

Weighing Up The Costs: Food Waste Monitoring And Reduction in Scottish Hotels

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Submitted 10 June 2016, Accepted 21 June 2016, Published online 4 March 2017

Citation: Iain Marchant and Joanna Cloy. 2017. Weighing Up the Costs: Food Waste Monitoring And Reduction in Scottish Hotels. MSc thesis. *Sustainability Cybernetics Journal* 2(2). ICEA. pp. 1–90.

Abstract

Approximately one third of all food that is produced for human consumption is lost or wasted globally, which equates to roughly 1.3 billion tonnes each year. This figure in itself is bad enough, but put in the context of rising food demand from an increasing global population (and an increasingly developed population) this figure is scary. There are numerous sources of wastage, from households and consumers, to the producers and wholesalers. But somewhat lost in the mix is food wastage from the hotel industry. According to Waste & Resources Action Plan (WRAP) the UK hospitality and food service sector produces approximately 920,000 tonnes of food waste annually, of which 75% is avoidable and could have been eaten. The Scottish hotel industry produces approximately 79,000 tonnes of food waste annually, which is equivalent to 1 out of every 6 meals served being thrown out. This project seeks to address this issue, both to help reduce the effects food waste has upon the environment, but also to help the hotel industry adapt to become more sustainable. This project involves the monitoring of food waste produced from the kitchens of three hotels located across Scotland. The food waste was segregated into different categories; 1) Plate waste, 2) Spoilage, 3) Preparation and 4) Prepared not served. During the project, meetings were held with the general managers to suggest prevention/reduction measures in an attempt to

reduce the quantity of food waste produced. The hotels managed to save a combined £5,440 and reduce their emissions by 5,520kg over the course of the project. These imply annual savings of £21,759, and 22.7t CO₂e. This report aims to act as a guide for hotels wanting to reduce their food wastage, as responses to the questionnaires that took place before and after the project with the general managers and head chefs highlighted potential barriers to food waste reduction, and identify key tips.

Acknowledgements

(By Iain Marchant – August 2015)

Many people have aided me throughout the production of this report, many of whom I am (somewhat annoyingly) not allowed to name. I am particularly grateful to Elene Dawkins for her time and consistent support throughout the production of this dissertation, as without her this project would have surely failed. You helped me create all the necessary documentation and assisted in designing the project, and made sure that I kept hounding the hotels for results, and for that I am very grateful.

I would also like to thank all employees of the hotels that undertook this project, as without your commitment this project would have never gotten off the ground. I also apologise for any additional work I may have caused you!

Thank you to Joanna Cloy, who provided guidance and advice from start to finish, and for reviewing my report. I would also like to thank you for your exceedingly quick responses to my emails!

Finally, I would like to thank my beautiful fiancé Lara Dunbar, as without you I think I would probably have called it quits and started another project when it looked like I was not going to get any results.

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Glossary of abbreviations

AD – Anaerobic Digestion

COSLA – Chief Officers of State Libraries Agencies

CSR – Corporate Social Responsibility

DEFRA – Department of Environment, Food and Rural Affairs

EC – European Commission

EU – European Union

FAO – Food and Agriculture Organisation

GM – General Manager

HaFS – Hospitality and Food Sector

HaFSA – Hospitality and Food Service Agreement

HC – Head Chef

IFAD – International Fund for Agricultural Development

UN – United Nations

UNICEF – United Nations Children’s Fund

UNRIC – United Nations Regional Information Centre

WCED – World Commission on Environment and Development

WFP – World Food Programme

WRAP – Waste & Resources Action Plan

1. Introduction

Ever since the Brundtland Report was released in 1987 sustainable development and environmental management have been a mainstream concept of governments across the globe (WCED 1987; Cole *et al.* 2014). Legislation, on both a national and international scale, has subsequently been introduced to improve environmental management and resource use. Many nations across the globe - including the USA, Sweden and New Zealand - are attempting to put into place zero waste policies (even cities including San Francisco, Vancouver and Adelaide are creating their own zero waste policies) (Zaman 2015). Zero waste policies are all-encompassing waste management strategies where nations reduce wastage through recycling, reusing materials and reducing resource use. Approximately one third of food produced for human consumption globally is lost or wasted, this produced but unused food not only provides a drain on resources but it also carries large environmental and economic costs (FAO 2013). Scotland produces over 2 million tonnes of food waste annually across all sectors (The Scottish Government 2010), and this figure is only set to increase. According to Waste & Resources Action Plan (WRAP) the UK hospitality and food service sector produces approximately 920,000 tonnes of food waste annually, of which 75% was avoidable and could have been eaten (WRAP 2013a; WRAP 2014). The Scottish government recognises the importance of this issue and wants to turn this problem into a resource. In 2010, the Scottish Government released its zero waste policy, detailing the direction of Scottish waste policy over the next 10 years (The Scottish Government 2010). There are numerous benefits for reducing national food waste, from environmental benefits such as reduced input to landfills and increased natural resource efficiency, to benefits to business by reducing waste disposal costs (Zero Waste Scotland 2015). One other benefit of reducing food waste is that humanity will be required to produce approximately 60% more food by 2050 to cater for the food demands of a more developed and populated world, so maximising efficient usage of food is crucial (Alexandratos & Bruinsma 2012). Effectively managing current food production and consumption to make the most out of the food we currently produce will result in increasing future production by a smaller amount.

1.1 Global Food Security and Food Waste

In 2014 the Food and Agriculture Organisation (FAO) released a report highlighting approximately 11% of the global population is currently chronically undernourished (FAO, IFAD and WFP 2014). Whilst this percentage has fallen from the 18.7% recorded in 1990-92, the fact remains that approximately 805million people are still classified as chronically undernourished, see Table 1 (FAO IFAD and WFP 2014).

As is to be expected, developed regions (USA, the EU etc.) have the lowest rates of undernourishment, with less than five percent of their populations suffering from undernourishment, Table 1. Despite efforts to reduce global food insecurity, there are still wide gaps between the developed and developing world. Asia contains the largest number of undernourished (525 million people), which is to be expected as it is the most populous region on earth, Table 1. Sub-Saharan Africa contains the highest percentage of people currently living with chronic undernourishment, and while this percentage has dropped by approximately 10 percentage points since 1990-92 levels, the total number of undernourished has increased by 38 million over the same time period, Table 1. Despite all of the progress that has been made, there is still much work to be done to combat this global problem.

There has been global support for ending world hunger, following the 2000 Millennium Summit of the United Nations a series of 8 goals were set with aim of reducing extreme poverty, hunger and child mortality rates, and combating diseases such as HIV/AIDs and Malaria (UN 2015a and b). Goal 1.C is to halve the proportion of people who suffer from hunger by 2015 (compared to 1990 baseline) (UN 2015c). The same goal was set at the 1996 World Food Summit (and agreed to by 186 nations), to “*reduce by half the number of hungry people in the world by 2015*” (FAO 2000). Latin America is the only region that has met these targets, and in doing so has highlighted the need for a combined effort from national government and society. Societies in South America pressured governments to reduce hunger which forced parliaments to take action and become responsible for ending this problem. Food production was supported which in turn boosted yields enabling greater quantities of food being available for the people, this combined with societal protection for the poorest allowed even those in poverty to obtain adequate food to reduce rates of undernourishment (FAO, IFAD and WFP 2014: UNICEF 2006).

Table 1: Global undernourishment figures from 1992-2014. Source FAO, IFAD & WFP 2014.

Undernourishment around the world, 1992–92 to 2012–14

	Number of undernourished (<i>millions</i>) and prevalence (%) of undernourishment									
	1990–92		2000–02		2005–07		2008–10		2012–14*	
	No.	%	No.	%	No.	%	No.	%	No.	%
WORLD	1 014.5	18.7	929.9	14.9	946.2	14.3	840.5	12.1	805.3	11.3
DEVELOPED REGIONS	20.4	<5	21.1	<5	15.4	<5	15.7	<5	14.6	<5
DEVELOPING REGIONS	994.1	23.4	908.7	18.2	930.8	17.3	824.9	14.5	790.7	13.5
Africa	182.1	27.7	209.0	25.2	211.8	22.6	216.8	20.9	226.7	20.5
Northern Africa	6.0	<5	6.5	<5	6.4	<5	5.6	<5	12.6	6.0
Sub-Saharan Africa	176.0	33.3	202.5	29.8	205.3	26.5	211.2	24.4	214.1	23.8
Asia	742.6	23.7	637.5	17.6	668.6	17.4	565.3	14.1	525.6	12.7
Caucasus and Central Asia	9.6	14.1	10.9	15.3	8.5	11.3	7.4	9.5	6.0	7.4
Eastern Asia	295.2	23.2	222.2	16.0	218.4	15.3	185.8	12.7	161.2	10.8
South-Eastern Asia	138.0	30.7	117.7	22.3	103.3	18.3	79.3	13.4	63.5	10.3
Southern Asia	291.7	24.0	272.9	18.5	321.4	20.2	274.5	16.3	276.4	15.8
Western Asia	8.0	6.3	13.8	8.6	17.0	9.3	18.3	9.1	18.5	8.7
Latin America and the Caribbean	68.5	15.3	61.0	11.5	49.2	8.7	41.5	7.0	37.0	6.1
Caribbean	8.1	27.0	8.2	24.4	8.4	23.7	7.6	20.7	7.5	20.1
Latin America	60.3	14.4	52.7	10.7	40.8	7.7	33.9	6.1	29.5	5.1
Oceania	1.0	15.7	1.3	16.5	1.3	15.4	1.3	13.5	1.4	14.0

Food waste is defined as food that was produced for human consumption, but is removed from the food chain primarily due to retailer and consumer behaviour (Parfitt *et al.* 2010). Whereas food loss is the wastage or loss of edible food at the harvesting, production and transportation stages of the food chain (FAO 2015; Parfitt *et al.* 2010; Gustavsson *et al.* 2011).

According to Gustavsson *et al.* (2011) and FAO (2013), approximately one third of all food that is produced for human consumption is lost or wasted globally, which equates to roughly 1.3 billion tonnes each year. Gustavsson *et al.* (2011) also states that Europe and North America waste the largest quantity of food, wasting nearly 95-115kg/yr per capita, which is roughly ten times the amount of Sub-Saharan Africa (6-11kg/yr per capita). The scale of food waste in the developed world is so large that the quantity of food wasted is greater than the total food produced by the entire African continent (Stuart 2009). The source of food waste also differs between these two regions, with the primary source of food waste in developing nations coming from the harvesting and post-harvesting stages, whereas food waste in developed nations arises at the consumption stage – signifying that this waste is still suitable for eating! (FAO 2015; UNRIC 2014). Not only does this wastage produce a large drain on resources, but the land used to produce this uneaten food takes up nearly 1.4 billion hectares of land, which represents approximately 30% of the world's

agricultural land area (FAO 2013). Helping to reduce food waste will not only enable us to reduce pressure placed upon resources, but will also decrease the pressure on global agriculture to produce the 60% more food required to cater for larger more developed populations by 2050 (FAO 2013). There are some who argue ‘how can our food waste and the world’s poor be connected?’, but the two are more interlinked than first thought (Stuart 2009). If we decreased the amount of food waste, pressure on global food production systems would decrease which would reduce fluctuating prices and improve the conditions of the hundreds of millions of farmers and the billions of people who depend on these markets for income and food (Stuart 2009; Lowder *et al.* 2014).

1.2 Food Waste in Scotland

Not only does Scotland’s waste produce adverse effects upon the environment, but it is also uneconomical. According to Resource Efficient Scotland (2015), Scotland spends approximately £95 million on disposing of resources (from card and paper, to electronics and food waste) valued at over £97 million. Scotland produces over two million tonnes of food waste annually across all sectors (The Scottish Government 2010), and this figure is only set to rise as Scotland’s population increases. The Scottish hotel industry is the 5th largest source of food waste in the hospitality sector, producing approximately 79,000 tonnes annually, which is equivalent to 1 out of every 6 meals served being thrown out (WRAP 2013a). This waste ends up costing the hotel sector £318m through procurement, labour and waste management costs (WRAP 2013a), see Table 2. On average, 43% of all waste produced in hotels is recycled, with 54% of packaging and other waste products being recycled (WRAP 2014). But only 16% of food waste is composted or sent to anaerobic digestion (the process of breaking down organic matter by bacteria in an anoxic environment to create bio-gas or bio-fertiliser (Romero-Güiza *et al.* 2015; WRAP 2014). This low percentage may be due to the fact that hotels, much like other establishments, are concerned about reducing the quantity of their food waste rather than changing where it ends up, as hotels can save more money by reducing the quantity of waste, when compared to changing where it ends up.

Table 2: Breakdown of sources of food waste within the hospitality and food service sector. Adapted from WRAP 2013.

Sub-Sector	Number of Outlets With Food Service	Total Food Waste (thousand tonnes)	Cost of Total Food Waste (£/tonne)	Total cost (£ millions)
Restaurants	40,958	199	3,500	682
Pubs	45,087	173	2,100	357
Hotels	45,763	79	4,000	318
Quick Service Restaurants	31,450	76	3,500	277
Staff Catering	7,172	21	2,200	44
Education	34,744	123	2,100	250
Healthcare	19,257	121	1,900	230
Leisure	9,255	60	4,000	241
Services	2,029	68	1,700	112
UK HaFS total	235,715	920	N/A	2,511

Scottish households produce approximately 566,000 tonnes of food waste each year (Resource Efficient Scotland 2011), with roughly 377,000 tonnes of this being avoidable. Which, if saved would reduce national carbon dioxide (CO₂) emissions by 1.7m tonnes, which is equivalent to removing one in every five cars from our roads (WRAP 2009). Not only will reducing this food waste reduce carbon emissions, but it will also save over £1bn, from reducing household food bills, waste disposal costs and supply chain costs (WRAP 2009). Despite these large figures, progress in recent years has been made. Since 2004 WRAP has introduced a home composting scheme which provides heavily discounted composting bins to households, with all local authorities in Scotland being partners in this project (Carr & Downing 2014). These projects are succeeding in reducing food waste production, between 2007 and 2012 the quantity of food waste from UK households fell by 15%, despite the number of households increasing by 4% over this time (Carr & Downing 2014). This shows that simple measures can lead to significant reductions, and now governmental focus is shifting to the business sector with the hope of achieving similar results.

1.3 Food Waste Policy

UK waste policy is governed by the European Union (EU) Waste Framework Directive (2008/98/EC), which was transposed into the UK Waste Regulation 2011, and Waste (Scotland) Regulations 2012. This EU legislation provides a framework for the collection, transport and disposal of waste with

the basic principle of managing waste without putting human and environmental health at risk (European Commission 2015; European Parliament and Council 2008). Previous EU legislation has focussed on waste treatment, but the focus has changed with the 2008/98/EC framework concentrating on waste prevention with the view of extracting secondary raw materials from waste (Carr & Downing 2014; DEFRA 2014). The legislation even outlines waste prevention targets for member states to achieve by 2020:

1. 50% of certain household waste materials to be prepared for reuse or recycling.
2. 70% of demolition waste to be prepared for reuse or recycling.

The directive goes further than just setting targets, it requires member states to create waste management and prevention programs - guidance on how to create these are provided by the European Commission (EC) - that should be transposed into national legislation (European Parliament and Council 2008). The guideline document provided by the EC highlights the hospitality sector (restaurants, hotels and catering cafeterias) as a key sector to receive attention from waste prevention and management programs (European Commission 2011). The framework also provides a hierarchy outlining waste reduction and disposal processes that all member states should abide by, Figure 1. The hierarchy concerns:

1. Prevention – Preventing the production of goods likely to be wasted
2. Preparation for re-use – Re-using goods and materials
3. Recycling – Waste items transformed into new usable goods
4. Recovery – Energy production from waste
5. Disposal – Waste disposal of non-recyclable/re-usable items



Figure 1: The waste hierarchy produced for the Waste Framework Directive 2008. Sourced from European Commission 2015a.

In 2014, a proposal to amend the directive was produced. This proposes the idea of creating a framework for member states to follow so that all food waste reporting is standardised across all sectors (European Commission 2014). The aim of this is to allow member states to accurately track the quantity of waste being produced, making it easier for nations to reduce waste and so the EC can determine progress towards reducing food waste by 30% by 2025 (European Commission 2014).

Over the last 15 years the focus of the Scottish Government, regarding food waste reduction, has been on household waste, but now the focus has shifted towards addressing food waste from the hospitality sector (WRAP 2009; Zero Waste Scotland 2015). In 2010 the Scottish Government released their Zero Waste Plan which outlines the course of Scottish waste policy for the next 10 years, with the principles of; Resources should be used as effectively as possible, fewer resources should be lost to the economy in the form of waste, and placing increased value upon secondary resources (The Scottish Government 2010). This plan states that Scotland wishes to achieve a zero waste society, where we reuse materials and do not produce waste that cannot be degraded or recycled. (The Scottish Government 2010). The plan also states the Scottish Governments target of recycling 70% of all waste produced by 2025, not only will this benefit the environment but it will also benefit the Scottish economy by £175million – through additional revenue gained through the sale of recyclable materials (The Scottish Government 2010; Zero Waste Scotland 2015).

