Household Food Waste Perceptions and Behaviors: A Vermont Case Study

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1. Introduction

The US government has set the target of reducing food waste by 50% by 2030 (USDA 2015). Simultaneously, industry-level initiatives are in place across the food supply chain to minimize waste and donate edible food (e.g., Food Waste Alliance 2016), and local and state governments have started to encourage food waste reduction, recovery and reuse strategies. Four states (Vermont, Connecticut, Massachusetts, and Rhode Island) have enacted policies that require large generators of food waste to divert this material from landfills. Vermont's law (Act 148) is the most stringent: by 2020, all food waste, including that generated by households, will be banned from landfills (VT DEC 2016). Thus far, local-level food waste policies are concentrated in the Western states, particularly in large cities such as San Francisco, Portland, and Seattle, where economies of scale and available infrastructure facilitate participation. The small-town nature of the New England landscape presents challenges to food waste recovery and reuse that relate to its rural character, culture, population density, and climate. These challenges extend to other parts of the nation; in 2016, more than 46 million US residents lived outside of metropolitan counties, as defined by the US Office of Management and Budget. Despite the challenges, areas outside of major cities likely provide opportunities for resource recovery and reuse driven by the proximity of residential areas where food waste is generated, sites of food waste processing, and farms where reuse products (e.g., compost) can be land applied.

These changing landscapes provide both challenges and opportunities for businesses in waste management, municipalities, and households. Since Vermont is the first state in the country to pass food waste legislation that includes households, it is an important area of focus to understand how households might respond to these changes. Importantly, the rural nature of Vermont elicits potential challenges to successful curbside food waste collection programs, which are also required under the Vermont law. This research sought to explore how Vermonters perceive the issue of food waste, the Vermont food law (Act 148), and the strategies Vermonters use currently and likely strategies in the future to comply with Act 148. This report details the methodological approach of the research and then key results based on survey data collection in February 2018.

2. Methods

Data were collected by the Center for Rural Studies at the University of Vermont as part of the 2018 Vermonter Poll. Prior to data collection, Institutional Review Board for human subjects approval was obtained through The University of Vermont. The survey was conducted between the hours of 10:00 a.m. and 8:30 p.m. beginning on February 20, 2018 and ending February 26, 2018.

Telephone polling was conducted from the University of Vermont using computer-aided telephone interviewing (CATI) drawn from a random sample from a list of Vermont landline and cellular telephone numbers. Only Vermont residents over the age of 18 were interviewed. The poll included questions on a variety of subject areas relevant to Vermonters. Questions specific to food waste and Act 148 were developed in conjunction with academic researchers and the funder (Casella Waste Management). In total, six questions (some with multiple components) were asked explicitly for the purposes of this research (Table 1). In addition, this analysis also utilized demographic characteristics captured through the survey methodology (Table 1).

Table 1. Survey questions and scales utilized in this analysis

Question	Scale
Have you heard about Vermont's food waste law before today?	Binary- yes/no
Please tell me if you already use each option or not, and how likely you would be to use that option in the future. *Subscribe to a curbside pickup program for food waste, similar to recycling?* *Drive to a drop off station with your food waste?* *Manage your own food waste with backyard composting, or by feeding to pets or livestock?* *Dispose of food waste in your garbage disposal?* *Throw your food waste into the garbage?*	Binary- yes/no for current use. Future Use five point scale from Very Likely (5) to Very Unlikely (1)
Please tell me your level of agreement with the following statement: "Food waste should be banned from disposal in the landfill." Do you...	Five point scale from Strongly agree (5) to Strongly disagree (1)
If curbside food waste pickup was available to comply with this law, from the following options, how frequently would you want the pick up?	Five point scale: Twice a week (5); Once a week (4); Twice a month (3); Once a week in the summer, twice a month in the winter (2); I would not use a curbside pickup program (1)
How much additional cost would you be willing to pay for service to divert your food waste and comply with this new law? Would you be willing to pay...	Five point scale: More than $30 extra per month (5); Between $20-$30 extra per month (4); Between $10 to $20 extra per month (3); Up to $10 extra per month (2); Nothing extra (1)
In which Vermont county do you currently live?	Categorical response of 14 Vermont counties
Urban/Rural location	Franklin, Grand Isle and Chittenden= Urban. All other Vermont counties= Rural
What is the highest level of education that you have completed?	Six point scale: Post graduate/professional (6); Bachelor (5); Associates/technical (4); Some college but no degree (3); High school graduate or GED (2); Less than high school (1)
Do you own or rent your home?	Binary- own/rent
Was your household's TOTAL income in 2016 more or less than $50,000 before taxes?	Binary- more/less
Do you identify as one of the following: Hispanic, Latino, or of Spanish origin?	Binary- yes/no
Indicate the race category with which you most identify*	Categorical: White or Caucasian; Black or African American; American Indian or Alaskan Native; Asian or Pacific Islander
Politically do you consider yourself to be	Categorical: Republican, Democrat, Independent, Progressive, Not politically affiliated
What gender do you most identify?	Categorical: Male, Female, Transgender/Other

* Note that the response rate for non white/Caucasian individuals was very low. For analysis purposes, data of non-white/Caucasian individuals was aggregated together

Data were analyzed using a series of statistical tests to explore statistically significant differences among groups including chi square tests, analysis of variance, and Kruskal-Wallis tests depending on variable distributions. In some instances, we show data broken down by county level. It should be noted that some counties had very low total numbers of responses, and this data should not be considered statistically significant, but rather demonstrates potential geographic trends in some data results.

