

## THE WASTE DIVERSION POTENTIAL OF BACKYARD COMPOSTING

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### ABSTRACT

The amount of waste diverted from curbside pick-up through home composting was determined for a sample population in the Regional Municipality of Hamilton-Wentworth, Ontario. Over the study period, 1,322 grams per household per day of organic waste was transferred to a manufactured home composting unit. Of this, 523 g/h/d was kitchen waste, 244 g/h/d grass waste, and 555 g/h/d yard waste. Previous composters transfer more kitchen and yard waste than do new composters. An estimate of the annual amount of waste diverted from municipal curbside pick-up to the composter can be derived from these data. By allowing for seasonal changes in the waste stream and the different proportions of previous and new composters, the annual household diversion is calculated to be 219 kilograms. New composters divert 279 kg, previous composters 97 kg.

Estimates of the composition and generation of residential waste vary substantially. In addition, there is a paucity of data on the proportion of residential waste amenable to composting. While the Municipality of Metropolitan Toronto estimates that this fraction is equivalent to one-third of a kilogram per person per day [1], estimates of the amount of such waste being diverted from curbside pick-up to backyard compost bins or piles are less common. The derivation of this figure has important implications for waste reduction strategies and programs. Accordingly, the purpose of this article is to report on the amount of food and yard waste a backyard composter diverts from curbside pick-up in an empirical study undertaken in the Regional Municipality of Hamilton-Wentworth, Ontario.

The total population of 434,000 in this municipality in 1988 was comprised of 161,100 households. While the population is projected to increase some 12.5 percent by 2006, the number of households is projected to increase at an even higher rate, by 20.1 percent, to 193,500. At the same time, declining landfill capacity in the region has made waste reduction strategies increasingly necessary. Accordingly, in May 1990, the Municipality began the Hamilton-Wentworth Home Composting Program with the acquisition of 16,000 Soilsaver composters from Barclay Recycling Inc. A description of this composter is provided below. The combination of a provincial and municipal subsidy meant that the final cost of a Soilsaver composter to a participant was \$15.00.

Interest in the Program was high from the start with requests for composters exceeding the Municipal order. Within twenty-four weeks all composters had been distributed and a waiting list prepared for future deliveries.

## BACKGROUND

There are very few empirical studies of the waste diversion potential of home composting. While a recent literature survey on composting has been prepared by M. M. Dillon and Cal Recovery Systems Incorporated [2], and the composition of residential waste in various Ontario communities has been examined by Gore and Storie Limited [3], estimates of the amount by weight of waste being composted are scarce and frequently unreliable.

These estimates will not be discussed here. Suffice it to say that the rationale for home composting programs in Ontario rests on the assumption that backyard composting diverts 150 kilograms of waste per household per year from curbside pick-up [1]. This figure is less than an estimate derived by Compost Management Associates Ltd. [4], in which household attitudes towards composting and the waste diversion potential of three different types of composting units, including the Soilsaver, were evaluated in the town of Newcastle, Ontario. The three major components of the study were to undertake monthly attitude surveys, a telephone survey, and an empirical examination of daily weight and volume data on the amount of food and yard waste being composted by each household.

Since the sample size for each composting unit is small (approximately 20), statistically significant results cannot be demonstrated. However, the study does provide useful information on some important questions about home composting. The survey found that there were a number of common problems with the three composting units, including the following: lid insecurity, insufficient capacity, difficulty of use, odors, insects, and scavenging animals. It was also found that receipt of a composting unit caused a change in composting behavior, and that participants became more conscious of their waste diversion practices. The empirical part of the study concluded that the three composting units captured 28 kilograms per month of various organic wastes over the months of September to December 1989. Since yard wastes are higher at this time of year (Autumn), a

year-round average of 20 kilograms per month was arbitrarily considered to facilitate discussion of what householders might divert over an entire year. Given this estimate, the waste reduction potential of a composting household is 240 kilograms per year.

