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Differences in waste generation, waste composition, and source separation across three waste districts in a New York suburb

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ABSTRACT

Six tonnes of discards and recyclables from three waste districts in a New York suburb were sorted in 2012. The districts were chosen because one had a higher recycling percentage, one had median performance, and one was a low performing district. ASTM standards were followed for the waste composition sorting. The results showed, as expected, that the waste district with the highest recycling rate appeared to have the highest separation efficiencies, leading to greater amounts of recyclable materials being source separated. The waste districts also had different overall waste generation, both in terms of the amounts of wastes generated, and their composition. The better recycling district generated less waste, but had a higher percentage of recyclables in the waste stream. Therefore, in some sense, its waste stream was enriched in recyclables. Thus, although the residents of that district recovered materials at a higher rate, they also left large amounts of recyclables in their discards – as did the residents of the other districts. In fact, the districts only recycled between one quarter and less than half of all available recyclables, so that their discards were comprised of up to one third recyclable materials. This level of performance does not appear to be unique to this Town; therefore, we believe that additional recovery efforts through post-collection sorting for recyclables may be warranted.

1. Introduction

US national recycling rates have been relatively flat since the turn of the century (28.5% recycling in 2000, 34.7% recycling in 2011) (USEPA, 2013). Recycling as used here is defined as the collection of material with the intention of using it to create new products; whether or not true recovery of the collected materials is achieved is not part of the measurement.

Recycling performance has been found to relate to three classes of recycling attributes: program characteristics; target population socio-demographic characteristics; and target population psychological characteristics. So, Pay-As-You-Throw (PAYT) programs have higher recycling rates to minimize participant disposal costs (Dahlen and Lagerkvist, 2010; Skumatz, 2008; Folz and Giles, 2002; Linderhof et al., 2001; Salkie et al., 2001; Callen and Thomas, 1999; Miranda and Aldy, 1998), mandatory recycling programs have greater participation rates than voluntary programs (Viscusi et al., 2012; Nixon and Saphores, 2009; Ferrara and Missios, 2005), curbside collection has better performance than drop-off programs (Best, 2009; Ebreo and Vining, 2000) and public outreach increases recycling (Sidique et al., 2010; Nixon and Saphores, 2009; Callen and Thomas, 1999; Fransson and Gärling, 1999; Read, 1999; Scott, 1999; Daneshvary et al., 1998). Factors such as differences in age (Sidique et al., 2010; Diamantopoulos et al., 2003; Scott, 1999), income (Jones et al., 2010; Ferrara and Missios, 2005; Berger, 1997), education (Nixon and Saphores, 2009; Jenkins et al., 2003), socio-economic status (Mukherjee and Onel, 2012), home-ownership (Oskamp, 1995), political ideology (Fransson and Gärling, 1999), race (Johnson et al., 2004), household size (Lebersorger and Beigl, 2011), and employment (Bach et al., 2004) have been shown to affect recycling rates, although the strength or direction of the trends may not be consistent (for instance, opposite findings regarding age as a predictor by Stern and Dietz, 1994 and Scott, 1999). Also, note that most of those papers tracked participation rates not separation rates. Attitudes that have been related to environmentally conscious activity and behaviors, and recycling participation, include: concern for the community (Vincente and Reis, 2008; Tonglet et al., 2004); convenience and effort (Barr and Gilg, 2005; Peretz et al., 2005; Sterner and Bartlings, 1999); positions regarding morality (Berglund, 2006), the environment

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generally (Best and Kneip, 2011), and government (Guerin et al., 2001); social norms (Halvorsen, 2008) and social interactions (Shaw, 2008); and, personality and past experience (Ajzen and Fishbein, 1977). One explanation for psychological linkages to recycling participation is that highly visible curbside recyclables collection programs increase social pressure (Vining and Ebreo, 1992).

Recycling performance is commonly measured in one of two ways. In survey-based studies, one common measure is based on self-reports of the recycling frequency (i.e., the number of events utilized by the participants for recycling as a function of the number of recycling events available to them). These "participation rates" can also be measured by counting the number of households setting out recyclables. Other studies measure the material or percent of material recycled. It is assumed that increased participation rates result in greater diversion rates, but there are no studies that document this. Therefore, most general recycling assessments (USEPA, 2013; Greene et al., 2011; NYSDEC, 2010; Johnstone and LaBonne, 2004) focus on recycling rates as reasonable means to compare recycling performance.

