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Toward zero waste: Composting and recycling for sustainable venue based events

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ABSTRACT

This study evaluated seven different waste management strategies for venue-based events and characterized the impacts of event waste management via waste audits and the Waste Reduction Model (WARM). The seven waste management scenarios included traditional waste handling methods (e.g. recycle and landfill) and management of the waste stream via composting, including purchasing where only compostable food service items were used during the events.

Waste audits were conducted at four Arizona State University (ASU) baseball games, including a three game series. The findings demonstrate a tradeoff among CO_2 equivalent emissions, energy use, and landfill diversion rates. Of the seven waste management scenarios assessed, the recycling scenarios provide the greatest reductions in CO_2 eq. emissions and energy use because of the retention of high value materials but are compounded by the difficulty in managing a two or three bin collection system. The compost only scenario achieves complete landfill diversion but does not perform as well with respect to CO_2 eq. emissions or energy.

The three game series was used to test the impact of staffed bins on contamination rates; the first game served as a baseline, the second game employed staffed bins, and the third game had non staffed bins to determine the effect of staffing on contamination rates. Contamination rates in both the recycling and compost bins were tracked throughout the series. Contamination rates were reduced from 34% in the first game to 11% on the second night (with the staffed bins) and 23% contamination rates at the third game.

1. Introduction

Venue-based events are a major part of Americans' lifestyles and often include food and drink services which generate a significant amount of waste. There were over 125 million people who attended NBA, NHL, MLB, and NFL games in the 2013 seasons (ESPN, 2014a,2014b,2014c,2014d) while domestic movie theater attendance exceeded 1.3 billion in 2013 (Nash Information Services LLC, 2014). These figures do not include non-professional sporting events, festivals, fairs, concerts, and other theaters all of which are venue-based events. The food and drink services provided by all of these venues represent a large amount of disposable products which must enter the waste stream. As institutions shift toward more environmentally friendly operations and aim for zero waste facilities, compostable products and alternative material pathways like composting and recycling become more attractive. These options can complicate decision making as facility managers must consider factors including source material selection, employee training, public awareness, simplicity of collection, and environmental tradeoffs for different approaches to waste management.

Sporting events and other venue based activities have increasingly become a focus for environmental improvement through sustainability initiatives. The environmental assessment of major sporting events, such as the Olympics and international championships, has become an important factor in determining where and how these events are hosted (Collins and Flynn, 2008; Collins et al., 2009). Sustainability efforts at sporting events in North America have been spearheaded by the Natural Resources Defense Council (NRDC) and the Green Sports Alliance who view waste management as one of the key areas of focus for improvement of

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environmental performance (Hershkowitz et al., 2012). Waste management has also been highlighted as a major operational focus for event managers looking to incorporate more sustainable practices. Not only can managers ensure the impacts of events are lessened but that "the event itself can be used to promote a green message" (Laing and Frost, 2010). This suggests that events may serve as a model of public waste disposal in the same way that behavioral models function, altering the way people behave collectively. Similar efforts aimed at waste reduction have been evaluated for airports and air travel, which is functionally similar to venue based events because of the captive audience and the control over what types of materials enter the waste stream (Coggins, 1994; Li et al., 2003; Pitt and Smith, 2003).

This research seeks to address public waste generation at venue based events through a two-pronged approach, (1) evaluate total waste generation from venues to model alterative handling scenarios and (2) evaluate different methods to reduce contamination in recycling and compost. Modeling was conducted using USEPA's Waste Reduction Model (WARM), which is designed to assess greenhouse gas emissions and energy impacts related to material types and waste management practices (USEPA, 2013b). WARM was developed to help waste planners model impacts by selecting material inputs and providing model parameters which include transportation distances and landfill conditions (e.g. methane capture efficiency and landfill moisture content). WARM enables scenario development to create comparisons between differing approaches to waste treatment and the subsequent impacts.

The two-pronged approach focuses on the evaluation of waste scenarios that incorporate more compostable products and the public's ability to adjust to new methods of collection through a case study at Arizona State University's (ASU) Packard Stadium at the Tempe, Arizona campus where collegiate baseball games are played. ASU's goal is to become a "zero waste institution" producing no landfill wastes, which corresponds to a larger regional effort by the City of Phoenix to achieve a 40% reduction in landfill wastes by the year 2020 (ASU, 2014; Phoenix, 2013; Reid, 2013).