The Waste (Scotland) Regulations 2012 were brought in to deliver the aims of the Zero Waste Plan. The regulations focus on business waste and state that businesses producing over 50 kilograms of food waste a week are to present the waste for separate collection from the 1st of January 2014, and that businesses producing more than 5kg of food waste must do the same by the 1st of January 2016 (Scottish Parliament 2012). Also from the 1st of January 2016 the use of macerators used to discharge food waste into public sewers will be banned. Food businesses operating in non-rural areas are now required to separate their food waste into recyclables and non-recyclables on site, if the site is not constrained by size (Scottish Parliament 2012). After the 1st of January 2021 there will be a ban on sending municipal biodegradable waste to landfill or incineration, putting pressure on local councils to find ways of recycling or re-using this waste (Scottish Parliament 2012; Mciver 2012). Further pressure is put on businesses to reduce the amount of waste they produce through the increasing landfill taxes. For every tonne of waste sent to landfill in 2014 a business would be charged £80, this has now risen to £82.60 for the 2015-16 period (COSLA 2014; The Scottish Government 2015). The waste hierarchy produced by the EU Waste Framework Directive has become a keystone in Scottish waste regulations, with waste regulations set to introduce

progressive bans on the nature of items sent to landfill, with the aim of sending no waste that can be recycled or re-used to landfill by 2020 (Mciver 2012). The Scottish Government are also set to implement regulations regarding the separate collection and treatment of waste to maximise recycling and reuse of materials, and to create a stable market supply of materials with an initial focus set on food waste (Mciver 2012).

Because the hospitality sector was identified as a sector to focus on by the Waste Framework Directive, the scale of WRAP's role has increased. In 2000 WRAP was created to aid business and homeowners to be able to reduce wastage and to make better use of resources, in an effort to reduce effects of waste on the environment (Carr & Downing 2014). WRAP works in every aspect of promoting a 'circular-economy' from waste reduction, reusing items and promoting recycling. WRAP works closely with hotels to enable these businesses to reduce their food wastage, and in 2012 created the Hospitality and Food Service Agreement (HaFSA). The HaFSA is a voluntary agreement which was created to target all businesses in the hospitality and food service sector, from multi-national wholesalers to small hotels (WRAP 2015). WRAP produces targets that the agreement signatories pledge to achieve by the end of 2015. The industry sector targets under the HaFSA include:

1. Reducing food and associated packaging waste by 5% by the end of 2015 (WRAP 2015).
2. Increasing the overall rate of food and packaging waste being recycled, composted or sent to anaerobic digestion to at least 70% by the end of 2015 (WRAP 2015).

The targets are gauged against a 2012 baseline and are measured as CO₂e emissions.

1.4 Aims and Objectives:

The purpose of this report is to aid the reduction of food waste in the Scottish hotel industry, by trialling a food waste monitoring and reduction scheme in a hotel chain operating multiple outlets across Scotland. This report can be used as a guide for hotels who wish to reduce the amount of waste they produce. From this purpose, several aims and objectives were created:

1. To determine whether attitudes and motivations towards waste reduction are different for kitchen staff and management (e.g. as management may be looking at waste reduction as a money saving tool, whereas kitchen staff may see it as a matter of pride).
 - 1.1. To gauge motivations through use of questionnaires which will be applied to hotel general managers and head chefs.
 - 1.2. Analyse and display these results through the use of coding.

2. Determine the extent to which a cultural shift on behalf of the consumer is required to reduce food waste.
- 2.1. Utilise customer plate waste data and relevant literature to determine how consumer culture dictates food consumption/wastage.
3. Use a systematic literature review to minimise bias when searching for appropriate literature.
- 3.1. Use this literature to determine whether the waste reduction measures proposed match those being practiced, and if they don't match, determine why.
- 3.2. To assess food waste reduction measures being practiced in hotels the following keywords were used: Hotel restaurant, food waste, monitoring, reduction, prevention measures

1.5 The Project

This project seeks to determine the source and quantity of food waste arising at Scottish hotels, and then determine appropriate waste reduction measures. Food waste data from a hotel chain with multiple outlets across Scotland was used for this project. This project consists of a waste monitoring scheme that commenced on the 9th of March 2015, and operated for the following 13 weeks (start date and termination date varied between hotels, but all monitored food waste production for at least 12 weeks). The first 2-3 weeks were used to produce baseline data, from which waste reduction measures were determined based upon the results. Overall, data from 3 different hotels was used, with these hotels varying in total capacity, services provided and location.

2. Literature Review

2.1 Background

Tourism is one of the largest global industries and is rapidly expanding (Oleskow-szlapka *et al.* 2011; Pirani & Arafat 2014), and for a rising proportion of tourists environmental awareness of attractions and accommodation is becoming increasingly important. Origins of the modern environmental movement began in the 1970's due to an increase in the implementation of environmental policy, yet the seeds had been planted several years before this (Rahman *et al.* 2012). The 1990's saw environmental awareness rise to prominence due to an increasing scientific interest in the impact humanity is having upon our planet after the realisation that humanity is inducing climate change (Rahman *et al.* 2012). This increase in awareness saw consumer focus shift towards favouring effective environmental responsibility, with some consumers showing willingness to pay more for services which have a reduced environmental impact (Iwanowski & Rushmore 1994).

Approximately 95% of tourists are influenced by the environmental condition of their destination (Mensah 2006), showing that amenities should be concerned with and aim to reduce the impact their actions have upon the environment (Mensah 2006).

Waste is one of the most noticeable environmental impacts from hotels, due to the large quantity of goods that are used in the provision of services and to the high frequency of establishments in our towns and cities (Pirani & Arafat 2014; Singh *et al.* 2014). Thus it has become the focus of national and international legislative efforts to reduce the quantity of waste produced, and its associated effects (Rahman *et al.* 2012; Bohdanowicz 2005). In the UK, the hospitality and food service industry produces approximately 2.87 million tonnes of waste annually, of which nearly 46% could be recycled or sent to anaerobic digestion (AD) (WRAP 2013a). Hotels produce approximately 289,700 tonnes of waste a year (WRAP 2014), with Oleskow-szlapka *et al.* (2011) estimating that roughly 75% of this waste is created due to excessive consumption. It is because of research like this and legislative pressure that hotels are seeking to reduce the quantity of waste they produce, with environmental management being the principle tool used to induce this change (Mensah 2006).

2.1.1 Waste management

Hotels have always been conscious of issues relating to food waste and food cost. With this level of awareness increasing during recent years to the point that now waste management is becoming an integral element of hotel management, and is becoming more important with the recent enforcement of stricter waste regulations (Worcester 1994; Mackenzie *et al.* 2011). Effective waste management strategies should be based on the waste management hierarchy as highlighted by the EU Waste Directive (European Parliament and Council 2008), see Figure 1. This hierarchy shows that measures should seek to amend the current business practices, and persuade consumers to waste less. This is especially true with food waste, as once the waste is created there are few options open for you to reduce costs (Pirani & Arafat 2014). So the emphasis of reduction strategies should be to use goods more efficiently to be able to reduce waste.

The literature regarding waste management in the hospitality sector is sparse (Pirani & Arafat 2014). Yet, the relevant articles revealed that the most common measures practiced by UK hotels to reduce their environmental impact concerns reducing energy and water consumption (Radwan *et al.* 2012). The majority of literature encountered relating to waste management focuses primarily on environmental management systems, and not solely on waste management (Mensah

2006). With the literature relating to waste management often lacking in data relating to food waste and focusses more on energy and water efficiency, and dry recycling (Pirani & Arafat 2014).

2.1.2 Food waste

The subject of addressing food waste is not a recent one, with some research dating back to the 1970's (Malik & Kumar 2012). Yet the majority of scientific publications relating to waste reduction are concerned with waste in a broad sense, often grouping materials together into general waste, packaging, organic and other recyclables. Therefore, this literature does not challenge the issue of food waste head on or provide effective food waste prevention strategies (Singleton 2012; Marthinsen *et al.* 2012). The majority of available literature concerning food waste originates from public sector organisations such as WRAP, Resource Efficient Scotland and Zero Waste Scotland, and often comes in the form of reports designed to be used by businesses and homeowners to help them reduce wastage (see WRAP 2009; WRAP 2013; WRAP 2014).

According to Singh *et al.* (2014) the most commonly recycled goods by hotels are dry goods (cardboard, paper etc.) as these can produce "*substantial revenue in terms of saving haulage fee's and salvage value*", whereas food waste does not possess the revenue potential of the other materials so it often does not receive as much attention (Singleton 2012). Reducing food waste does however have significant implications on reducing costs, as the UK hotel industry spends approximately £238 million each year on avoidable food waste (WRAP 2013a). Thus preventing this waste has the potential to significantly increase revenue.

2.2 Benefits of Reducing Food Waste

A pro-active waste prevention strategy can produce numerous benefits including:

1. Boosting the economic potential of the hotel,
2. Providing a competitive edge,
3. Aiding environmental protection

2.2.1 Economic benefits

2.3.1.1 Revenue

Waste is the source of a variety of costs, signifying that a reduction in waste will lead to savings (Pirani & Arafat 2014; Iwanowski & Rushmore 1994; Mackenzie *et al.* 2011; Ball & Taleb 2011). A

report by WRAP (2013b) identified that the UK hotel industry could save a potential £317 million annually through the prevention in avoidable food waste. The same report also stated that if the UK reduced the quantity of food waste produced by just 5%, the hospitality industry would achieve savings of £250 million over 2 years (WRAP 2013). As well as providing instant savings, tackling waste management can increase the long term profitability of the hotel, with the savings achieved potentially being passed onto the customer the hotel can even seize an advantage over competitors by providing cheaper services (Rogerson & Sims 2012). Even if the savings are not passed on a study by Chung & Parker (2008) revealed that 70% of individuals asked stated that they are extremely likely to actively seek out and stay in hotels that attempt to reduce their environmental impact. Furthermore, these individuals are willing to pay a premium for these services (Ho *et al.* 2012). A study conducted by Cummings (1997) revealed that self-proclaimed eco-tourists (of which there are approximately 43 million in the US alone, and this number will only have risen since this study) are willing to pay approximately 8.5% more for services and accommodation provided by environmentally friendly establishments. This added income is not guaranteed, as while consumers state they are willing to pay extra it does not mean that they will in practice (Cummings 1997).

2.2.1.2 Competitiveness

Preventing waste can provide a business with a competitive edge due to numerous factors. Promoting an environmentally friendly image is important, as environmental awareness among tourists is increasing and is now influencing the choice of destination, accommodation, and which attractions are visited, see Iwanowski & Rushmore (1994), Oleskow-szlapka *et al.* (2011) and Mensah (2006). According to Mensah (2006) 95% of tourists are concerned with the environmental condition of the area which they visit, which shows that caring for the local environment can aid competitiveness in the long run. Iwanowski & Rushmore (1994) seconds this opinion by stating *“hotel properties where practices are environmentally sensitive will have an advantage in the market place due to the number of eco-tourists increasing”*.

Hotels can increase their environmental image by simply attracting the right staff. The literature studied identified that environmentally friendly businesses attract like-minded individuals, these employees can aid profitability as they are often more dedicated to reducing wastage and the environmental impact of the site, which can lead to reduced costs and improved company image (Bohdanowicz *et al.* 2011; Rahman *et al.* 2012). Singh *et al.* (2014) identifies that effective waste management abides by ‘Instrumental Stakeholder Theory’. This states that businesses should not reduce environmental impact for themselves but for their shareholders and stakeholders, as they

in turn will reward the business with repeat custom and their loyalty resulting in reliable revenues, so everyone benefits. The greatest benefits, according to Pirani & Arafat (2014), of waste management relate to competitiveness and relationships with the local community and tourists, as if your establishment can provide heightened consumer satisfaction then your business will receive long term profitability.

2.3.1.3 Eco-labels

Reviewing the literature highlighted that advertising environmental awareness can prove challenging, with various reports stating that accreditation is the best medium through which to advertise this awareness (Pirani & Arafat 2014; Singleton 2012; Oleskow-szlapka *et al.* 2011). Ecolabels and certificates are increasing in popularity and are an effective way to easily communicate the environmental awareness of an establishment with potential customers. They can be used to provide a competitive edge over other hotels and are also effective at reducing environmental impacts, as they require specific criteria to be met in order to achieve the label or certificate (Oleskow-szlapka *et al.* 2011; Singleton 2012). There are more than 100 eco-labels/certificates worldwide which only cater for the hospitality industry (Singleton 2012), with their rise in popularity indicating a rise in sustainable waste management (Pirani & Arafat 2014).

2.2.2 Environmental benefits

The literature studied revealed that few articles/reports promoted the reduction of waste purely for environmental benefit, and that the best way to advertise waste prevention measures is through economic terms. Yet that does not make the environmental benefit any less important. The process of organic matter decomposition leads to the creation of methane, which is 25 times more harmful than CO₂ (Pirani & Arafat 2014). Methane is a harmful green-house gas and is targeted for reduction through the 1997 Kyoto Protocol, resulting in national governments seeking to reduce its production, with one key measure being food waste prevention (Singleton 2012). If all food scraps were removed from UK landfill sites, the savings would equal the removal of 1 in 5 cars from our streets (Pirani & Arafat 2014). Reducing the quantity of food waste will not just reduce green-house gas emissions from the hotel, but also from the supply chain resulting in increased benefit (Singh *et al.* 2014; Ball & Taleb 2011).

Food waste is a drain on global resources, annually it accounts for 25% of global freshwater consumption and roughly 300 million barrels of oil (Hall *et al.* 2009), thus reducing wastage will decrease the consumption of these resources, therefore reducing the impact their extraction has

upon the planet. Only one piece of literature encountered argued that waste should be prevented because “*It’s the right thing to do*”, with all others stating a hotel should reduce waste for increased profitability with occasional environmental well-being afterthoughts (Rogerson & Sims 2012).

Due to their impact upon the environment, hotels and other hospitality services have the responsibility to implement waste reduction measures and strategies to reduce their environmental impacts (Singleton 2012).

2.3 Causes of Food Waste

Food wastage occurs due to a combination of economic, societal and cultural factors as well as a lapse in communication between the multiple agents within the food system (Halloran *et al.* 2014). Engström & Carlsson-Kanyama (2004) identified that consumption stage waste (e.g. plate waste) was the single largest source of food waste in Swedish hotels, this will not be same for all other hotels however. Pirani & Arafat (2014) highlight that there is a huge difference in food waste production (in both quantity and source) between hotels due to factors such as guest attributes (e.g. families on average produce more wastage), occupancy rate, hotel type and food service method. This is evidenced by general waste from guest rooms varying between 0.2kg to 12.9kg in hotels in Orlando, Florida (Pirani & Arafat 2014).

A certain level of food wastage is unavoidable, with Edwards and Hartwell (2003) suggesting that there is an acceptable level of wastage. WRAP (2014) identified that roughly 37% of hotel food waste is unavoidable (approximately 29,300 tonnes annually in the UK, (WRAP 2013)), which suggests there is an acceptable limit. Hotels attempt to predict demand and tailor food production accordingly, yet this is an impossible task which inevitably leads to over production resulting in food wastage (Pirani & Arafat 2014).

WRAP (2014) states that in the UK hospitality industry food preparation is the greatest source of food waste, with customer plate waste being second and spoilage providing the least, see Figure 2. The same report also states that 41% of consumers regard portion sizes as the reason for them leaving food on their plates, with the most popular foods left behind being side orders (with chips being left behind approximately 32% of the time).

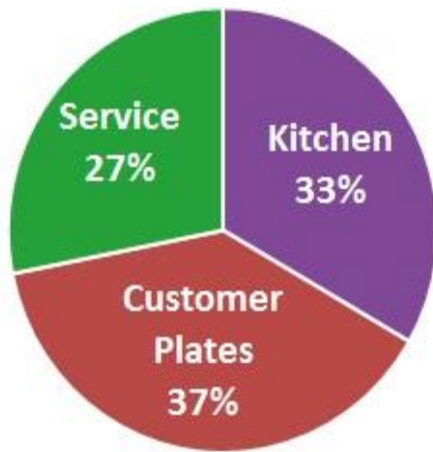


Figure 2: Sources of food waste, produced by WRAP 2014.



Figure 3: Sources of food waste in Finnish hotels, data taken from Silvennoinen et al. 2012.

As stated earlier, quantity of food waste produced varies according to type of hotel, and also to varying consumer culture (Halloran *et al.* 2014). Hotel kitchens in the USA produce on average 0.450kg of waste per meal (Pirani & Arafat 2014), compared to the 0.129kg per meal produced by UK hotels (WRAP 2013).

In a study of Finnish hotels and restaurants, Silvennoinen *et al.* (2012) discovered that 32% of food waste comes from the kitchen, 37% from plate waste and 27% from 'service' (prepared but not served), see Figure 3. They also identified that the primary source of food waste from buffets is from overproduction.

There is difficulty comparing studies between nations for many reasons, primarily there is no standardisation in waste categories, see Figures 2 and 3, resulting in inaccurate comparison between studies. Studies conducted by WRAP typically use the categories:

- Plate waste – leftovers from customer plates.
- Preparation – waste produced during the preparation of food (this can include prepared not served which is food produced for the customer but is not served, this includes buffet container wastes and food items held in bain-maries).
- Spoilage – food items that have spoiled before preparation stage, this includes items that have exceeded their use-by date, spoiled perishable foods and goods damaged during transit.

Whereas other studies use categories that define waste based upon its location within the hotel restaurant. Silvennoinen *et al.* (2012) uses the categories:

- Kitchen – all waste produced in the kitchen.

- Plate waste – leftovers from customer plates.
- Service – “*food that was set out for consumption but never reached the customer*” (Silvennoinen *et al.* 2012).