The composition of solid waste is different from nation to nation (Hoornweg and Bhada-Tata, 2013), has been said to vary across the US as a whole (USEPA, 2013; OTA, 1989), and has been documented to be different from state-to-state (Staley and Barlaz, 2009) and for communities across the rural-suburban-urban spectrum in one state (DSM Environmental Services Inc. and MSW Consultants 2013; NYSDEC, 2010). Because waste streams vary, ability and success at recycling may be at least partially dependent on the amount of recyclables that are available to recycle – the composition of the generated waste stream. Comparisons of recycling performance across varying programmatic, demographic, and psychological groupings appear to assume there is similar waste stream composition, and that differences in effort at recycling will therefore equate to differences in recycling performance. This assumption appears to be shared by those who link participation rates directly to recycling performance. Although recycling rates may very well vary due to programmatic, demographic, and psychological differences, the effects could be masked or accentuated by differences in the availability of materials to recycle.

Determining the composition of pre-source separation solid waste turns out to be more difficult, and undertaken fewer times, than might be supposed. USEPA uses its Franklin Associates model to determine waste composition for the nation as a whole before any management of those wastes is accomplished (USEPA, 2013). The accuracy of this methodology has been questioned (Tonjes and Greene, 2012). There are many site, locality, and state level waste composition studies, made by sorting collected wastes in a formalized fashion. ASTM (2006) has issued widely followed guidance for this. We have collected 107 examples of local and state waste composition studies. All begin with discarded wastes. We are not aware of any studies, save one (RW Beck, 2005), that also included collected recyclables, and attempted to relate recycling and waste discard rates to subsets of the studied region. The sprawling RW Beck report to New York City Department of Sanitation never directly linked particular subset area waste generation with recycling, partly because there were mismatches between routes for waste collection and routes for recycling.

We report here on a waste composition study for the Town of Brookhaven, conducted with an eye on multiple objectives. We sought to quantify the capture rate for particular recyclable materials, and to relate those capture rates to three different levels of recycling performance in the Town. We sought to determine the composition of discards and recyclables for the three districts. We also sought to create a composite waste composition for each district, and to determine if there were meaningful differences in the overall waste compositions in the three districts, and if those differences related to any differences in recycling.

2. Materials and methods

2.1. Study location

The Town of Brookhaven (Long Island, New York) is located approximately 75 km east of Manhattan Island, New York City (Fig. 1).

The Town created a residential waste collection program in 1988. Mandatory curbside recycling was added in 1989. Separate collection of leaves and brush and a ban on grass clippings collection was instituted in 2002. Recycling switched from alternate week dual stream collection to single stream collection in 2014. Residents pay a fixed fee per household serviced, which is collected through property tax bills. Approximately 115,000 single, two, and three family housing are provided service. Multi-family, condominiums and cooperatives and other areas with private streets, and the nine incorporated villages in the Town are not included in the collection program.

Town government administers the program, but the physical collection of wastes is accomplished by contracted private companies. There are 35 geographically distinct districts in the Town waste collection program.

2.1.1. Waste districts

We selected three districts that delivered discarded wastes to the Town Transfer Station on the Monday/Thursday collection cycle: District 1, District 18, and District 31. District 1 had the greatest curbside separation percentage of all 35 districts in 2011, District 18 ranked 15 (of 35), and District 31 ranked 33. Curbside separation rates were defined as the sum of paper and container recyclables divided by the sum of the collected recyclables plus collected discards. District 1 is smaller than the other two districts, contains a smaller percentage of minority residents, and its residents tend to be wealthier, and better educated (Table 1). Town waste administrators believed that the three carting companies for these districts have better than usual compliance with various collection rules, such as avoiding using the same truck to collect from two districts on the same day (doing this would confuse our analysis).

2.2. Waste sorts

2.2.1. General procedures

We assumed that the waste composition data would be normally distributed, and used ASTM (2006) assumptions regarding waste composition, selecting "mixed paper" as our key component, as it required many fewer samples than all other components under the guidelines. The ASTM algorithm for samples, with an allowable error of 10%, produced a value of 17 samples needed per district. We collected 18 discard samples per district, and five container samples from each district.

All discard samples were processed on Mondays and Thursdays in a paved, open area near the transfer station at the Town Waste management Facility. The first truck generally arrived by 10 am. All waste from the three samples was processed by 4 pm. No rain occurred on any of the 18 sampling days. Some materials were lost to wind and scavenging gulls, but the impact was minimal.

All recyclable samples were processed within the on-site Materials Recycling Facility (MRF) on Wednesdays. Only container loads were sampled, so at most two samples were processed each day. The first sample generally arrived after 10 am, and all materials were processed by 3 pm.