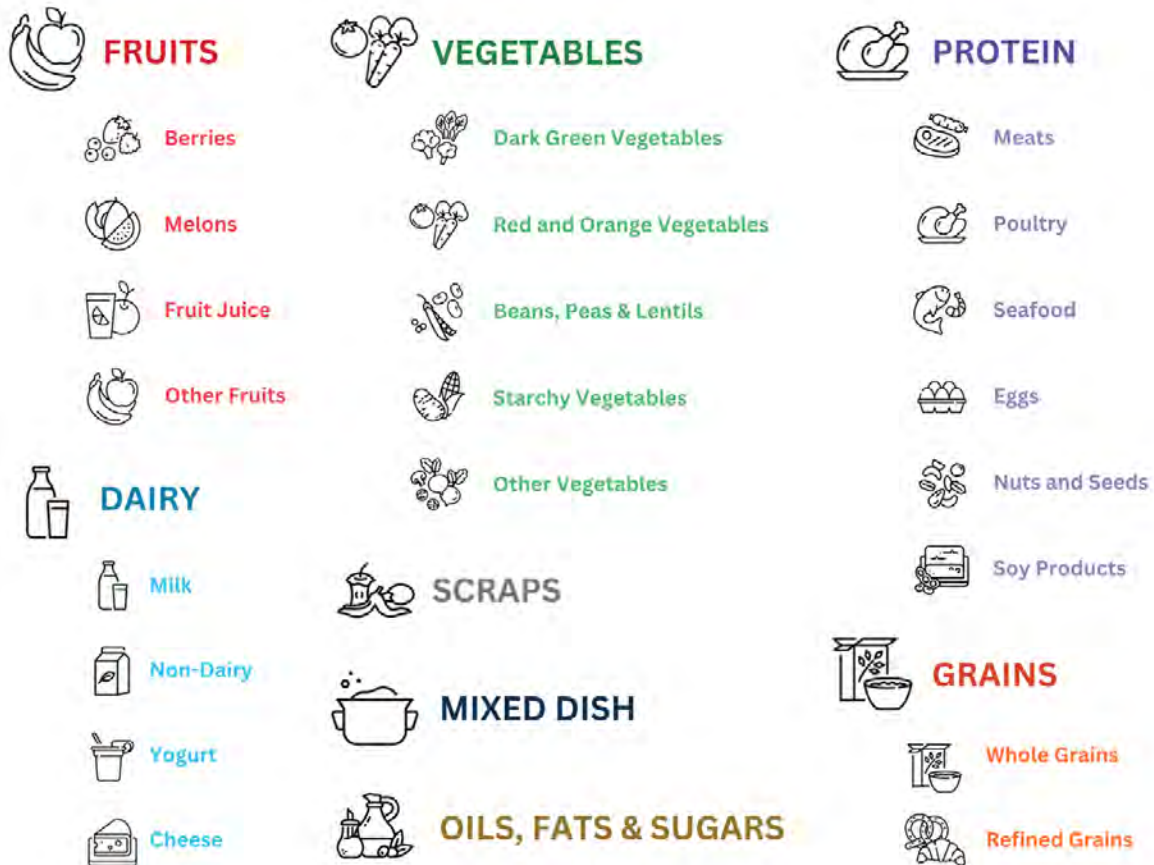
Household Food Waste

The study aimed to capture food waste amounts on normal, high, and low waste days. It can be difficult to remember exactly how much food we threw away a few days or weeks ago, especially if we are not paying attention to it. To help remember how much food was wasted, we sent respondents an announcement one week prior to the survey and asked them to monitor their food discards during the upcoming week. Respondents indicated whether the week's food waste amount was higher, lower, or about the same as usual.

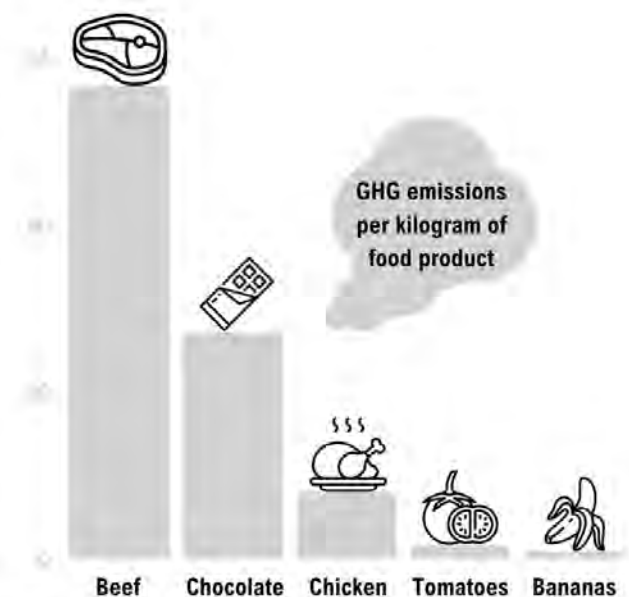


During the week of the study:
18% indicate **HIGHER** than typical waste
66% indicate **TYPICAL** waste
12% indicate **LOWER** than typical waste

Survey respondents rated their food waste in each of the eight food categories below, which are based on the United States Department of Agriculture’s (USDA’s) MyPlate Food Guidance System. [More information about MyPlate can be found at <https://www.myplate.gov/>.]



Wasting some foods impacts the environment more than others when evaluated at each stage of the supply chain, from farm to fork. Take for example, the vast difference in greenhouse gas emissions per kilogram of beef compared to bananas. Not to mention, some foods take significantly more resources—water, land, fertilizer, feed—to produce than others. This makes the categorization of wasted food a key step in research efforts.



Source: Poore & Nemecek (2018), Reducing food's environmental impacts through producers and consumers. *Science*

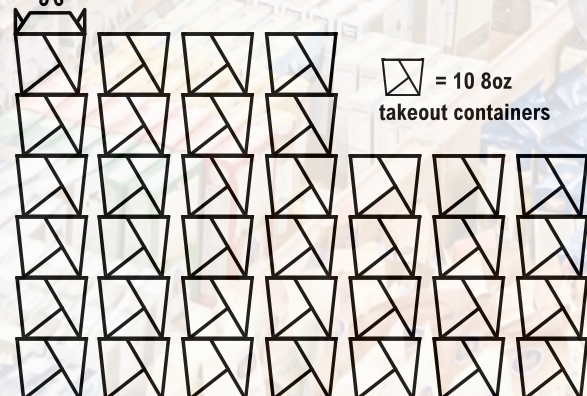
KEY SURVEY FINDINGS

- The average amount of food wasted by American households¹⁵ in **one week is 6.2 cups**¹⁶ or about 322 cups per year.
- The **price of food is the primary food-related concern** among American households, with concern expressed by **81%** of households. Only 33% are aware the average American household could save at least \$1,500¹⁷ per year by eliminating food waste, and almost half (49%) **underestimate potential cost savings**. Increasing awareness about cost savings and providing practical steps to reduce food waste and overspending could significantly motivate behavior change.
- **45%** of households believe **throwing away food harms the environment**. Increasing awareness of the link between food waste and environmental outcomes could motivate household food waste reduction.
- **86%** of households—irrespective of household size, number of children at home, education level, or income level—think **Americans should do more to reduce the amount of food we waste**.
- **Leftover use is a critical factor** linked to food waste amounts. People who frequently throw away leftovers waste much more food each week (12 cups) than those who do so less frequently (3.5 cups).
- **Households with children tend to waste more food** per week (8.5 cups) than those without children (5.1),¹⁸ and rate food cost as their highest food-related concern, making food-saving tips tailored to families impactful.
- **59%** of households report **date labels often or always influence their decision to purchase food items**, and **31%** often or always **throw away food that has passed its date label**, despite the fact that date labels generally indicate freshness, not safety. People who often or always throw away food that has passed its date label waste over twice as much food per week (8.9 cups) as those who never or rarely throw away past-date food (4 cups).
- Households with higher levels of **education**, higher levels of **income**, and lower **age** tend to waste more food.

Takeout the Trash



Food waste from each American household could fill nearly 360 takeout containers every year





Most people don't realize how often they waste food and the negative impacts it can have for food security, the environment, and climate change. Reducing food loss and waste could benefit them, their families, and the world, now and in the future.

Jean Buzby, USDA, Office of the Chief Economist

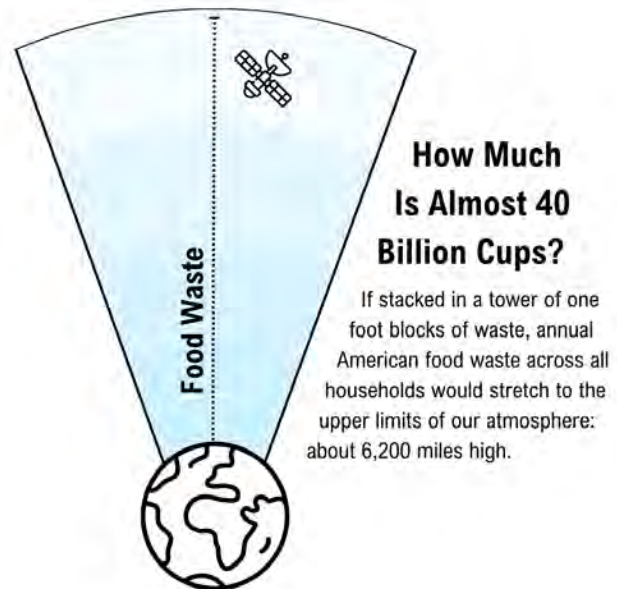


THE STATE OF FOOD WASTE IN AMERICA

The MITRE-Gallup study examined the amount of food Americans waste in a week, as well as how food waste differs across food categories, such as fruits, vegetables, protein, grains, and dairy. Additionally, the study examined whether food waste amounts differ significantly at the state level.

