

Crowdsourcing Change: An Analysis of Twitter Discourse on Food Waste and Reduction Strategies

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Abstract

Food waste has emerged as a major issue in the United States as the nation collectively sends more than 133 billion pounds of food to its landfills every year. In September 2015, the USDA and EPA announced an initiative to cut U.S. food waste in half by 2030. Between 2015 and 2016, nearly 100,000 posts about food waste have been published on Twitter, a microblogging platform that has been a hub of “slacktivism” since its inception in 2006. Using a conceptual framework of social cognitive theory, online activism, and crowdsourcing, we analyzed food waste conversation participants’ demographics, online communities, and proposed solutions. Data analysis was conducted with listening software Sysomos MAP and a qualitative content analysis of conversation content. The analysis revealed that more than 2,000 U.S. users engaged in the conversation, forming four discrete conversation communities led by influencers from government, news media, and environmental organizations. Proposed solutions to the food waste crisis included domestic or household behavior change, food-waste diversion and donation, recycling and upcycling, consumer education, and governmental action and policy. We recommend using Twitter to mine, test, and deploy solutions for combating food waste; engage with influential users; and disseminate materials for further research into the behavioral implications of online activism related to food waste.

Keywords

Social media, activism, food waste, influencer, crowdsourcing

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Introduction/Purpose

“Food waste is like the band Rascal Flatts: It can fill a surprising number of football stadiums even though many people consider it complete garbage.”

So quipped the eponymous host of *Last Week Tonight with John Oliver*, HBO’s late-night news program, in a 17-minute-long segment aired on July 19, 2015 (Saad, 2015, para. 5). Oliver’s seriocomic takedown of the United States’ food waste crisis was viewed live by 1.04 million people (Bibel, 2015) and went viral online, having been played more than 6.8 million times on YouTube (LastWeekTonight, 2015) by September 2016.

The show brought to public attention the vast amount of waste generated by the production, manufacturing, and consumption of foodstuffs in the United States. Americans collectively throw away some 133 billion pounds of food, or one-third of the nation’s food supply, annually (Grewal, Hmurovic, Lamberton, & Reczek, 2019; Moodie, 2015; USDA, 2015), leading to hundreds of billions of dollars’ worth lost to landfills and costing U.S. consumer households approximately \$936 per year (Buzby & Hyman, 2012). In response to these damning statistics, federal agencies vowed to tackle the issue head on. On September 16, 2015, the United States Department of Agriculture (USDA) and Environmental Protection Agency (EPA) announced an initiative to reduce U.S. food waste by 50 percent over a 30-year period (USDA, 2015).

John Oliver’s segment seems to have been a catalyst for online discussion about the U.S. food waste problem. The hashtag #foodwaste began trending on Twitter within hours of the show’s airing (Sanderson, 2015), indicating a sharp uptick in conversation on the social-media platform. Twitter, a microblogging tool, has been identified as a means of influencing users’ perceptions of and subsequent behaviors toward topics ranging from health and wellness to social justice (Kuo, 2018; Kende et al., 2016; Moscato, 2016; Centola, 2013; Korda & Itani, 2013) since its launch in 2006 (“Twitter milestones,” n.d.). Because of social media’s power to influence—as well as their ubiquity—they are increasingly being harnessed to advance the human condition. In the realm of health promotion, researchers have leveraged Twitter and other social media platforms to encourage habits that improve individual and collective wellbeing. In a meta-analysis of health-promotion research, Korda and Itani (2013) identified social-media and Web interventions applied to weight loss, cessation of tobacco-product use, and increasing physical activity. Evidence suggests that these platforms empower and engage patients by building online “communities” (Korda & Itani, 2013; DeBar et al., 2009).

Twitter has also been studied as a potential *predictor* of real-world collective behavior: Abbasi et al. (2012) note that researchers have found strong correlations between Twitter sentiment and stock market trends (Bollen, Mao, & Zeng, 2011) and Twitter discussion and films’ box-office earnings (Asur & Huberman, 2010). Calling social media a form of “collective wisdom” (p. 492), Asur and Huberman (2010) analyzed “tweet-rates,” or the number of tweets referring to a film posted per hour, in relation to opening-week earnings. Their study reported a positive and predictive relationship ($r=0.90$; $R^2=0.80$) between tweet-rate and movies’ box-office receipts.

