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The prospects of zero-packaging grocery stores to improve the social and environmental impacts of the food supply chain

Elisa F. Beitzen-Heineke [a], Nazmiye Balta-Ozkan [b,*], Hendrik Reefke [c]

[a] Dorfstr. 4, 37574, Einbeck, Germany
[b] School of Water, Energy and Environment, Cranfield University, Cranfield, Bedfordshire, MK43 0AL, United Kingdom
[c] School of Management, Demand Chain Management, Cranfield University, Cranfield, Bedfordshire, MK43 0AL, United Kingdom

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ABSTRACT

Increasing consumer awareness of the environmental and social externalities of food supply chains in developed countries instigates the opening of grocery stores that renounce the use of disposable plastic packaging for their entire product range. The opportunities these novel stores offer in moving to an alternative, more sustainable retail system are currently not well understood. Semi-structured interviews with representatives of seven stores across Europe and six food supply chain experts were conducted in order to address this gap. Findings suggest that these stores may induce more resource-efficient behaviour in suppliers and consumers due to the reduction of packaging and food waste. Social benefits range from the support of small, regional farmers, to higher transparency along the supply chain and better informed consumers. However, these benefits come at the expense of consumer convenience due to slower shopping operations and limited product variety. A wider adoption of zero packaging will require influencing consumer behaviour, convincing suppliers to change their packaging practices, and solving the dependency of food logistics on packaging. In order to achieve wide-ranging, significant environmental and social benefits, zero-packaging stores will ultimately have to offer service levels that are comparable to conventional supermarkets. Potential pathways illustrating how zero-packaging could overcome current market limitations are presented.

1. Introduction

The UK Food Supply Chain (FSC) generated 17.3 million tonnes (Mt) of waste which had an economic value of £19.2 billion in 2011 (WRAP, 2015). Almost 90% of this waste (15.3 Mt) is food waste which accounts for a third of all food purchased. This resembles the trend in the European Union where 88 million tonnes of food with an economic value of 143 billion Euros were wasted in 2012 (Stenmarck et al., 2016). Furthermore, the UK FSC emitted 176 Mt of CO_2 equivalents (CO_2e) in 2011. Hence, FSCs in developed countries are generally not sustainable but wasteful (Tassou et al., 2014). Looking to the future, the food industry faces many challenges: By 2030, global demand for food and energy is expected to increase by 50%, leading to a 40% increase of water use and freight transport (FoodDrinkEurope, 2012).

In addressing these challenges in developed countries, Fox and Vorley (2004) recognise supermarkets as the 'gatekeepers' of FSCs. They not only hold the power to induce positive change at both consumer and supplier side but can also pass down their external costs and responsibilities to food processors and farmers. Some measures on how to improve the social and environmental impacts of the food industry have been proposed but *"more radical solutions will be needed to reduce further energy demand in the food sector and mitigate the related climate change impacts"* (Tassou et al., 2014, p. 163). Fundamental change is necessary, but there is limited research on what such radical solutions might look like and how they can be realised. Most efforts have focussed on individual environmental or social impacts and on optimising rather than rethinking the current system.

Even the UK government's ambition to move towards a zero waste economy falls short of its expectations by promoting merely waste reduction and recycling (DEFRA, 2010). As recognised in the waste hierarchy, a better strategy is actually waste prevention (UNEP, 2010). Putting this first principle of the waste hierarchy into practice, a number of grocery stores renouncing disposable plastic packaging have opened across Europe. In these stores, consumers

* Corresponding author.
E-mail address: n.ozkan@cranfield.ac.uk (N. Balta-Ozkan).

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bring their own containers, weigh the tare, fill in the product and pay according to the weight. The potential of this approach to support the transition towards a low-impact FSC are currently unknown.

This paper addresses this gap using Porter and Kramer (2006)'s value chain framework in order to analyse the processes through which these stores provide social and environmental benefits whilst profiting economically. Semi-structured interviews were conducted with store owners and FSC experts in order to address three key objectives:

1. Analyse and depict the operations at zero-packaging grocery stores;
2. Illustrate the interactions among FSC actors and the influences they have on each other;
3. Assess and evaluate the environmental and social impacts.

Whilst we acknowledge that economic impacts (e.g. employment opportunities, revenue generation, and product pricing) are important, they have not been explicitly included in this study. The rationale being that the store concept is novel and any economic analysis at this stage could be misleading due to a lack of long-term data.

The paper is structured as follows: Section 2 reviews the environmental and social impacts of the FSC and contextualizes zero-packaging stores against other alternative food retail concepts. The methodology is discussed in Section 3. Section 4 presents the results from the interviews with both the store owners and experts. Section 5 offers a discussion of the findings while the last section identifies the barriers and drivers for long-term success and scalability of zero-packaging grocery stores.