Using different categories such as these make it difficult to accurately compare between studies, as preparation waste in the WRAP studies can include items that would be categorised under both kitchen and service waste in the Silvennoinen study. Despite these differences Engström & Carlsson-Kanyama (2004), WRAP (n.d), WRAP (2014) and Silvennoinen *et al.* (2012) all identify customer plate waste as the producing a similar portion of food waste, see Figures 2 and 3, with Engström & Carlsson-Kanyama (2004) identifying that 11-13% of food served is wasted.

Upon review of the relevant literature it is clear that few studies exist showing the source and quantity of food waste disposed of by hotels. Stuart (2009) proposes this is due to establishments not wanting to publish data that could potentially give their rivals a competitive edge, as higher waste quantities could lead to negative impact on brand image.

2.4 Sources of Food Waste

There are a variety of different sources of waste, with some contributing greater quantities than others. See Table 3 below for the different sources.

Table 3: List of the different sources of food waste in hotel kitchens, and the relevant literature.

Source of Waste	Evidence
Plate size	(Kallbekken & Sælen 2013)
Poor storage	(Dilly & Shanklin 2003; Youngs, Nobis & P. Town 1983)
Over-purchasing	(Hu <i>et al.</i> 2004; Mackenzie <i>et al.</i> 2011; Youngs, Nobis & P. Town 1983)
Large portion sizes	(WRAP 2014; Youngs, Nobis & P. Town 1983; Giorgi 2013)
Overproduction	(Hu <i>et al.</i> 2004; Mackenzie <i>et al.</i> 2011; Pirani & Arafat 2014)
Poor preparation	(Mackenzie <i>et al.</i> 2011; Youngs, Nobis & P. Town 1983)
Ineffective stock rotation	(Merricks & Jones 1996; Mackenzie <i>et al.</i> 2011)
Menu design	(Dilly & Shanklin 2003)

Food service	(Youngs, Nobis & P. Town 1983; Dilly & Shanklin 2003; Pirani & Arafat 2014)
Inadequate cooking and holding techniques	(Youngs, Nobis & P. Town 1983)

2.4.1 Plate size

Plate size can lead to increased food waste production at buffets, as the same portion of food on a larger plate produces the illusion of less resulting in the consumer taking more than they would normally, inevitably leaving food on their plate. Providing larger plates at buffets also allows the consumer to pile more on, and unless proper judgement is used excess food is taken that cannot be put back, so it is wasted.

2.4.2 Poor storage

Poor storage conditions can lead to increased spoilage, as increased temperatures and moisture can lead to accelerated bacterial growth and fouling of items. Even if there was no reduction in nutritional benefit of the item, if physical imperfections form the items are disposed of.

2.4.3 Over-purchasing

Over-purchasing stems from poor judgement in predicting demand, this leads to inability to use surplus stock which increases spoilage waste and purchasing costs.

2.4.4 Large portion sizes

Unnecessary portion sizes provide customers with more food than they can eat, especially so if the sizes are not made clear in the menu as customers may also buy side orders, leading to increased plate waste. Approximately 41% of consumers stated that they leave food on their plates when eating out due to excessive portion sizes.

2.4.5 Overproduction

After studying the available literature, it is clear that hotels see producing too little as more problematic than overproducing. This has long been an issue for two reasons:

1. Predicting exact quantities of meals to prepare is impossible.

2. Establishments like to provide an image of being able to cater for everyone.

2.4.6 Poor preparation

Failure to use by-products increases waste, as items such as peelings can be used to produce stocks/sauces instead of being wasted.

2.4.7 Ineffective stock rotation

This increases spoilage as perishable food items can often be left on shelves to deteriorate, and other items not being used before their use-by or best before dates.

2.4.8 Menu design

Sites that use fewer ingredients and more pre-prepared food often see a reduction in food waste as there are fewer actions that produce waste, as the more ingredients used enables increased waste to be produced. The diversity of a menu influences food waste production, as the increased number of common ingredients often increases the portion of items being used, reducing preparation and spoilage wastes.

2.4.9 Food service

Method of food service dictates food waste, as buffets produce greater quantities of food waste than an 'a la carte' menu. This is due to 'a la carte' items often being made to order, where-as buffets involve production of large quantities of food with little knowledge of what will be popular.

2.4.10 Inadequate cooking and holding techniques

Inadequate cooking and holding techniques increases wastage by over-heating or under-cooking. This food is disposed of, and even perfectly cooked food if not stored properly can burn and become dry during holding, resulting in this food becoming unsatisfactory for customers.

2.5 Barriers to Food Waste Reduction

Upon review of the literature it is clear that there are numerous barriers to preventing food waste in hotels. These barriers influence every aspect of hotel operation, including; challenges in implementing monitoring and prevention measures, barriers produced by guests, barriers to achieving employee participation, and general societal issues.

2.5.1 Monitoring and prevention measures

2.5.1.1 Food donation Issues

Donating or re-using surplus food poses a challenge, as it can be laborious to guarantee the food complies with health and safety regulations as inducing food poisoning can reduce the hotels reputation (Pirani & Arafat 2014). This results in large quantities being wasted due to it being easier for employees to dispose of the food. There are organisations in the UK including FareShare and Planzheroes that provide advice, organise donations and uplifts, and have legal frameworks in place to designate what food can be used (Stuart 2009).

2.5.1.2 Composting

One prevention measure is using the food waste to produce compost which can be used on hotel grounds or sold to farmers and members of the community. A common issue with this is that there is not reliable consumer demand for this to be a viable option for many establishments (Singleton 2012).

2.5.1.3 Lack of time and capital

Upon review of the literature, the main issue relating to implementing waste prevention is lack of time and capital, as this can decrease participation rates as many prevention measures require an investment of both (Singleton 2012; Whitehair *et al.* 2013; Malik & Kumar 2012; Mensah 2006; Pirani & Arafat 2014). This is particularly an issue during peak times, as staff are busy despite the added workload of segregating and attempting to reduce wastage. This problem is typically associated with small hotels who often possess smaller profit margins and lack the financial means possessed by large establishments and chain hotels (Singh *et al.* 2014; Mensah 2006). Typically, small hotels produce less waste so face reduced pressure from stakeholders compared with larger chain hotels, but combined, smaller hotels generate significant portions of waste so should face pressure to change (Pirani & Arafat 2014).

2.5.1.4 Lack of space

Lack of space to implement waste prevention or monitoring measures is an issue as some kitchens may be too small to be able to effectively (and easily) separate waste (Singleton 2012; Bacot & Plagman-galvin 2002). To prevent this, further investment in facilities may be required but this leads back to the issue of lack of time and capital (Singleton 2012).

2.5.2 Guest

2.5.2.1 Consumer behaviour

Youngs *et al.* (1983) states that consumer behaviour poses a barrier to food waste reduction, as consumers often look for specific items. A study by Giorgi (2013) states that at least 35% of hotel consumers leave food on their plates after a meal, this may be due to the issue that, sometimes, food costs are included in the room 'package' and is not bought separately, so guests see no negative consequence of leaving uneaten food. The study goes further and argues that consumers see eating out as a 'treat' and should not have to worry about wasting food, showing that they do not value food as a precious resource. This issue is covered in section 5.1.4 later in this report.

Hotels can actively attempt to change customer behaviour to promote waste prevention, but this can be difficult as staff do not want to offend guests, despite the majority of consumers supporting waste reduction (Singh *et al.* 2014). A study by Cummings and Cummings (1990) states that "*consumers may be accustomed to be able to waste...due to their convenience, and making their guests comfortable is their highest priority*". This is true, as for a hotel to receive repeat business and produce revenue customer satisfaction must be high, and some hotels may not want to implement resource efficiency measures if it means that they are putting customer satisfaction at risk.

2.5.2.2 Customer satisfaction

Wrap (2011) and Youngs *et al.* (1983) state that waste reduction strategies can be problematic to implement as customers expect value for money, and the prevention measures must not compromise customer satisfaction (e.g. portion size must not be reduced to the extent that decreases satisfaction).

2.5.3 Staff

2.5.3.1 Staff motivation

For hotel staff, the most important factor for reducing food waste is reduced costs (Pirani & Arafat 2014). This shows that if the hotel will not save money then motivation and participation will decrease. Employees *modus operandi* must change for food waste prevention to be effective, but this can be problematic as if employees see no benefit in changing, they will continue with the same methods (Bohdanowicz *et al.* 2011).

Under the Waste (Scotland) Regulations all food waste must be collected separately in 'non-rural areas', resulting in no separate collection in rural locations (Mciver 2012; Scottish Parliament 2012). This results in lack of motivation from hotel managers in rural areas, with one stating that they lack motivation to spend time and money on implementing a food waste prevention scheme if the food will just go to landfill anyway (General Manager 1, 2015, pers., comm., 12th May), see Appendix F for personal communication transcripts. This barrier will only be torn down if economic benefits - such as tax breaks or incentives, or even proving that the hotel will save money by reducing wastage are provided (Singleton 2012).

2.5.3.2 Reduced awareness

Awareness of the scale of food wastage is a factor with non-compliance, as not all employees know how to implement a waste monitoring or prevention scheme or know where they can go for help (Radwan *et al.* 2012). In the UK, WRAP provides advice and assistance for hotels seeking to reduce food wastage, yet they rely on key staff members to relay the information back to hotel staff.

2.5.3.3 Reduced productivity

A study by Singleton (2012) highlighted that there is a perception amongst hotel staff that segregating waste and implementing waste preventing measures can slow productivity. Singleton (2012) goes on to say that educating and providing advice and methodologies to these managers can increase participation, awareness and motivation.

2.5.3.4 Lack of co-ordination

Lack of coordination amongst staff leads to a decrease in participation in food waste monitoring and prevention due to stakeholders being unaware of their role and the impact of their actions (Singleton 2012; Pirani & Arafat 2014). This can be produced by (and cause) a breakdown in

communication between staff members and departments, potentially resulting in increased food waste production.

2.5.4 Societal barriers

2.5.4.1 Waste prevention or diversion from landfill

Stuart (2009) reveals that while measures that divert food waste from landfill (e.g. anaerobic digestion) are beneficial in the short term, they are not viable in the long run. This is because they incentivise the production of food waste, whereas the attention should be on preventing the production of waste. As only this will reduce wastage of food across the entire supply chain.

2.5.4.2 Value of waste

Youngs *et al.* (1983) argues that there is a misunderstanding regarding the value of food as it is no longer seen as a precious commodity. Once food is bought people often consider it to stop having a financial value and are not concerned about disposing of it (WRAP 2015a). Whereas if food is seen to still have this financial value when it is disposed of there will be added incentive to reduce wastage and maximise efficiency.

2.6 Approaches to Waste Prevention

This section of the literature review is conducted in greater detail later in the report, see sections 4.7 in the Results section and 5.4 in the Discussion.

To effectively manage food waste, the key steps are to first identify the sources that generate the most food waste relative to the other streams (Singleton 2012). Then encourage reduction, prevention and/or recovery measures amongst the sectors identified as producing the greatest quantities of waste (Singleton 2012). It is important for waste prevention/reduction strategies to be constructed by following the waste reduction hierarchy as outlined by the Waste Framework Directive (Singleton 2012), see Figures 1 and 4. This is because the hierarchy provides focus relating to the preferred options of waste management. There are two main forms of food waste reduction measures; those that treat food waste as food, and those that focus on diverting food waste from landfill (Filho *et al.* 2015). Figure 4 displays how these two forms comply with the waste reduction hierarchy. The measures that treat food waste as food focus on reducing production of food wastage, with those that treat it as waste concentrate on diverting the waste from landfill. Both options are viable, but as Stuart (2009) states, focus should be on reducing the production of food

waste, as investing in diversion from landfill measures only incentivises the production of food waste.

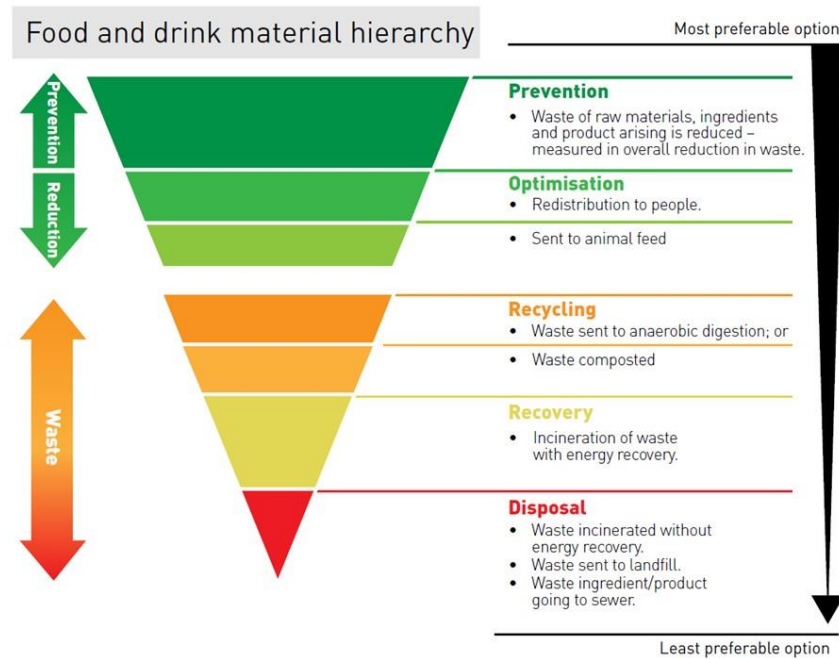


Figure 4: Waste prevention hierarchy broken down to display the differing focus between the management options (WRAP 2015b)

A study by the European Commission (2010) recommended that the EU should aim to establish a standardised food waste reporting methodology to ensure that waste prevention was being conducted by each country consistently and effectively. This would facilitate effective comparisons to be made between regions and enable tracking of food waste production to determine if targets are being met.

Pirani & Arafat (2014) produced a diagram displaying the different stages of the food system in a hotel, see Figure 5. This shows that once you identify the different stages you can measure the food waste that arises at each stage, thereby identifying the greatest sources of waste which enables the determination and implementation of effective prevention measures. Another method for displaying this information is in the form of a 'Food Waste Map', see Appendix C. Both of these methods display similar data, yet the visual aid is different.

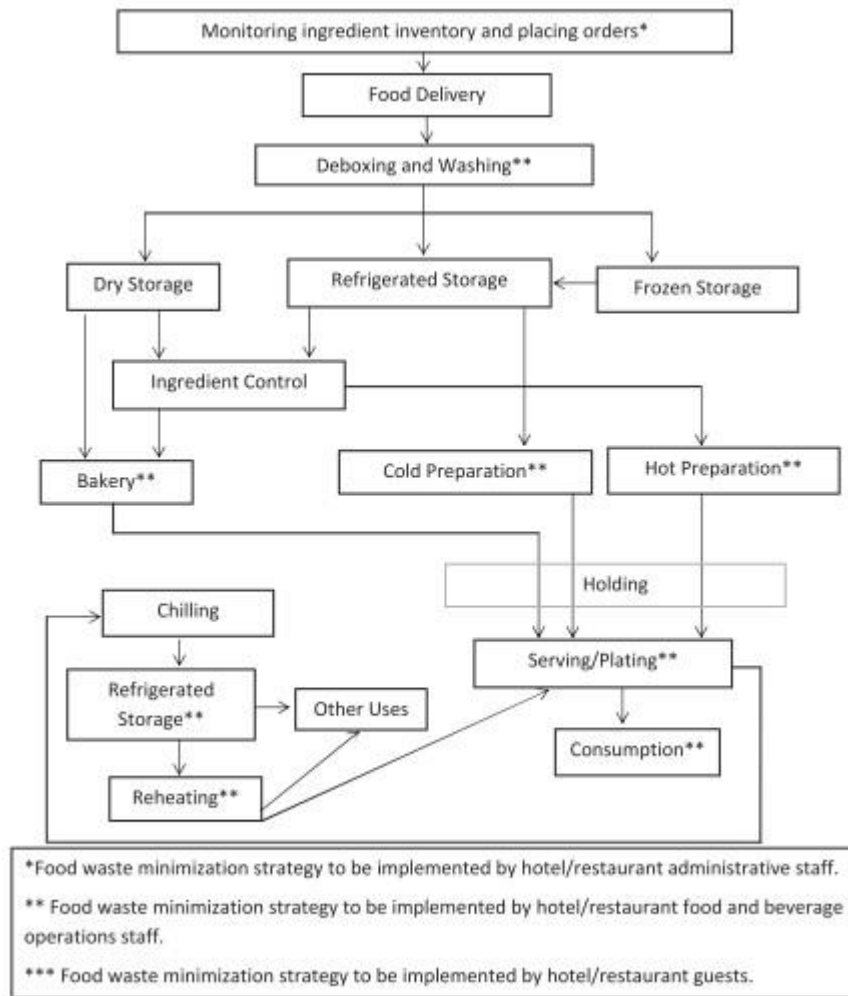


Figure 5: The food service systems of a hotel (Pirani & Arafat 2014).

Freedman & Brochado (2009) argue that attention should be on targeting food intake reduction, as reducing this can lead to food waste reduction. Bender (1994) determined measures that could be used to reduce food demand:

1. Alter structure of diets. As purchasing local food direct from suppliers instead of ready meals and processed foods reduces the amount of food being wasted in the supply chain, and diverts food that would be lost during the strict cosmetic criteria imposed by supermarkets (Stuart 2009).
2. Change food storage, transportation and handling practices to reduce spoilage.
3. Adjust calorie requirements resulting from improved nutritional food values.

These measures seek to reduce food demand with the aim of reducing the quantity of food that is open to being wasted.