Social media are important agents for change in an increasingly computer-mediated communications environment (Freelon, McIlwain, & Clark, 2018). Undertaking this research, we sought a deeper understanding of how perceptions and behavior change regarding food waste were promoted via Twitter. The purpose of this study, therefore, was to describe the social-media conversation surrounding the U.S. food waste crisis in the wake of the USDA’s announcement of its food waste reduction initiative. We outlined the following research objectives to guide the study:

RO1: To describe the demographic and psychographic characteristics of Twitter users engaged in food waste-related discussions;

RO2: To identify communities of Twitter users engaged in food waste related discussions and influential members of those communities; and

RO3: To describe specific solutions to the food waste crisis produced or shared by those users.

To address these objectives, we constructed a conceptual framework that includes social cognitive theory, online activism, and crowdsourcing.

Social Cognitive Theory and Collective Agency

Albert Bandura's social cognitive theory posits that individuals' attitudes, beliefs, and behaviors are influenced, but not caused by, "personal factors in the form of cognitive, affective, and biological events, behavioral patterns, and environmental events" (Bandura, 2001a, p. 266)—that is, people possess the agency necessary to make decisions within the context of their sociocultural milieu. According to Bandura (2001b), "To be an agent is to intentionally make things happen by one's actions. Agency embodies the endowments, belief systems, self-regulatory capabilities and distributed structures and functions through which personal influence exercised" (p. 2). Exposure to social media can influence individuals' perceived personal agency:

The revolutionary advances in electronic technologies have transformed the nature, reach, and loci of human influence. These new social realities provide vast opportunities for people to bring their influence to bear on their personal development and to shape their social future. (Bandura, 2001b, p. 17)

As individuals become empowered to make decisions, so too can *groups* of individuals (Bandura, 2001a; 2001b; 1997). Collective agency, "people's shared belief in their collective power to produce desired results," is the product of "the interactive, coordinated, and synergistic dynamics of their transactions" (Bandura, 2001a, p. 13). Collective agency relies on environmental factors, including the agency of the group's individual members:

The more efficacious groups judge themselves to be, the higher their collective aspirations, the greater their motivational investment in their undertakings, the stronger their staying power in the face of impediments, the more robust their resilience to adversity, and the higher their performance accomplishments. (Bandura, 2001b, p. 270)

Citizen Participation and Social Media

Social media have in some ways democratized mass media, increasing both the personal and the collective agency of individual media users. Ordinary citizens can now participate in the broad dissemination of information within society, a task formerly reserved by news outlets and broadcast networks. This empowerment of individuals has led to the advent of online activism, or the use of social media and other Web platforms to promote social change via "fundraising, community building, lobbying and organizing" (Lee & Hsieh, 2013, p. 818). Sometimes dubbed "slacktivism" or "hashtag activism" by critics (Fatkin & Lansdown, 2015; Moscato, 2016), this form of citizen participation is able to "leverage audience interest to amplify messaging. Retweeting, for example, allows a movement's members not present at an event or rally to still participate in the distribution of information and thus the shaping of public opinion (Moscato, 2016, p. 5; Penney & Dadas, 2014). Online activism is low-cost, low-risk, and low-effort, allowing more individuals to participate (Lee & Hsieh, 2013).

Despite some concerns that online activism reduces real-world collective action, the use of social media to encourage change may in fact encourage prosocial behavior and collective change. Perhaps the most famous example is the rise of the online opposition movement in Egypt in the early 2000s, which culminated in the Tahrir Square revolt that toppled the country's authoritarian regime in 2011 (Lim, 2012). The Google employee who created the first anti-government Facebook page dubbed the uprising "Revolution 2.0" (Lim, 2012, p. 232). Lee and Hsieh (2013) found that "slacktivism" actually increased the likelihood of individuals engaging in charitable activities: After signing an online petition, study participants were more likely to donate to a charity than their peers who were not asked to sign the petition. Online activism, therefore, may act as a priming activity that promotes prosocial behaviors outside the confines of a social-media platform. Likewise, Fatkin and Lansdown's (2015) findings suggest that social media coverage of natural disasters can spur prosocial collective action, including charitable donations to aid organizations and actual involvement in rescue and recovery efforts. More recent studies of social-justice movements like Black Lives Matter found inferential evidence that online activism contributes to real-world movement goals and, perhaps most importantly, to commitment to prosocial causes (Freelon, McIlwain, & Clark, 2018).