Seven out of eight American households (87.5%) report wasting some edible food in the week prior to the survey. Almost all Americans (97.1%) report producing food waste in the week prior to the survey when including inedible food scraps.¹⁹

The average amount of food wasted by American households in one week is 6.2 cups, or about 322 cups per year. This estimate does not include inedible food scraps. When including scraps, the average American household wastes 8.8 cups per week. Across all 124,010,992 U.S. households, that amounts to almost 40 billion cups per year!



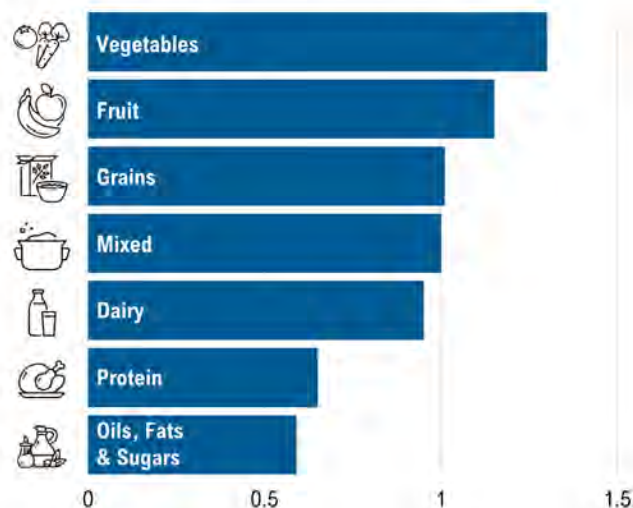
In the week prior to the survey, out of all households:

- 64% report wasting vegetables
- 58% report wasting fruits
- 50% report wasting grains
- 44% report wasting dairy
- 42% report wasting mixed food
- 39% report wasting protein
- 39% report wasting oils/fats/sugars (OFS)²⁰

On average, American households waste approximately 1.3 cups of vegetables, 1.2 cups of fruits, 1 cup of mixed foods, 1 cup of dairy, and 1 cup of grains. Households wasted slightly less protein and oils/fats/sugars (OFS) than other food categories, each less than one cup in the week prior to the survey.²¹ Protein dishes tend to be the most expensive and environmentally impactful food category, yet they still make up about 10% of all reported food waste.²²

Food Waste by Food Type

Average cups wasted per household over one week



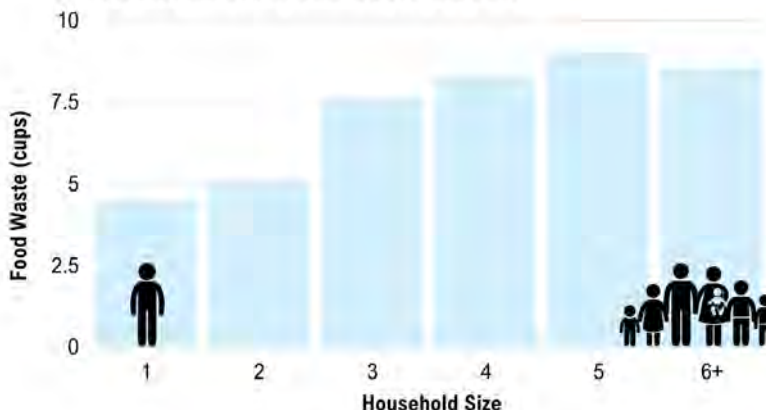
Note: OFS = Oils, fats, and sugars

Food waste amounts differ by household characteristics such as the number of people in the household, presence of children, education level, household income, and age.

In terms of household size, larger households tend to waste more food than smaller households; however, they tend to waste less food when considering the amount per person.

Food Waste by Household Size

Average cups wasted per household over one week



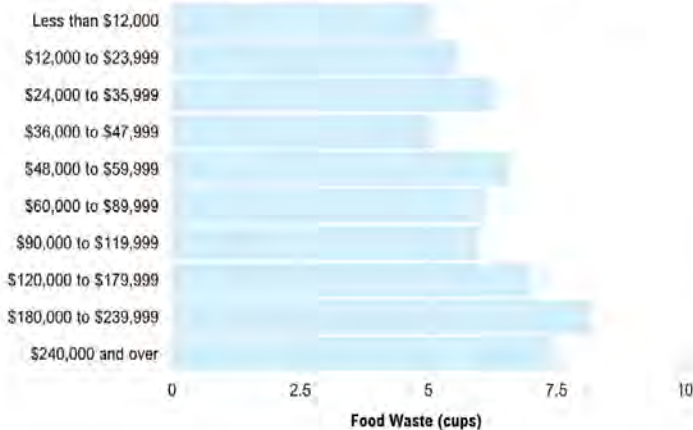
For example, households with two people report wasting an average of 5 cups per week—or 2.5 cups per person, while households with four people report wasting an average of 8.3 cups per week—around 2.15 cups per person.

Households with children report wasting more food (8.5 cups per week) than those without children (5.1 cups per week), and this holds true across all household sizes.

Younger households and those with higher income and education levels tend to waste more food.

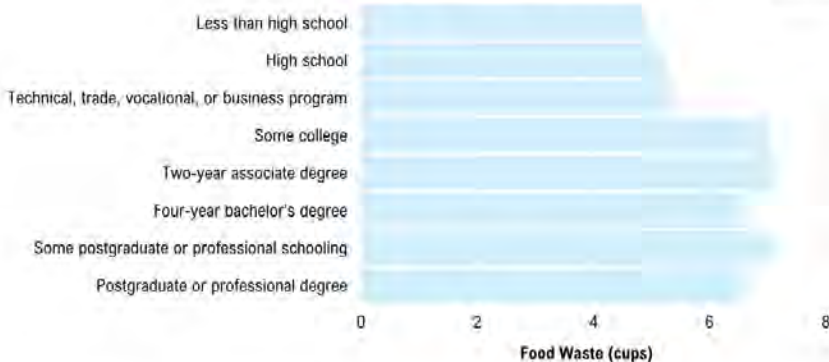
Food Waste by Household Income

Average cups wasted per household over one week



Food Waste by Highest Education

Average cups wasted per household over one week

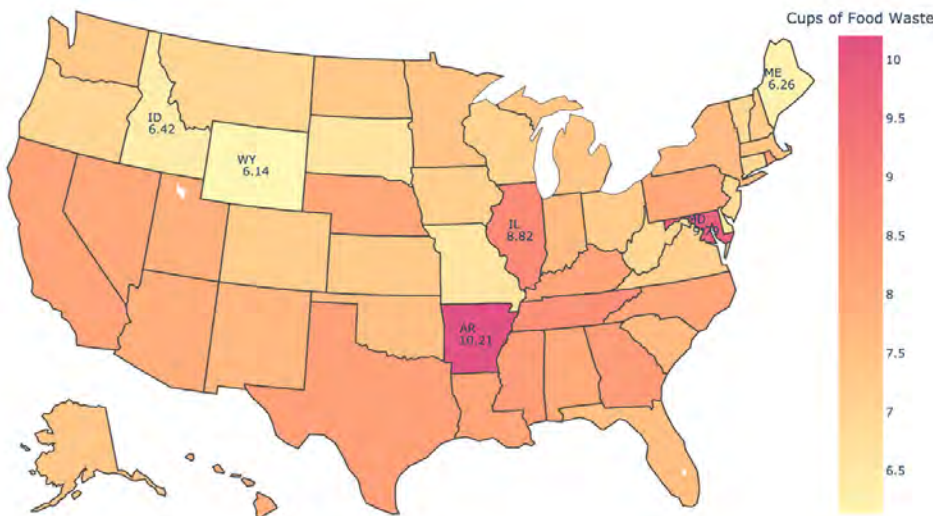


TIPS

Vegetables may be the most-wasted food group, but they don't have to be! Chop your veggies into sticks for a bright, refreshing snack. Learn how to store vegetables for maximum taste and freshness.²³ For instance, store asparagus in a glass with water. Remember to use your older veggies before purchasing new ones. And if they lose their crunch, toss them into a pot for a hearty vegetable soup.

Make the most of your fruits by slicing them and storing any leftovers in transparent containers in the refrigerator. Leftover fruit gone squishy? When baked into pastries or whirled into a smoothie, older fruits are virtually indistinguishable from fresh ones.