It is critical that we develop a food service system that inhibits the overproduction, decay and wastage of food in a hotel system, as this is another means of promoting and achieving long term profitability (Mackenzie *et al.* 2011). One way to create this system is through the promotion of the idea of a circular economy, whereby waste is not solely viewed as unwanted items but instead viewed as a resource (Halloran *et al.* 2014). This economy promotes the ideas of recycling and reusing waste products and reducing the production of waste.

2.7. Why Is This Study Important?

Upon review of the literature, it is clear that the majority of scientific publications relating to waste concern waste in a general form, combining waste types into categories such as “mixed recycle”, “organic” and “general waste”. These publications thereby do not face the food waste issue directly or propose detailed waste prevention strategies for differing sources of food waste.

There are many papers that only state which measures are out there, but very few match prevention measures to the different sources of food waste, and fewer discuss the costs of implementing these measures. For example, Radwan *et al.* (2012) discusses numerous food waste prevention measures, but does not estimate the implementation costs or the potential reductions that could be achieved by these measures. Malik & Kumar (2012) only focusses on low cost measures and does not provide different options depending on the source of waste.

There is limited literature relating to food waste in the hotel industry, the majority of publications encountered concerned general waste management, environmental management systems and food waste on a broad scale. This resulted in many papers only providing a short section relating to food waste within the hotel industry. Further still, many of the reports discussing waste management often lacked data in the food waste sections, thus very few facts and figures were provided. There are reports that provide costings and achieved reductions (see Pirani & Arafat 2014; Singleton 2012; WRAP n.d.), with this report seeking to add to this knowledge base.

This report aims to produce a factual manual that can be utilised by those in the hotels industry as a guide relating to effective management of food waste, and provide advice for those seeking to implement food waste monitoring and prevention measures. This report utilises real data provided by hotels, thus providing an accurate assessment of the effectiveness of measures and the barriers encountered. This report seeks to assess whether the waste prevention measures conducted in reality match those proposed by the literature, and to determine the scale of change required by the consumer in order to reduce food wastage in the hotel industry.

3. Methodology

I combined qualitative and quantitative methodologies in order to gather greater quantities of data, and to produce an accurate report that contains all relevant information that can aid our understanding of food waste arising and prevention in the hotel industry.

3.1 Action Plan Construction

To achieve buy-in and support from hotel management, I constructed an action plan outlining all relevant documents, signage, goals and procedures that would be provided/carried out in order to monitor and prevent food waste. This plan included:

1. Background context document – outlining relevant current and future legislation and their requirements
2. The hotels environmental and Corporate Social Responsibility (CSR) policies
3. A description of the project
4. Objectives and targets
5. The daily food waste tracker – this was used in the kitchens allowing kitchen staff to record the quantities of waste produced.
6. Examples of excel spreadsheets – The data from the daily trackers were uploaded onto these and were used to track the quantity of food waste throughout the project. Each hotel had their own sheet and a summary sheet was created to allow visualisation of data from every hotel in one place.
7. Signage – included; signage for bins to aid segregation, definition of waste categories, posters to raise awareness of financial costs of food waste and quantities produced, buffet and canteen signage to promote only taking/buying what you can eat, and good practice documents that can be printed out to display results to staff.
8. Guidance documents – including; how to use the excel spreadsheet, guidance documents from WRAP ('Hotels Taking Action on Waste', food cost information, how to reduce wastage) and case studies to show the results achieved by other similar hotels.

See Appendix A to see a copy of the action plan provided to each hotel.

3.2 Achieving Management Buy-in

In order to achieve effective waste reduction, buy-in from all staff members is required. A meeting between myself and hotel management was held to facilitate the presentation of the action plan to the general manager and head chef to achieve their support. This occurred at every hotel to enable me to introduce myself and receive verbal consent that I would be allowed to implement the project. The second purpose was to assure management that all data will be held confidentially, with all names and locations being omitted from the report and that all data would be deleted upon submission of the report. See Appendix B for a copy of the confidentiality agreement.

3.3 Questionnaire

To gauge awareness of food waste, obtain background information, assess motivations for reducing waste and to determine deciding factors when choosing waste prevention measures, two questionnaires were conducted for hotel managers and head chefs. One was conducted at the initial meeting with management, and one upon completion of the food waste monitoring period. The questionnaires were applied to every hotel and were carried out face to face to allow myself to explain the questions and ask follow up questions to allow the interviewee to expand upon their answer. A copy of the questionnaires can be found in Appendices D and E.

3.3.1 Introductory questionnaire

The purpose of this questionnaire was to enable the construction of baseline data concerning the different hotels. Data which could later be used to determine why certain measures were implemented in certain hotels, or whether hotel properties influenced the attitudes towards waste prevention. The questions included in the questionnaire were chosen as they were deemed most appropriate at assessing motivation, highlighting any potential barriers/strengths to address/build on, and to determine whether the head chef and general manager know how much food waste is actually costing them. The questionnaire was also used as a means of constructing a contact list for each hotel so that I could contact different employees if I had difficulty reaching the general manager, or if I had queries that could be answered by specific employees. The other purpose of the questionnaire was to be able to address one of the aims of this study;

“1. To determine whether attitudes and motivations towards waste reduction are different for kitchen staff and management (e.g. as management may be looking at waste reduction as a money saving tool, whereas kitchen staff may see it as a matter of pride).

1.1 To gauge motivations through use of questionnaires which will be applied to hotel general managers and head chefs.”

The questionnaires were conducted face to face with all three general managers and two of the head chefs, the final head chef was located in the largest and busiest hotel so it became apparent that sending the questionnaire via email was most appropriate. The conversations were recorded so the responses could be transcribed at a later date. The answers to some of the questions in the ‘Hotel Data’ section requiring numerical answers often could not be answered during the face to face meeting, so the answers were emailed to me after the meeting.

3.3.2 Exit questionnaire

This was used to determine why certain prevention measures were chosen by each hotel. With the idea that this data could provide an insight as to what barriers exist, or what preferences exist relating to the type of prevention measure chosen. The other purpose of this questionnaire is to provide an insight into the process of what properties of waste prevention measure are prioritised during the selection of measures, e.g. is implementation cost most important?

3.4 Food Waste Monitoring

Food waste data was gathered from three city centre hotels from the same hotel chain. This project utilised a waste monitoring scheme to gather data, with the monitoring planned to commence on the 9th of March 2015, and operate for at least the following thirteen weeks (Hotel A was only able to capture twelve weeks of data, but Hotel C was able to capture fourteen weeks of data). The start date was adhered to by two hotels, but due to high occupancy rates and short staffing the third hotel postponed commencing this project until the 04/05/2015.

The first week of monitoring was used for kitchen staff to highlight issues with the system which could then be addressed prior to the commencement of the project. The following two-three weeks were used to collect data to produce a baseline, from which waste reduction measures will be measured against, and to achieve staff commitment.

3.4.1 Required equipment

In order to carry out the food waste monitoring, each hotel required;

1. A set of scales for weighing the waste,
2. Adequate number of bins to allow effective waste segregation,
3. Signage to advertise costs, progress and segregation,
4. The daily waste tracker and spreadsheet provided in the action plan.

Hotels were advised to test out the system and start recording waste if they received all relevant equipment needed before the 9th March. Scales were located either in the kitchen, or next to the external bins, see Figure 6, this depended on the location of available space. With regards to the separate bins, if the hotel kitchen possessed enough space different bins were used for different waste categories (see section 3.4.3 for further details), but one hotel kitchen was small so only used two bins, one for preparation and the other for plate waste. Spoilage typically occurs at set time periods (the beginning and end of each day) so this waste can be collected in one bag and disposed of, rather than steadily collecting throughout the day as is the case with plate and preparation wastes.

3.4.2 Food waste categories

In order to fully determine the source of food waste, the waste will be divided into different categories;

1. Spoilage – Bruised or mouldy vegetables, spoiled meats and any unusable dry goods e.g. those that have passed their sell by dates.
2. Preparation – Food waste produced during the preparation of meals, e.g. bones for stock, fruit and vegetable peelings etc.
3. Plate Waste – Any food that comes back to the kitchen on the plate of the customer.
4. Prepared Not Served – Food that has been prepared for consumption but never reached the customer.
5. Events – Food waste produced by events held at the hotel, e.g. wedding receptions, conferences etc.
6. Staff Canteen – Only one hotel (the largest) monitored waste from here.

Not all hotels segregated food waste into all of these categories as they were not always applicable, e.g. one hotel did not cater for events and one did not produce prepared not served waste. So the categories were tailored to each hotel.



Figure 6: The scales used to weigh food waste at Hotel A

3.4.3 Measuring food waste

The waste was weighted (in kilograms) by kitchen staff and recorded under different time periods (breakfast, lunch and dinner) to allow daily fluctuations to be observed and highlight the primary sources of waste. A daily food waste tracker was provided on which the weights and any additional notes regarding the waste (any items frequently disposed of etc.) could be recorded, see Figure 7. Each hotel was supplied with a spreadsheet upon which the data from the daily food waste trackers could be uploaded onto, to allow management to track the food waste produced over the course of the project, and to allow data analysis. This spreadsheet contained all food waste data, daily number of covers, an additional comments column and a section that produced graphs displaying weekly average food waste cover over time (see Figure 18 in the results section for an example) as this allowed visualisation of results and progress. A nominated champion had the role of uploading the daily data onto this spreadsheet, but this did not occur with all hotels. Two of the hotels scanned the daily food waste tracker sheets and sent them to myself, allowing me to input the data into the spreadsheet. The hotel general manager was responsible for calculating the number of covers per day and either inserting this figure into the online spreadsheet, or sending it to myself so that I could upload the data.

3.4.4 Data analysis

The data inserted onto the excel spreadsheets enabled the production of graphs to visualise results and observe trends. The statistical programme 'R' was used to determine whether the trends observed are statistically significant. In order to determine whether prevention measures and/or increased awareness resulted in a reduction in food waste production, paired t-tests are to be used if data is normally distributed, or Wilcoxon matched pairs test if data is not normally distributed.

3.5 Systematic Literature Review

A systematic literature review was used to fulfil the following aim of the report;

“3. Use a systematic literature review to minimise bias when searching for appropriate literature.

3.1 Use this literature to determine whether the waste reduction measures proposed match those being practiced, and if they don't match, determine why.”

The systematic literature review was used to minimise bias when searching for relevant publications in order to write a comprehensive review of the food waste prevention measures recommended by the literature. The methodology was recommended by my dissertation supervisor, as it was determined that this is the most appropriate method for collection of accurate data to compare with the data collected from the hotels.

A systematic literature review is a systematic methodology that utilises pre-determined eligibility criteria (keywords) to search for publications to address a specific research question while minimising bias (Righi *et al.* 2015). The keywords identified were: Hotel restaurant, food waste, monitoring, reduction, prevention measures. These keywords were entered into predetermined databases chosen due to them containing relevant articles on previous occasions. The databases were; Science Direct, Wiley Online Library, Springer, JSTOR and Google Scholar (only the first 500 articles were subjected to first round of review, as articles number 300-500 returned no positive results). Articles were subjected to two rounds of review, the first was used to determine if the articles related to waste management in the hotel industry. This was determined by looking at the title and (if still unclear) the abstract. The second round of review entailed reading through the article to determine its relevancy and if food waste prevention/reduction measures are suggested, with all relevant articles containing prevention measures being utilised by this study.

Hotel:

DATE:

Please record food waste from buffets in the yellow boxes. Once complete, please hand this form to your waste monitor at the end of the day.

TYPE OF FOOD WASTE ARISING	BREAK-FAST	LUNCH	DINNER	Events	COMMENTS e.g., FOOD WASTE ARISING, INCLUDING IDEAS FOR PREVENTION
SPOILAGE					
PREPARATION					
FOOD PREPARED NOT SERVED					
PLATE WASTE					

No. Covers					Total Covers for the day:
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Figure 7: Copy of the daily food waste tracker utilised in the hotel kitchens to record the quantity of food waste disposed of.

4. Results

4.1 Hotel Description

Table 4: Summary of each hotel included in this study.

	Hotel A	Hotel B	Hotel C
Number of rooms	150	119	66
Typical occupancy rate	+80%	92%	81%
Typical number of hotel guests using the restaurant	~70%	170	40 breakfast, 10 dinner
Typical number of dinner guests	~50%	20	30
Provide buffet option?	Hot and cold breakfast buffet and conference catering.	Cold breakfast buffet.	No
Average number of covers per week	400 (can reach over 2800 in peak season).	300	280
Services/facilities	Conference room (300 capacity), 7 meeting rooms (8-60 capacity) can provide sit down meals in 3 meeting rooms (capacity 20, 30, 60), Spa, room service to all 150 rooms.	Room service to all 119 rooms.	Room service to all 66 rooms, event hosting (max 10 persons in the conference rooms).

Each hotel utilised by this study was different, with no hotel providing the same number of rooms, services, or catering for the same quantity of people. Each hotel belongs to the same chain of hotels and are all located in the city centre/inner city of major Scottish cities.

As shown in Table 4, Hotel A is the largest, with catering for the greatest number of weekly covers being mirrored by the largest number of rooms and conference/event facilities. Hotel B possesses the second highest number of rooms and average weekly covers, yet does not provide any events or conference facilities due to recent refurbishments converting these facilities into more bedrooms. Hotel C is the smallest hotel with 66 rooms and caters for 280 average weekly covers, table 4. This hotel does provide small event hosting rooms. Two of the general managers (Hotels A and C) have only been working at their respective hotels for less than a year, which could lead to

them not knowing the full extent of food waste production and reduction measures being practiced at their hotels.

4.2 Introductory Questionnaire Analysis

4.2.1 Have you thought about reducing food waste?

When head chefs (herein known as HCs) and general managers (herein known as GMs) were asked if they have thought about reducing their food waste, all stated that they had. When prompted about their reasoning for doing so, the primary responses concerned providing the hotel with a competitive edge and because it is good business practice, and reducing costs. This was followed by environmental benefit, with only one response quoting legislation as a driving factor behind reducing food waste, see Figure 8.

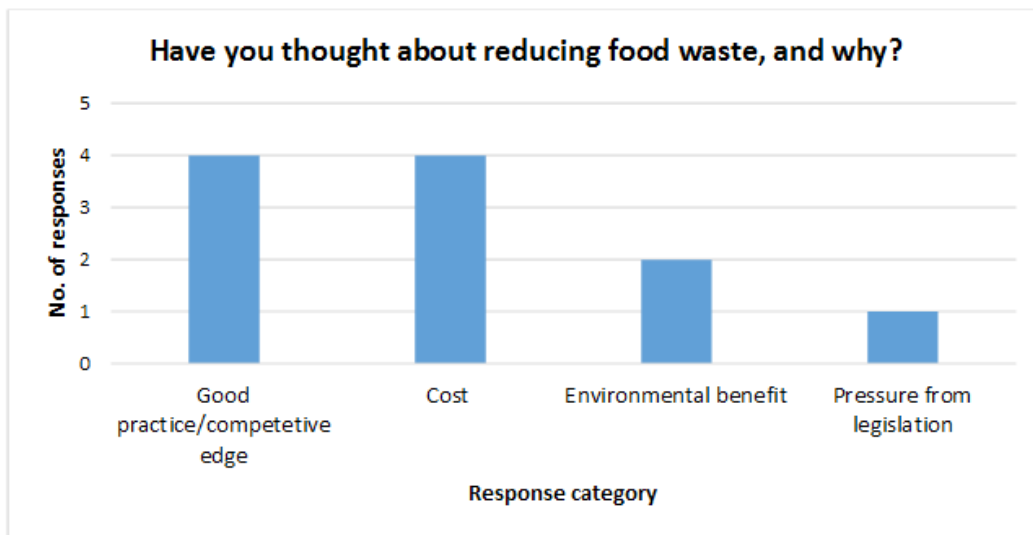


Figure 8: Analysis of responses to the question “Have you thought about reducing food waste, and why?”

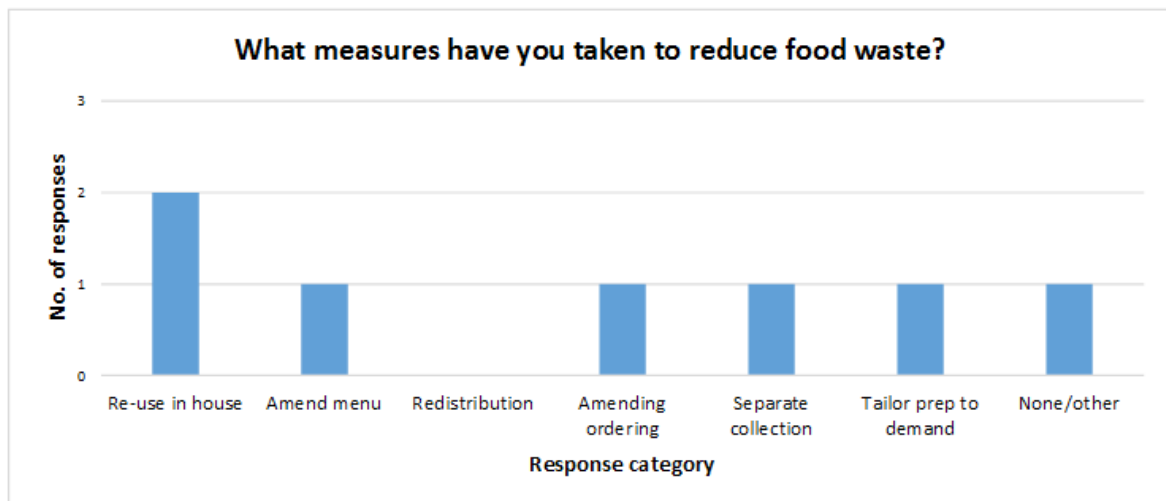
There was no clear preference displayed by either HCs or GMs. The only two categories that did not possess an even split between HCs and GMs were cost (one HC, two GMs) and pressure from legislation (one HC).

