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Estimating solid waste generation by hospitality industry during major festivals: A quantification model based on multiple regression

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ABSTRACT

Major-religious festivals hosted in the city of Kerbala, Iraq, annually generate large quantities of Municipal Solid Waste (MSW) which negatively impacts the environment and human health when poorly managed. The hospitality sector, specifically hotels, is one of the major sources of MSW generated during these festivals. Because it is essential to establish a proper waste management system for such festivals, accurate information regarding MSW generation is required. This study therefore investigated the rate of production of MSW from hotels in Kerbala during major festivals. A field questionnaire survey was conducted with 150 hotels during the Arba'een festival, one of the largest festivals in the world, attended by about 18 million participants, to identify how much MSW is produced and what features of hotels impact on this. Hotel managers responded to questions regarding features of the hotel such as size (Hs), expenditure (Hex), area (Ha) and number of staff (Hst). An on-site audit was also carried out with all participating hotels to estimate the mass of MSW generated from these hotels.

The results indicate that MSW produced by hotels varies widely. In general, it was found that each hotel guest produces an estimated 0.89 kg of MSW per day. However, this figure varies according to the hotels' rating. Average rates of MSW production from one and four star hotels were 0.83 and 1.22 kg per guest per day, respectively. Statistically, it was found that the relationship between MSW production and hotel features can be modelled with an R^2 of 0.799, where the influence of hotel feature on MSW production followed the order Hs > Hex > Hst.

1. Introduction

Today, travel and tourism has grown to be one of the largest industries around the world. In 2015, international tourism numbers grew by 4.4% reaching a total of 1184 million travellers, accounting for around 10% of the world's Gross Domestic Product, one in every ten jobs and 7% of worldwide exports (WTO, 2016). With such expansion comes responsibility as tourism-related activities are blamed for being one of the leading sources of pollution globally, generating large amounts of Municipal Solid Waste (MSW) (Arbulu et al., 2015). This applies to large festivals and events, considered common tourist destinations in many countries, worldwide (Cierjacks et al., 2012). Religious tourism, where individuals of a particular belief travel to participate in events or festivals of spiritual importance, is one facet of travel and tourism. Every year, around 300 million individuals from around the world take part in religious festivals, according to the World Religious Tourism Association (WRTA, 2011).

To meet the demands of increasingly sophisticated tourists, the hospitality sector is expected to grow significantly in the next few years. For instance, Revenue Per Available Room is expected to increase by 2.3% in 2017 in the United States (Berman et al., 2017) and by more than 6.8% in several European cities in 2018 (Trunkfield and Mayer, 2017). Gulf Cooperation Council countries in the Middle East also expected to see an increase in their revenue in 2016 (MeetMiddleEast, 2013). This growth in hospitality industry operations results in increased quantities of MSW constituting a substantial increase in the environmental footprint and ecosystem damage. Municipal Solid Waste Generation (MSWG) is one of the most tangible impacts that hospitality establishments, including hotels, have on the environment (Bohdanowicz, 2006; Pirani and Arafat, 2014).

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The literature reports that in one night stay, 1 kg of MSW is produced by a typical hotel guest (Bohdanowicz, 2005; Losanwe, 2013). Previous work by Axler (1973) found that in general, guest rooms were responsible for around 0.91 kg of MSW per day, while around 0.45 kg of MSW was produced by both dining rooms and kitchens. In contrast, Earle and Townsend (1991) reported MSW generated per room, per day varied from 1.81 to 3.18 kg. The same study included reference to a MSW audit conducted in the Orlando area where MSW generation in guest rooms ranged from 0.23 to 12.93 kg per day. As a rule, there is wide variation between hotels when it comes to how much waste per room is produced on a daily basis. For instance, The Rezidor Hotel Group (2014) reported that Park Inn hotels produced 2.87, 1.77 and 0.76 kg/guest of unsorted MSW per night in the United Kingdom, France and Germany, respectively. Research has attributed this variation to a range of parameters including MSW management practice, hotel type and size, type of food, occupancy rate, guest and staff activities, guest attributes and purchasing practices (Snarr and Pezza, 2000; Bohdanowicz, 2005, 2006; Ball and Abou Taleb, 2010; WRAP, 2011; Pirani and Arafat, 2014; Pirani and Arafat, 2016). For instance, Ball and Abou Taleb (2010) studied MSWG rates from 24, five-star hotels in Cairo, Egypt, of various sizes and occupancy rates, over two months. Their results illustrated that there were strong relationships between both hotel size and occupancy rates with MSWG. Given there is a large fluctuation in the generation rate of MSW from hospitality sector, it is of interest to establish this in the Middle East, specifically during major festivals, to develop proper management systems.