A total of 583 Vermont residents over the age of 18 agreed to participate and completed the survey. Based upon 583 valid responses, the overall study results have a margin of error of plus or minus 4.1% with a confidence level of 95%. This means that if this study were replicated 100 times, 95 of those times, the results would fall within +/-4.1% of the results found in this effort.

3. Results

3.1 Knowledge and Perceptions about Act 148

Overall 71% of respondents had heard about Vermont's food waste law prior to the survey (Figure 1). Factors associated with greater awareness of the law include younger Vermonters ($p = 0.002$) and homeowners (74.9%) compared to renters (43.8%, $p < 0.000$).

Overall, respondents agree that food waste should be banned from the landfill (56.1% strongly or somewhat agree) (Figure 2). Characteristics associated with higher agreement that food waste should be banned from landfills:

- Higher levels of education ($p = 0.012$)
- Women (mean 3.65 compared to 3.35 for men, $p = 0.030$)
- People currently using backyard composting (mean 3.70 compared to 3.03, $p = 0.0001$)
- People currently not using garbage disposal (mean 3.10 using garbage disposal compared to 3.63 non-users, $p = 0.001$)
- People currently not using garbage (mean 2.94 using garbage compared to 3.92 non-users, $p = 0.0001$)

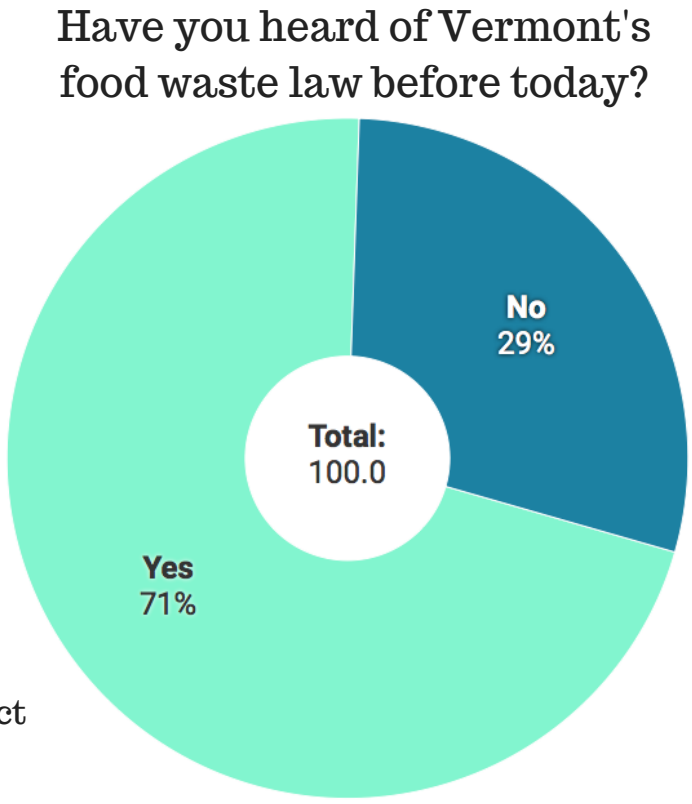

Figure 1. Vermonter's Knowledge of Act 148, Vermont's Food Waste Law

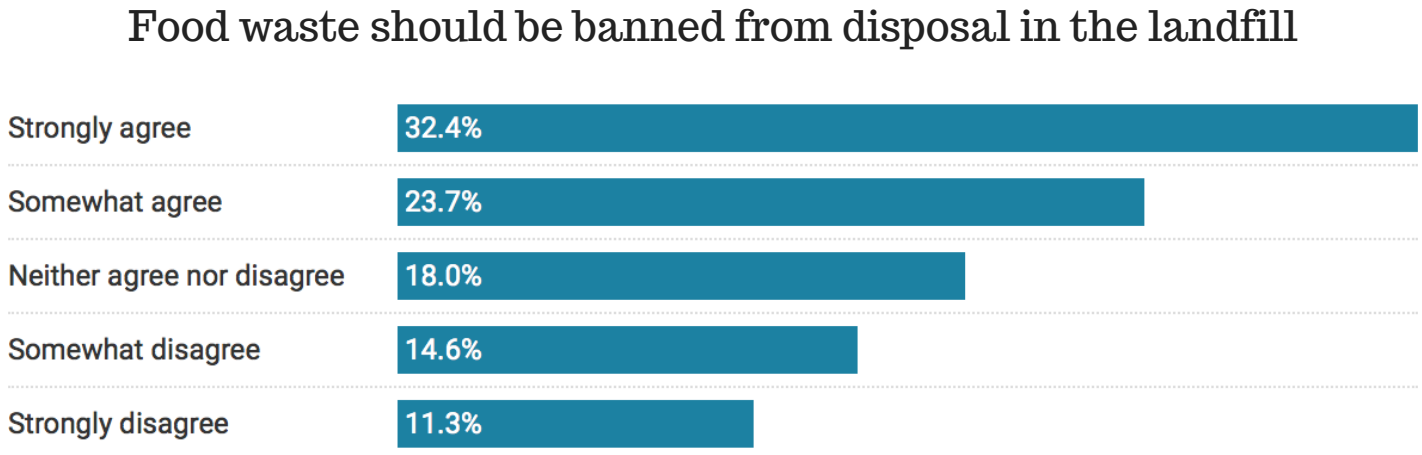

Figure 2. Level of agreement about banning food waste from landfills

3.2 Current Food Waste Strategies

The majority of respondents currently manage their own food waste through backyard composting or feeding food waste to pets or livestock (72.4% of respondents) (Figure 3, it should be noted respondents could choose more than one option). The second most common strategy was putting food waste in the garbage (43.1%) followed by use of a garbage