4.2.2 What measures have you taken to reduce food waste?

Every hotel stated that they had taken some action, the GM from hotel C stated that “*I don’t think we have done anything*”, yet the HC of the same hotel stated that they are improving on tailoring preparation and ordering by using up to date occupancy figures as a guide for how much food to

prepare. Another HC made an interesting point: “we are realistically always going to be left with a percentage of product that has not been sold or utilised”, showing that there will always be unavoidable food waste. The most popular food waste measure practiced before this project took place was re-using the surplus food in-house, with two hotels utilising the surplus food by using it to produce staff meals in their canteens, with one hotel also using the surplus to produce a ‘dish of the day’ which is served in the restaurant, see Figure 9. Hotels often practice multiple reduction measures, with Hotel A using food surplus in house and amending the ordering by purchasing some pre-cut items to reduce preparation waste. Hotel B also utilises food surplus in house to produce a ‘dish of the day’ and to provide meals for the staff canteen, they also amend the menu when necessary to include items nearing their use-by dates. Hotel C was the only hotel to practice one reduction method, by tailoring preparation to demand through the use of occupancy rates to predict number of meals to prepare for.

Figure 9: Analysis of the responses to the question “What measures have you take to reduce food waste?”



4.2.3 What are the key barriers to reducing food waste?

As shown in Figure 10, the main barriers highlighted by the questionnaire were staff participation and customer behaviour, both with four mentions. Space came second with three mentions, and cost was only mentioned as a barrier once, see Figure 10.

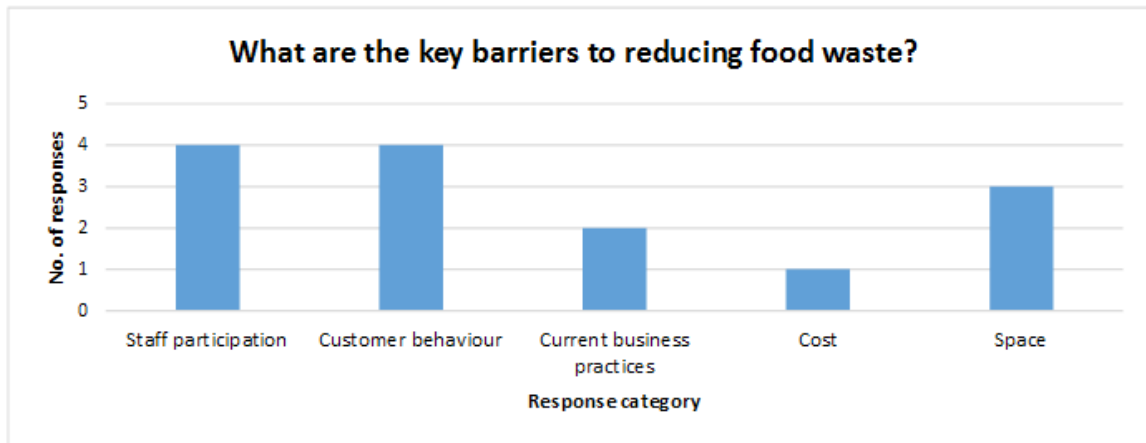


Figure 10: Analysis of the responses to the question "What are the key barriers to reducing food waste?"

With regards to staff participation, two HCs mentioned that training the staff and getting them engaged with food waste reduction can be difficult as the employees may not see the initial benefit of reducing food waste. The attitude of GMs was different, as while they stated staff attitudes must change, they focussed more on people in general needing to change their attitudes and perceptions of waste, with one stating; *"We need to get people educated about waste and saving stuff, we have a very common goal"*. The responses from the two GMs were also included in the customer behaviour category, with the other two responses focussing on buffet waste, with one stating *"Customers, we used to provide a buffet option and they would think if they paid for it then they'll take it"*. With regards to space, the responses regarding space came from two smallest hotels (Hotels B and C). The GM of Hotel C stated that *"We certainly have limitations in terms of the space itself"* and the HC added *"space is probably our number one"*. This point of space is shown in Figures 11 and 12, which both show limited available space for the additional bins. The third response regarding space, came from the GM of Hotel B and concerned limited storage space - although the HC made no comment about this - but in other communication the HC stated they have more available space as they no longer cater for events.



Figure 11: The kitchen in Hotel C, note the white bucket on the counter top (highlighted by the red box) which is used for collecting preparation waste.



Figure 12: The kitchen in Hotel C.

Current business practices concerned event organising and catering for tour groups. Hotel C (due to its size) does not possess an events organising team, so are unable to communicate with the

clients to determine how much food they would like. The second response concerned a similar issue at Hotel B; *“We get bus tours that come in here quite a lot. But we never know how much people want or how many people will eat so we end up with quite high plate waste”*. The only reference to cost came from the GM of Hotel B, who stated that limited storage space is leading to increased delivery costs, as they require more frequent deliveries, yet there was no mention of potential costs from implementing prevention measures.

4.2.4 What are your key strengths?

When asked about key strengths, every response quoted that they possess a strong team, see Figure 13, with one GM stating *“We have a small and strong kitchen team that are experienced so are more likely to adhere to policy”*, with another stating that communication between their staff is crucial. The HC of Hotel B stated another strength is that they only have one kitchen, whereas some of the larger hotels in the chain possess two.

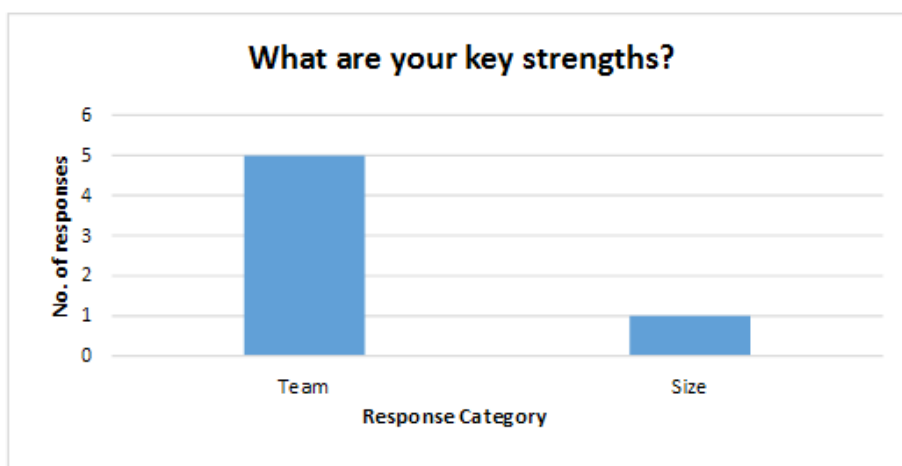


Figure 13: Analysis of the responses to the question "What are your key strengths?"

4.2.5 What do you think is the primary source of food waste?

According to the responses given, breakfast waste was deemed to be the primary source of food waste, followed by prepared not served, with only two stating plate waste, preparation and events wastes as the primary sources, see Figure 14. Some of the waste sources are related, as one GM stated *“prepared not served for conferences”*, and another mentioned that the prepared not served waste from the breakfast buffet can be high. There did not appear to be any preference by GMs or HCs with most of the responses, both breakfast and plate waste saw an even split in mentions

between HCs and GMs, preparation was only mentioned by two HCs and events was only mentioned by two GMs.

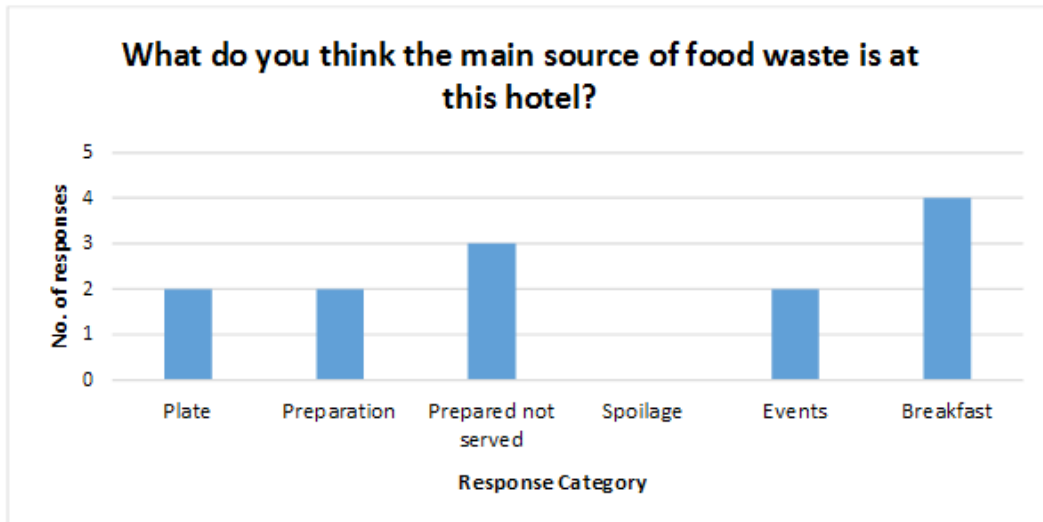


Figure 14: Analysis of the responses to the question "What do you think the main source of food waste is at this hotel?"

4.3 Hotel A Results

Hotel A is the largest of the three hotels undertaking this project, yet event facilities provision is the primary difference, see Table 4. This hotel caters for events including: weddings, conferences, meetings and special occasions. It is because of this that results are expected to fluctuate throughout the monitoring period, as event frequency fluctuates. The hotel has one kitchen (as is the case with the other hotels in the project) which caters for the staff canteen as well as the restaurant. This hotel records waste from the canteen due to the large number of staff who use this service.

4.3.1 Food waste recording process

Food waste was segregated into different bins in the kitchen, with different members of staff being responsible for segregating different types of waste. Plate waste and prepared not served' were segregated by the kitchen porters, and preparation and spoilage wastes were segregated by kitchen staff who were preparing meals. The bags were then removed and weighed on scales that were located beside the external bins to save space, see Figure 6. The kitchen staff recorded the food waste on the daily food waste trackers, which were then scanned and sent to myself who

uploaded the data onto the excel spreadsheet. I was also provided with the daily breakdown of covers which I uploaded onto the spreadsheet. The hotel also bought different coloured bin bags to aid with segregation.

4.3.2 Food waste results

4.3.2.1 Baseline

The hotel began recording food waste on the 04/05/2015 due to periods of short staffing, high occupancy rates and numerous event bookings. Due to the predicted fluctuations in food waste a three week baseline period was allowed to capture some of these fluctuations. Plate waste was highlighted as the largest source of food waste, contributing 53% of food waste a week, see Figure 15. Second largest was preparation waste (36%), followed by prepared not served (5%), the staff canteen (4%), with spoilage producing 1%. Table 5 shows the time of day responsible for producing the most wastage is lunch, which produces 0.926kg per cover of waste a week, although this is influenced by one day that saw lunch produce 78kg of waste for 15 covers, but 50kg of this was produced through making stock. Without this additional 50kg, per cover waste falls to 0.813kg. Dinner is the second largest source, producing 0.485kg per cover, with breakfast (0.396kg per cover) and events (0.361kg per cover) producing the rest. As expected, this hotel produces the largest quantity of food waste as well as producing the most waste per cover compared with the other two hotels, see Table 6.

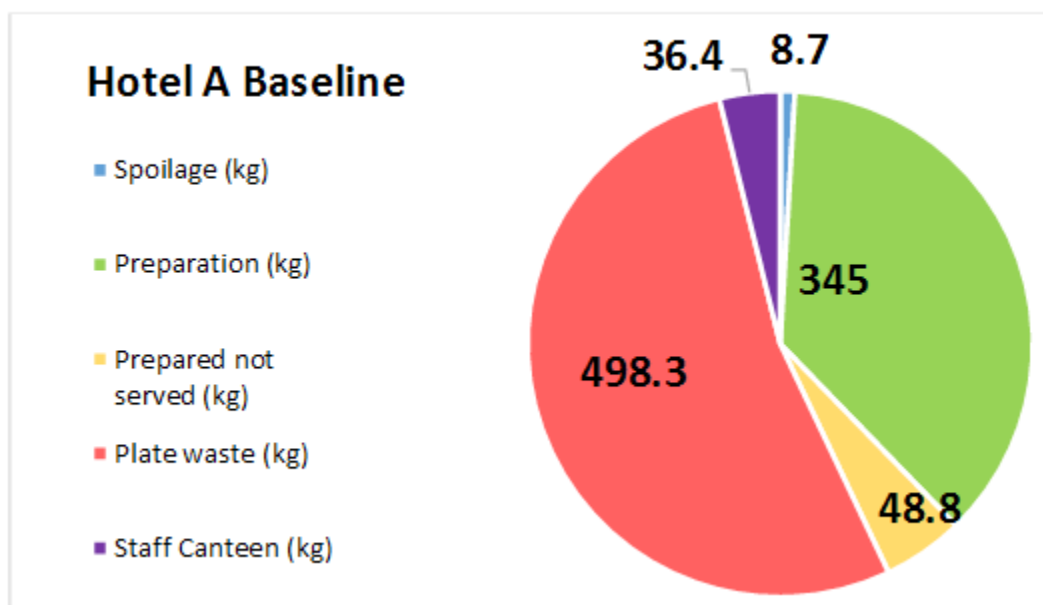


Figure 15: Baseline data for Hotel A, sources of waste categorised by production method

Table 5: Baseline data for Hotel A, sources of waste categorised by time of day, and events.

Baseline				
	Breakfast (kg)	Lunch (kg)	Dinner (kg)	Events (kg) ¹
Total	332	286	265	209
Per cover	0.396	0.926	0.485	0.361

¹ Events waste was categorised alongside time of day, as food waste from events was not consistently segregated and recorded separately and was often recorded as 'prepared not served' and 'plate waste', so it would be counted twice if displayed alongside 'preparation' etc. However, covers for events were provided by time of day e.g. "special events lunch", "special events dinner" etc. So the quantity of food waste from events was calculated by multiplying the waste produced at lunch by the proportion of lunch event covers, e.g. if lunch waste was 10kg, and there were 5 lunch covers and 5 event lunch covers, the calculation was 10×0.5 (as 50% of lunch covers were from events), resulting in that days lunch events producing 5kg of food waste. This process was followed for calculating events waste from Hotel C as well.

Table 6: Comparison of baseline data captured by each hotel.

Baseline		
Hotel in chain	Average Weekly Food Waste (kg)	Average Per Cover Food Waste (kg)

Hotel A	900.8	0.351
Hotel B	180.1	0.267
Hotel C	117	0.177

4.3.2.2 Food waste reduction and prevention measures

Figure 16 and Table 7 show the quantity of food waste produced by Hotel C fluctuates throughout the course of the project, with the food waste per cover fluctuating around the 0.340kg per cover mark. The fluctuations are mirrored by the varying number of event covers, Figure 17.

Figure 16: Summary of the progress made by Hotel A during the 12 week monitoring period.

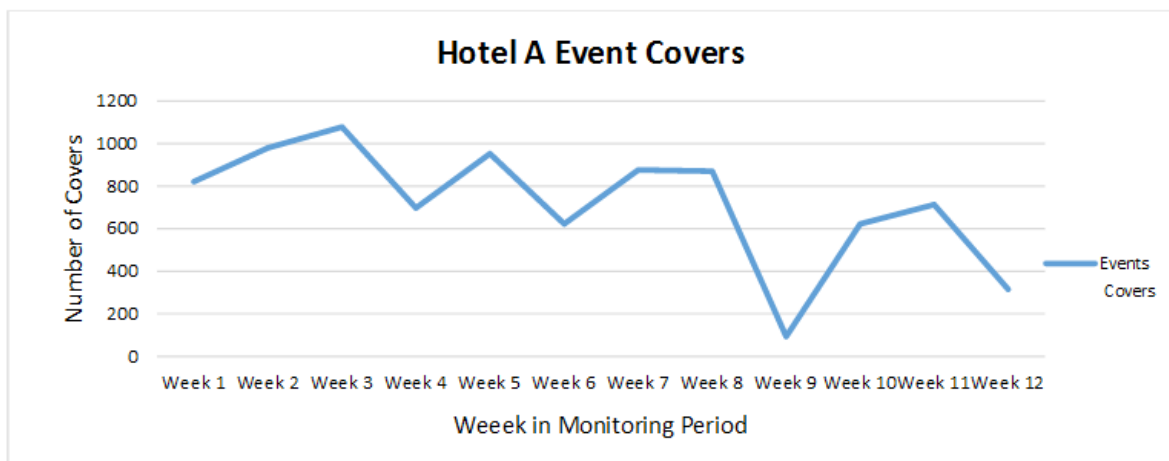
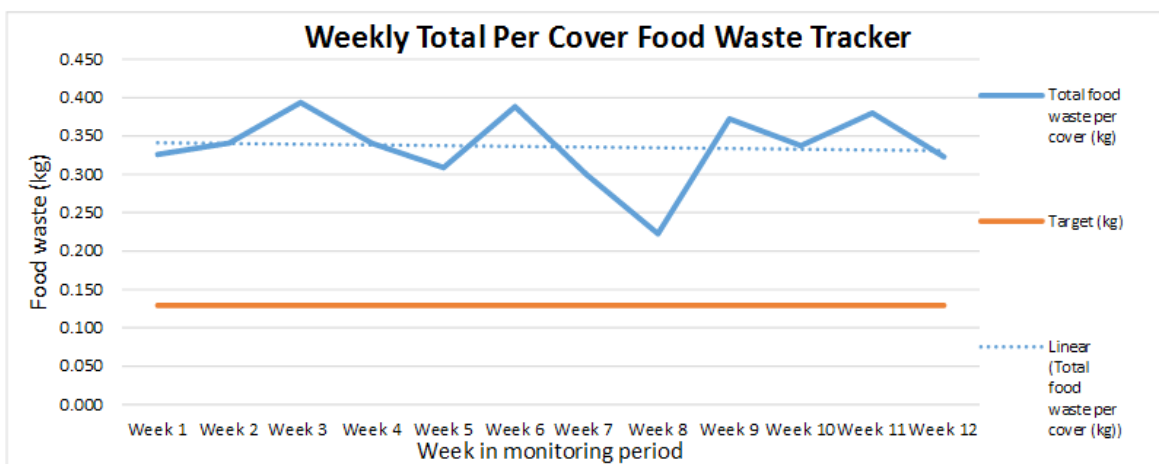


Figure 17: Number of event covers at Hotel A across the monitoring period.