The study did not, however, indicate the proportion of previous composters to new composters. As Maclaren [5] has discovered in a study of Metropolitan Toronto's Home Composting Program, this has implications for estimating the net amount of waste being diverted by backyard composting because previous composters are already diverting a fraction of kitchen and yard waste. Her study involved a questionnaire survey of 734 participants in the Program, 80 percent of whom used the Soilsaver composter. Three different survey techniques were employed: personal interviews, mail questionnaires, and telephone follow-ups. Several important findings are particularly relevant. First, the problems with the three composting units, such as flies, odors, scavenging animals, poor fitting lids, insufficient capacity and some difficulties associated with winter composting, were found to be similar to those reported by Compost Management Associates Ltd. [4]. For most respondents, these problems were comparatively insignificant. Only 3 percent actually stopped composting because of them.

Second, Maclaren discovered that one-third of the participants had composted previously, and that in some instances the attitudes and behaviors of previous composters were statistically significantly different from those of new composters. For example, the primary reason previous composters want to compost is attributed to benefits for the garden. New composters, however, are more likely to cite waste reduction as their primary reason for composting.

It was found that previous composters tend to compost a significantly higher percentage of their garden wastes in the fall, spring and summer, and compost a higher percentage of their leaves in spring and summer. As well, over the course of the year previous composters composted about 10 percent more leaves and 14 percent more garden wastes than do new composters. New composters are more likely to rely on municipal yard waste collections than previous composters and a larger proportion of previous composters than new composters would continue home composting all of their food and yard wastes if a municipal collection program was provided. It is thus important to consider the two types of composters when assessing the waste diversion potential of a composting program.

## THE STUDY

The Hamilton-Wentworth study reported herein is divided into two parts: a questionnaire survey (which is only briefly referenced), and an empirical sort and weigh study. The survey is based on the names of the first 5000 applicants who received a Municipally sponsored Soilsaver composter. A systematic sampling procedure was adopted and every fifth name from the list of 5000 recipients was selected.

Of the ninety-one respondents, almost all indicated that they own their present dwelling, live in a single detached house, speak English in the home, and are using their Soilsaver composting unit. The overall level of education is high with more than half having a post-secondary education. Some 39 percent of households have annual incomes greater than \$53,000; 17 percent have annual incomes less than \$28,000. While some households had slight problems with insects, odors, insufficient composting capacity, insecure lids, and rodents, such problems rarely interfered with composting habits.

The results of the survey also indicate that more than a third of respondents (35%) are previous composters. The presence of a large group who have composted in the past raises a number of important questions beyond the scope of this study. For example, how serious is this group about composting? Do they use simple compost piles and compost a minimum of waste, or do they use bins and compost a significant fraction of waste? Do they compost kitchen waste, and if so, how much?

The empirical part of the study is based on the survey list. The objectives are threefold:

1. To determine how much kitchen and yard waste is transferred to the composter during the study period;
2. To estimate the amount of waste transferred to the composter on an annual basis; and
3. Given that previous composters already divert a fraction of kitchen and yard waste, to estimate the annual amount of waste *diverted* from Municipal curbside pick-up.

Of the ninety-one householders who responded to the questionnaire, sixty agreed to participate in the sort and weigh study during the period July 29 to November 3, 1990. Each household received the same make of kitchen and yard scales and separate pails for kitchen and yard wastes. Householders were asked to record the weight of kitchen waste, grass waste, and garden wastes when transferring the waste to the composter. Data sheets were provided to each household. The completed sheets were returned each week in stamped, addressed envelopes prepared for this purpose.

The Soilsaver Composter is a black plastic container which measures 71cm × 71cm × 79cm high when assembled. It sits on the ground and is covered by a lid which lifts off from the top. Food wastes, excluding meat and bones, and yard wastes are deposited in the Soilsaver by removing the lid. Aeration slats are built into the side of the composter allowing air to circulate. This is necessary for aerobic decomposition to occur. Compostable wastes should be watered periodically until the waste is as moist as a wrung-out sponge. The waste should be turned over from time to time with a pitchfork. The length of time it takes to produce finished compost varies with the nature of the wastes and with temperature and moisture conditions. Finished compost is removed from a trap door at the base of the container.