disposal (22.0%), drive to a drop-off station (18.8%) and subscribe to a curbside food waste pickup program (10.7%). Most respondents use only one (45.9%) or two (37.7%) food waste strategies (e.g. someone might both compost and throw their food waste in the garbage). Backyard composting was the most common single strategy (32.5%) followed by garbage only (7.9%). The use of backyard composting and garbage was the most common strategy for respondents using two food waste strategies (12.6%).

72%

of Vermonter's surveyed currently compost or feed their food waste to pets or livestock

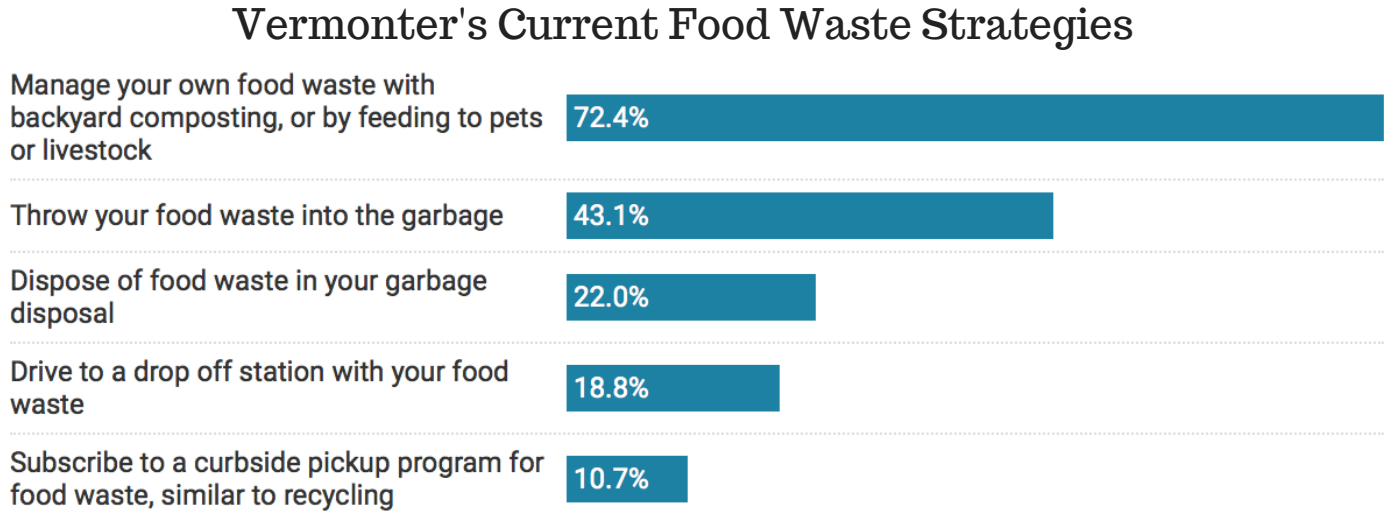

Figure 3. Strategies used by Vermonter's to currently manage their food waste. Respondents could choose more than one option.

A number of demographic factors were correlated with use of different food waste strategies. These include:

Backyard composting

• Rural households more likely to use this strategy (76.4% in rural compared to 62.7% in urban counties, ($p < 0.001$) (Figure 4).
• Younger people more likely to use this strategy ($p = 0.052$)
• Homeowners more likely to use this strategy (73.7% compared to 59.6% for renters, $p = 0.040$)

Waste in garbage

• Renters more likely to use this strategy (57.1% compared to 41.2% homeowners, $p = 0.030$)

Garbage disposal

• Urban counties more likely to use this strategy (30.6% compared to 18.2% in rural counties, $p = 0.001$)
• Income more than $50K more likely to use this strategy (24% compared to 12.3% income less than $50K, $p = 0.002$)

Drop-off station

• No statistically significant differences

Curbside pick-up for food waste

• Larger households more likely to use this strategy ($p = 0.052$)

Further, knowledge of the food waste law did result in some statistically significant differences with regards to current strategies. People who knew about the law were less likely to use the garbage and less likely to use curbside pickup (Table 2).