Cooking for children can be difficult. Practical steps to provide attractive options for children include starting with smaller portions and preparing vegetables (a food type more commonly wasted in households with children) in dishes such as pasta, casseroles, soups, sauces, and smoothies that may be more palatable for kids to consume—and also easier to freeze, store or incorporate into future meals on busy days. Serve yourself less at each meal while expecting to eat what the children don't finish at a meal. Give children tasting portions to find out what they like.



The state-level food waste estimates are weighted predictions from statistical models, whereas national food waste amounts are based on raw data. The state-level averages and the national average, therefore, reflect different analyses and should not be directly compared.

Survey Findings by State

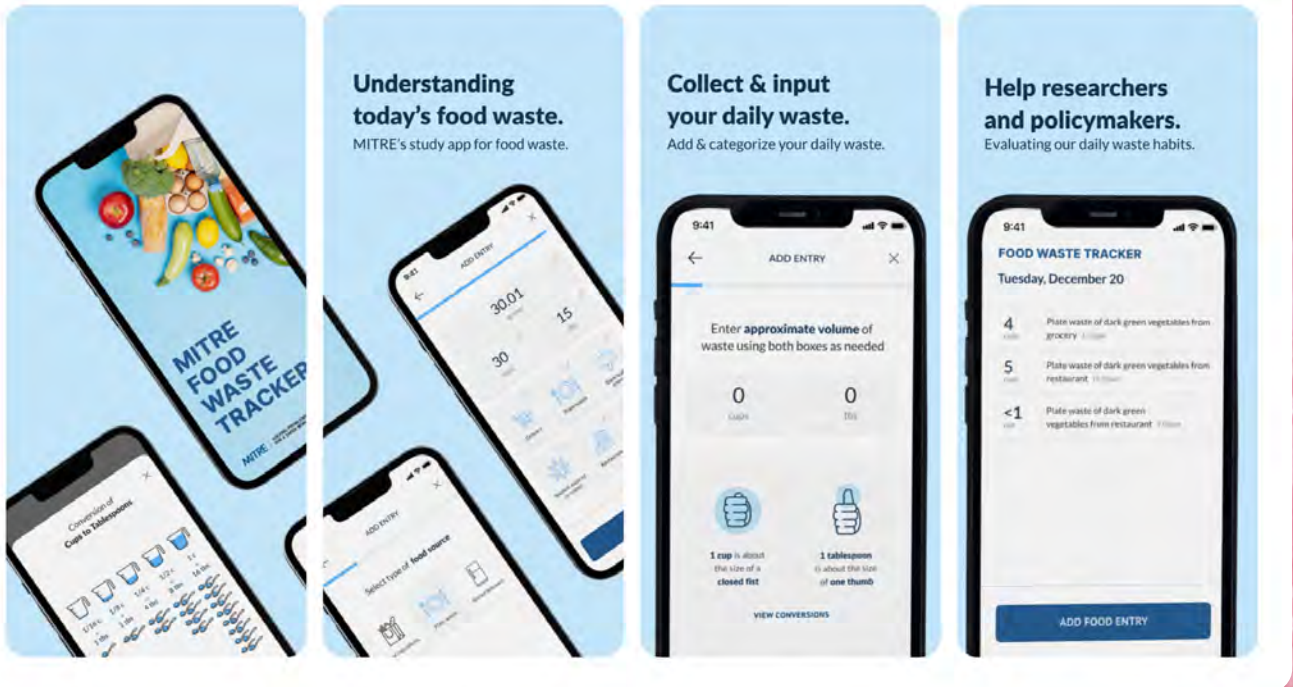
Food waste patterns differ considerably across geographical regions. This study surveyed households in all 50 states and found the states with the highest average levels of household waste are Arkansas, Maryland, and Illinois. And the states with the lowest levels of household food waste are Wyoming, Idaho, and Maine.

Two of the three highest wasting states (Maryland and Illinois) have higher household income and education levels

than the U.S. average, which may relate in part to their higher food waste levels. In contrast, two of the three lowest wasting states (Maine and Wyoming), have smaller average household sizes and lower median household income than the U.S. average, which may relate in part to their lower food waste levels. Note that the findings here are preliminary and additional research is needed to better understand reasons for differences between states.

	Median Household Income	Household Size	Age	Education % (Bachelor's Degree or Higher)
Arkansas	\$52,123	2.5	18% over 65 23% under 18	24.3
Maryland	\$91,431	2.6	17% over 65 22% under 18	41.6
Illinois	\$72,562	2.5	17% over 65 22% under 18	36.2
Wyoming	\$68,002	2.4	19% over 65 22% under 18	28.5
Idaho	\$63,377	2.7	17% over 65 24% under 18	29.1
Maine	\$63,182	2.3	23% over 65 18% under 18	33.6
U.S.	\$69,021	2.6	17% over 65 22% under 18	33.7

NOTE: DEMOGRAPHIC DATA FROM U.S. CENSUS QUICK FACTS [HTTPS://WWW.CENSUS.GOV/QUICKFACTS/](https://www.census.gov/quickfacts/)



The State of Food Waste in America: Summary

Almost 90% of households report wasting edible food over the course of the week. Of this edible waste, vegetables and fruits are the top two waste categories. The most expensive and environmentally impactful category, protein, represents 10% of waste.

Household characteristics have a strong relationship with waste outcomes. Though larger households waste more food in general, they waste less per person than smaller households. Households with children waste more than households without children, irrespective of household size. Those with higher income and higher education reported more waste than those with less education and income.

In all, on average, American households waste 6.2 cups of food in a week, or 8.8 cups when including inedible scraps.

Find Out How Much Food Your Household Wastes

As you read this report, you may be wondering how much food your household wastes. MITRE developed a Food Waste Tracker app, available on **Android and iOS devices**, which you can use to easily track your household food waste. Tracking food waste for a week may take effort and focus, but it is an eye-opening and important exercise to see your own household's food waste. Try it out and see how you compare to MITRE/Gallup study respondents!



“

It is my sense that being able to increase the skillset to re-optimize, use leftovers, use leftover ingredients, and improvise when we are cooking is one of the biggest factors in reducing household food waste. Then we won't have to meal plan perfectly, won't have to shop perfectly. Building the skillset to reduce waste in our households is going to be a crucial element of this food waste reduction.

Brian Roe, Ohio State University

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THE RELATIONSHIP BETWEEN FOOD BEHAVIORS AND WASTE

The MITRE-Gallup study examined Americans' behaviors in purchasing, storing, cooking, and discarding food, and identified some behaviors that are associated with the amount of food wasted in households.

The Value of Leftovers

One of the most effective strategies to reduce household food waste is eating leftovers. Three out of 10 Americans frequently (at least 2-3 times/week) use leftovers as ingredients in future meals, and 5 out of 10 Americans frequently eat leftovers as a meal by themselves. Those who report frequently throwing away leftovers because no one wanted to eat them (9% of households) estimate wasting approximately 12 cups of food each week. People who report infrequently (once a month or less) throwing away leftovers because no one wanted to eat them (38% of households) estimate wasting only 3.5 cups per week of edible food.

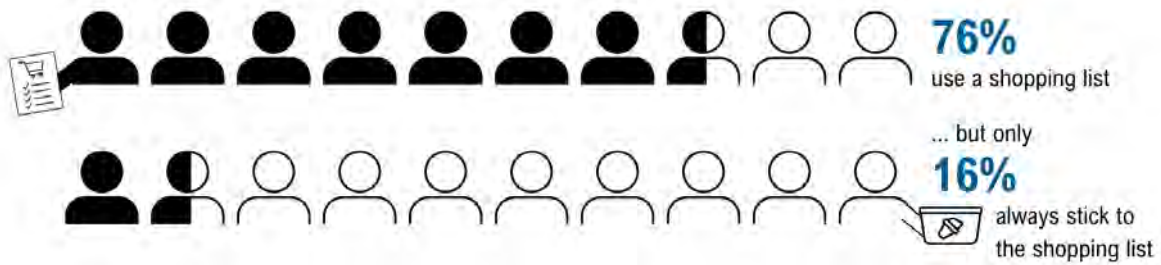
Use By Dates

Previous food waste studies²⁴ found that one key reason people waste food is they assume that if the date on the food label has passed, the food is unsafe to purchase or eat. ReFED estimates that nearly 10% of all food waste results from confusion over date labels. Consumers

might not realize that most date labels are the manufacturer's best estimate of peak food quality, not food safety.

In the MITRE-Gallup study, 59% of American households indicate that date labels often or always influence their decision to purchase food items, and 31% say they often or always throw away food that has passed its date label. For instance, people who say they often or always throw away food that has passed its date label report wasting more food (8.9 cups per week) than those who report never or rarely throwing away food that has passed its date label (4 cups per week).