Crowdsourcing

In 2006, *Wired Magazine* writer Jeff Howe used the term "crowdsourcing" to describe labor—in this case, photography—previously completed by trained professionals that had been overtaken by the work of technologically savvy amateurs. Crowdsourcing is a "web-based business model that harnesses the creative solutions of a distributed network of individuals" (Brabham, 2008, p. 76). Unlike outsourcing, which takes advantage of lower costs by exporting labor, crowdsourcing takes advantage of the "hobbyists, parttimers, and dabblers [who] suddenly have a market for their efforts, as smart companies in industries as disparate as pharmaceuticals and television discover ways to tap the latent talent of the crowd" (Howe, 2006, p. 2).

Crowdsourcing takes a variety of forms, including crowd funding, crowd labor, crowd research, and creative crowdsourcing (Nishikawa, Schreier, Fuchs, & Ogawa, 2017; Parvanta, Roth, & Keller, 2013). Creative crowdsourcing, which Parvanta et al. (2013) link to endeavors like Pillsbury's famous bake-off, may be used by private or public entities to brainstorm new products, services, or ideas from large audiences. The formula is relatively simple: "A problem, or creative brief, is posted online, and Internet users are challenged to respond with their best work" (Parvanta et al., 2013, p. 165). Brabham (2008) describes the creative process as "collective intelligence," noting that the Internet is an ideal vehicle for "aggregating millions of disparate, independent ideas in the way markets and intelligent voting systems do" (p. 80).

Using this conceptual framework, this study will outline the convergence of collective agency, online activism, and creative crowdsourcing in the context of Twitter-mediated food waste discussion and solution generation.

Methods

The research team undertook this study to describe the Twitter conversation surrounding food waste in the United States following the USDA's announcement of its food waste reduction initiative in September 2015. The study consisted of a qualitative content analysis of food waste-related Twitter content, as well as an analysis of participant demographics, communities, and influencers.

Data Collection

Researchers undertook data collection using the subscription service Sysomos Media Analysis Platform (MAP), a “listening” tool that allows users to identify, analyze, and archive social media, news media, blog, and video content related to keywords, hashtags, and individual pages or users. Agricultural communications scholars have previously used Sysomos MAP and other similar platforms to investigate conversations regarding water quality, foodborne illness, and extreme weather events (Seeloff & Specht, 2016; Wickstrom & Specht, 2016; Wagler & Cannon, 2015). The Sysomos MAP search function uses Boolean queries to identify content containing the search terms and also allows the user to refine results based on demographic information (geographic location, user gender) or specific timelines. For this study, the query “food waste” was used, with results narrowed to content posted in the United States between October 1, 2015 and September 1, 2016.

The Sysomos service has access to the Twitter Firehose, or a 365-day archive of all public Twitter content. Users can download Twitter content in the form of comma-sorted variable (.csv) spreadsheets; this data can be drawn in order of posting or randomly sampled by Sysomos MAP. The “food waste” search resulted in 90,391 tweets, a random sample of 3,000 of which were downloaded in .csv format and opened in Microsoft Excel 2011 for Mac for further filtering. A preliminary review of the data found 1,967 tweets that were not relevant to the search at hand, that had been deleted, or that teased but did not directly suggest a solution; these tweets were eliminated from the data set. The final spreadsheet was then saved in Microsoft Excel format and uploaded into MAXQDA12, a content-analysis tool.