Table 7: Numerical representation of the data displayed in Figure 16.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Total Food Waste (kg)	752.50	871.6	1108.4	874.7	787.2	905.5	804.41	621.4	681.2	854.8	1021.1	770.5
Covers	2309	2558	2816	2568	2549	2332.5	2683.5	2789	1829.5	2534	2686.5	2386
Per Cover Food Waste (kg)	0.326	0.341	0.394	0.341	0.309	0.388	0.300	0.223	0.372	0.337	0.380	0.323

One area the GM wanted to address was the food waste produced by events,; *“in December we served around 3,000 covers in the conference rooms...people have a choice of 3 starters, 3 main courses and 3 desserts...I remember going to the kitchen after the service of the main course...I saw a whole rack full of the salmon, all cooked off, as people then decided they wanted the turkey, so salmon is wasted”*. This observation was based on the waste from one occasion, but he stated that he had witnessed similar scenes at other times as well. The GM decided to minimise waste though liaising with customers to more accurately predict demand. This reduction measure was implemented in Week 6, with results showing that it failed to decrease food waste. As food waste from events increased from 0.449kg per cover across Weeks 1 – 5, to 0.539kg per cover in Weeks 6 – 12. The GM expressed interest in putting up a poster in the staff canteen to promote awareness of food waste, but declined the opportunity to put it up at the guest breakfast buffet, see Appendix A. The GM was also interested in providing different portion sizes when the chain wide menu changes in August/September time.

4.3.3 Statistical analysis

The data was split into sections (Baseline, Awareness (Weeks 4-5) and Treatment (Weeks 6-12), and First 5 Weeks (combination of the baseline and awareness periods)). The same was done for the event data. The awareness period was too small for a normality test to be conducted, so nonparametric Wilcoxon matched pairs tests were carried out on each of the pairs to determine whether the waste increase occurred due to the treatment, or just chance. The results for the event data and complete data show that the increase did occur due to chance, see Table 8.

Table 8: Results of the statistical analysis for Hotel A.

Pairs	Complete Data Set (P value)	(P Event Data (P value)
Baseline and Awareness	1	0.5
Baseline and Treatment	0.75	0.5
Awareness and Treatment	1	1
First 5 weeks and Treatment	1	0.437

4.4 Hotel B Results

Hotel B recently undertook renovations converting the event hosting rooms into an additional 5 bedrooms. This produced available space in the kitchen that used to be used for preparation and storage of produce for events (Head Chef Hotel B, 2015, pers., comm., 17th February), allowing additional bins and scales to be stored in the kitchen without impeding daily activities. The HC was the primary contact at this hotel and was responsible for enforcing waste segregation and recording the data onto the daily trackers, the HC also uploaded the daily food waste data onto the excel spreadsheet. Upon initial meeting with the HC to explain the project, I found there were issues with effectively segregating food waste from other wastes, as shown in Figure 18. The issue was raised with the HC who stated that he would utilise the signage provided in the action plan to ensure that food waste was segregated correctly.



Figure 18: Example of a food waste bin at Hotel B prior to the commencement of the food waste project.

4.4.1 Food waste recording process

Through communication with the HC, Hotel B's food waste recording process was as follows; "I have a folder above the scales and the Kitchen porters are recording (on the daily food waste tracker, Figure 7) like clockwork. In the folder I have a poly pocket for each week. At the beginning of the next week I input all the information onto the excel document." Because the HC uploaded all of the food waste and cover data onto the spreadsheet himself, we do not have the daily breakdown of waste that is provided for the other hotels.

4.4.2 Food waste results

4.4.2.1 Baseline

The hotel began recording food waste on the 09/03/2015, yet had been practicing food waste monitoring for a few days beforehand in order to determine any issues and allow staff to get used to the new methods of disposing of waste. The HC sent over the first two weeks data in order to be able to construct a baseline. As shown in Figure 19, the primary source of food waste is customer plate waste, accounting for 61% of food waste produced, preparation accounted for 31% and prepared not served made up the final 8%. No spoilage waste was produced during the baseline period.

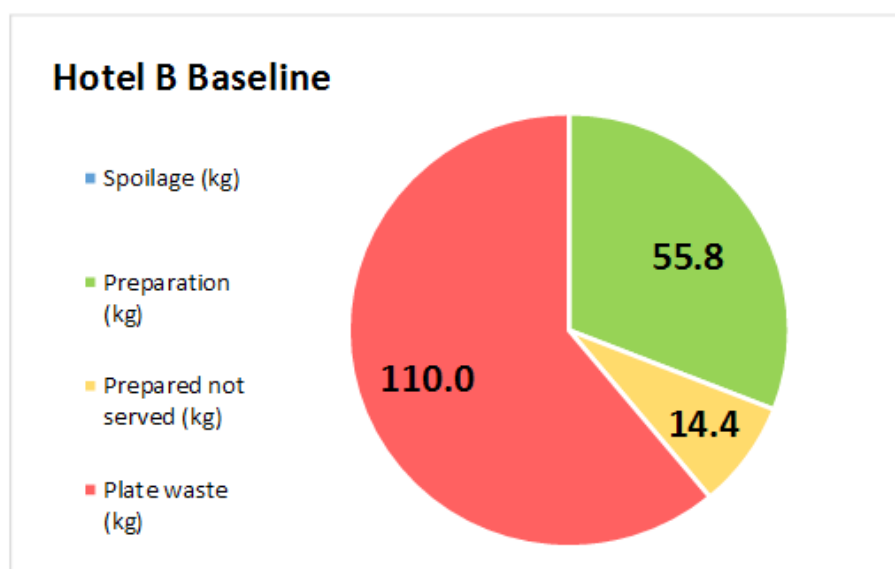


Figure 19: Baseline data regarding quantity of food waste produced by Hotel B over the first two weeks of monitoring.

4.4.2.2 Food waste reduction and prevention measures

Figure 19 and Table 9 show that Hotel B manages to steadily reduce the quantity of food waste produced throughout the monitoring period. The hotel managed to achieve a 33% decrease in per cover food waste between the baseline period and the final week of monitoring.

Through communicating with the HC, he informed me that; *“Breakfast is definitely the biggest culprit, with cold buffet & plate waste the highest (culprits)”* (Head Chef Hotel B, 2015, pers., comm., 29th April) – these observations were based on the data he had seen in the daily waste trackers. Thus they switched from buying fresh fruit for the cold breakfast buffet to pre-cut fruit in order to reduce the preparation waste from the breakfast period. This reduction measure was implemented on the 14/04/2015 (week six), and while the per cover waste reduction that followed only showed a decrease of 4%, the per cover preparation waste produced over the final eight weeks decreased by 49% compared to the first five weeks. This was the only food waste prevention measure to be implemented, but after the first five weeks of monitoring food waste had been reduced by 30%, Figure 20.

Figure 20: Summary of the progress made by Hotel B during the 13 week monitoring period.

Table 9: Numerical representation of the data displayed in Figure 20.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13
Total Food Waste (kg)	186.1	174.1	178.8	235.8	232.4	184.3	214.1	176.4	179.9	191.5	170.9	165.2	192.15
Covers	619	728	745	654	894	984	943	836	933	1115	1006	1063	1075
Per cover Food waste (kg)	0.301	0.239	0.24	0.361	0.26	0.187	0.227	0.211	0.193	0.172	0.17	0.155	0.179

4.4.3 Statistical analysis

The data was split into sections (Baseline, Awareness (Weeks 3-5), Treatment (Weeks 6-13) and First 5 Weeks). The same was done for the preparation data. The baseline period was too small for a normality test to be conducted, so non-parametric Wilcoxon matched pairs tests were carried out on each of the pairs to determine whether the waste reduction occurred due to the treatment, or just chance. The results for the preparation data and complete data show that the treatment had no effect, see Table 10.

Table 10: Results of the statistical analysis for Hotel B.

Pairs	Complete Data Set (P value)	Preparation Data (P value)
Baseline and Awareness	1	1
Baseline and Treatment	0.53	0.5
Awareness and Treatment	0.25	0.25
First 5 weeks and Treatment	-	0.625

4.5 Hotel C Results

Hotel C is the smallest hotel in the chain, and the kitchen size reflects this fact, see Figures 11 and 12, which resulted in the issue of lack of available space. The GM was the primary contact at this hotel as he shared a mutual interest in sustainable business practices, so was an effective champion in motivating and maintaining staff compliance. The hotel experienced difficulties with recording food waste due to staff shortages and busy periods resulting in food waste segregation and monitoring proving too difficult at times resulting in gaps in the data, but they still completed 14 full weeks.

4.5.1 Food waste recording process

They overcame the issue of space by sliding the scales - when not in use - under one of the work stations, they also only used two bins to record three (later four) categories of food waste. One bin was for plate waste with preparation waste being kept in the other. Preparation waste was collected in small buckets located on the counter tops, this waste was collected in small bags within the buckets (see Figure 11) which were then added to the bin. The kitchen staff collected spoilage

waste at the start and end of each day in a bag when they checked the fridges and storage areas for spoiled items. These actions resulted in the kitchen requiring only two food waste bins. The hotel is now recording events waste by collecting it in a bag once the event is over.

The kitchen staff recorded the food waste on the daily food waste trackers, these were then scanned and sent to myself, who uploaded the data onto the excel spreadsheet. I was also provided with the daily breakdown of covers which I was to upload onto the spreadsheet. This enabled me analyse trends in further detail.

4.5.2 Food waste results

4.5.2.1 Baseline

The hotel began recording food waste on the 09/03/2015 after an initial period of short staffing. Due to the hotel experiencing difficulty prior to the commencement of the project, we allowed three weeks to be included in the baseline. This revealed 'plate waste' was the primary source of waste, as this accounted for 68% of food waste, with 'preparation' contributing 31%, with 'spoilage' only contributing <1%, see Figure 21. The dinner period was the largest source of food waste, producing 0.336kg per cover, breakfast was the second largest with 0.175kg per cover. Events produced 0.103kg per cover, and lunch produced the least at 0.096kg per cover.

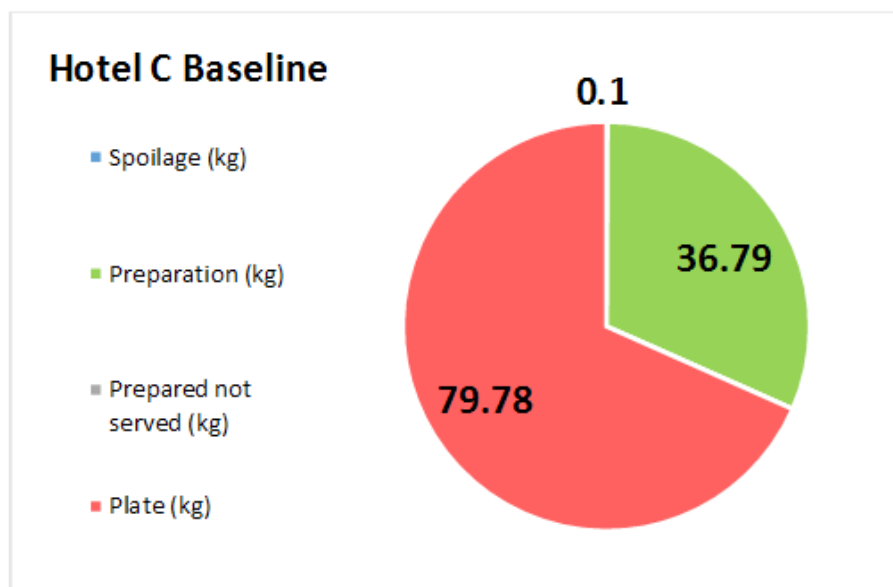


Figure 20: Baseline data regarding quantity of food waste produced by Hotel C over the first three weeks of monitoring.

4.5.2.2 Food waste reduction and prevention measures

The data provided in Figure 22 shows the quantity of food waste produced by the hotel greatly fluctuates. Week 4 saw the same quantity of food waste produced as Week 2 (118kg) but had a much lower number of covers (729 in Week 2 and 532 in Week 4). The food waste then proceeds to fluctuate due to high occupancy and staff shortages and monitoring of food waste ceases (apart from a two week period in May). Per cover food waste peaks in Week 18 as number of covers sharply falls from 798 covers in Week 17, to 488 covers in Week 18, see Table 11. Week 18 produced the largest quantity of spoilage (25.5kg) observed during the project, weekly spoilage only exceeds 10kg at one other point, in Week 17. This period of high wastage appears to level out, as Weeks 19 and 20 produce 0.113kg and 0.128kg of food waste respectively. This is the only Hotel to beat the hotel industry average of 0.129kg of food waste per cover, it does so in Weeks 10, 16, 19 and 20. During the baseline period the hotel produced 0.177kg of food waste per cover, due to the large spike in Week 4 this rose to 0.184kg during the increased awareness phase (Weeks 4 – 6). The final six weeks produced 0.160kg per cover.

The hotel is in the process of being able to organise its own events (events at this hotel are currently organised through head office), thus I requested the hotel to begin recording events waste to determine whether this change in organising will have an impact on food waste production. The hotel has not currently achieved this change, but will be able to organise its own events in the future. An increase in general awareness saw the kitchen porters highlighting food that needed to be used up in the kitchen, and write these items down on notes on the fridges. The hotel changed its menu on the 01/06/2015 to utilise more of the ingredients to reduce waste. The hotel also has increased communication with clients hiring the event/conference facilities to more accurately predict food demand. The GM also stated his intention to provide different meal sizes in the restaurant to cater for people who do not want a full meal (General Manager Hotel C, 2015, pers., comm., 29th June). This measure is due to be implemented when the chain wide menu changes in August/September.

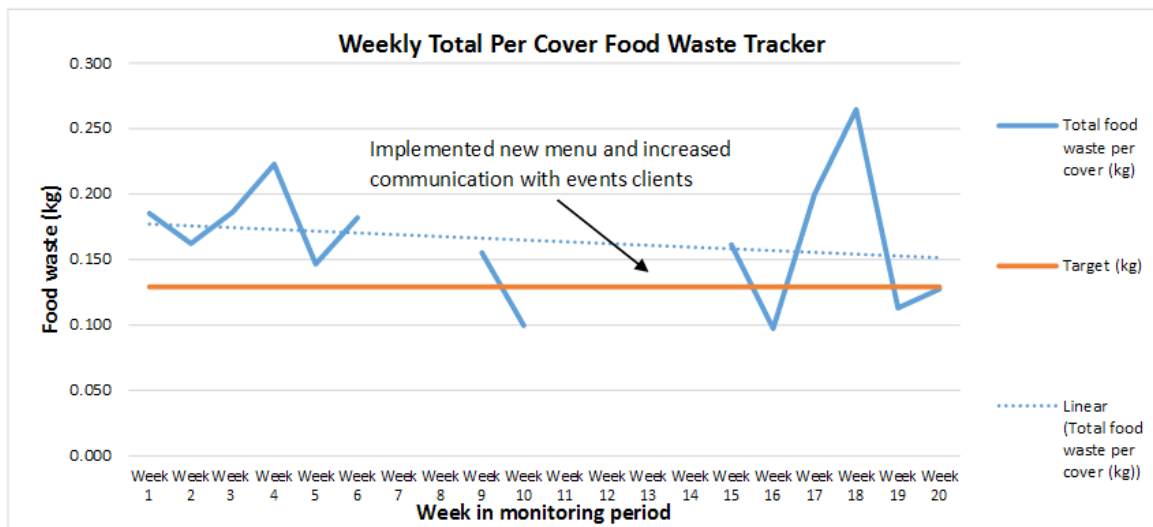


Figure 21: Summary of the progress made by Hotel C during the 14 week monitoring period

Table 11: Numerical representation of the data displayed in Figure 18.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 9	Week 10	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20
Food waste (kg)	98.49	118.2	133.3	118.5	166	68.5	79.6	78.9	100.1	63.6	159.7	129	79.3	60.1
Covers	532	729	716	532	511	377	513	793	621	654	798	488	703	472
Per Cover Food Waste (kg)	0.186	0.181	0.217	0.245	0.147	0.181	0.172	0.130	0.171	0.112	0.215	0.263	0.113	0.128

4.5.3 Statistical analysis

The data was split into sections (Baseline, Awareness (Weeks 4-6, 9-10), Treatment (Weeks 15-20) and First 8 Weeks). The same was done for the events, spoilage and preparation data, as the food waste prevention measures target these sources. A Wilcoxon Matched Pairs test was utilised to test whether the treatments produced a reduction in food waste. This test was used due to the low number of pairs. The results from the statistical analysis show the treatments did not produce a reduction, Table 12.