One bipartisan policy solution currently gaining momentum in the federal government is to standardize date label language. The Food Date Labeling Act would reduce the many different ways food labels are written today into two date labels. If passed, this bill would require a consumer education campaign to reduce confusion, and it would help businesses more easily donate surplus safe-to-eat foods past their expiration date—which at least 20 states ban today.²⁵



Shopping Lists

Past studies have found that making and sticking to shopping lists reduces consumer food waste amounts.²⁶ In the MITRE-Gallup study, 8 out of 10 survey respondents report often or always making shopping lists prior to obtaining food. However, only 2 out of 10 survey respondents report always sticking to their shopping list when obtaining food. Similar to the result from previous studies, respondents who stick to their shopping lists waste less food. In this study, respondents who say they often or always stick to their shopping lists waste less food each week on average (5.7 and 4.8 cups, respectively) than those who say they sometimes, rarely, or never stick to their shopping list (7.8, 9.3, and 6.7 cups, respectively).

Other Contributing Behaviors

According to the survey:

- 80% of American households regularly buy amounts of food they know they can eat
- 9% regularly donate excess food
- 59% prepare portion sizes they know will be eaten
- 69% freeze food before it goes bad

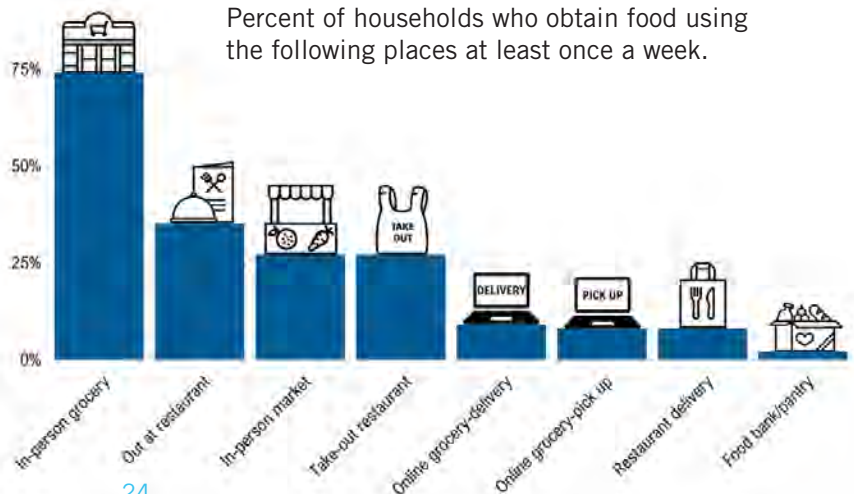
Households who regularly prepare portion sizes they know will be eaten, waste less food (average of 5.4 cups per week) than others (average of 7.2 cups per week).

The frequency of purchasing food is also related to food waste amounts. There is great variety in how American households obtain food. The most common way is in-person shopping at a physical grocery store, followed by eating in restaurants, shopping in-person at smaller stores and farmers markets, and ordering take-out from restaurants.

Households who more frequently shop at the grocery store, eat in a restaurant, order takeout from a restaurant, and order food for delivery from a restaurant tend to waste more than those who do so less frequently.

Where Does our Food Come From?

Percent of households who obtain food using the following places at least once a week.



Is “Best By” the Best Measure?

Did you know date labels can indicate the safety OR quality of food, and are only federally regulated on infant formula? The language on date labels is unstandardized and misinterpreted by many, resulting in prematurely discarded food. For your safety, follow package date recommendations on high risk foods such as ready-to-eat deli meats that are typically consumed without being cooked; however, for most food, trust your senses when deciding if something is safe to buy or eat!



31% of Americans **dispose** of food that has passed its date label

59% of Americans are frequently influenced by date labels when **deciding to purchase a food item**

18% of Americans **worry** about eating food past its “use by” date, and 15% past its “best if used by date” even with no signs of spoilage

INSTEAD...



LOOK for discoloration, mold, or signs of spoilage



SMELL anything unusual? Check for rancid or unexpected odors



FEEL for bruising, sliminess, or staleness



TASTE a bite if it seems safe, to make sure the flavor is as expected

NOTE: SOURCES FOR INFORMATION IN ABOVE GRAPHIC INCLUDE [HTTPS://WWW.NRDC.ORG/SITES/DEFAULT/FILES/DATING-GAME-REPORT.PDF](https://www.nrdc.org/sites/default/files/dating-game-report.pdf) AND [HTTPS://WWW.TOOGOODTOGO.COM/EN-GB/INITIATIVE/LOOK-SMELL-TASTE/LOOK-SMELL-TASTE](https://www.toogoodtogo.com/en-gb/initiative/look-smell-taste/look-smell-taste)

The Two Most Important Factors

Of all the behaviors covered in the survey, date label observance and leftover use are the most important factors in predicting food waste. When looking at these behaviors as a function of other household characteristics:

- Households with children do not differ from those without children in terms of leftover use; however, they do differ in terms of date label behavior. More specifically, households with children report a higher tendency to use date labels when deciding to purchase or throw away food.



Tool Kits Help Americans Reduce Food Waste

Many organizations have created tools to help Americans reduce food waste, save money, conserve resources and energy, and reduce greenhouse gas emissions. Some examples include:

- The [Guest-imator](#) is a fun tool that tells you how much food to get when feeding guests.
- The [Meal Prep Mate](#) helps you make shopping lists, portion meals, and get as much use as possible out of what's in your fridge.
- [Save the Food](#) is a tool that teaches you how to store foods to keep them fresh and tasty for as long as possible.
- The EPA's [Preventing Wasted Food At Home](#) website includes tips on how to plan and shop for food, how to store food for lengthiest freshness, and cooking and preparation tips.
- The USDA's [Food Keeper app](#) provides tips to maximize freshness and quality of food by storing it properly.
- Ikea created a [Waste-Less Cookbook](#).
- Hellmann's created an [app and cookbook](#) to help Americans have fun and reduce waste.

- Households with higher income report more frequently using leftovers. However, households with higher income are also more likely to have leftovers in the first place, as they tend to more frequently than others: shop in person at the grocery store, eat in a restaurant, order takeout from a restaurant, and order food for delivery from a restaurant.
- Older Americans report using leftovers less frequently.
- Older Americans less frequently rely on date labels when deciding to purchase or throw away food.

The Relationship Between Food Behaviors and Waste: Summary

One benefit of our survey is that it has identified behaviors that can help reduce food waste if shared and scaled. For example:

- **Almost 60% of households** indicate that date labels influence their purchasing choices, and more than 30% reported they always discard food when it passes its labeled date. Can we educate consumers about what these date labels really mean (i.e., most food is still wholesome and edible after the date indicated by its label²⁷) to reduce food waste?
- **26% of respondents** report frequently saving partially used leftovers and ingredients for future meals, and 49% report frequently making an entire meal out of leftovers. Those who more frequently use leftovers waste less food, and there are many tips available



Wasted Food Scale

How to reduce the environmental impacts of wasted food



for how to use leftovers wisely. Producing fewer leftovers by ordering and cooking less in the first place is an even better way to reduce food waste.

- **While 76% of households** make shopping lists to plan out their grocery trips, only 16% always stick to those lists, and those that do waste less food. By sharing this information and tips on how to stick to the list, we could all help reduce food waste.

NOTE: The MITRE-Gallup Food Waste study identifies relationships, but we cannot speak to whether these relationships are causal in nature. For instance, we don't know if low food wasters are inherently better at sticking to a list or, equivalently, if interventions designed to help people stick to a shopping list will translate into less waste. The relationships do highlight potentially useful interventions to test out in future studies to determine their effectiveness.

I Already Compost. Why Should I Worry About How Much Food I Waste?

The [EPA Wasted Food Scale](#) prioritizes reducing the amount of food waste created (i.e., source reduction) even more than donating food, feeding animals, or composting food. Why? Because it prevents pollution that occurs during food production, such as from fertilizers and pesticides. Source reduction saves energy associated with growing, preparing, and transporting food. By reducing demand at the source, it puts downward pressure on the market price for food, which helps food insecure households afford the food they need. It also helps Americans save money by buying only what is needed and saves labor costs through more efficient handling, preparation, and storage of food that will actually be used.

So, while it is true that donating food to feed people, feeding extra food to animals, and composting food waste are all better options than sending it to the landfill or putting it down the drain, it's even more important to stop waste at the source. This will help Americans make progress in reducing the \$1,500 they spend per year on food that they don't eat. Additionally, source reduction helps signal to the wider food system to correct over time the overproduction that currently occurs today, which ultimately can lead to reduced food prices.



When I started thinking about the things we all can do, myself included, and the magnitude of the beneficial impact of our individual changes in behavior, that's amazing. You think about the biggest problems surrounding us today globally, most of them we as individual citizens can do very little about. This is one where we each can do something that will really move the needle, and it's within our grasp. It doesn't take big investments, it's zero cost—in fact we save money, and we can all do it immediately.

Dr. Jay Schnitzer, MITRE Senior Vice President,
Corporate Chief Engineer, Chief Medical Officer



AMERICANS' ATTITUDES TOWARD FOOD WASTE

To reduce food waste, we need to know what Americans do that increases or decreases waste, and we also need to know what Americans think and feel about food and waste. These attitudes are a crucial aspect of understanding and reducing food waste. We asked survey takers to select up to five food issues they are most concerned about from a list of 15 (They could also select, “I don’t have any concerns about food.”). The number one concern is food prices—noted by 81% of American households. Number two is food healthiness.