Data Analysis

Content analysis. Once opened in MAXQDA12, the resulting data set was content-analyzed for proposed solutions or mechanisms for alleviating the U.S. food waste crisis. Content analysis is a common tool for social media studies, being “beneficial in capturing patterns and themes in large amounts of data” (Fatkin & Lansdown, 2015, p. 582). We conducted a systematic thematic analysis, or a search for important emergent themes related to a particular phenomenon (Fereday & Muir-Cochrane, 2006; Daly, Kellehear, & Gliksman, 1997), with the phenomenon in question being food waste and, more specifically, solutions to the U.S. food waste crisis. Using an inductive coding process in which emergent patterns in the data drive the development of themes (Boyatzis, 1998), the researchers developed a series of codes based on the collected tweets. One researcher was responsible for the coding process and developed initial themes; a secondary coding process was completed in which the original codes were clarified, collapsed, and grouped as subcodes under broader thematic categories.

Sysomos MAP demographic and community analysis. In addition to its aggregation capabilities, Sysomos MAP provides researchers with demographic information for public Twitter users engaged in conversations of interest. This broad demographic data includes gender, distribution by country, and distribution by state (for U.S. users) and province (for Canadian users). The platform also visualizes relationships among conversation participants—conversation communities—and identifies influential members of those communities using a proprietary algorithm based on followership, number of interactions, and tweet volume. Sysomos MAP’s authority scores range from 1 (little or no authority) to 10 (very high authority). Each community’s members are given influence scores based on their interactivity with other members of the conversation. These scores range from 0% (no influence) to 100% (most influential). Demographic

data, communities, and influencers were recorded for the 2,892 profiles that produced the original 90,391 tweets generated in the #foodwaste discussion.

Findings

The Sysomos MAP “food waste” search generated 90,391 Twitter mentions of the search term that were posted during the selected timeline. *Figure 1* illustrates the term’s popularity, with unusually high “bursts” of activity denoted by the red circles at the top of each peak.

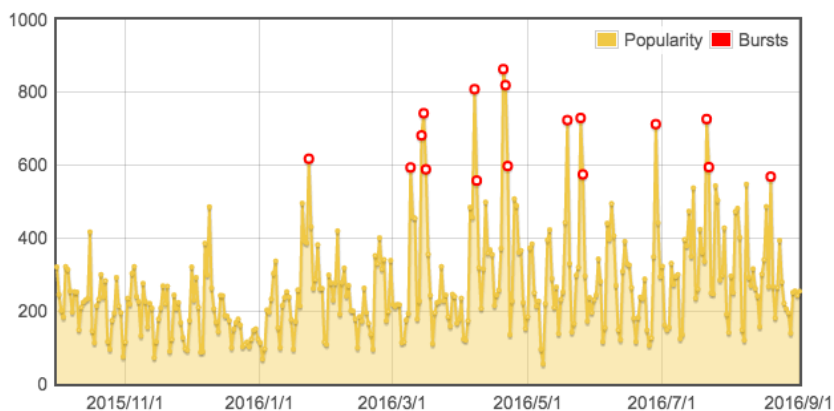


Figure 1. Popularity of the search term “food waste” on Twitter between October 1, 2015 and September 1, 2016. The y-axis represents the number of tweets posted per day.

Analysis of the cluster of bursts between April and May 2016 reveals that Twitter users tied their food waste discussion to Earth Day—April 22—while news outlets like *The Guardian* released articles about environmental impacts that mentioned food waste (Somerville, 2016).

RO1: Demographic and Psychographic Characteristics of Twitter Users Engaged in Food Waste-Related Discussions

Sysomos MAP tools were used to collect and report demographic and psychographic characteristics of conversation participants. As noted above, 2,892 Twitter users contributed to the food waste conversation, of which 1,329 provided gender information. Among these users, female participants (52%) slightly outnumbered male participants (48%). All 2,679 users who provided geographic locations were located in the United States, per the geographic filter, with California (18.63%), New York (10.94%), and Washington, D.C. (6.49%) best represented (*Figure 2*).