Table 2. Current food waste strategy compared by knowledge of food waste law

Current Strategy	Knowledge of Act 148	No knowledge of Act 148
Backyard composting	74.0%	66.6%
Waste in garbage*	39.7%	51.3%
Garbage disposal	20.7%	25.3%
Drop-off station	18.4%	18.5%
Curbside pickup*	9.0%	15.1%

* Statistically significant $p < 0.05$

Current Use of Backyard Composting

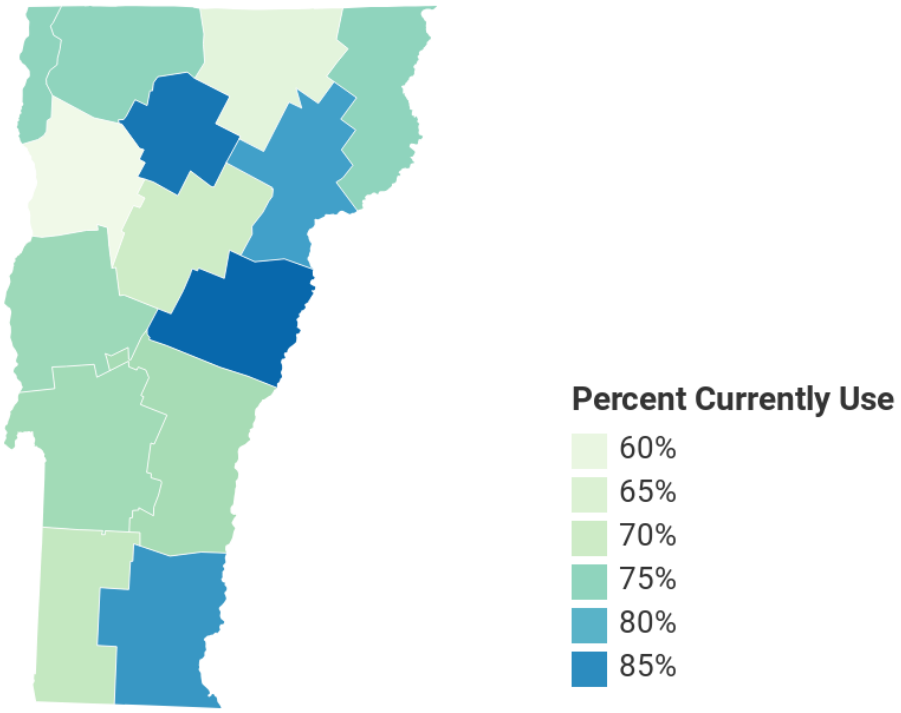

Figure 4. Percent of respondents currently using backyard composting as a food waste management strategy by county. This map is only for illustrative purposes and does not suggest a statistically significant population at the county level, as the total number of people surveyed in some counties is small.

3.3 Future Food Waste Strategies

The majority of respondents (76%) are likely to manage their own food waste through backyard composting in the future to comply with Act 148 (Figure 5). A further 34% of respondents each suggested that they would be likely to subscribe to a curbside pickup program or continue to throw their food waste into the garbage (a practice that would technically be illegal). Less likely strategies include driving to a drop-off station (33% likely) and using the garbage disposal for food waste (20% likely).