Many Americans are also concerned about food safety and food poisoning. For example, around 1 in 10 American households worry about health risks associated with eating leftovers with no signs of spoilage: 45% report they’re worried about eating food past its “use by” date (with no signs of spoilage), and 36% say they’re worried about eating food past its “best if used by” date

(with no signs of spoilage). Americans who worry more about health risks tied to eating food past its date tend to waste more food.

For instance, Americans who worry more²⁸ about health risks of eating leftovers with no signs of spoilage report wasting approximately 10.1 cups of food per week, while those who don’t worry

report wasting approximately 5.9 cups of food per week. Households with children tend to worry more about food health risks than households with no children. Households with higher income and older Americans tend to worry less about food health risks.

Food waste is the third most significant concern. Level of concern about food waste holds steady irrespective of household size, number of children at home, level of education, or level of income.

- 89% of Americans believe throwing away food is a waste of money
- 45% believe that throwing away food is bad for the environment
- 86% think Americans should do more to reduce the amount of food they waste.

What motivates Americans to minimize food waste?

- 82% of participants said saving money
- 76% said wanting to manage one's home efficiently (76%)
- 60% said feelings of guilt when throwing food away that could have been eaten
- 44% said food shortages in the United States or elsewhere in the world
- 40% said reducing one's impact on the environment.

It is important to note that awareness of the connection between food waste and the environment remains low, and promoting this awareness along with practical tips about how to reduce food waste can help reduce food waste.

We found a surprising disconnect in the data when it comes to the environment and food waste behaviors. (See diagram below) Americans who seem to know more about the negative consequences of food waste on the environment also tend to waste slightly more food, contrary to what would be expected. For instance, households tend to waste more food if they tend to agree with the following:

- Reducing my impact on the environment motivates me to reduce food waste
- Pollution of land, water, or air is a consequence of food waste
- Food waste wastes water, energy, or natural resources
- Climate change is a consequence of food waste.

Top Food-Saving Motivators

Percentage of respondents who indicate the issue motivates them "a fair amount" or "a great deal" to reduce their food waste



82% saving money

76%

managing home more efficiently



60% feeling guilty when throwing away food

44%

considering global or national food shortages



40% reducing impact on the environment

Only 23% of households say there is not much they can do to minimize the amount of food thrown away in their household, while 53% disagree, which means most people feel there are actions they can take to reduce food waste.

Of all attitudes examined in the survey, the factors that reliably predict food waste amounts are concern about food safety and awareness of environmental consequences. Households with children have more concern about food safety than others, as do households with lower income levels and younger Americans.

Americans' Attitudes Toward Food Waste: Summary

Significant percentages of respondents are concerned with issues surrounding spoilage and food-borne illness, and these respondents wasted more food than their counterparts.

Saving money motivates 82% of respondents to reduce food waste. Other reported motivators include the desire for efficiency in home management, feelings of guilt surrounding food disposal, consideration of food shortages, and environmental concern. While respondents report that these factors motivate them to reduce food waste, none of these attitudes are related to lower food waste amounts. Interestingly, those more concerned about the environment tend to waste more food.

However, according to the survey, most Americans believe that there are actions they can take to tackle the problem of food waste.

Close the Gap Between Attitudes and Behavior

You may be familiar with the disconnect between our attitudes (what we think, what we feel) and our behavior (what we do). This has been referred to by researchers as the “attitude-behavior gap,” which means while you may feel guilty about wasting food or want to save money by not wasting food, you still end up wasting more food than you’d like. How can we bridge this gap? Researchers have recommended that people adopt implementation intentions, which are if-then statements that can provide a framework to act on and align your attitudes with your behaviors.

Here are a few examples: “IF I don’t use my broccoli by Wednesday, THEN I will add it to a salad, a stir-fry, or an omelet.” “IF I want to try a new food that I’m not sure I will like, THEN I will only purchase a small amount at first.” And “IF I don’t use all of an ingredient in dinner tonight, THEN I will freeze the leftovers for use in a soup.”

Van Geffen, L., van Herpen, E., & van Trijp, H. (2020). Household Food waste—How to avoid it? An integrative review. In E. Närvänen, N. Mesiranta, M., Mattila, & A., Heikkinen (Eds.), Food waste management. Palgrave Macmillan. https://doi.org/10.1007/978-3-030-20561-4_2



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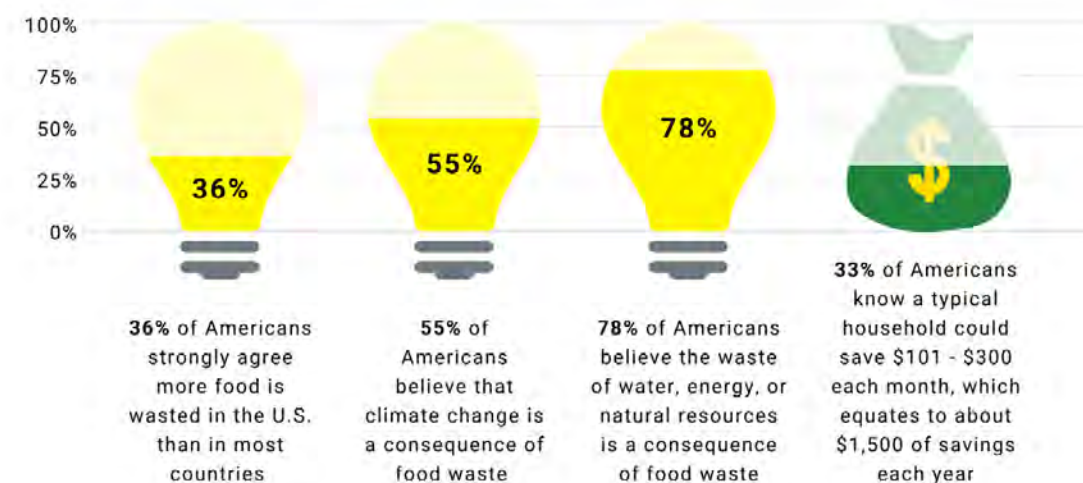
Food waste is the largest contributor to landfills and those landfills generate around 15% of all methane emissions in the United States according to the EPA's most recent statistics. We are spending a lot of resources on food that we just throw away. About 20% of water and agricultural land used in production is spent on food that isn't consumed. That doesn't take into account money, pesticide, or fertilizer use.

Tori Oto, Harvard Law School, Food Law and Policy Clinic

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FOOD WASTE AWARENESS

How aware are Americans about food waste? On average, survey respondents estimate that approximately 36% of all food produced for human consumption in the United States each year is thrown away, which closely mirrors FDA estimates of 30-40%.²⁹



Also, 36% of Americans strongly agree that more food is wasted in the United States than in most other countries (which is true); and 55% believe that climate change is a consequence of food waste³⁰ (which is true).

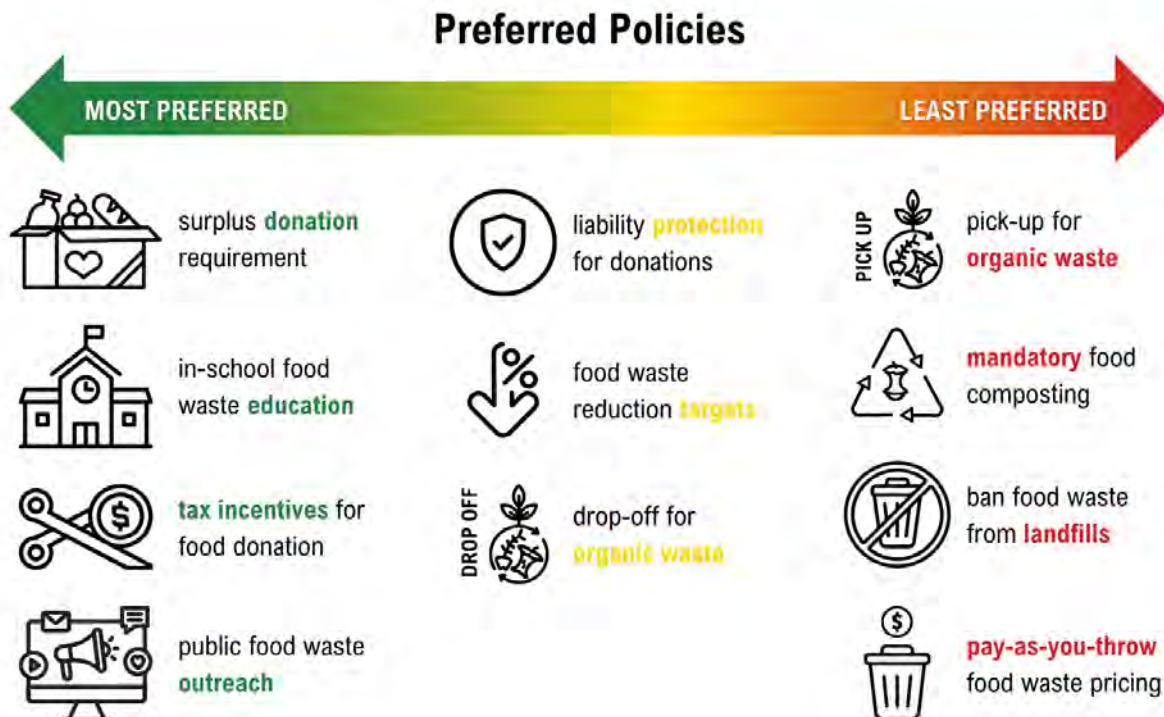
Only 33% of Americans are aware that the average American household could save at least \$1,500 per year by not wasting food,³¹ while 49% think the amount of potential savings is less than \$1,500.