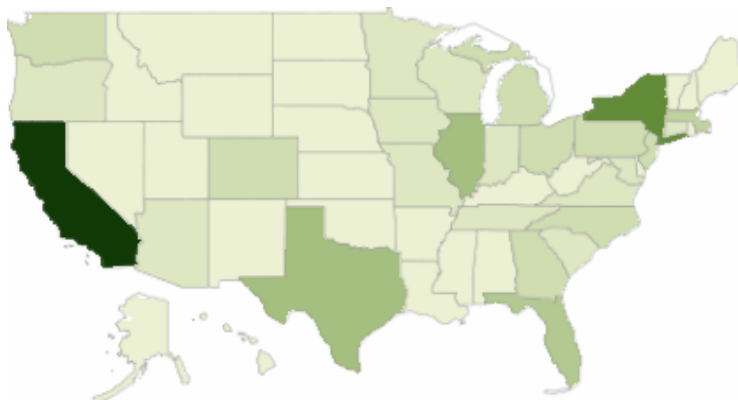


Figure 2. A map of the United States displaying food waste conversation participation among users who publicly share location information. States with higher participation are shaded darker than their counterparts.

Psychographic data, or information related to users’ beliefs, attitudes, and lifestyle choices, were gleaned from Sysomos MAP analysis of Twitter biographies (or “bios”) of top influencers’ followers. Bios are user-generated information related to individuals’ interests, hobbies, and professional and personal lives. We compared user bios of followers of the following influencer accounts, which scored over 90% using Sysomos’s proprietary influencer algorithm: Food Tank founder Danielle Nierenberg (@DaniNierenberg), online news outlet Grist (@grist), *Smithsonian Magazine* (@SmithsonianMag), *Sierra Magazine* (@Sierra_Magazine), Fast Company’s Co.Exist campaign (@FastCoExist), nonprofit organization Food Tank (@Food_Tank), food news site Civil Eats (@CivilEats), and the United Nations Foundation (@unfoundation).

Comparison of word clouds generated from influencers’ follower bios revealed that these individuals share interests in food, sustainability, and healthy living. Most of them work in creative fields, such as writing, music, design, and photography, or in business, marketing, or technology-related careers. They enjoy instructive pursuits like travel, reading, and cooking and place value on family time. They respect science and believe in and are concerned about climate change and other environmental issues. These individuals are also likely to engage in community leadership activities—many describing themselves as “passionate”—making them ideal conduits for change in their urban and suburban surroundings.

RO2: Food Waste-Focused Twitter Communities and Their Influential Members

Sysomos MAP uses network analysis to generate communities of users that interact with each other within the parameters of the search terms and filters. The “food waste” search generated seven user communities (Figure 3); for brevity, the four largest communities will be described below.

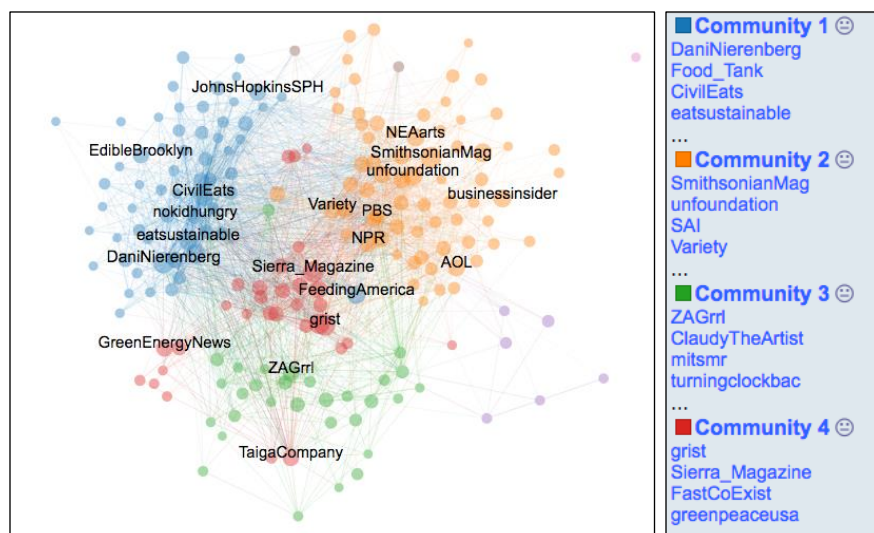


Figure 3. The six communities identified by Sysomos MAP (left) with color codes, sentiment, and key influencers (right). Communities 5 (purple), 6 (brown), and 7 (pink) lacked sufficient user data to warrant further description.