Vermonter's Likely Future Food Waste Strategies

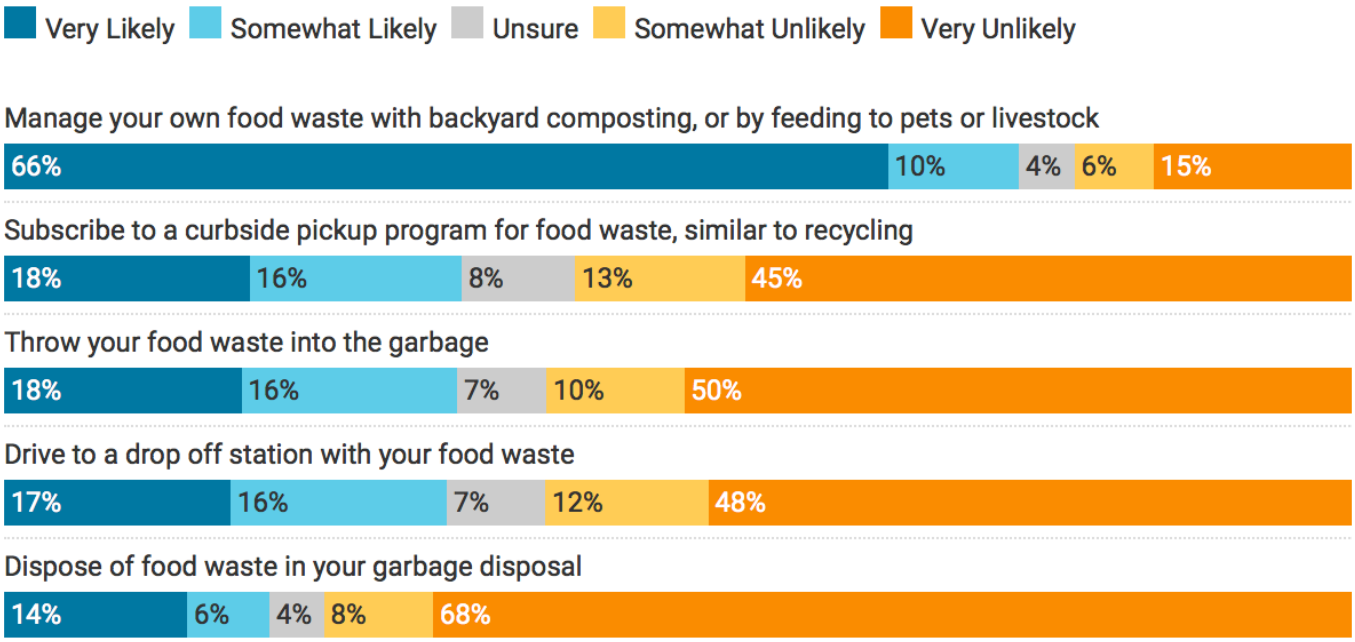

Figure 5. Likely future food waste strategies to comply with Act 148.

A number of demographic factors were correlated with the likely future use of different food waste strategies. These include:

Backyard composting:
• Rural counties more likely to use this strategy (mean 4.17 compared to 3.79 rural counties, p = 0.008)
• Larger households more likely to use this strategy (p = 0.001)
• Households with 1-2 children more likely to use this strategy (means: 0 children = 3.97, 1 child = 4.28, 2 children 4.83, 3 children 3.88, p = 0.002)
• Younger people more likely to use this strategy (p = 0.018)
• Homeowners more likely to use this strategy (mean 4.12 compared to 3.45 among renters, p = 0.009)

Curbside composting:
• Urban counties more likely to use this strategy (mean 2.69 compared to 2.40 rural counties, p = 0.040)
• Renters more likely to use this strategy (mean 3.09 compared to 2.43 of renters, p = 0.004)

Garbage disposal:
• Urban residents more likely to use this strategy (mean 2.21 compared to 1.74 for rural residents, p = 0.001)
• People making more than $50K more likely to use this strategy (mean 1.93 compared to 1.60, p = 0.050)

34%

of Vermonter's surveyed indicated they were likely to use a curbside compost pickup program in the future to comply with Act 148 - the same number that indicated they would continue to throw their food waste in the garbage despite Act 148.

In addition, there are relationships between the types of current and future potential strategies. Mean likelihood of using a future strategy depends on current strategy (Table 3). There are several cases where current strategies are correlated with greater potential use of another strategy in the future. For example, individuals currently using backyard composting have a mean of 2.28 likelihood (five point scale from 5= Very Likely to 1= Very Unlikely) for using curbside pickup in the future. Orange boxes indicate that this mean score is less likely than non-users of backyard composting. These results suggest that individuals are quite set in continuing to use their existing strategy in the future. However, those using garbage currently are more likely to use curbside pickup, drop-off and garbage disposals in the future.

Table 3. Likelihood of using future strategies based on current food waste strategy. Statistical significance is compared to non-users of the current strategy. Blue boxes indicate when a current strategy is more likely to use a future strategy compared to non-users; whereas, orange boxes indicate when a current strategy is less likely to use a future strategy compared to non-users.

	Future Strategies (Mean Likelihood, 5= Very Likely, 1= Very Unlikely)				
Current Strategy	Backyard composting	Curbside pickup	Garbage	Drop-off station	Garbage disposal
Backyard composting	4.80*	2.28*	2.03*	2.27*	1.63*
Curbside pickup	3.75	4.70*	2.5	2.44	1.85
Garbage	3.54*	2.83*	3.92*	2.73*	2.18*
Drop-off station	3.64*	2.70	2.45	4.63*	1.60*
Garbage disposal	3.51*	2.62	2.90*	2.28	4.30*
Overall mean	4.05	2.49	2.42	2.41	1.89

* statistically significant $p < 0.05$

3.4 Use of Curbside Pickup Program in the Future

While curbside pickup for food waste is the second most likely strategy that respondents will use, an additional question suggested that almost 40% of respondents would not use a curbside pickup program at all. If curbside pickup were available, most commonly respondents wanted pickup once a week, followed equally by twice a week or once a week in summer and twice a month in the winter (Figure 6).