Simply learning about the connection between food waste and food affordability could help many Americans

save money. In 2021, households in the lowest income quintile spent an average of \$4,875 on food per year (representing 30.6 percent of income), while households in the highest income quintile spent an average of \$13,973 on food (representing 7.6 percent of income).³² Interestingly, those Americans who are more aware of the cost of food waste tend to waste more food. The relationship may be driven by the fact that those who waste more food are more familiar with exactly how expensive that waste is.

Effective policies at federal, state, and local levels of government could facilitate food waste reduction. When presented with 12 possible policies that could be implemented in their communities, respondents said:

- 49% would like businesses to be required to donate surplus food
- 47% would like food waste education within local schools
- 44% would like businesses to receive tax credits or deductions for donating food
- 40% would like public food waste education and outreach (e.g., public service announcements, educational campaigns, and workshops)
- 32% would like businesses and individuals to be protected if they donate food and the recipient becomes ill
- 27% would like food waste reduction targets
- 26% would like local organic waste drop-off for composting
- 25% would like household organic waste pick-up
- 22% would like mandatory food composting
- 14% would like a ban on throwing food waste in landfills
- 9% would like pay-as-you-throw food waste pricing (costs more to throw away more food)





Acceptable donations include:

- Discontinued products
- Recalled items
- Imperfect/ underweight packaging
- Quality control
- Food approaching expiration
- Highly perishable items

Donations are provided to **food banks and meal programs** across the country, and help feed people facing hunger

Among survey respondents, the most desired food policy is a requirement for businesses to donate surplus food. Interested in corporate food donations? Feeding America receives food from national and local retailers, food service providers, and food companies, and moves donations to where they're most needed. Food can be donated via the [MealConnect app](#), which connects posted donations to nonprofit partners who will arrange a pickup.

Seventy-two percent of Americans said that, to the best of their awareness, their community does not have any food-waste policies. Only 7% of Americans said their community has a food waste reduction target. Moreover, only 5% indicated that businesses and individuals in their community are protected if they donate food and the recipient becomes ill. Fourteen percent said that in their community, businesses receive tax credits or deductions for donating food.

Food Waste Awareness: Summary

Survey participants' estimates of food waste align with the national estimate of 30-40%. Though most Americans worry about saving money, only 33% are aware of the potential to save \$1,500 annually by reducing food waste.

50% by 2030

The Zero Food Waste Coalition—a coalition of over 100 public, private and non-profit members across more than 30 states—has developed a comprehensive set of policy measures it advocates for (both at the federal and state levels, along with model policies) to help the United States and its communities to reach the national goal of halving food waste by 2030, reducing methane emissions from landfills, improving food access and nutrition security, and building more sustainable food systems.

There are many other examples of community programs. For example, the World Wildlife Fund's Food Waste Warrior program focuses on K-12 schools looking to take action on food waste. It provides a free, bilingual, hands-on curriculum to help schools turn cafeterias into classrooms and teach students about food waste and the environmental impacts of the food system.



“

About 75% of Americans say they waste less than the average American. That gets at the problem that – whether or not they think food waste is an issue – they don't see themselves as part of the problem. That's because it's mostly invisible. My kid didn't finish their meal, or the yogurt went bad.

Dana Gunders, ReFED

”

WHY DOES REDUCING FOOD WASTE MATTER?

Food waste is a major contributor to negative economic outcomes, food insecurity, and climate change. The waste and misuse of food resources incurs billions of dollars of damage each year. Initiatives to reduce and repurpose this waste could drive extensive positive change. Food waste affects us as communities and nations—but also as individuals.

Boost Your Wallet

In 2021, food waste cost the United States \$310 billion³³ and most of this loss came straight from consumers' pockets. In fact, the average family of four loses approximately \$1,500 annually on wasted food.³⁴ This presents households with the opportunity to save thousands of dollars by modifying their routines to reduce food waste. This also provides policymakers with a significant opportunity to help constituents facing food insecurity and food inflation.

Help Your Neighbors

The phrase “food waste” may conjure images of moldy leftovers and slimy spinach fermenting in a refrigerator drawer, but much of the food we waste is fully safe and edible. And with 13.5 million U.S. households experiencing food insecurity in 2021,³⁵ the redistribution of safe and healthy surplus food to those in need could improve nutritional outcomes for millions of Americans while reducing waste.

There are many ways we can share excess food with neighbors and communities, for example, via mobile apps like Olio or through local food banks in certain cases. Furthermore, broad-scale reductions in consumer food waste lower overall food demand, which in turn reduces food costs through downward pressure on market-level prices. Thus, reducing food waste can permit food insecure households to purchase more food with limited funds.

Save Our Resources

When we prevent food waste, we ensure responsible use of the resources going into that food. All these resources—crop land, fuel, animal feed, and hours of sweat and labor—hang in the balance of each meal, and we have the opportunity to better leverage these resources and the work of our agricultural communities through less food waste.

Another resource vital to agricultural production is water. Each year, producing food that is ultimately wasted in the United States uses up enough freshwater to fill 9 million Olympic-sized swimming pools. This water could make a huge difference to the communities across the United States facing droughts and water shortages.

Protect Our World

By reducing food waste, we reduce the amount of harmful gases released by decomposing food in landfills. These gases contribute to the warming of our planet, making their reduction a vital part of the mission to steward our planet for future generations.

In fact, the reduction of food waste has been identified as a top climate solution, meaning that it is one of the most attainable, measurable, and financially advantageous strategies for confronting the threat of rising global temperatures.³⁶



Interested in finding out more about how to reduce food waste in your household and community? Please see the resources listed on our website. Spread the word!

<https://sites.mitre.org/household-food-waste/>

The background of the page is a dense, colorful collage of sliced fruits. It features several slices of bright orange citrus, likely oranges or grapefruit, showing their internal segments and white pith. Interspersed among these are slices of green kiwi fruit, revealing their characteristic black seeds and white core. There are also slices of pinkish-red grapefruit. The overall composition is bright and fresh, with a variety of colors and textures.

**SURVEY METHODOLOGY APPENDIX
& REFERENCES**

Methodology Summary

The MITRE-Gallup National Food Waste Survey was fielded between June 21 and August 23, 2023. The survey covered adults, ages 18 and older, living in the United States. The sample was drawn from the Gallup Panel, a probability-based panel that is representative of the U.S. adult population. The nationally representative survey was conducted as a web survey, with English and Spanish versions available. We also used a mail survey to reach Gallup Panel members who have previously indicated that they do not have internet access (English version only). A total of 9,271 U.S. adults completed the survey, including 538 who participated by mail survey and 8,733 who participated by web.

We conducted small area estimation for a subset of the questions included in this survey to generate state-level estimates for key indicators.

Sample Gallup Panel

The Gallup Panel is a probability-based panel of U.S. adults that is recruited using random digit-dial (RDD) phone interviews that cover landline and cell phones and address-based sampling methods (ABS). At the conclusion of the RDD and ABS surveys, respondents are asked if they are willing to be

recontacted for a future Gallup survey. Approximately 80% of respondents agree to be recontacted for a future survey and are eligible for recruitment into the Gallup Panel.

Approximately 80,000 panel members have provided Gallup with an email address, mailing address and telephone number and can be reached for web, mail and telephone surveys. Another 20,000 panel members do not have email access but have provided a mailing address and telephone number and can be reached for mail and telephone surveys.

Panel members receive an average of three surveys per month, and the typical survey is 10 to 15 minutes in length. Most Gallup Panel surveys are self-administered, and Gallup typically sends respondents an invitation and up to five reminders. The average response rate on a Gallup Panel survey is approximately 40% to 45% depending on the length of the survey, length of the field period, target population, and the survey topic. Incentives are offered to respondents based upon a variety of factors, such as survey burden, available sample size, target population, length of field period, and project budget. Some surveys offer no incentive at all, and most surveys do not offer more than \$5 for participation.

Members may remain in the panel for as long as they would like, given they continue to participate. Gallup frequently reviews participation records and refreshes the panel sample. Members who have been invited to but have not participated in any surveys for more than six months are contacted by Gallup and encouraged to participate and update contact information. Members who continue to be non-responders are removed from the panel. Gallup conducts regular recruiting efforts to refresh the sample and recruit new members. As with most surveys, adults between the ages of 18 and 34, individuals with lower education levels, and minorities tend to have lower participation rates than other demographic groups.³⁷ Gallup's recruiting efforts generally oversample from these groups to maintain a demographically balanced sample. Unequal selection probabilities at the selection stage are taken into account in the panel weight assigned to each member.