Table 12: Results of the statistical analysis for Hotel C

Pairs	Complete Data Set (P value)	Preparation Data (P value)	Events Data (P value)	Spoilage Data (P Value)
Baseline and Awareness	1	0.75	0.25	0.371
Baseline and Treatment	0.5	0.25	0.5	0.25
Awareness and Treatment	0.25	0.461	0.5	0.375
First 8 weeks and Treatment	0.315	0.437	0.25	0.181

4.6 Exit Questionnaire Analysis

There was no response to this questionnaire from Hotel B, as the primary contact (the HC) left the hotel chain just before the questionnaire was written, and no other staff member knew enough about the project to be able to answer all of the questions.

4.6.1 Do you think you saw a reduction in the quantity of food waste between the first and final weeks of the project?

Both hotels were unsure as to whether a reduction was achieved, with the GM of Hotel A stating that *“Difficult to say as the business fluctuates significantly. I do feel it is important to monitor as you cannot control something if you do not measure it. The focus of monitoring the waste will automatically make people think about wasting less. From a staff perspective this is good but from a guest perspective I am less convinced that they pay particular attention to this”*. The GM of Hotel C said *“I am not sure how much of it (reduction in food waste) is related to the project”*, as the reduction could be due to changing *“business practice”* within the kitchen. He went on to add that *“portion sizes (for events) are much better now”*, implying reduction in certain areas has been achieved.

4.6.2 Which food waste reduction measures have you implemented?

Both hotels elected (in the short term) to address business practices to reduce wastage. With Hotel A focussing on *“Banqueting food delivery”*. Hotel staff started *“Being prescriptive on orders and pre orders...as well as changes to the delivery”*. Hotel C aimed to tackle business practices in the kitchen as *“there was not always proper stock rotation”* which led to unnecessary waste. They also

implemented *“the new menu...is slightly better at using up the ingredients”*. The GM wants to implement different meal sizes or ‘lite bite’ options for guests, but he said in the questionnaire that *“portion sizes in the kitchen is something we still wish to address”*.

4.6.3 What made you choose the waste reduction measures you chose?

Hotel A chose this measure as *“a significant amount of waste originated from this area”*. The *“cost of waste”* was also an important factor, as large quantities of waste mean greater costs. The GM wanted to minimise any impact upon guests, as the measure *“whilst easy for guest, impacted on service delivery and waste”*. The GM of Hotel C undertook these measures as *“one of the many issues was waste”* and that *“our food GP (Gross Profit) not being high enough... This has financial implications”*.

4.6.4 If you were to carry out another food waste monitoring/prevention scheme in the future, would you do anything differently?

Hotels A and C had different attitudes with regards to this, the GM of Hotel A believes *“food waste prevention should cover the full spectrum so that waste is being handled responsibly before products arrive at our door and after waste has left our bins. We need to question what happens to it and is this responsible... this (food waste) can be put to good use”*. Whereas Hotel C would look at achieving greater staff buy-in through *“advertise costs and savings more to staff... as they see it (monitoring food waste) as extra work for no benefit.”*

4.6.5. Did you encounter any barriers or difficulties with food waste monitoring/prevention?

The responses here differed slightly, but both focussed on the theme of general awareness/education being poor and leading to increased waste. The GM of Hotel A focussed on achieving employee buy-in and stated that *“Staff naturally will question the time it takes to fit this task in amongst their other tasks”*, so justifying the action through a *“cost / benefit analysis ... would be important to justify the viability”*. The GM of Hotel C argued that general education is a problem, as *“The big barrier is still the lack of training and education”* as *“the chefs don’t really understand why we are doing it, they still look at it as a bit of an annoyance... They don’t think they gain anything”*. The GM went on to say that *“there is the decade of lack of education, learning, training, a mentality. I think the biggest barrier is the mental side...Once you get into a habit, it’s hard to break”*.

4.6.6. The first questionnaire highlighted staff and customer habits as being the greatest barriers to reducing food waste. Do you feel that these are the greatest barriers?

Both GMs agreed that these are still the greatest barriers, with the GM of Hotel A saying *“guests want to feel that they are getting value for money...In terms of a Buffet or prepaid meal the perception is that I have paid for this so I will take 3 sausages even though at the end of the breakfast I have only eaten 2”*. However, the GM recognises that *“just because the Staff or Customer may not support this does not mean it should not be done”*. The GM of Hotel C follows on from their earlier answers by saying *“Training and education have made these habits that are difficult to break, there is definitely a generational thing, as the younger staff are much more motivated.”* Which implies that there is a change both within the hotel, but also within society.

4.6.7. Did you notice any particular strengths that made the running of the scheme easier?

Both Hotels focussed on employee motivation, with staff at Hotel A possessing a *“let’s just do it attitude”*, with the staff at Hotel C being actively engaged with segregating and monitoring and buying in straight away, these were the younger staff members mentioned in his answer provided in section 4.6.6.

4.6.8. Did you notice anything in particular that motivated staff to keep segregating and monitoring food waste?

Hotel A kept their staff motivated through *“re-enforcing the message and...good practise”*, whereas the younger staff at Hotel C had *“a bit of a positive mentality”* when compared with the older staff. The young staff were self-motivated, possibly because *“These were the ones that were writing notes and highlighting products that are to be disposed of”*. The GM stated that there has been talk among management about implementing a sustainability training programme across the chain, but this is currently still up in the air.

4.6.9. Were there any occasions when monitoring of food waste stopped?

Hotel A had no trouble maintaining monitoring as they only had an initial delay at the start of the project. Hotel C suffered from periods of high occupancy and a *“few staff shortage issues”*, which led to external kitchen porters coming in and not knowing what the waste segregation procedures were, so the project was paused until the regular staff returned, or occupancy fell to the point that food waste monitoring was practical again.

4.6.10. Do you have any advice you would like to give to the other ***** hotels who are thinking of implementing the scheme?

The hotels both focussed on staff buy-in, with the GM of Hotel A saying *“just start and you will work this into the daily tasks and get buy-in along the way”*. While the GM of Hotel C argued that the manager needs to buy-in, as *“There needs to be more explaining to the staff”*, as if staff do not have direction and motivation, they may revert back to old habits.

4.6.11. Research highlighted food redistribution, staff education, food waste monitoring, composting and improved menu planning, as the main methods for tackling food waste, would you consider implementing any of these measures?

Hotel A would consider implementing all of these measures, if they would decrease food waste. The GM of Hotel C states that staff training and menu planning are best for their hotel, as composting is not relevant as they do not possess a garden, but would consider composting if contractors *“collected all of the food waste. To take it away”*. Food redistribution was not appropriate as the GM stated *“the way we handle food is basically there is no time to do anything like that”*, and stating that requirements regarding the handling of the food makes it difficult. The main factor that would influence implementing these measures would be the staff, and that *“cost benefit analysis would help to show the savings of segregating and reducing waste.”*

4.6.12. Is your job, or the head chefs’ job, less secure if profitability of the hotel does not increase, even if the environmental friendliness (reduced environmental impact) increases?

The GMs differed slightly in their opinions about this, the GM of Hotel A stated that *“Yes profitability is a key driver and if profitability does not improve this threatens hotel”* indicating that profitability is more important than reduced environmental impact. The GM of Hotel C argues that *“more profitability is always very important...it’s a business”*, but that *“if we meet our targets and make what we should be making, then after that I think there is time and space to do things like looking after the environment.”* And that *“if we are still profitable, if we do something to improve on our impact, it should be seen as positive”*. So while he says that profitability is more important, it is not the only factor in determining how successful a hotel is.

4.6.13. How important is communication and support between management and kitchen staff with regards to waste management?

Both hotels found this important, but the GM of Hotel C added that with a project like this communication is crucial because food waste is not always in the front of everyone’s mind. The GM

expanded to say that “it is very important to convey a positive message...as you see with some of the other hotels, some failed to complete it.”

4.7 Systematic Literature Review

The total amount of journals returned after entering the chosen keywords was 19,882, see Table 13. From this, only fifteen journals passed through the two rounds of review, with those fifteen being used to determine food waste reduction/prevention measures.

Table 13: Results of the search for relevant journal articles. Only the first 500 results shown by ‘Google Scholar’ were used, as no positive results were shown after article number 300.

Database	No of journals found	No. of journals after round 1 of review	No. of journals used
Science Direct	1402	8	2
Wiley Online Library	346	4	0
Springer Link	304	3	2
JSTOR	930	3	0
Google Scholar	16,900	26	11
Total	19,882	44	15

After reviewing the literature, the most advised methods of food waste reduction/prevention in hotels were; food redistribution (six journals), staff education (five journals), food waste monitoring (four journals), composting (four journals) and improved menu planning (four journals), see Table 14 for full results. The top seven measures contain a mix of processes by encompassing many levels of the waste prevention hierarchy, see Figure 4. With staff and guest education, menu planning and signage falling under the ‘Prevention’ category, as these measures aim to reduce the production of waste. Food redistribution falls into the ‘Optimisation’ category as this treats food as a resource and aims to optimise its usage. Composting treats food waste as a resource which can be recycled into another useful product, thus it falls into the ‘Recycling’ bracket.

Table 14: Results from the systematic literature review.

Prevention measure	Description of measure	Supporting literature
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Food waste monitoring	Conduct food waste audit to raise awareness of how much food is disposed of	(Bohdanowicz <i>et al.</i> 2011; Filho <i>et al.</i> 2015; Pirani & Arafat 2014; Silvennoinen <i>et al.</i> 2012)
Food redistribution	Redistributing surplus food to local charities	(Chan 2009; Filho <i>et al.</i> 2015; Halloran <i>et al.</i> 2014; Malik & Kumar 2012; Oleskow-szlapka <i>et al.</i> 2011; Pirani & Arafat 2014)
Staff education	Improving staff awareness to improve compliance with waste reduction policy	(Mensah 2006; Filho <i>et al.</i> 2015; Pirani & Arafat 2014; Youngs, Nobis & P. Town 1983; Singleton 2012)
Guest education	Providing leaflets in rooms etc. in order to help reduce waste produced by guests	(Mensah 2006; Filho <i>et al.</i> 2015; Pirani & Arafat 2014)
Composting	Gathering food waste and storing it to produce compost	(Mensah 2006; Oleskow-szlapka <i>et al.</i> 2011; Pirani & Arafat 2014; Radwan <i>et al.</i> 2012)
Composting with earthworms	Same as composting but the earthworms speed up the process	(De Lange 2012)
Inventory management	Effective stock rotation, and implementing 'first-in, first-out' mentality	(Filho <i>et al.</i> 2015)
Batch cooking to chill/freeze	Cook batches of meals and freeze them, then defrost as required	(Filho <i>et al.</i> 2015; Pirani & Arafat 2014)
Portion control	Enforce portion control to minimise waste through plating up too much food	(Filho <i>et al.</i> 2015; Pirani & Arafat 2014)
Provide range of portion sizes	Provide 'lite bite' options if customers do not want large meals	(Filho <i>et al.</i> 2015)
Signage	Create signage to promote effective waste management to guests	(Filho <i>et al.</i> 2015; Pirani & Arafat 2014; Kallbekken & Sælen 2013)
Improved menu planning	Plan menus to utilise surplus produce, remove items regularly seen to be disposed of, utilise fewer ingredients	(Filho <i>et al.</i> 2015; Pirani & Arafat 2014; Radwan <i>et al.</i> 2012; Youngs, Nobis & P. Town 1983)
Reduce buffet replenishment rate	Only top up buffet containers when necessary	(Filho <i>et al.</i> 2015; Pirani & Arafat 2014)
Replenish buffet dishes with smaller portions	Only top up small quantities and state 'if more is required, please let our staff know'	(Filho <i>et al.</i> 2015)

Re-use surplus food to produce new meals	Creating 'dish of the day' which utilises surplus food	(Malik & Kumar 2012; Youngs, Nobis & P. Town 1983)
Food waste mapping	Maps out the sources of food waste and quantities, enabling the viewer to visualise the primary sources of food waste	(Pirani & Arafat 2014)
Switch from buffet to 'a la carte' menu design	'A la carte' menus cater on a cook to order basis and produce less wastage	(Pirani & Arafat 2014)
Decreasing plate size at buffets	Smaller plates reduce the quantity of food customers can fit on the plate	(Pirani & Arafat 2014; Kallbekken & Sælen 2013)
Provide take-away packaging	Allows guests to take away their leftovers	(Pirani & Arafat 2014)
Cook to order	Cook to current demand	(Radwan <i>et al.</i> 2012)
Purchasing pre-prepared food items	Reduces preparation waste	(Radwan <i>et al.</i> 2012)

5. Discussion

5.1 Cultural Change

5.1.1 Hotel attitudes

The questionnaires highlighted how much attitudes towards food waste have changed over the past 17 years. A study by Kirk (1998) showed that hotel managers in Edinburgh did not think waste management could improve the profitability of their hotel. Yet this project showed that two hotel GMs thought that reducing food waste can save the hotel money, and two again think reducing waste leads to more sustainable business practices. This shows an increase in awareness of waste management, and of its benefits. But, cost is still more of a driving force compared to committing to actions purely because of their pro-environmental benefit (Park 2009). I believe this is partly due to hotel managers being judged primarily on profitability, as highlighted by the GM of Hotel A in the exit questionnaire. This shows managers have more of an incentive to achieve greater profit margins than to reduce the environmental impact of their hotel. However, the GM of Hotel C stated that after targets have been met, there is room to focus solely on reducing environmental impact, and that improving the environmental friendliness of their hotel should be held in greater standing. While this GM does not state this is actually the case, but more argues that it should be, it still supports the fact that environmental awareness is increasing within hotel management. But, regardless of the motivation, as long as environmental benefit is achieved, the process and motivation does not matter as the impact of the establishment is being reduced. While in an ideal world, businesses and consumers alike would aim to minimise their environmental impact for the sake of the environment, our current behaviours are often driven by monetary or materialistic incentives (Fietkau & Kessel 1981). But as long as the destination is the same, the process is not as important. Dewhurst & Thomas (2012) and Rohrschneider (1988) instil a sense of hope, as they state the ideas of environmental responsibility are formed during our informative years, and as sustainability becomes more mainstream, future generations will possess a greater interest and passion for sustainability. This opinion is supported by the GM of Hotel C, who stated that it is the younger employees who drive food waste reduction in the workplace and seek to change business practices to reduce their environmental impact.

Part of the purpose of the questionnaire was to determine whether or not the attitude of GMs and HCs regarding food waste were the same. The results show there was no great difference in attitudes. The difference predicted between HCs and GMs was that management would be more focussed on the cost of waste, whereas HCs would prioritise the quantity of waste. While chefs are still focussed on the quantity of waste and using ingredients efficiently, the questionnaire

highlighted that trying to keep down costs is the main driver, with one reason being that they are judged on profitability. The HC of a hotel that pulled out of this project said that cost is such an important factor as part of their role is to keep costs low, as they have a set budget with which to buy ingredients (Head Chef 1, 2015, pers., comm., 17th March). Thus, if they save money by reducing wastage, then they can purchase higher quality ingredients and look better to management, which provides job security. This hints at a larger issue, that profitability overrides environmental benefit (Dewhurst & Thomas 2012).

5.1.2 Profitability and environmental benefit

A study by Williamson & Lynch-Wood (2001) revealed that management, in general, is only concerned about the environment in an economic sense, and that reducing environmental impact should be reflected by minimised costs. One respondent to the Williamson & Lynch-Wood (2001) study stated that reducing environmental impact should be pursued if it makes sense economically. In reality, profitability will only play a supporting role in a project if the company has enough money to spare in order to pursue environmental beneficial policies. According to the Office for National Statistics (2011) and Hotel Industry Magazine (2015), there are 38,939 hotels in the UK, of this roughly 19,850 are independently run. This means that the majority of hotels are less likely to prioritise environmental benefit over profitability due to more limited capital and funds (Singleton 2012). Coutrice (2014) argues that for hotels to prioritise sustainability over profits, pressure must come from different levels of the supply chain, from consumers demanding different products, to suppliers who will only buy or sell goods to like-minded businesses. Dewhurst & Thomas (2012) argue that showing a belief that the staff member has personal responsibility for their actions, and an understanding of the impact they have on the environment is likely to lead to a positive attitude towards sustainability. A failure to act is also closely linked with profit driven motivations, therefore an attitude of 'just do it' should be adopted by hotels, as this is the way of achieving environmental benefit, by actually practicing sustainable behaviour (Dewhurst & Thomas 2012).

5.1.3 General awareness

The questionnaire highlighted general awareness (both from staff and the public) as the main barrier to reducing food waste. This has been noticed by other studies (Giorgi 2013; Youngs, Nobis & P. Town 1983; Singh et al. 2014; Dewhurst & Thomas 2012), as often hotel staff are blamed for falling into bad habits, e.g. over portioning, and guests are blamed for not practicing sustainable behaviour, e.g. ordering more food than they can eat. The primary method of engaging and

motivating staff is through training and communication, as this can teach how simple actions impact waste, costs and the environment (Marthinsen *et al.* 2012). This can also be used to provide alternative actions and habits they can practice in order to reduce their impact. For guests, awareness campaigns and opening up dialogue can promote sustainable behaviours in an unintrusive fashion. Posters and leaflets can be used to nudge the consumer into not being wasteful, as guests are often willing to reduce their environmental impact (Marthinsen *et al.* 2012; Pirani & Arafat 2014; Mensah 2006; Iwanowski & Rushmore 1994; Filho *et al.* 2015).

