



Food waste generation and potential interventions at Rhodes University, South Africa



Kathleen Painter^a, Gladman Thondhlana^{a,*}, Harn Wei Kua^b

^a Department of Environmental Science, Rhodes University, Grahamstown 6140, South Africa

^b Department of Building, School of Design and Environment, National University of Singapore, 4 Architecture Drive, S117566, Singapore

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ABSTRACT

Estimation of food waste generation represents the first step when considering efforts to reduce waste generation and monitor food waste reduction against set targets. This study reports on an estimation of food waste generated in university dining halls at Rhodes University, South Africa. Daily food waste generation was estimated at about 555 g per student or 2 tonnes across all sample dining halls, translating to about 450 tonnes per year. The results show that food waste is influenced by an array of contextual factors, including distance to dining hall, gender composition of hall and meal times and meal options. It is estimated that the university could save up to US\$ 80 000 annually for every 10% reduction in the current rate of food waste generation. Possible educational, technical and administrative interventions for food waste reduction are discussed.

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1. Introduction

In recent years, sustainability debates have focused on food waste as empirical evidence shows substantial levels of and the potential to minimise waste generation (FAO, 2011; Lebersorger and Schneider, 2011; Quested et al., 2013; Göbel et al., 2015). It is estimated that approximately one third (about 1.3 billion tonnes) of all food produced globally is wasted annually (FAO, 2011), translating to a cost of US\$ 750 billion (Parizeau et al., 2015). The social, economic and environmental implications associated with food waste are significant hence food waste has become a key topic on political and research agendas. From a social perspective, the implications of food waste relate to ensuring food security. While the food produced globally is enough to feed everyone, a lot of people remain largely food insecure (FAO, 2013; Stewart and Bell, 2015). From a moral perspective, it is ethically unacceptable to waste food that could otherwise be used to feed food insecure people (Nahman et al., 2012; Thyberg and Tonjes, 2016). Thus, in principle, reduction of food waste could reduce the number of food insecure people, though this may be harder to achieve than imagined due to inequitable and complex food systems. In economic terms, the costs associated with food waste management are phenomenal for governments, organisations and

consumers. For example, the costs of landfill planning and management are high, and often cash-strapped municipalities, especially in developing countries struggle with waste collection and proper disposal. In some cases, waste remains uncollected, which poses serious and costly health risks. With regards to the environment, the impacts associated with food waste include greenhouse gas emissions (FAO, 2013) and resource use inefficiency including land, water, energy and fuel used for food production (Nahman et al., 2012; Quested et al., 2013). Therefore, food waste means there is unnecessary resource consumption and wastage (e.g. land, water, labour and energy) used for food production (Munesue et al., 2015). Given this context, food waste intervention strategies are garnering more support than ever in both policy and academic debates (Thyberg and Tonjes, 2016).

Critical to promoting food waste reduction is understanding the quantities of waste and waste production patterns, yet there is still limited and comparative data on food waste quantities (Lebersorger and Schneider, 2011; Nahman et al., 2012), especially in the emerging 'BRIC' economies (Parfitt et al., 2010). Further, there are few studies on why food gets wasted yet such an understanding is needed for designing waste reduction measures that target specific behavioural elements (Parfitt et al., 2010; Grahams-Rowe et al., 2014). In particular, when compared to household level studies, comparatively little is known about food waste production in universities though dining hall facilities in these institutions represent a potentially significant source of food waste (Wilkie et al., 2015). According to Alshuwaikhat and

* Corresponding author.

E-mail addresses: g.thondhlana@ru.ac.za (G. Thondhlana), bdgkuahw@nus.edu.sg (H.W. Kua).

Abubakar (2008), universities can be seen as smaller versions of cities owing to their large population sizes, hence the financial and environmental implications of their activities are potentially substantial. For example, it is estimated that universities worldwide, produce around 540 million tonnes of food waste annually (Creighton, 1998), enough food to feed a sizeable number of hungry people. Therefore, any changes to foster sustainability practices may have positive outcomes on resource use efficiency and address environmental concerns (Thiagarajah and Getty, 2013; Munesue et al., 2015). Another potential opportunity is that universities have a community of practice of people with knowledge and expertise (Bailey et al., 2015); which could be used to change habits that are detrimental to the environment. Over and above the financial and environmental considerations, universities have a moral and ethical responsibility to ensure their actions act as living examples of pathways towards sustainability (Cortese, 1992; de Vega et al., 2008; Mtutu and Thondhlana, 2016), which can in turn be replicated in surrounding communities (Saphire, 1998; Wilkie et al., 2015).