Sampling Procedures

The target survey sample size was 6,500 completes, with 500 of those completes from the offline population obtained via mail, and state-level oversamples utilized as necessary (up to 2,500 completes) to allow for small area estimation

to generate high-quality state-level estimates for a subset of indicators (i.e., survey questions).

In addition to the stratification approach described below, sampling is conducted to balance samples demographically by age, gender, education level, and race/ethnicity, accounting for differential response rates. Furthermore, all sampling (and weighting) procedures take into account the known probability of selection in the panel and into the study for Gallup Panel members.

Gallup statisticians used the Gallup Panel to draw a stratified random sample of U.S. adults, ages 18 and older. First, the Gallup Panel was stratified into 55 strata based on interview mode, interview language, and region. To achieve an estimated 500 completes for the offline population, based on typical mail survey response rates for Gallup Panelists of 25%, a sample of 2,000 records was drawn from the strata encompassing English-speaking mail survey respondents. The sample size was allocated proportionally across the four major census regions according to each region's corresponding total population size per the U.S. Census Bureau, 2022 Projection Estimates.

To achieve the estimated 6,000 completes for the web survey portion, assuming a typical web survey response rate for Gallup Panelists of 35%, a sample of 17,142 respondents was drawn from the strata comprised of English and Spanish speaking web survey respondents. For the web survey portion, instead of allocating the sample geographically based on census region, the sample was allocated geographically based on state population (per U.S. Census Bureau, 2022 Projection Estimates), with oversamples in smaller states to achieve a minimum completion rate of at least 70³⁸ completes per state. This would ensure a minimum sample size for small area estimation.³⁹ The state-level allocation was completed by first assigning 6,400 cases to small states and then assigning the remaining 10,742 cases to the other relatively big states.

Survey Development

Literature Review

An extensive literature review served as the foundation for instrument development. Based on the literature review, the following areas of focus were identified for survey development:

- Food waste amounts
- Food shopping behaviors
- Home food management behaviors
- Food safety and expense concerns
- Perceptions of food waste as a problem
- Awareness of food waste mitigation efforts
- Knowledge of causes and consequences of food waste

External Partner Engagement

We obtained additional information on these and other content areas during collaborative meetings (hosted virtually) with external partners from academic institutions and other organizations who have significant experience and/or expertise in food waste. Separate one-on-one meetings were also conducted with select members of this external partner group to follow up on specific suggestions or materials mentioned during larger meetings.

We also conducted seven in-depth stakeholder interviews with members of the external partner group. Each stakeholder interview was conducted by a researcher as a one-on-one semi-structured interview. The interview guide was developed to elicit perspectives on the magnitude of the food waste problem in the United States, existing or upcoming efforts to mitigate food waste, common barriers to mitigating food waste, and priorities for measuring food waste behaviors and attitudes. Each interview was 30-45 minutes in duration. Aggregated responses were used to inform instrument development.

The external partner group also participated in reviewing the survey.

Cognitive Interviews

Cognitive interviewing is a best practice in survey development, allowing researchers to obtain respondent feedback during the survey construction process that can be used to improve resultant data quality when the survey is deployed.⁴⁰ Typically, cognitive interviews are conducted as a type of semi-structured interview: researchers will ask participants to respond to potential survey questions alongside follow up questions designed to assess respondents' understanding of the question and the accuracy or honesty of their responses.

We conducted 22 cognitive interviews (virtually) with members of the Gallup Panel to assist in developing the survey instrument and respondent communications for the survey. Interview duration averaged 30 minutes. Additional details about the cognitive interview procedures specific to each of the instrument development activities can be found in the following sections.

Survey Construction

Based on the content and measurement priorities identified in the literature review and stakeholder interviews, we developed a draft of the survey instrument using best practices in item construction to ensure that questions were written clearly and prevent biased responses. Members of the external partner group reviewed the survey instrument to further refine content and questions based on their domain expertise.

Once a draft instrument had been agreed upon, we conducted cognitive testing of the survey with nine members of the Gallup Panel. A week before their scheduled interview, we sent participants an email asking them to be aware of their food waste (types and amount) over the next seven days, in preparation for their interview. These instructions also indicated that they should keep track of food waste for their

entire household and recommended they communicate about food waste with their other household members during this time.

The cognitive interviews focused on respondents' food waste estimates, including follow-up questions to understand how estimates were reached, confidence in estimates, and factors that may have affected their estimates. Respondents were also asked questions about their perceptions of and compliance with the pre-interview instructions and asked for their feedback on a subset of additional proposed survey questions. Cognitive interview responses were used to refine recruitment materials and the survey instrument.

The updated survey instrument was submitted through Gallup's Corporate Survey Peer Review system. Gallup submits all surveys that are developed for use in research that will be publicly disseminated through this system as part of its quality assurance provisions. Gallup's Corporate Survey Peer Review team comprises Gallup's most highly experienced senior methodologists who conduct independent peer reviews of survey instruments to ensure that all best practices are followed and make any recommendations for improvement of measurement properties, data quality, or respondent experience.

Data Collection Procedures

Summary of Materials

Pre-Study Instructions. Approximately one week before receiving an invitation to complete the survey, respondents were sent a letter (by mail or email, as specified in Research Design below) which informed them about the upcoming survey and asked them to pay attention to their food waste and the food waste of other household members (types and amounts⁴¹) for the next seven days in preparation for answering the survey questions. It was recommended that they keep notes to help them remember what they disposed of.

Survey Invitation and Cover Letter.

The survey invitation (for web respondents) and cover letter (for mail respondents) described the study as a survey about how American households use different types of foods with the purpose of understanding food use and informing efforts to improve the American food system.

Survey Reminders. Survey reminders were sent to urge participation in the survey and highlighted again the purpose and importance of the research. For the mail survey, all respondents received two reminder postcards, regardless of whether or not they had returned the survey yet. For the web survey, respondents only received reminders (up to four total) if they had not yet completed their survey.

National Food Waste Survey. The survey instrument consisted of 81 multiple choice survey items (10-15 minute duration) regarding food waste and food management behaviors; attitudes and perceptions of food waste and food safety; and awareness of policies or practices to mitigate food waste.

Research Design

All field work was completed between June and August 2023. Unless otherwise mentioned,⁴² respondents who completed the survey were sent a code for a \$5 incentive through the Gallup Panel Rybbon system.⁴³ Additional information about the study procedures and timing by group are provided below.

- Mail survey respondents received all communications and study materials by mail. Pre-study instructions were sent to this group on June 21, 2023. The survey booklet and cover letter were sent June 28, 2023. We finalized counting returned surveys on August 18, 2023. All respondents received a \$5 pre-paid incentive to participate.⁴⁴ Additionally two post-card reminders were sent to these respondents to urge return of completed surveys.
- Web survey respondents received all materials via email. Four email reminders were sent to non-responders to improve completion rates.

Response Rates

Of the 2,000 respondents invited to complete the survey by mail, 27% (538 respondents) completed and returned the mail survey.⁴⁵ Of the 18,192 respondents selected for the web survey, 48% (8,733 respondents) completed the web survey.⁴⁶

Data Processing Procedures

Data Integration and Cleaning

After scanning in all mail survey responses and combining those responses into a single data file with the web survey responses, we conducted data cleaning prior to weighting the dataset. These checks included manual and automated reviews of the data to ensure all questions were assigned the correct codes and variable labels. Cases with blank data or no valid responses, aside from demographic information, were also removed from the dataset. This process reduced the overall survey sample size to 9,259 respondents.

There were also several instances of extreme outlying cases for the food waste estimates (e.g., 40 cups of wasted fruit). Due to the likelihood that these few cases would bias analyses and substantive inferences, and without being able to determine whether they were the product of data entry errors, we elected to set these outlying estimates to NA. For these individuals, we also set all

other volume estimates for that person to NA: for example, if a person wasted 40 cups of fruit, 2 cups vegetables, 0 cups grains, etc., their volume estimates were changed to NA for fruit, NA for vegetables, NA for grains, etc. We did this to ensure that these outliers did not overly influence analyses and to avoid including potentially incomplete data for that case.

Additional demographic information was appended to the dataset from the Gallup Panel Member Database, including age, gender, zip code, metropolitan statistical area, state, region, population density ratio, and population density quintile.

Data Weighting

Gallup statisticians weight the survey data to minimize bias in survey-based estimates. The weighting process for this data was as follows.

First, Gallup constructed the base sampling weight based on the known selection probability of each respondent into the Gallup Panel and into this study. Next, Gallup created post-stratification weights. Due to reasons such as oversampling and nonresponse, the demographic distributions of respondents in the unweighted dataset can be different from their corresponding distributions among the U.S. adult population (aged 18 or older). To improve the relationship between the sample and the target population,

Gallup further calibrated weights to match the sample to known population targets for age, gender, education, race, ethnicity, population density quintiles, and state. This process, called raking, iteratively adjusts the base weights of the cases in the sample so that the marginal totals of the adjusted weights, on specified characteristics, agree with the corresponding totals for the population.