Community 1. Community 1 possesses an average influence score of 66% and comprises such influencers as Food Tank, Food Tank founder Danielle Nierenberg, anti-hunger charity Feeding America, Johns Hopkins Bloomberg School of Public Health, and USDA. The focus of Community 1 seems to be institutional changes that may impact food waste reduction, such as consumer education, governmental initiatives, and community programs.

Community 2. Community 2 consists of a number of news organizations, including print publications (*Smithsonian Magazine*, *Variety*, *Business Insider*, *Time Magazine*, and *The Economist*); broadcast outlets and programs (NPR, PBS, YouTube, Yahoo!, and *The Today Show*); and popular public figures, including meteorologist Al Roker and First Lady Michelle Obama. Community 2’s average influence score is slightly higher than Community 1’s at 71%.

Community 3. Community 3 contains a number of lower-influence users representing private individuals rather than organizations, government agencies, or media outlets. The average influence score is 64%.

Community 4. Environmental impacts of food waste constitute the central issue of Community 4. This community includes a variety of environment-related organizations, including *Sierra Magazine* and Sierra Club, Greenpeace USA, the Environmental Protection Agency, and Grist, with an average influence score of 71%. These users can be found at the center of the community network, indicating that Community 4 is a hub for information shared by other communities.

RO3: User-Provided Solutions to the Food Waste Crisis

Of the 3,000 tweets downloaded for use in the content analysis, 1,033 were found to be relevant to Research Objective 3. In these tweets, users suggested or discussed solutions to the U.S. food waste crisis. Thematic analysis of the Twitter data revealed the following themes (examples of tweets from which may be found in Table 1): 1) domestic or household behavior change; 2) food-waste diversion and donation; 3) recycling and upcycling; 4) consumer education; and 4) governmental action and policy.

Table 1
Food Waste-Related Themes and Subthemes Produced by a Content Analysis of Topic-Related Twitter Conversations

Theme and Subthemes	Tweet Examples
Domestic or household behavior change	
<i>Meal planning</i>	#2016HomeResolutions: Have you ever considered a weekly meal calendar? It can save you money time and eliminate food waste!
<i>Waste mitigation</i>	SHARE this with friends to promote reducing food waste by using #leftovers! https://t.co/bo0FBEV1xB https://t.co/FiWS0ashzM
<i>Smart technology</i>	RT @ScienceChannel This smart fridge helps reduce food waste. See more cool tech stories tonight at 8p! https://t.co/xnSWO5wbuW

Food waste diversion and donation

- Large-scale food donation* UK grocery giant @Tesco is donating all unsold food to help curb food waste. #everylittlebithelps
<https://t.co/mx4skaGJp7>
- Food waste markets* Walmart's UK grocery chain is selling ugly veggies to reduce food waste. It's time we follow
<https://t.co/uQQRKOPymP> via @HPLifestyle
-

Recycling and upcycling

- Value-added products* RT @ProjectDrawdown Can food waste become fashion?
<https://t.co/HOkpHTF2sb>
- Converting food waste into energy* How Colorado Is Turning Food Waste Into Electricity:
<https://t.co/oQSVnmbgFJ> #Innovation #EmpowerNext
<https://t.co/YiXJC7Fdw>
- Food waste for agricultural purposes* RT @AllScienceGlobe Feeding food waste to pigs could save vast swathes of threatened forest and savannah -
<https://t.co/zbnnlSLtUZ>

Consumer education

- Public information campaigns* Ugly fruit?? "A Campaign to Reduce Food Waste: The #InnerBeauty of Fruits and Vegetables"-
<https://t.co/qWpYUmBUmU> #FoodForThought
- Mobile technology* RT @UglyFruitAndVeg This app fights food waste by letting u buy restaurant leftovers. @derekmarkham @TreeHugger
<https://t.co/PLZgdxWXXw>
<https://t.co/92anAzjyYh>
- Family and consumer science training* Could a Home Ec Revival Help Slash Food Waste?
<https://t.co/72G2khnfro> via @TakePart