Waste handling is an actively changing system with the introduction of new types of waste and new approaches to waste management that can alter impacts on a broad scale. Biodegradable and compostable plastics that meet the ASTM and ISO standards (ASTM, 2003a,2003b,2004; ISO), such as polylactic acid (PLA), may prove to be useful in reducing landfill wastes but the composting for these materials needs to happen at an industrial facility. The requirements for the degradation of these products requires sustained temperatures and biological activity that are difficult to reproduce in home composting systems (Song et al., 2009). Additionally, PLA, the most common compostable biopolymer in the US, can be recycled but the current quantity and flow of the material is not significant enough to be financially competitive with landfill disposal (Song et al., 2009). Cradle-to-gate life cycle environmental impacts of biopolymers are similar to traditional petroleum based plastics; however, end of life has not been well studied. The few life cycle assessments of biopolymers which include waste management, use generic scenarios based on traditional plastics, with even fewer assessments including composting as an option despite the fact that recycling is not viable and composting as a waste management option is one of the main benefits of these products (Hottle et al., 2013). Disposal is a key area of inquiry as it is a large source of uncertainty and is largely unexplored for these products.

Consumer involvement in waste systems dictates how materials enter the different waste streams. This is true for residential and commercial waste handling and public collection. The social components of waste management are complex, including factors like convenience, perceived efficacy, consumer awareness, outreach, and participation; ultimately resulting in patterns of consumer behavior. Behavior change is a central factor, necessary for shifting to more sustainable waste management but there is a lack of research with regards to behavior change interventions (Zhang et al., 2011). Sussman and Gifford (2013) and Sussman et al. (2013) found that prompts, such as signage, and people modeling how to sort compost in public settings have a significant influence on the behavior of the people around them. Additionally, they found that the positive behavior changes persisted even after the behavior models were removed from the research setting. These studies, which have investigated behavior, inform the development of new waste collection strategies in public venues and highlight the benefits of an approach that incorporates techniques to encourage positive behavior change through social dynamics and traditional outreach.

2. Methods

The methods are divided into three specific areas that were integral to this research. The first section, raw data collection, describes the process of conducting the waste audits including weighing, sorting, and determining the mix of materials in the waste stream. The second section, modeling and scenario analysis, describes the parameters used for the WARM tool and the seven scenarios that were modeled for the assessment. The final section, waste disposal behavior at public events, describes the use of signage and volunteers to aid in material identification that were used throughout the four games so that behavioral factors could be assessed.

Through a partnership with ASU Athletics and University Sustainability Practices (USP) waste audits were conducted at four university baseball games. Events like the ASU baseball games provide an opportunity to run large experiments with reasonable control since most of the waste materials being handled are generated within the game and are limited to products that vendors offer. This research tracked the efficacy for different methods of waste collection that have been implemented at the games as well as determining the quantity and composition of the waste. ASU's Packard Stadium has over 3000 grandstand seats and can accommodate over 7800 attendees, with an average attendance of 2809 per game in 2013 (Cutler, 2013).

As a part of ASU's zero waste effort, Packard Stadium has moved to a two bin collection system offering receptacles for composting and recycling only. The bins are colored to help distinguish the two material streams, blue for recycling and green for composting (Fig. 1). In addition to the bin color, ASU has attached signs to the front of each bin which labeled and described which materials belong in each bin. The composting signs listed food, liquid, napkins, plates & cups, and compostable spoons & forks. The recycling signs listed paper, plastic, aluminum, glass, and cardboard. Using EPA's WARM (USEPA, 2013b) this research explored the dynamics between different management scenarios, carbon emissions, and energy use.

Data collection occurred over a span of four baseball games at Packard Stadium, three of which were in a consecutive weekend series. Fig. 2 charts raw data collection and the subsequent analyses of this research which addresses two separate areas of inquiry: (1) Characterization of game-day wastes (quantification and categorization) and the assessment of different management scenarios using WARM and, (2) The public's ability to adjust to new methods of material collection at venue-based events.

2.1. Raw data collection

Materials from the compost and recycling bins were weighed for each of the four games. At the games, attendees were required