## RESULTS

### Amount of Waste Transferred to Backyard Composter during Study Period

Over the period in question, the total amount of organic waste transferred to the composter was 6,781.2 kilograms. This is equivalent to 1,322 grams per household per day (g/h/d). A further breakdown of the data is given in Table 1. In aggregate, householders transferred 523 g/h/d of kitchen waste, 244 g/h/d of grass waste, and 555 g/h/d of garden waste. Previous and new composters transfer similar amounts of grass waste to the composter. However, previous composters transfer 17 percent more kitchen waste and more than twice as much garden waste than new composters.

### Annual Amount of Waste Transferred to Backyard Composter

For the period in question, late summer and fall, the total amount of waste transferred to the composting unit is equal to 1,322 g/h/d. The *annual* amount of waste transferred to the composter can be determined by extrapolating the empirical data in Table 1. The extrapolations are given in the following three tables.

Table 1. Weight of Wastes from Empirical Study (July 29 to November 3)

|  | Previous Composters | New Composters | Total        |
|--|---------------------|----------------|--------------|
| Number of households                           | 20                  | 40             | 60           |
| Number of occupants                            | 64                  | 120            | 184          |
| Total weight of kitchen <sup>a</sup> waste (g) | 986,668.00          | 1,736,924.00   | 2,723,592.00 |
| Weight of kitchen waste/h/d (g)                | 578.77              | 495.70         | 523.39       |
| Rounded weight of kitchen waste/h/d (g)        | 579                 | 496            | 523          |
| Total weight of grass waste (g)                | 404,376.00          | 857,280.00     | 1,261,656.00 |
| Weight of grass waste/h/d (g)                  | 233.73              | 249.26         | 244.08       |
| Rounded weight of grass waste/h/d (g)          | 234                 | 249            | 244          |
| Total weight of garden <sup>b</sup> waste (g)  | 1,462,296.00        | 1,333,643.00   | 2,795,939.00 |
| Weight of garden waste/h/d (g)                 | 897.76              | 383.00         | 554.59       |
| Rounded weight of garden waste/h/d (g)         | 898                 | 383            | 555          |
| Total weight of waste (g)                      | 2,853,340.00        | 3,927,847.00   | 6,781,187.00 |
| Weight of waste/h/d (g)                        | 1,710.26            | 1,127.97       | 1,322.07     |
| Rounded weight of waste/h/d (g)                | 1,710               | 1,128          | 1,322        |

<sup>a</sup> Kitchen wastes do not include meat and bones or dairy products.

<sup>b</sup> Garden wastes may include branches, twigs, leaves, trimmings, and fruit and vegetable remains grown in the garden.

Table 2. Estimate of Annual Kitchen Waste Transferred to Composter

|  | Number of Days                  |                       |                                  |                                  |                |
|--|---------------------------------|-----------------------|----------------------------------|----------------------------------|----------------|
|  | November to<br>March<br>(= 151) | April & May<br>(= 61) | June, July<br>& August<br>(= 92) | September &<br>October<br>(= 61) |                |
| <b>Previous Composters</b>   |                                 |                       |                                  |                                  |                |
|  | 151 x 579                       | 61 x 579              | 92 x 579                         | 61 x 579                         |                |
|  | = 87,429.00                     | = 35,319.00           |                                  |                                  |                |
|  | -10%                            | -10%                  |                                  |                                  |                |
|  | = 78,686.10                     | = 31,787.10           | = 53,268.00                      | = 35,319.00                      | = 199,060.20   |
|  |                                 |                       | Annual Total                     | 199,060.20/365                   | = 545.37 g/h/d |
| <b>New Composters</b>  |                                 |                       |                                  |                                  |                |
|  | 151 x 496                       | 61 x 496              | 92 x 496                         | 61 x 496                         |                |
|  | = 74,896.00                     | = 30,256.00           |                                  |                                  |                |
|  | -10%                            | -10%                  |                                  |                                  |                |
|  | = 67,406.40                     | = 27,230.40           | = 45,632.00                      | = 30,256                         | = 170,524.80   |
|  |                                 |                       | Annual Total                     | 170,524.80/365                   | = 467.19 g/h/d |
| Previous composters = 33% of households: 545.37 x 33% = 179.97                   |                                 |                       |                                  |                                  |                |
| New composters = 67% of households: 467.19 x 67% = <u>313.02</u>                 |                                 |                       |                                  |                                  |                |
| Estimated annual transfer of kitchen waste/h/d for all composters = 492.99 g/h/d |                                 |                       |                                  |                                  |                |