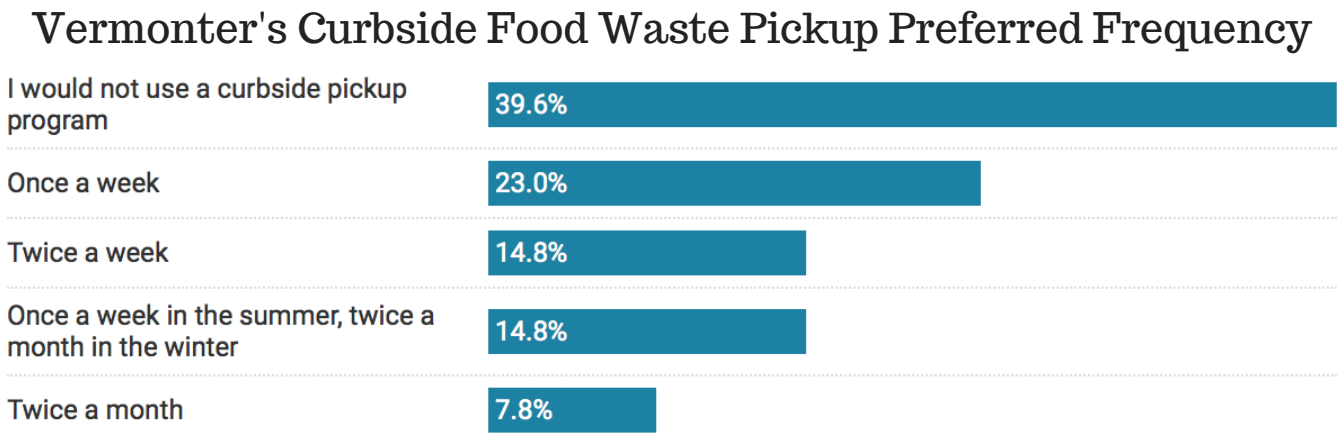

Figure 6. Preferred frequency for curbside pickup programs, if they were made available to comply with Act 148.

A number of demographic factors were correlated with frequency of use of curbside pickup:

- Household owners would like the service less frequently ($p = 0.050$)
- People who use a garbage disposal currently would like the service more frequently ($p = 0.024$)

As shown in Table 4, urban counties were more likely to want to use a curbside compost pickup program (66.6% compared to 57.7%, $p = 0.046$).

Table 4. Desired frequency for curbside compost pickup in urban versus rural counties.

Frequency	Urban	Rural
Twice a week	18.1%	13.4%
Once a week	19.9%	24.3%
Twice a month	8.8%	7.3%
Once a week in the summer, twice a month in the winter	19.9%	12.7%
I would not use a curbside pickup program	33.3%	42.3%

In addition, the following characteristics were also associated with the use of a compost pickup program of any frequency:

- More likely to be households with two children (84.8% compared with 57.1% with 1 child, or 58.4% with no children, p = 0.058)
- More likely to be people already using curbside service (90.2% compared with 56.9%, p = 0.0001)
- Less likely to be people using backyard compost (55.7% compared with 72.1%, p = 0.004)
- More likely to be people using garbage disposal (70.5% compared with 57.9%, p = 0.012)
- More likely to be people using garbage (72.7% compared with 51.1%, p = 0.0001)

