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Role of compostable tableware in food service and waste management. A life cycle assessment study

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ABSTRACT

It is estimated that in Europe 88–100 million tonnes of food waste are generated every year, with a Global Warming Potential (GWP) of around 227 MT of CO_2 equivalents generated for their collection and disposal. A 12% of this waste is estimated to arise from food service within the hospitality sector, which includes quick service restaurants, casual and fine dining, contract catering (canteens, prisons, hospitals, schools etc.) as well as indoor and outdoor events and exhibitions. Given this considerable amount and that the mixed unsorted collection is often the only practicable way to handle such waste flows, the choice of tableware and cutlery can make a big difference in facilitating waste collection as well as in reducing the overall environmental impact of food waste management. This study compares the environmental performance of using biodegradable & compostable single use tableware with organic recycling of food waste through composting against a traditional scenario using fossil-based plastic tableware and disposal of the waste flows through incineration and landfill. The study has taken into account the main requirements of the recently published Product Environmental Footprint (PEF) methodology of the European Commission. The results confirm that the use of biodegradable and compostable tableware combined with organic recycling is the preferred option for catering in quick service restaurants, contract catering and events, since it reduces significantly the carbon, water and resource footprint and is fully in line with the principles of a circular economy.

1. Introduction

It is estimated that in Europe 88–100 million tonnes of food waste are generated every year[1]. The production and disposal of this food waste has an estimated Global Warming Potential (GWP) of around 227 million tonnes of CO_2 equivalents[2] and consumes 261 million tonnes of resources[3]. The financial impact is also significant with the cost of the production and disposal of the EU's food waste estimated to be € 134 billion[4]. Given the huge social, economic and environmental costs associated with food waste, in recent years a number of national and industry led policies and programmes have been developed which seek to reduce, redistribute or recycle more food waste, with the topic gaining increasing interest within the European Commission and their ambition to drive towards a circular economy.

The organic recycling of biowaste, which includes both food and garden wastes, is well established in Europe with over 30 MT being composted or anaerobically digested in 2013. Composting predominates over anaerobic digestion for the biowaste stream, resulting in over 90% of food and green waste being processed into compost[5]. Like all recycling processes, in order to manufacture high quality composted products, the feedstocks must be of a sufficient quality i.e. free from or containing minimal contaminants. The inclusion of non-biodegradable plastic or packaging items with organic waste is generally not acceptable for organic recycling facilities. The maximum acceptability of such levels range from about 2% (Organics Recycling Group Manager – Scotland) up to 5% (CIC, Italian Composting Consortium). Since 2000, producers and suppliers of

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[1] FUSIONS (2016) for European Commission http://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf.
[2] http://www.eu-fusions.org/index.php/about-food-waste#_ftn1.
[3] European Parliament (2016) http://www.europarl.europa.eu/thinktank/en/document.html?reference = EPRS_BRI(2016)593563.
[4] FUSIONS (2016) op cit.
[5] European Compost Network (2016) http://www.compostnetwork.info/download/bio-waste-recycling-europe-backdrop-circular-economy-package/.

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biodegradable and compostable packaging products have been able to demonstrate to the whole value chain that their products are suitable for organic recycling through compliance to the harmonised European Standard EN13432[6]. The value of using biodegradable and compostable packaging products is mostly realised during the end of life – organic recycling – phase and therefore the main focus for designers and manufacturers has been on applications where the contents of the packaging is biodegradable or the packaging/item will be "contaminated" with food. Traditionally, such products are made with standard, non-biodegradable polymers from non-renewable, fossil resources. Due to the presence of food and the low inherent material value of these items, the mechanical recycling system (separate collection, sorting, cleaning, recycling) is not practical or economic. The most common applications where biodegradability and compostability are valuable characteristics are bags for separate collection of biowaste, fresh produce bags, food packaging and tableware items such as single use cutlery, drinks cups and lids, straws and any other application with plastic and food contact".

Of the 88–100 MT of EU food waste, 12% or 10.5 million tonnes is estimated to arise from food service within the hospitality sector, which includes quick service restaurants, casual and fine dining, contract catering (canteens, prisons, hospitals, schools etc.) as well as indoor and outdoor events and exhibitions. There are very few studies which have attempted to quantify where in the food service system – preparation, spoilage, customer – food waste arises. One UK study (WRAP 2013, Where food waste arises within the UK hospitality and food service sector: spoilage, preparation and plate waste) which did so found large differences in on-site food waste generation depending on the type of hospitality as shown in Table 1 below. Another UK study, which looked at food waste generation in schools found that approximately 36% of food waste was produced from plates[7].