To develop an integrated MSW management system, the literature agrees that a precise prediction of the quantity of MSW generated is required (Kumar et al., 2011; Intharathirat et al., 2015; Peeters et al., 2015; Azadi and Karimi-Jashni, 2016; Ghinea et al., 2016; Jiang and Liu, 2016). Inaccurate forecasting may result in difficulties such as negative impact on the environment, MSW treatment facilities which do not have the required capacity and inappropriate policies (Beigl et al., 2008; Intharathirat et al., 2015). Researchers have developed various modelling techniques of differing complexity, to predict the rate of MSW generation. These models have been used to investigate the influence of many explanatory variables related to economic conditions including, waste management measures, waste management policies, public habits, weather conditions and population growth (Edjabou et al., 2015; Fu et al., 2015; Intharathirat et al., 2015; Suthar and Singh, 2015; Azadi and Karimi-Jashni, 2016; Grazhdani, 2016). One of the most common approaches to forecasting MSWG is by considering varying trends in MSW production, over a long period, in the targeted area or event (Intharathirat et al., 2015). Unfortunately, such historical records in developing countries do not exist owing to improper management systems and inadequate funds (Intharathirat et al., 2015; Azadi and Karimi-Jashni, 2016). To tackle this problem therefore, new approaches need to be adopted where historical MSWG rates are not required (Azadi and Karimi-Jashni, 2016).

Various complex forecasting techniques have been proposed by researches to predict MSWG including Multiple Linear Regression (MLR) (Parisi Kern et al., 2015; Grazhdani, 2016), artificial neural networks (Azadi and Karimi-Jashni, 2016) and grey models (Intharathirat et al., 2015). Parisi Kern et al. (2015), for example, suggested an equation using MLR to determine the mass of waste generated in the construction phase of high-rise structures by examining the influence of building design and production systems, concluding that the suggested equation was useful for prediction purposes. Intharathirat et al. (2015) used a multivariate, grey modelling technique to predict the quantity of MSW production from residential and commercial sectors in Thailand, consequently suggesting that grey models can be used to forecast MSWG rates when a complete historical record is not available. Jahandideh et al. (2009) also used MLR to forecast the generation rate of medical MSW from 50 hospitals in Fars Province, Iran, their results also suggesting that MLR can be used to forecast the generation rate of medical waste from medical establishments. Among these previously mentioned models, MLR, which models the relationship between one or more Independent Variables (IVs) and a Dependent Variable (DV), is commonly applied to predict MSWG rates due to its simple algorithms and theory.

Based on the literature review above, there appears to be limited, if any, research analysing waste production from the hospitality sector during multi–million participants festivals, making this study the first. This research was carried out by conducting a comprehensive field survey of the hospitality sector during AL-Arba'een, one of the largest festivals in Iraq and worldwide. A prediction model was developed using the MLR technique that employs the collected data from the field survey to estimate the quantity of MSW produced from the hospitality sector. This research may be a platform for future studies concerning the development of MSWM systems for major festivals. It is also suggested that the results can be used by local authorities in order to develop integrated waste management systems.

2. Events and festivals tourism

Recently, there has been a surge in research in tourism related events and festivals (Getz, 2010). Although all planned events have the potential to be of interest to tourists, the literature focuses on four broad categories: business, entertainment, sport and festivals and other cultural celebrations (Getz and Page, 2016).

Business events such as exhibitions and conventions have received quite a lot of attention, as the majority of major cities hold a substantial number of these events (Boo et al., 2008). Topics such as constraints which influence exhibition attendance (Lee and Palakurthi, 2013), loyalty and satisfaction (Tanford et al., 2012), economic impact (Dwyer, 2002) and the impact on public sectors (Andersson and Samuelson, 2000) have already been examined. However, Mair (2012) has acknowledged the need for research focusing on the environmental impacts of business events.

Entertainment events including recorded music, film, museums and theme parks, have also been studied by various researchers around the world (Getz and Page, 2016). Easto and Truzzi (1973) surveyed the nature of various carnivals in the USA, estimating that they attract 85 million visitors every year. The motivation for music tourism in South Africa (Kruger and Saayman, 2012) and the environmental consequences of several music festivals in Germany (Cierjacks et al., 2012) have also been investigated.

A growing amount of research on sport events now exists in the literature (Getz and Page, 2016). Researchers have explored many sport tourism related topics such as motivation, satisfaction and behaviour (Prayag and Grivel, 2014), the relationship with urban development (Rozin, 2000) and their economic impact (Lee and Krohn, 2013). For instance, Kennelly and Toohey (2014) studied how the co-operation between sport tour operators and sport events' organizers could enhance the financial outcomes of sport tourism while Wicker and Hallmann (2013) investigated willingness to pay to travel to, and participate, in marathon events.

Festivals and cultural events have occupied an important place in tourism-related studies (Getz and Page, 2016). A comprehensive review, conducted by Getz (2010), identified several facets of festivals and cultural events including pilgrimage, celebrations and carnivals. Matheson et al. (2014) investigated the impact of spiritual attitudes on visitor attendance to the Beltane Fire Festival in Edinburgh, UK. Buzinde et al. (2014) investigated the experiences, activities and motivations of pilgrims on the Kumbh Mela pilgrimage, Allahabad, India. Giovanardi et al. (2014) investigated encounters between residents and visitors during the 'Pink Night'

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