The annual amount of kitchen waste transferred to the composter is calculated in Table 2. As noted elsewhere, a distinction is drawn between previous and new composters. (The twenty previous composters represent 33 percent of the sample population of households collecting data; the forty new composters 67 percent.) To ensure that the calculations are reasonably conservative, and in the absence of substantive information on winter composting, the assumption is made that less fresh fruit and vegetables are consumed in winter. A decrease of 10 percent in the amount composted is arbitrarily suggested. The average annual transfer of kitchen waste is thus 493 g/h/d. Previous composters transfer 545 g/h/d, or 16 percent more kitchen waste than new composters at 467 g/h/d. Calculations of the annual amount of grass waste transferred to the composter are given in Table 3. It is assumed that grass is regularly cut over a five-month period from June to October. Accordingly, the average annual transfer rate of grass waste is 102 g/h/d. Previous and new composters transfer 98 g/h/d and 104 g/h/d, respectively. The annual amount of garden waste transferred to the composter is calculated in Table 4. The assumption is made that garden wastes are not placed in the composter during winter months. The annual amount of garden waste transferred to the composter is thus 279 g/h/d. Previous composters transfer 453 g/h/d, over twice the amount of

Table 3. Estimate of Annual Grass Waste Transferred to Composter

|  | Number of Days                  |                       |                                  |                                  |                |
|--|---------------------------------|-----------------------|----------------------------------|----------------------------------|----------------|
|  | November to<br>March<br>(= 151) | April & May<br>(= 61) | June, July<br>& August<br>(= 92) | September &<br>October<br>(= 61) | (= 365)        |
| Previous Composters                                    | 0                               | 0                     | 92 x 234<br>= 21,528.00          | 61 x 234<br>= 14,274.00          | = 35,802.00    |
|  |                                 |                       | Annual Total                     | 35,802.00/365                    | = 98.09 g/h/d  |
| New Composters   | 0                               | 0                     | 92 x 249<br>= 22,908.00          | 61 x 249<br>= 15,189.00          | = 38,097.00    |
|  |                                 |                       | Annual Total                     | 38,097.00/365                    | = 104.38 g/h/d |
| Previous composters = 33% of households:               |                                 |                       |                                  | 98.09 x 33%                      | = 32.37        |
| New composters = 67% of households:                    |                                 |                       |                                  | 104.38 x 67%                     | = <u>69.93</u> |
| Estimated annual grass waste/h/d for all<br>composters |                                 |                       |                                  |                                  | = 102.30 g/h/d |

Table 4. Estimate of Annual Garden Waste Transferred to Composter

|   | Number of Days                  |                                      |                                  |                                  |                 |
|---|---------------------------------|--------------------------------------|----------------------------------|----------------------------------|-----------------|
|   | November to<br>March<br>(= 151) | April & May<br>(= 61)                | June, July<br>& August<br>(= 92) | September &<br>October<br>(= 61) | (= 365)         |
| Previous Composters                                     | 0                               | 31 <sup>a</sup> x 898<br>= 27,838.00 | 92 x 898<br>= 82,616.00          | 61 x 898<br>= 54,778.00          | = 165,232.00    |
|   |                                 |                                      | Annual Total                     | 165,232.00/365                   | = 452.69 g/h/d  |
| New Composters  | 0                               | 31 <sup>a</sup> x 383<br>= 11,873.00 | 92 x 383<br>= 35,236.00          | 61 x 383<br>= 23,363.00          | = 70,472.00     |
|   |                                 |                                      | Annual Total                     | 70,472.00/365                    | = 193.07 g/h/d  |
| Previous composters = 33% of households:                |                                 |                                      |                                  | 452.69 x 33%                     | = 149.39        |
| New composters = 67% of households:                     |                                 |                                      |                                  | 193.07 x 67%                     | = <u>129.36</u> |
| Estimated annual garden waste/h/d for all<br>composters |                                 |                                      |                                  |                                  | = 278.75 g/h/d  |

<sup>a</sup> May only.