Governmental action and policy

- Legislating food waste reduction* RT @michaelpollan: French law forbids food waste by supermarkets | World news | The Guardian
<https://t.co/QhaLmbJhcj>
- Food date labeling* RT @SavorTooth This @99piorg on milk expiration dates is a shining moment in the campaign against food waste
<https://t.co/p2mN89dA8v>
-

Domestic or household behavior change. According to Twitter users engaged in the “food waste” conversation, food waste reduction begins at home. *Meal planning*, including weekly

meal calendars, using grocery lists, controlling portions, and utilizing meal-delivery services, was a popular suggestion for households trying to curb food waste. *Waste mitigation* techniques, including kitchen garbage disposals, reuse of leftover food, and use of small-scale compost bins, were discussed at length, as was the use of *smart technology*, such as refrigerators with cameras that monitor food quality.

Food waste diversion and donation. Food waste diversion, or redirection of food waste from farms, production facilities, and kitchens away from landfills, was a key theme among conversation participants. *Large-scale food donations* from grocery stores, restaurants, and cafeterias to food pantries and homeless shelters generated positive feedback from users: British grocery chain Tesco and American coffee company Starbucks were lauded for their policies of donating leftover food products. Many users also cheered a Danish grocer's decision to open *food waste markets* to encourage the purchase of previously unsold produce, a tactic echoed by American superstore Wal-Mart with its special section of "ugly" and discounted fruits and vegetables.

Recycling and upcycling. Many users identified examples of *value-added products* made from food waste that may serve as alternatives to landfills. These products included art, such as food-based portraits of clients' pets; upscale meals created by top chefs to demonstrate the value of superfluous food; and clothing produced from food waste. *Conversion of food waste into energy* through methods like digesters and the creation of biofuels was another alternative outlet: Users identified several states and metropolitan areas experimenting with such technology, including Colorado's use of a methane digester to turn food waste into electricity. Leveraging *food waste for agricultural purposes* was recommended by a number of participants, some of whom noted that insects, worms, and microorganisms could be used to spur composting and that food waste could potentially be used to supplement livestock feed.

Consumer education. Based on the Twitter conversation content, food waste is a growing perceptual issue among consumers, and many identified specific *public information campaigns* targeted at households. For instance, toy company Hasbro created an "ugly" Mr. Potato Head figure to normalize blemished produce; a photography contest allowed artists to depict food waste and share their images online. *Mobile technology*, such as smartphone apps, could bring food waste monitoring and measurement tools direct to consumers, and several participants specifically mentioned FoodKeeper, an app that monitors groceries' freshness based on purchase dates. A number of participants advocated for the return of *home economics training* to K-12 education in the United States.

Government action and policy. The United States lags behind in *legislating food waste reduction*, a fact brought to bear by conversation participants who praised laws cutting down waste from restaurants and grocery stores in Italy, France, Spain, and Denmark. Many participants identified Congresswoman Chellie Pingree's Food Recovery Act as a potential statutory solution to food waste. Likewise, *food date labeling* was a major area of discussion: Imprecise expiration dates result in large amounts of food being thrown out, and participants pushed for more research and, potentially, bureaucratic action on improving the efficacy of food labels.

Discussion

The purpose of this study was to investigate the Twitter conversation surrounding food waste in the United States; specifically, to describe participants, to define communities of users, and to catalog potential solutions based on participants' informal creative crowdsourcing. While we cannot, of course, claim causation between Twitter users' participation in this discussion and their

practicing food waste reduction techniques, based on the work of Bandura and other social cognition researchers, we may infer that their information-sharing represents the potential for exertion of thought into action. As Fatkin and Lansdown (2015) note, online activism does not require strong organizational structure or interpersonal relationships; rather, social change may be affected by individuals who feel empowered by networking online with likeminded individuals.