Given the considerable amount of food waste produced during hospitality and events, the choice of tableware and cutlery can make a big difference in facilitating waste collection as well as in reducing the overall environmental impact of food waste management.

One previous study (Razza et al., 2009) on the environmental impact of food service in quick service restaurants, contract catering and events considered different types of single use cutlery and alternative waste management in two scenarios and with a life cycle approach. It assessed food service using non-biodegradable cutlery and the collection of mixed heterogeneous waste, composed of food waste and non-biodegradable cutlery (the traditional situation) and food service using biodegradable and compostable cutlery and the collection of a mixed, yet, homogeneous waste, composed of food waste combined with biodegradable and compostable cutlery.

In the first scenario, the resulting waste is not recyclable (because of incompatible waste fractions being mixed together) and was thus modelled as incinerated or landfilled, whilst the second scenario considered the resulting waste as homogenous and recoverable through organic recycling to produce high quality compost. It is well known that recycling requires homogeneous waste streams to be successful: organic waste is not suitable for plastic recycling and non-biodegradable and non-compostable wastes are not suitable for organic recycling (composting).

The study concluded that from an environmental point of view, the best choice was the use of biodegradable and compostable plastic cutlery and the generation of waste containing only compostable fractions. Conversely, if plastics are not biodegradable, mechanical recycling is not applied and organic recycling (composting) is not applicable, and only waste treatments without material recovery (landfill and incineration) can be adopted.

This study also highlighted that the biodegradability and compostability of plastic products can be instrumental in increasing the recyclability of waste and improving waste management under specific conditions, e.g. whenever the organic waste (food, kitchen waste) is contaminated with plastics or the possibility to divert the plastic fraction is technically, economically or socially difficult.

The mentioned study did however suffer from one major limitation as it only considered cutlery (knife and fork with the packaging) so neglecting the other tableware which typically is distributed to consumers (plastic or laminated paper dishes, plastic or laminated paper cups, paper tray mats, paper napkins, etc.). The present study develops and surpasses the previous LCA study by taking into account the whole tableware set and applying the recently developed Product Environmental Footprint (PEF) approach. Biodegradability under composting conditions is determined by applying the standard EN 13432[8].

The Product Environmental Footprint (PEF), whose technical guide was developed by the European Commission JRC IES in 2011, is a multi-criteria measure of the environmental performance of a good or service throughout its life cycle. One of its objectives is to "establish a common methodological approach to enable Member States and the private sector to assess, display and benchmark the environmental performance of products, services and companies based on a comprehensive assessment of environmental impacts over the life-cycle ('environmental footprint')".

2. Goal and scope, methodology and data sources

The purpose of this study was to evaluate the environmental impacts through Life Cycle Assessment of two different systems of food service in quick service restaurants, contract catering and events followed by two different waste treatment systems, which create two distinct scenarios:

Scenario A: food service using biodegradable and compostable tableware, collecting the total waste in a single *homogeneous* stream followed by organic recycling through composting;
Scenario B: food service using traditional tableware, collecting the total waste in a single *heterogeneous* stream and disposing it of by means of incineration and landfilling;

A further goal of the study is to provide verifiable and unbiased information to three groups of stakeholders:

- Policy makers and public administrators;
- Municipal waste management managers;
- Quick service restaurants and contract catering managers as well as event organizers

2.1. Methodology

The study has been carried out following the Life Cycle methodology in agreement with the following standards:

[6] CEN EN13432:2000 Packaging. Requirements for packaging recoverable through composting and biodegradation. Test scheme and evaluation criteria for the final acceptance of packaging https://standards.cen.eu/dyn/www/f?p = 204:110:0::::FSP_PROJECT:13285&cs = 139C639D4EB147B435AF2A19A3673488E.

[7] WRAP (2011) Food waste in schools http://www.wrap.org.uk/sites/files/wrap/Food%20waste%20in%20schools%20full%20report%20.pdf.

[8] Strictly speaking the EN 13432 standard is about organic recycling of packaging; mugs, plates, cups are considered to be packaging. By scope extension, EN 13432 is also applied to non-packaging items (e.g. cutlery, napkins).

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