2. Framing environmental and social impacts of the food industry

Environmental impacts focus on emissions, energy and water use, as well as food and packaging waste. Social impacts include food safety, nutrition and ethical trade. We recognise that describing a single exemplary market will provide consistent understanding with regard to the magnitude of environmental and social impacts of the respective FSC. As a result, we draw examples primarily from the UK, a country of high quality data on food waste (Stenmarck et al., 2016) and supplement this further with information from other comparable markets where relevant. A discussion of the unique position of zero-packaging stores in comparison to alternative food retail concepts like ethical, organic and fair-trade concludes this section.

2.1. Environmental impacts

The food industry has changed significantly for both suppliers and consumers in past decades. While in 1954 the product range in a grocery shop was 1400 products, nowadays there are over 30,000 different products (Hayn et al., 2005; J Sainsbury plc, 2016) and in some cases even up to 90,000 (Wood and Butler, 2015). Large retailers are highly price-competitive, sourcing food globally and managing their distribution through multi-tier structures. Consumers demand fully stocked stores and a full product range irrespective of the season. Opposing trends towards slow food and eating consciously versus consuming more processed meals (DEFRA, 2006; Kuhn and Sternbeck, 2013) indicate possible consumer trade-offs between the convenience of ready-made meals and home cooking. Additional trends prevalent in Western economies are an ageing population and smaller households, resulting in vastly different consumption patterns. The proportion of single households is rising which generate up to 45% more food waste per person than the average home. Retailers offer products in smaller packaging, which might reduce food waste but simultaneously increases the packaging per food unit (Akkerman et al., 2010; Verghese et al., 2015).

A typical retail FSC including packaging practices is presented in Fig. 1 with packaging waste highlighted in red. It should be noted that the chain configuration depends on the type of FSC. The FSC of local and unprocessed food is usually less complex and shorter than FSCs of global and processed food products (Smith, 2008).

In 2011, the UK FSC consumed about 18% of total primary energy use, generating 115 $MtCO_2e$ (around 21% of UK emissions, excluding emissions from non-fertiliser pre-farm production, packaging, food waste and land use change). Additionally net trade contributed 61 $MtCO_2e$ (Defra, 2014a; Sneddon et al., 2015).

Agricultural production contributes between 47% and 61% of greenhouse gas (GHG) emissions related to the FSC (Vermeulen et al., 2012). Other agricultural impacts include biodiversity loss, degradation of fertile land and high water consumption (Baldwin, 2015). Studies suggest that certified organic production consumes 30%–50% less energy due to reduced usage of fertilisers and pesticides. However, this advantage may not be valid per unit of output due to a lower productivity in comparison to intensive production (Garnett et al., 2003).

Food processing can be held accountable for high energy consumption, water use and waste generation, driven by an increasing demand for processed and packaged food (Baldwin, 2015; Canning et al., 2010). A life cycle assessment comparison of ready-made and home-made meals reports latter to be more environmentally responsible because of fewer manufacturing stages, less waste, and a decrease in cold storage (Schmidt Rivera et al., 2014).

Food transport along the supply chain creates emissions, congestions and air pollution, which contributes to a range of health problems (Baldwin, 2015; Yakovleva, 2007). Refrigeration during transportation results in consumption of further energy and chemical refrigerants, causing up to 40% of overall transportation emissions. Transporting frozen food is about 1.7 times more energy-intensive than transporting food at ambient temperature (James and James, 2010). There are two key issues regarding transport. Firstly, shorter transport distances may have fewer impacts, but entire product life cycles need to be considered when assessing impacts. Although generalisations should be made with caution, seasonal and native foods usually have lower carbon foot prints (Akkerman et al., 2010; Saunders and Barber, 2008; Sim et al., 2007; Weber and Matthews, 2008; Wilson, 2007). However, energy intensive production in greenhouses or refrigerated storage is likely to balance out the benefits of short distances. Secondly, the efficiency of the material and product flow is essential (Azevedo et al., 2011). In the UK, around 23% of vehicles in FSCs drive empty (Garnett et al., 2003) whilst more frequent deliveries with smaller quantities lead to higher emissions. Hence, instead of focusing on food miles, it is suggested that product assessment should look at "*the carbon emission per unit of produce over the transport chain*" (Coley et al., 2009, p. 154). Using this approach, it is clear that the last mile, i.e. the shopping trip of the consumer, causes high emissions per product (Gevaers et al., 2014; Seebauer et al., 2015). While many large companies already manage their fleet via decision support and information systems (Akkerman et al., 2010), increasing the sustainability of supply chain logistics remains an on-going research area of international efforts.[1] Food retail does not

[1] Among this, Step Change in Agri-food Logistics Ecosystems (SCALE) project aims to establish different tools and frameworks to increase efficiency and sustainability of supply chain logistics.

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