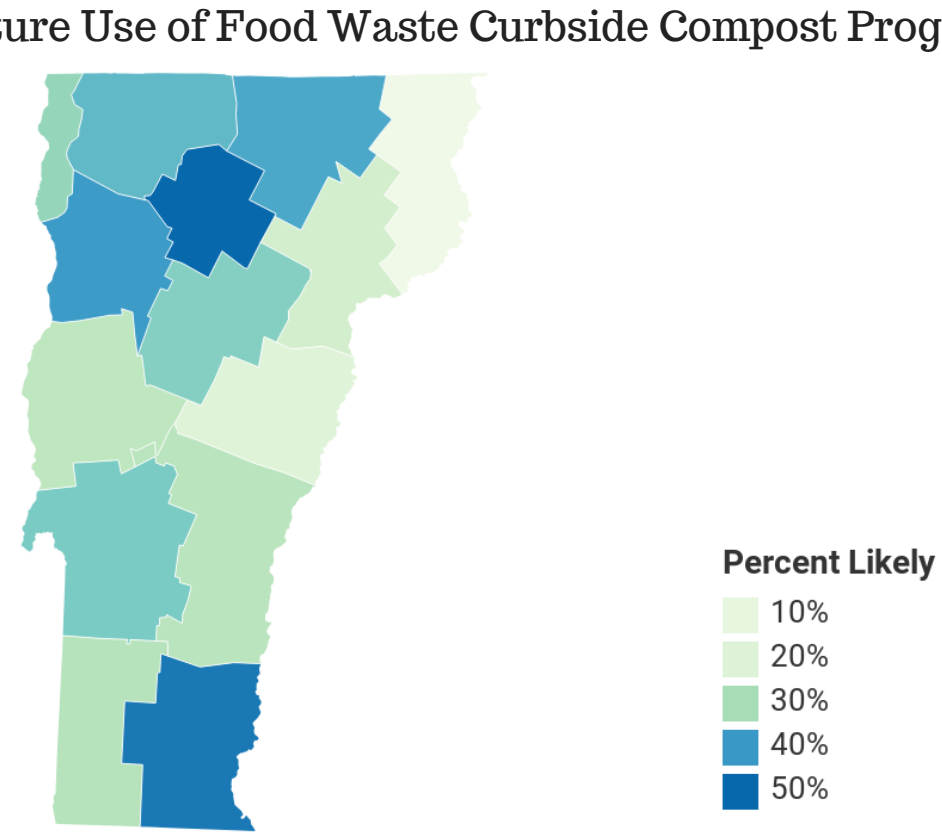

Figure 7. The likely future use of a curbside pickup program of any frequency by county. Note that this map is only for illustrative purposes and does not suggest a statistically significant population at the county level, as the total number of people surveyed in some counties is small. Likelihood may also relate to existing use of a curbside pickup program, such as in Windham County.

However, while many respondents indicated they were interested in a curbside compost pickup program, (albeit at varying regional levels (Figure 7)) the majority (55.5%) of respondents suggested they were not willing to pay any additional cost for the service (Figure 8 and Figure 9).

Characteristics associated with higher willingness to pay:
- Higher rates of education ($p = 0.014$)
- Households with 2 children (compared to no children, $p = 0.023$)
- Younger people ($p = 0.001$)
- People already using curbside compost programs ($p = 0.0001$)

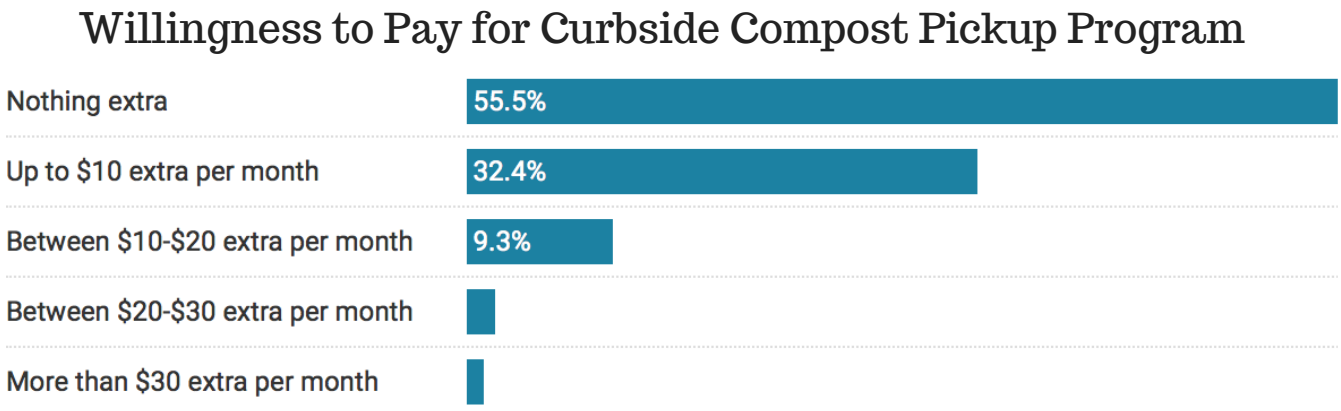

Figure 8. Additional cost that Vermonters are willing to pay to have curbside food waste pickup.