The post-stratification weights accounted for age, gender, education, race, ethnicity (Hispanic vs. non-Hispanic), population density quintiles, and state. The target for population density quintile is based on Census 2020,⁴⁷ while the target for the others were all based on Current Population Survey March 2021, U.S. Census.⁴⁸

The weights obtained through raking may, however, exhibit considerable variability, with some sampling units having extremely low or high weights relative to most of the other sampling units. This can lead to inflated sampling variance of the survey estimates. To resolve the issue, the weights obtained through the raking step were trimmed to avoid extreme weights. Trimming points were selected based on the distribution of post-stratification weights. The trimmed weights were then normalized so that they sum up to the number of completed interviews.

With the above weighting approach applied, the differences in demographic distributions between the sample and the target population decrease, making the sample more representative of the U.S. adult population.

For results based on this sample, the maximum margin of sampling error, which accounts for the design effect from weighting,⁴⁹ is ± 1.5 percentage points at the 95% confidence level. Margins of error for subgroups are higher. In addition to sampling error, question wording and practical difficulties in conducting surveys can introduce error or bias into the findings of public opinion polls.

The weight variable should be used when analyzing data to generate nationally representative estimates (and standard errors). This weight should also be used to generate estimates when analyzing sub-groups. Although the weighting procedures used were designed to improve the estimates of key subgroups, it is important to note that weighting cannot perfectly eliminate bias for all potential subgroups. This is primarily because reliable population targets are not available for all potential sub-groups that can be considered in analysis.

Data Analysis Procedures: Descriptive Statistics and Predictive Analyses

MITRE conducted two sets of analyses. The first set of analyses was descriptive in nature, focusing on how individuals responded to each individual survey question. For each question, we estimated (weighted) means, standard deviations, and percentage endorsement of each response option (e.g., % who responded “Agree”). These analyses allowed us to gain an understanding of how individuals responded to questions from a descriptive point of view.

We further cross-tabulated certain survey questions with other survey questions, examining, for example, the average amount of food waste for individuals with children at home versus for individuals without children at home. These analyses allowed us to understand relationships between variables, especially with respect to the amount of food waste.

The second set of analyses was predictive in nature, focusing on which variables were most strongly related to the amount of household food waste. We began by following best practices in scale development⁵⁰ to conduct exploratory factor analysis on a random subset of the data (N = 1,388) and then

to confirm the factor structure of the variables via confirmatory factor analysis on a larger random subset of the data (N = 7,871).

Having constructed scales for variables, rather than continuing to analyze individual survey questions, we proceeded to compute (weighted) correlations between all variables and food waste amount. Then, we computed a multiple regression model by regressing the food waste amount on demographic variables, behavioral variables, attitudinal variables, and knowledge variables. This analysis allowed us to test whether certain variables predicted food waste while controlling for the effects of other variables. Finally, we conducted a relative importance analysis to estimate the percentage of variance accounted for by each predictor.

Data Analysis Procedures: Small Area Estimation

Overview of Small Area Estimation

Gallup used multilevel regression models with poststratification (MRP) to generate state-level estimates of food waste in the United States. MRP was selected as the preferred method for small area estimation because it is a popular technique for generating estimates at geographic levels below that which the data was collected and can work well

even when the overall data distribution is unrepresentative of the data distribution at the geographic level of interest.⁵¹

Traditional MRP uses a multilevel model and proceeds in a series of discrete steps. In addition, it requires two distinct datasets: the original data matrix containing the independent and dependent variables, and a poststratification matrix. In the first step, a regression model is estimated on the original data for a specific outcome variable, using a set of demographic covariates. Multiple models may be estimated, and the best performing model is chosen. The best-performing model is then used to predict the outcome on the poststratification matrix. Each prediction from the poststratification matrix is weighted by the percentage of people who hold that prediction's unique combination of demographic characteristics within the geographic level of interest. Weighted predictions are then summed at the geographic level of interest to generate a single prediction.

Selected Indicators and Data Preparation

Estimates were generated for food waste amounts. The food waste estimates were converted to volume equivalents, expressed in tablespoons. Food waste amounts expressed in cups were

converted to tablespoons and added to food waste amounts expressed in tablespoons. Waste amounts were estimated for the following food types and groups: fruits; vegetables; grains; dairy; protein; mixed; scrap; and oils, fats, and sugars. Outliers were treated as missing data using a listwise approach: respondents who indicated wasting more than 40 cups of any type of food were dropped from all MRP analyses.

The independent variables used in all MRP models were sex, race, education, age, region, and state. The post-stratification dataset was sourced from the Current Population Survey (CPS) conducted by the U.S. Census Bureau in partnership with the U.S. Bureau of Labor Statistics.

MRP Modeling

Separate ensemble learners were estimated for each variable in the MRP analysis. Ensemble learning was used because it combines multiple algorithms together in a way that averages their results. This can yield better performance than any single algorithm alone and, in some cases, can outperform multilevel models because of its ability to estimate non-linearities and interactions. Each model within each ensemble was weighted according to its overall performance. Higher performing models were given more weight, and

lower performing models were given less (or no) weight. The learner used these weights to average predictions from each model according to each one's predictive ability and contribution to the overall ensemble.

Each ensemble learner was fine-tuned in two ways. The first was by either omitting or including algorithms in the learner depending on their contribution to the learner's predictive ability. Algorithms yielding no performance gain were excluded, and algorithms providing a benefit were included. Additionally, hyper-tuning parameters for each algorithm, and for learner itself, were fine-tuned throughout the process. This was generally performed by a grid search over various parameter combinations to find the set of parameters that best optimized an algorithm-specific metric. This validation step was combined with a critical examination of the output estimates to ensure that each model was optimized in a way that generated more convincing MRP estimates. In this way, MRP estimates were evaluated holistically and qualitatively, as it is not guaranteed that a metric-optimized model will generate "better" MRP estimates.

State-level food waste amount estimates were converted back to cups.

Institutional Review Board Approval

All research procedures discussed herein, including stakeholder interviews, cognitive testing, and deployment of the nationally representative mail/web survey, were reviewed and approved by the Institutional Review Boards (IRBs) of both Gallup and MITRE. The Gallup IRB served as the primary institution for review. The IRB is the party responsible for overseeing the ethics and protection of any research activities involving human subjects. Their reviews focus on considerations such as appropriate selection of research participants; participants' rights, privacy, and confidentiality; and the risks and benefits of research protocols.⁵²

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4. 2021 is the most recent year for which this data was available.
5. <https://refed.org/food-waste/the-problem/>
6. <https://www.epa.gov/recycle/preventing-wasted-food-home#planning>. Note that the \$1,500 estimate is from 2010, and likely underestimates the actual amount of possible savings.
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14. For instance, Economic Research Service defines food loss as the amount of postharvest edible food that is available for human consumption but is not consumed for any reason. The Federal Interagency Collaboration to Reduce Food Loss and Waste (EPA/FDA/USDA) considers that food waste includes edible food mass anywhere along the food chain and notes that the term waste is sometimes stretched to include parts of foods non-edible by humans (e.g., banana peels, bones, and eggshells). <https://www.usda.gov/foodwaste/faqs>
15. Average U.S. household size is 2.6 persons per household <https://www.census.gov/quickfacts/fact/table/US/HCN010217>. In our survey, average household size is 2.68.
16. This does not include inedible food scraps. When including scraps, the average American household wastes 8.8 cups per week.

17. Note that the \$1,500 estimate is from 2010, and likely underestimates the actual amount of possible savings.
18. This finding is true even after controlling for differences in household size.
19. Note that the survey was taken in the summer of 2023, and food waste amounts and behaviors may differ at other times of the year.
20. Additionally, 88% of households report discarding inedible food scraps in the week prior to the survey. Food scraps refer to parts of food items that are not usually eaten, such as bones, eggshells, and pits.
21. Protein for this study includes meats, poultry, seafood, eggs, nuts and seeds, and soy products.
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23. The USDA's Food Keeper app provides tips to maximize freshness and quality of food by storing them properly.
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30. This question asked participants to indicate if they believe climate change is a consequence of food waste (yes/no response option).
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38. 60 for North Dakota due to the limit of Gallup Panel sample in that state.
39. Gallup has discovered during previous small area estimation studies that region-based sampling can lead to very low sample sizes in some low-population states, which increases the chances of low levels of variability, biased state estimates, or lower quality model-based estimates when using small area estimation. For these reasons, state-level allocation and oversamples of small states have been employed to compensate.
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41. For frame of reference, respondents were told that one cup is about the size of their closed fist and one tablespoon is about the size of their thumb.
42. Note that incentive structures differ for mail respondents (Group 1) and for the Pilot Test.
43. Rybbon is the standard system used by Gallup for issuing incentives or other rewards to Gallup Panel members; all Gallup Panel members are familiar with this system.
44. Note that due to an error by the mail vendor, the incentive was sent out with a separate letter slightly after the initial cover letter and survey booklet.
45. This response metric only takes into account respondents who returned the survey by August 18th, 2023 and were included in the final weighted sample; some respondents returned the survey after this date but are not included in any calculations or analysis.
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