Through this study, we now know a bit more about the individuals and communities engaged in online food waste problem-solving. They tend to be located in states and regions known for environmental awareness and policy (Wingfield & Marcus, 2007), and they tend to be white-collar professionals in creative or technological fields with an interest in health and sustainability. They build social-media networks by following influencers in news media, government, and science and technology, and their willingness to disseminate information regarding topics of importance—their collective agency—indicates that they may be ripe for turning their online words into actions. Online social support has been shown to influence Web 2.0 users' perceived real-world self-efficacy (DeAndrea et al., 2012); thus, becoming part of likeminded networks for change could encourage food waste discussants to deploy solutions and tools in their everyday lives.

The food waste Twitter chatter itself reveals a wealth of information about how participants feel they—and American society—can best address the food waste crisis. With solutions ranging from startup technologies to reviving family and consumer science training in schools, the conversation represents a sort of unorganized but passionate crowdsourcing of ideas or collective intelligence (Brabham, 2008). The concepts addressed most often—among them household behavior change, food diversion and donation, reusing or upcycling food waste, consumer education, and government intervention—provide an excellent starting point for nonprofits, government agencies, universities, and other groups to plan and mobilize collective action among individuals who already feel strongly about their own agency to contribute.

As researchers continue to analyze the issue, the aforementioned topics can serve as a stepping off point to further look for solutions and how to engage consumers interested in solving food waste problems. For example, the concept of “ugly produce” has already opened lines of research on consumer attributes (such as self-esteem) and how they can be leveraged to change purchase and waste behaviors (Grewal et al., 2019).

Recommendations for Organizations

Based on our findings, we recommend that organizations leverage Twitter as both a space to mine solutions, volunteers, and other resources and as an area in which to test ideas among motivated and receptive audience members. Social-mediated crowd wisdom is essentially low-risk market research that allows engaged entities to test new technologies or concepts without incurring the high costs of production or dissemination. The Twitter communities identified in this study represent potential test markets: groups of users with similar interests and backgrounds that are linked thru shared connections to specific influencers in a variety of fields.

Organizations should not only utilize the influencers' followerships and communities, but should also engage with the influencers themselves. The Twitter accounts shown in Figure 4 represent loci of online conversation; information circulated by those users has the ability to reach and sway whole communities and to stimulate both collective agency toward real-world involvement and creative crowdsourcing of solutions. At the same time, Freelon, McIlwain, and Clark's (2018) work on social-mediated protest movements also supports the notion that

community engagement in these online discussions encourages elites' participation and attention, thus amplifying social issues in the cultural milieu.

Recommendations for Future Research

Using Twitter as a scientific research tool is a relatively new concept, and care must be taken to avoid extrapolating real-world outcomes based only on social media-generated data. To that end, food waste researchers should survey members of the identified communities to see what solutions they actually do or plan to implement; potential correlations could then be calculated between social media use and real-world food waste reduction agency. In a similar vein, these Twitter users could help identify barriers to implementation of new technologies or techniques aimed at eliminating discarded food. The communities identified could also potentially serve as a testing ground for online snowball sampling techniques, wherein influencers could identify key individuals for study, disseminate surveys among their community members, and encourage participation to improve response rates.

Because we focused our data collection on Twitter conversations, potential material generated by users of other social media remains unstudied. Future research should investigate how food waste is discussed (and by whom) on Facebook, Instagram, and other emerging social media platforms. Researchers should explore the benefits of studying such tools around moments in time that spark such intense discussion like that of Mr. Oliver's segment did. By watching social media trends at times of movement like political speeches or organizational announcements we can also begin to better understand how the online populace will continue these discussions and influence movement.

The movement of this issue was not new when Mr. Oliver engaged his audience, but it did serve as part of the catalyst in the uproar that led to the announcements seen by federal agencies. As researchers and communicators, we should strive to better understand how such online influence can impact our political leaders in pushing forward on important agriculture and food related issues.

As society and media continue to engage in complicated issues, like food waste, it behooves us to capture the power of crowdsourcing and social media engagement to not only keep pulse on situations, but to also explore the range of proposed solutions and ideas being offered. As seen in this study, the communities are well connected to many influencers and by pulling together such knowledge from a variety of communities, undiscovered ideas and thoughts could be garnered and lead to further change and growth. We have done a good job of researching and using traditional media to move the needle on many important issues. It is now time that we better grasp online communication and networks to do the same.

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