Table 5. Estimate of Annual Waste Transferred to Composter

|                             | Previous Composters | New Composters | Total         |
|-----------------------------|---------------------|----------------|---------------|
| Weight of kitchen waste/h/d | 545.37              | 467.19         | 492.99        |
| Weight of grass waste/h/d   | 98.09               | 104.38         | 102.30        |
| Weight of garden waste/h/d  | <u>452.69</u>       | <u>193.07</u>  | <u>278.75</u> |
| Total Annual Waste/h/d      | <u>1,096.15</u>     | <u>764.64</u>  | <u>874.04</u> |

new composters at 193 g/h/d. Given the calculations in the preceding three tables, the total annual amount of waste transferred to the composter, summarized in Table 5, is estimated to be 874 g/h/d. Some important differences exist between previous and new composters. While new composters transfer 765 g/h/d (or approximately  $\frac{3}{4}$  kg/h/d), previous composters transfer 1,096 g/h/d (approximately 1.1 kg/h/d). This can be attributed to the fact that previous composters place more than twice the amount of garden waste in their composters than new composters.

### Annual Amount of Waste Diverted from Municipal Curbside Pick-Up

The amount of waste which new composters transfer to the backyard composter is, by definition, the amount which is diverted from curbside pick-up for subsequent disposal by the municipality. The same is not true of previous composters. Since part of their waste stream is already composted it cannot be included in the amount diverted from landfill. It is thus necessary to determine whether previous composters compost more or less waste given the presence of a manufactured composting unit, such as the Soilsaver.

Ideally, this would involve an empirical study of the amount of waste previous composters transfer to their compost pile in the absence of a manufactured unit. Since this information is not available in the present study, an estimate was derived by consulting fifteen of the twenty previous composters. Estimates of the daily amount of waste diverted from curbside pick-up on an annual basis can be found in Table 6. Each previous composter was asked if the Soilsaver made a difference in the amount they composted. The responses varied depending on the waste stream considered. While five householders did not believe that the Soilsaver affected the amount of kitchen waste composted, ten reported that they were composting more kitchen waste than before. The estimates vary considerably but amount to a 42 percent increase over the amount previously composted.

As regards grass waste, four householders stated that since they received the composter the amount they composted had increased by 11 percent on average. Most householders, however, leave their cut grass as mulch. Six of the fifteen