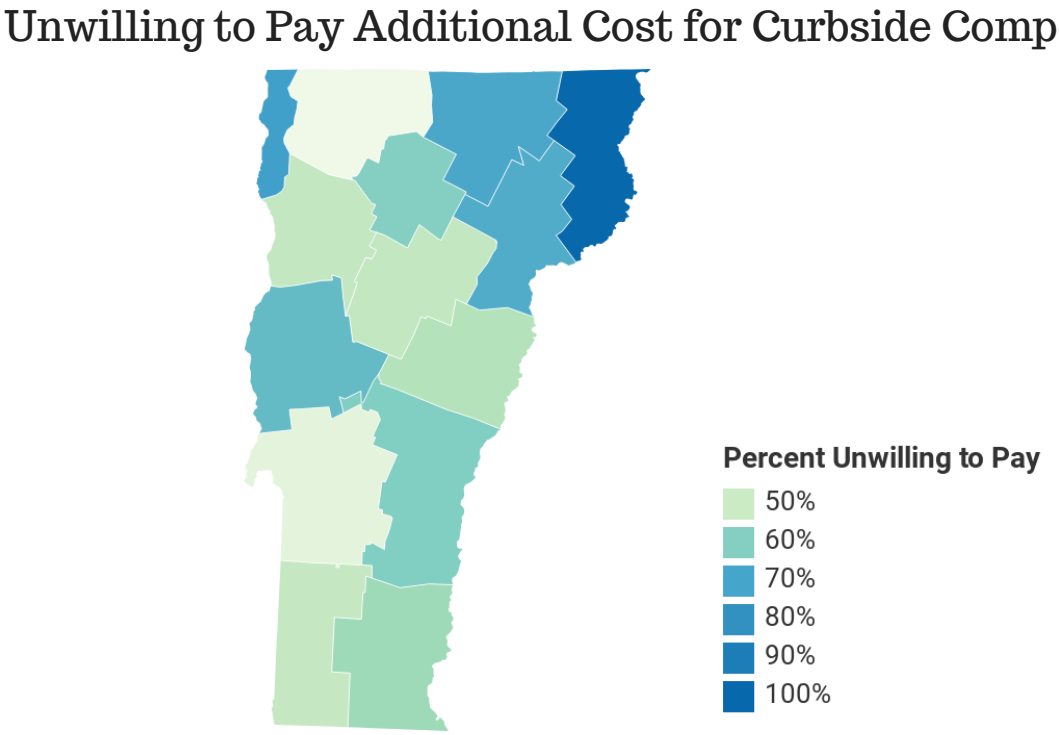

Figure 9. Percent of respondents indicating they would not be willing to pay anything additional for a curbside pickup program for food waste. Note that this map is only for illustrative purposes and does not suggest a statistically significant population at the county level, as the total number of people surveyed in some counties is small.

4. Business and Policy Implications

4.1 Business Implications

The results of this work provide helpful insight into the ways that Vermonters manage their food waste now and may do so in the future under Act 148. These results suggest that most Vermonters are aware of Act 148 and agree that food waste should be banned from the landfill. However, these results also suggest that the majority of Vermonters are also already implementing strategies that keep food waste out of the landfill, either through backyard composting (72%), garbage disposal (22%), drop-off stations (19%), or existing curbside pickup programs (11%). Less than half (43%) of respondents suggested that they currently throw their food waste in the garbage. This data also demonstrates that the majority of respondents are most likely to continue using their existing strategies into the future under Act 148, with the notable exception that those currently using garbage to dispose of food waste are more likely to utilize alternative strategies in the future.

For businesses in waste management that will be required to offer curbside compost pickup this data suggests that nearly 40% of respondents would be unlikely to use a curbside pickup program at all. Further, only about 12% of respondents were willing to pay more than $10 per month, which may be challenging to achieve if there is low participation. The households that are most likely to use a curbside compost pickup program in the future include:

- Urban counties
- Households already using a curbside compost pickup program (which, likely doesn't represent new business)
- Households already using garbage service (which may provide insight into existing routes)
- Younger Vermonters
- Households that rent

12%

the number of respondents willing to pay more than $10 a month for curbside food waste compost pickup

4.2 Policy Implications

These findings also offer data to the policy process. First, while the majority of Vermonters are aware of Act 148, older Vermonters and renters are less likely to be aware of the new law. This suggests that education efforts via landlords may be important to assist rental households with compliance. Importantly, renters are also more likely to want to use a curbside compost pickup program, but, as previous efforts for implementing recycling practices in multi-family or rental units has demonstrated (Cascadia 2012), it can be complex and challenging for quality participation. Such challenges may be further confounded by a lack of knowledge of the law. Second, these results indicate that Vermonters are

already making great strides to keep food waste out of landfills, a primary goal of Act 148. Many households are already managing their food waste to minimize its inclusion in the landfill. This is especially true in rural areas, where backyard composting is common. These results indicate that demand for a curbside food waste program may be limited in many regions of the state, where households already manage their food waste without throwing it in the garbage. Additional research may be necessary to explore the feasibility and cost-benefit of statewide curbside food waste pickup in regions where such services may not be utilized, and could present unintended economic or environmental impacts on rural communities. However, these results also suggest there may be great need and opportunity for educational programs about backyard composting, since many Vermonters are either already engaging in this process today or may be in the future. Outreach and education throughout the state, especially in more rural regions, could be a useful component of future work. Many existing programs could provide assistance in this context, such as The University of Vermont's Plant and Soil Science Department course on Compost Ecology and Management, which follows the recommendations of the US Composting Council, or University of Vermont Extension's Master's Composter program.

"THESE RESULTS SUGGEST THERE MAY BE A GREAT NEED AND OPPORTUNITY FOR EDUCATIONAL PROGRAMS ABOUT BACKYARD COMPOSTING"

4.3 Implications beyond Vermont

Vermont is the first state in the country to implement a food waste policy that bans food from landfills. However, food waste policies at large are becoming more common across multiple scales. As well, fee-based food waste collection programs where residents voluntarily pay for their food scraps to be composted, are also growing in popularity throughout many urban and peri-urban regions. As such efforts continue to grow, understanding the human behavior components of food waste and sustainable materials management is an important focus of research. These results suggest that there may be important geographic and cultural context that influence the scale and relevancy of certain policy approaches to food waste management. For example, at least based on these results, rural regions may be more likely to manage their food waste through their own composting efforts, which may minimize interest or willingness to pay for a curbside compost pickup program. Conversely, this research also confirms that where current programs exist- largely in urban and peri-urban areas- that there is demand and interest in curbside pickup programs, and that these households are also most likely to report a willingness to pay for this additional service. This can provide useful insight for both policymakers and waste management companies as they continue to make strides to improve waste management systems.

Acknowledgements

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