5.1.4 Consumer attitudes

Using customer plate waste as an indicator of consumer attitudes, this poses the largest barrier to preventing food waste, as this accounted for approximately 54% of all food waste produced across the project, and it is the source of waste that hotels have least control over. Hall *et al.* (2009) states that consumers are wasting increasing quantities of food due to “*increased food availability*”, resulting in people buying more than they can eat. This is the case both in retail and hotels, as guests often buy more/too much as they interpret the occasion as a treat, and should not be concerned about wasting, which would explain the reasoning for plate waste contributing the largest portion of waste (Giorgi 2013). Both Hall *et al.* (2009) and Youngs, Nobis & P Town (1983) recognise this problem, as food is seen as readily available and that once you have bought it you can waste what you want. Another reason is that within society on a whole, food is no longer seen as a precious or economic commodity (Youngs, Nobis & P Town 1983), as when food is bought it loses economic value and can therefore be wasted. Stuart (2009) states that food is readily available to the point that consumers can easily restock, and they apply views when eating out. When hotel guests purchase a meal, the cost of the meal is often included in the room cost, therefore they feel the food is ‘free’ as they do not have to pay for it separately (Giorgi 2013). Giorgi (2013) goes on to argue that current social norms create wastage, as approximately 8% of people in the study said they left food as they did not want others in the party thinking they were ‘overweight’. This view is unhealthy both in terms of wastage, but also from a body image and health perspective, so facilitating cultural change will produce multiple benefits. From the production side, plate waste is large due to portion sizes being too great (Giorgi 2013), a point that was observed by hotel managers in this study, who subsequently agreed to review meal sizes. Consumers need to see food as an economic commodity to provide incentive to prevent waste. During communication with one GM, it became apparent that to induce behavioural change in hotel staff you must show staff the potential economic savings, this puts an economic value on

food, as the more you waste, the higher the costs (General Manager Hotel A, 2015, pers., comm., 24th July). A proven way to bringing around change on behalf of both the consumer and staff, is through education (Dewhurst & Thomas 2012; Kollmuss & Agyeman 2002; Singleton 2012).

5.2 Solutions

Any solutions must be created in line with the waste prevention hierarchy, with attention paid to the prevention and optimisation of food. As these treat food as food, and not waste, leading to reduced demand. Firstly educating staff and the public can show just how their actions impact wastage, and how they can reduce the quantity of food they waste. Communication and teamwork are crucial in the workplace, as this provides direction, motivation and participation with reducing wastage. The food waste reduction measures will vary between hotels, as the measures practiced depend on: capital, available space, source of waste and attitude of management. See Table 14 in the results section for details of reduction measures.

5.2.1 Education

According to Singleton (2012) and Filho *et al.* (2015), educating staff and the public will lead to an increase in motivation and participation with regards to pro-environmental behaviour. Yet Kollmuss & Agyeman (2002) add that individuals often follow social norms, and that simply educating individuals is not always going to bring about the desired change in behaviour. Hines, Hungerford & Tomera (1987) argue that to achieve pro-environmental behaviour the following need to occur:

- The individuals need to be familiar with the problem
- The individual should know how they can act to lower their impact
- People must feel a sense of responsibility for their actions
- People must feel like they personally can contribute to bringing about a change
- Incentives are more likely to induce change (Fietkau & Kessel 1981)

Therefore, an education program must include all of these features. The individuals must know what the problem is before starting, and be shown how their actions - be it simple (providing too large portion sizes) or complex (estimating demand) – can influence the quantity of food waste produced. The individuals (either employees or consumers) can be provided with information stating how their current practices/habits can change in order to reduce food waste, these actions

could be simply removing items from planned meals that are often seen to be disposed of, or by providing a range of smaller portion/meal sizes. Giorgi (2013) showed that 42% of individuals stated the reason for leaving food on their plates is due to excessive portion sizes. The manager of Hotel A stated that in order to achieve staff interest and motivation to take the lessons on board, a financial benefit must be seen, as otherwise staff feel burdened with additional work without achieving a benefit (General Manager Hotel A, 2015, pers., comm., 24th July). Therefore a cost benefit analysis conducted prior to the training will show staff the economic benefit of the actions, and thus enhance participation and motivation. Signage can improve awareness to both guests and staff, as they can show how much simple actions are costing and the impact they have. This can be done by simply weighing the waste produced from the action (e.g. disposing of surplus food) over the space of one day. Then multiply the figure by seven to obtain how much food waste is produced by the action a week. Then multiply this figure by four (if the waste is measured in kilograms), as this is the true cost of food waste calculated by WRAP (2013). This true cost of waste includes; procurement, labour, waste disposal, electricity etc. (WRAP 2013). This methodology produces the weekly cost of the action. Implementing a general awareness campaign across the hotel can convey the impact our actions have on our resource constrained world, and can help break social norms so that food possesses an intrinsic value, and that it becomes socially unacceptable to waste food (Filho *et al.* 2015). To achieve these desired social changes, education and awareness campaigns must not be limited to the hotel industry, but it must also occur in schools, workplaces and on television, as this advertises this global problem to the greatest number of people (Beddington *et al.* 2012). Some guests or staff may not approve of suggesting guests should change their behaviour, but as the GM of Hotel A said: *“just because the Staff or Customer may not support this does not mean it should not be done”*.

5.2.2 Communication and teamwork

A strong team was noted as being the greatest strength at each hotel in order to tackle food waste reduction before the project. One hotel that withdrew from the project did so because of a *“lack of commitment”* (General Manager 2, 2015, pers., comm., 05th June), and the GM and HC there also stated their key strength was their strong kitchen team. The GM went on to say that *“I have been rather occupied over the last few months”* (General Manager 2, 2015, pers., comm., 05th June), which highlights a potential lack of support from management. Tuppen (2013 & 2014) and Bridging the Gap (1995) state that if effective waste reduction is to be achieved, drive, focus and engagement from all business levels is required. Tuppen (2013) also argues that staff require

continuous training to enable management to communicate the goals and methods required to achieve a reduction. A report produced by Bridging the Gap (1995) goes further and argues that the key to successful waste reduction is “*firm, and visible management support*” as effective strategies rely upon participation from all staff. The GM of Hotel C stated in the exit questionnaire that achieving management buy-in is crucial, as they need to explain to staff what they need to do and why. This point is echoed by the HC of one of the hotels which pulled out, “*it (the project) never got started really, no one explained when it was starting and who was monitoring it*”, this shows how important management leadership can be (Head Chef 2, 2015, pers., comm., 22nd July). The GMs of Hotels A and C also stated that communication between management and the staff is important, as otherwise the staff will have little motivation and direction. Marthinsen *et al.* (2012) argues that the way to convey and convince people that creating food waste is socially unacceptable is through effective communication, both with guests and staff. Therefore a strong support network is key in reducing food waste, as this provides direction and motivation (Tuppen 2014).

5.3 Hotel Results

Despite the statistical results for each hotel showing that increased awareness and the reduction measures had no effect, the hotels managed to save a combined £5,440 (£2,311 from Hotel A, £2,582 from Hotel B, £547 from Hotel C), and reduce their emissions by 5,520kg (2,345kg CO₂e from Hotel A, 2,620kg CO₂e from Hotel B, 555kg CO₂e from Hotel C) over the course of the project. These imply annual savings of £21,759, and reducing emissions by 22.7t CO₂e. Cost savings based on true cost of waste provided by WRAP (2013) and carbon savings are based on the carbon factor for food waste produced by DEFRA (DEFRA 2015). So despite the lack of supportive statistical analysis, environmental benefit was achieved, which should be the primary focus.

The large fluctuations observed at Hotel A were expected as the frequency of events can greatly vary, as Week 4 had nearly 500 people attending events over a 2 day period, this induced an increase in wastage. Yet Week 9 saw just 93 event guests in the entire week, which brought on a drop in the quantity of food waste produced. The reduction measures implemented may not have brought about a decrease in the quantity of food waste produced, which highlights how much unavoidable food is produced, and how hotels can only do so much to reduce their wastage, as (Wrap 2011) states that approximately 37% of hotel food waste is unavoidable. Through catering for as many guests as Hotel A does, it might be unfeasible to think that it can beat the industry average. Waste reduction measures that include the consumer have been shown to be effective in other studies (Filho *et al.* 2015; Pirani & Arafat 2014; Kallbekken & Sælen 2013; Mensah 2006),

showing that the GM needs to be convinced that including the guest will not impact the profitability of the hotel. As many guests (Bohdanowicz 2005) prefer environmentally conscious hotels, and with the number of these tourists increasing, maybe it is time to include the guests in food waste reduction (Singleton 2012).

It was surprising to see the statistical analysis suggest the reduction in food waste at Hotel B occurred due to chance. As the per cover quantity of preparation waste produced over the eight weeks following the change in ordering procedures was 49% lower than that recorded over the first five weeks of the project. Yet, the evidence was not strong enough to prove that the treatment had an effect, but if the dataset was larger by having equal number of weeks before and after the treatment, then more pairs would be analysed and more accurate results would be produced (GraphPad 2015). Purchasing pre-cut fruit may be beneficial for the hotel, but in terms of reducing food waste it just passes the waste further up the supply chain, so there is no environmental benefit of doing this. Stuart (2009) and Stuart (2012) state that reduction measures must address the entire food chain, and one way of doing that is reducing demand. Hotels should focus on reducing the amount that they purchase, through more accurately predicting consumer demand, not replenishing buffet containers as often, replacing buffets with 'a la carte' menus, and utilising more shared ingredients in meals to utilise greater portions of the items (Pirani & Arafat 2014; Filho *et al.* 2015; WRAP 2015c).

Looking at Figure 22, it is surprising that environmental benefit was achieved by Hotel C, as the peak in Weeks 17 and 18 show large rises in the quantities of food waste. But through communication with the GM I was informed that the high quantities of spoilage were "*probably the remains of the stock from the last menu being thrown away*" (General Manager Hotel C, 2015, pers., comm., 3rd August). This suggests these weeks were not representative of the reductions produced through implementing the new menu, as the weeks surrounding the peaks all produced lower than the hotel industry average. Thus if more time was allowed for monitoring, then more accurate data concerning the effects of the menu would be produced. Regarding food waste from events, improved communication can only help so much, as people always change their order on the day, or are not hungry so don't want the whole meal. Therefore accurately and consistently predicting demand is impossible. This view is supported by WRAP (2013a), who state that hotels are often afraid to under prepare items (especially if there is a selection of items), as hotels must cater for their customers' needs, as they may run the risk of losing repeat business if the customers do not get what they want. The hotel could ask the guests as they arrive if they have any final

adjustments to their order, but a change must also come from the side of the consumer. As they must be educated to the point that they realise how their actions can impact food waste.

5.4 Systematic Literature Review

There is limited literature on this topic, so my theory for why composting and donating surplus food are the most popular reduction measures in the literature is that they treat food as an alternate resource, and can be used to provide more services to humans whilst also diverting waste from landfill. Composting can provide the hotel with additional income and be used in hotel gardens, and food donation can boost hotels reputation and help those in need.

Another reason why food redistribution, staff education, food waste monitoring, and composting are the most commonly recommended and studied reduction measures may be because they have minimal impact upon the guests experience. This attitude may explain why the only food waste reduction measures introduced during this project were; buying pre-cut fruit, altering ordering practices and improving communication with clients to more accurately predict food demand at events. All of these measures focus on providing the same service, but utilising resources more efficiently. This may be the case as management may be fearful of altering the guest experience in case the guest feels like they are not achieving value for money (Pirani & Arafat 2014). This was noted in the exit questionnaire, as the GM of Hotel A stated that *“guests want to feel that they are getting value for money. Less portion on a plate will make them question that the business is giving value”*. Another reason why these measures were chosen over those provided by the literature, was cost. As composting and food redistribution will not reduce the cost of food waste at the hotel, as food waste disposal only contributes approximately 3.4% of the cost of food waste (WRAP 2013). Thus, reducing the quantity of waste is better for business than redirecting it from landfill. The measures that are most popular with the hotels in this project (both implemented and planned) are those that seek to reduce the quantities of waste produced, as this is where savings occur. As 52% of the total cost of food waste is from food purchase, so savings are achieved if less food is bought (WRAP 2013).

Both GMs agreed that staff training is essential if quantities of food waste are to decrease, as both recognised staff and customer habits as being the greatest barriers to reductions. While the measures suggested by the literature review were not all practised, the GMs of Hotels A and C both said they would consider implementing the top five measures (apart from food redistribution and composting at Hotel C), as long as they could be shown to help reduce food waste.

5.5 Limitations

1. The primary limitation of this study was that I was not responsible for segregating, weighing and recording the food waste. This meant that I was unable to verify all of the figures produced, as it was the responsibility to of the hotel to segregate waste correctly, weigh it and record the quantities in the correct box on the daily tracker. While this was a limitation, it must be said that it would not have been feasible for me to undertake the data collection in person, as the three hotels were scattered between two different cities, and produce food waste throughout the day.
2. Also, the different hotels each had their own methods of recording the waste, as is shown in sections 4.3.1, 4.4.1 and 4.5.1. This resulted in lack of consistency between hotels, yet it was interesting to see how different hotels tackle the same problem, and whether each method influenced staff participation.
3. The data collection period was only run for 13 weeks. This was a problem as it did not leave enough time for hotels to implement the desired reduction measures, e.g. Hotel C wanted to alter their menu to include different meal sizes, but they wanted to do this when the chain produced its autumn/winter menu. An expansion of the data collection period would have also enabled more accurate statistical analysis.
4. I underestimated how difficult it would be to communicate with the key contacts in hotels, and how much time would be needed to organise and convince contacts to implement the desired reduction measures. Whilst hotels will be implementing measures, the time scale is much longer than I had first thought. I thought the monitoring program would commence at the proposed start date and did not think about short staffing and technical issues that would delay project commencement, and produce hold ups throughout.
5. The study was undertaken during the busiest time of year for the hotels, and segregating food waste took a back seat during busy periods, leading to inaccurate results as occasionally only waste from dinner or lunch periods was recorded, or the whole days waste was recorded under dinner or lunch.
6. I was unable to obtain the cover data for Hotel B which meant that the daily breakdown of waste could not be produced. This resulted in incomplete comparison between the three hotels.

6. Conclusions

If replicating the study, I would advise expanding the data collection period, as this would enable hotels to implement reduction measures and determine their effect. Expanding the data collection period would also enable more time being dedicated to ensuring waste is segregated correctly, and that all kitchen staff know how to effectively segregate and record food waste. I would also recommend undertaking the project during a quieter time of year, as this would reduce pressure on the kitchen staff to record waste when they are busy, and lead to the gathering of more accurate data. I would also liaise more often with the head chef and kitchen staff as this would allow me to understand any difficulties or issues encountered, clarify methods, and suggest potential improvements to current practices and to produce more accurate results. I would also take some of the advice heard from the hotels and incorporate that into the project, as this could aid the promotion of good practice.

Tips for hotels aiming to reduce food waste:

- Just do it, one of the ways to break bad habits is to start monitoring and implement reduction measures.
- Monitor food waste. This allows you to track progress and highlight sources of waste. Does not have to be every day, but has to be regular, e.g. monitor the last two weeks of every month etc.
- Achieve management buy-in. As this provides staff direction and motivation.
- Implement 'Green Team' of employees who champion sustainable business practices in the workplace. They can boost motivation and staff compliance with waste management policy.
- Undertake cost-benefit analysis of reduction measures before you implement them to show potential savings to staff.
- Maintain regular communication between management and staff to ensure they adhere to policy.
- Create staff training programme to highlight the impact their actions have upon the environment, and what they can do to reduce this impact.
- Produce signage to promote savings and progress to date. Keep it simple and focus on key figures, such as cost savings or emissions reductions.
- Ensure effective stock rotation system is in place.
- Utilise surplus food by producing staff meals, or 'Dish of the day' for guests.
- Explore options for purchasing pre-cut/prepared food items for large events as this will save time preparing items and reduce wastage and costs.
- Primary focus should be on resource efficiency and reducing demand, as this minimises costs and reduces environmental impact.

- If able, have one bin for each food waste category.
- Utilise different coloured bin bags to aid waste segregation.
- Review menu to utilise fewer ingredients, and provide a range meal sizes
- Consider food re-distribution, companies such as Planzheroes and Fairsharing can collect surplus meals so you don't have to worry about delivery/transport.

While this project did not achieve the desired reductions, it did highlight the difficulties surrounding food waste reduction in the hotel industry. While there is only a limited amount that staff can do, it is crucial that staff maintain commitment to waste reduction as this is the only way for it to become normal practice. Obtaining this commitment can be achieved through effective training and communication, which advertises costs and the environmental impact of daily activities. The attitudes of the consumer must also change for any permanent reduction to take place. As highlighted by one GM, a societal change with regards to attitudes to waste is occurring, with younger staff taking a greater interest and actively trying to reduce waste. While this displays hope for the future, we need to act now. As while progress has been made, the change is far from mainstream. Not only do the attitudes of guests need to change, but management ideals also need to evolve. Focus should not be permanently fixed on growth and profit, but hotels and other businesses should have ecological goals written into their principles, and seek to preserve their local environment upon which part of their business is dependent (Jackson 2010). Even if the motivation is to maintain profits, as long as the environmental impact of the business is reduced, the motivation is of secondary importance.

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in fulfillment of the requirements for the degree Master of Technology : Tourism and Hospitality Management in. Cape Peninsula University of Technology.

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