Table 6. Daily Estimate of Wastes Diverted from Curbside Pick-Up

|  | Empirical Study      | Estimate of Annual Transfer | Estimated Increase Over Amount Previously Composted | Amount Previously Composted | (Difference) Increase in Amount Composted |
|--|----------------------|-----------------------------|---|-----------------------------|---|
| <b>Kitchen Waste</b>                     |                      |                             |   |                             |   |
| Previous composters                      | 579                  | 545                         | 42%   | 383.80                      | 161.20                                    |
| New composters                           | 496                  | 467                         | N/A   | -                           | -   |
| Average                                  | 523                  | 493                         | N/A   | -                           | -   |
|  | Previous Composters  |                             | 161.2 x 33% =                                       | 53.2                        |   |
|  | New Composters       |                             | 467.0 x 67% =                                       | <u>312.9</u>                |   |
|  | Annual Daily Average |                             |   | <u>366.1</u>                |   |
| <b>Grass Waste</b>                       |                      |                             |   |                             |   |
| Previous composters                      | 234                  | 98                          | 11%   | 88.29                       | 9.71                                      |
| New composters                           | 249                  | 104                         | N/A   | -                           | -   |
| Average                                  | 244                  | 102                         | N/A   | -                           | -   |
|  | Previous Composters  |                             | 9.7 x 33% =   | 3.2                         |   |
|  | New Composters       |                             | 104.0 x 67% =                                       | <u>69.7</u>                 |   |
|  | Annual Daily Average |                             |   | <u>72.9</u>                 |   |
| <b>Garden Waste</b>                      |                      |                             |   |                             |   |
| Previous composters                      | 898                  | 453                         | 27%   | 356.69                      | 96.31                                     |
| New composters                           | 383                  | 193                         | N/A   | -                           | -   |
| Average                                  | 555                  | 279                         | N/A   | -                           | -   |
|  | Previous Composters  |                             | 96.3 x 33% =  | 31.8                        |   |
|  | New Composters       |                             | 193.0 x 67% =                                       | <u>129.3</u>                |   |
|  | Annual Daily Average |                             |   | <u>161.1</u>                |   |
| <b>Total</b>                             |                      |                             |   |                             |   |
| Previous composters                      | 1,710                | 1,096                       | -   | 828.78                      | 267.22                                    |
| New composters                           | 1,128                | 765                         | N/A   | -                           | -   |
| Average                                  | 1,322                | 874                         | N/A   | -                           | -   |
| Previous composters = 33% of Households: |                      |                             | 267 x 33% =   | 88.11                       |   |
| New composters = 67% of Households:      |                      |                             | 765 x 67% =   | <u>512.55</u>               |   |
|  |                      |                             |   | <u>600.66 g/h/d</u>         |   |

previous composters did not compost more garden waste as a result of the composter. The nine who reported increases said that they were now composting 10 to 90 percent more waste than before, an average increase of 27 percent.

Errors may arise in these perceptual estimates. Nevertheless, despite this shortcoming, the estimates are necessary for calculating the amounts composted before the composter was introduced to previous composters.

Accordingly, on an annual basis the daily amount of waste diverted from curbside pick-up is 600 g/h/d, of which 366 g/h/d is kitchen waste. New

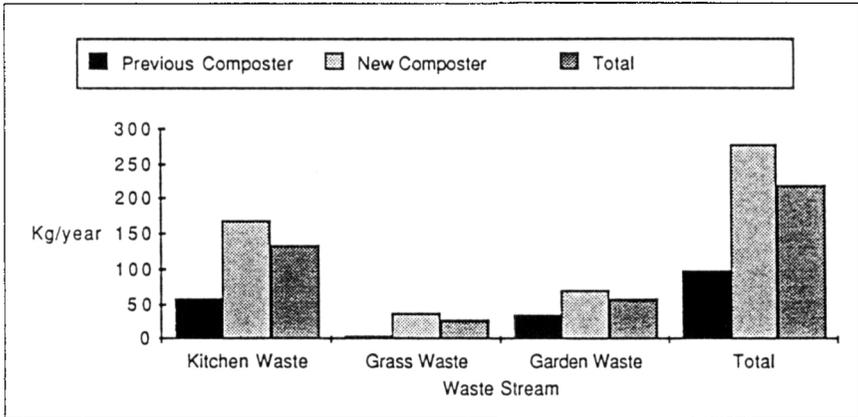


Figure 1. Estimate of annual amount of waste diverted from landfill with use of backyard composter.

composters divert a total of 765 g/h/d (approximately  $\frac{3}{4}$  kg/h/d); previous composters divert 267 g/h/d (more than  $\frac{1}{4}$  kg/h/d). This is equivalent to an annual rate of diversion of 219 kilograms per household (Figure 1). New composters divert 279 kilograms, previous composters 97 kilograms.

## SUMMARY AND IMPLICATIONS

In the Regional Municipality of Hamilton-Wentworth, the annual amount of residential waste diverted from curbside pick-up which can be attributed to use of backyard composters is approximately 219 kilograms per household (of which 134 kilograms is kitchen waste). This is less than the estimate of 240 kilograms reported elsewhere, but considerably more than the 150 kilograms noted by the Regional Municipality of Metropolitan Toronto as the rationale for creating a home composting program. Assuming that householders find the compost satisfactory on a yearly basis, backyard composting is thus an effective way of diverting waste from landfill.

## REFERENCES

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