Food waste interventions such as educational and technical ones, targeted at wasteful behaviours have been employed in different settings worldwide, including households and universities. Educational and awareness messages that highlight the positive impacts of one's actions related to food waste behaviour could yield positive outcomes. For example, the "Love food, hate waste" campaign launched in Great Britain in 2007 yielded moderate success (Lebersorger and Schneider, 2011; Quested et al., 2013). Whitehair et al. (2013) found that simple written messages reduced food waste by up to 14% in a university dining hall facility in the USA. According to Wilkie et al. (2015) educational campaigns can foster pro-environmental behaviour beyond the institutional borders, as learners could convey food waste reduction information to their parents, guardians or communities. From a technical perspective, simple changes to existing systems may also result in food waste reduction. For example, Thiagarajah and Getty (2013) found significant reductions in solid food waste when a tray food system was replaced by a trayless one in a university dining hall, as patrons made their food choices more carefully.

With respect to interventions, Thyberg and Tonjes (2016) argue that studies should focus on the drivers of food waste generation as this can provide insights into best policy strategies for dealing with food waste. Nozue et al. (2010) suggest that intervention measures should focus on gender as it shapes the amount of food consumed and in turn, the amount of waste generated. Nozue et al. (2010) show that male students generally consume more food (and are willing to take second helpings) hence produce less food waste than females. Similarly, Al-Domi et al. (2011) and Kuo and Shih (2016) found that female students wasted more food than males. Other factors such as distance to a dining hall facility, availability of meal options and perceived quality of food (Lam, 2010), have been found to either facilitate or constrain food waste but detailed analyses on how these factors affect food waste are still limited (Lebersorger and Schneider, 2011). Therefore, there is a need for more information on these drivers to allow comparisons and conclusions to be made.

In South African universities, as is the case internationally, plans are underway to grow the student body (MacGregor, 2012) and obviously universities need to expand support infrastructures such as halls of residences and dining hall facilities that are proportionate to the projected growth. According to MacGregor (2012), the South African government plans to raise university enrolment to about 1.5 million students by 2030 from the 2012 figure of about 900 000. The rapid expansion in student numbers will, in turn, result in increased consumption of food and the resources required to make it such as water and energy. Therefore, there is a need for thinking about pathways towards sustainable resource use. Inter-

vention strategies could improve resource use efficiency and minimise the environmental and operational costs incurred by institutions (Amutenya et al., 2009; Mtutu and Thondhlana, 2016). However, to the best of our knowledge, though many universities have waste management programmes, there is no reported data on neither food waste quantification nor potential interventions. Notwithstanding the variability in institutional and food cultures and residence systems across communities and nations, more authoritative data on the quantities of food waste generation may allow comparability (Wilkie et al., 2015).

Therefore, there is a need to estimate food waste quantities and get an understanding of where and how interventions for food waste reduction could be employed (Wilkie et al., 2015). More broadly, the information garnered could highlight the magnitude of the food waste problem in universities and potential benefits from food waste prevention and reduction. Within this context, the main aim of this study was to estimate food waste quantities generated in university dining hall facilities as a basis for identifying potential areas for promoting food waste reduction. Key questions included:

- What is the amount of food waste produced in dining halls?
- What factors explain variances in food waste production between dining halls?
- What are students' perceptions on causes of food waste.
- Based on the findings, what educational, technical and administrative food waste interventions could be adopted to encourage food waste reduction?

2. Materials and methods

2.1. Study area

The study took place at Rhodes University located in Grahamstown in the Eastern Cape province of South Africa. Rhodes University has approximately 7000 registered students, out of which 3445 live in the university's residences. Rhodes University's residence system comprises 42 residences each located around 9 dining halls. Halls of residence are made up of either male residences only, female residences only or a combination of both. Dining hall facilities range in distance from central campus - some are located closer to central campus whereas others are approximately 15 min walk away. Central campus consists of key support services for students such as the student bureau, lecture rooms, the main library, computer labs and a café; hence, it is used as a reference point.

Three meals per day; breakfast, lunch and dinner, are provided to resident students in the dining halls during term time. There are various diets available at each meal including vegetarian, African, Hindu/Halal, health, fast food and the default meal option. Students are supposed to book meals of their choice at least 48 h in advance using a computerised meal booking system to give the catering staff enough time to account for the amount of food and meal options they should prepare. To get a double portion of a standard meal, students can double book at an extra cost. Students may also unbook a meal at least 48 h in advance should they not want to take a meal for various reasons. Food trays are provided for all meals. At meal times, students get a food tray and go through a biometric recognition system (fingerprint scanning) to ascertain the meal option booked before getting their main meal. Food portion sizes are consistent for all students and are governed by the serving staff. At lunch and dinner times students have the option to take either two fruits only or two glasses of juice only or a combination of one fruit and one glass of juice. In addition, up to four slices of bread and various bread spreads and salads are provided to students at every lunch and dinner. Once in each semester (or twice a year), brunch, (a meal that combines breakfast

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