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

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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

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offer service levels that are comparable to conventional supermarkets. Potential pathways illustrating how zero-packaging could overcome current market limitations are presented.

**Keywords**

Food Retail; Reusable Packaging; Food Supply Chain; Green Business Model; Food Waste; Sustainable Supply Chain
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 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 CO₂ equivalents (CO₂e) 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 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 1,400 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, 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 Figure 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).
Figure 1 Main stages and packaging practices in the FSC

Source: Adapted from Naik et al. (2010).

In 2011, the UK FSC consumed about 18% of total primary energy use, generating 115 MtCO$_2$e (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$_2$e (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% to 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 footprints (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. Food retail does not contribute significantly to the overall energy use of the food industry, but nevertheless has potential to reduce its environmental impacts by recovering heat and using renewable energy systems in refrigeration (Tassou, 2014).

Emitting 18 MtCO₂e yearly, UK households including catering facilities are the second biggest contributors to the GHG emissions of the food industry (Defra, 2014a). Recognising the role of dietary habits and lifestyle choices, including increasing demand for meat products and convenience food, some scholars

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2 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.
argue that a change in diet would be the most sustainable solution (Garnett, 2011). On the other hand, households are also the principal contributor of food waste (7.2 Mt, accounting for 46% of total food waste), followed by manufacturing (26%), whereas grocery retail and wholesale generate only 2.9% food waste (Defra, 2014b). Overall, 75% of the food waste, and hence emissions related to food production, transportation, and processing could be avoided (WRAP, 2015). For this reason, Rivera et al. (2014, p.308) claim that food waste “is the single most important factor for reducing the environmental impacts of food”. A study by WRAP (Waste and Resources Action Programme) found that food not being used in time is the main reason for food waste (Quested et al., 2013). In this context Verghese et al. (2015) state that packaging helps to decrease food waste along the supply chain by reducing damage in transport and handling as well as prolonging shelf life.

Packaging provides several functions: Protection, utility and communication in physical, atmospheric and human environments. This includes containment to avoid leakage and loss, safe and efficient transportation, as well as convenience and attraction of consumers (Risch, 2009). While packaging provides these functionalities, the global FSC also accounts for about 70% of packaging waste (Emblem and Emblem, 2012). Furthermore, packaging is responsible for 7% of the UK food-related GHG emissions (Garnett et al., 2003). Plastic production uses approximately 8% of global oil production which is also causing adverse environmental effects. One third of all food packaging is produced for short time use only, even though it is unclear how many hundreds of years plastic needs to fully degrade (Koelmans et al., 2014; Roy et al., 2009). Jambeck et al. (2015) calculated that about 2-5% of the 275 Mt of plastic waste generated in 192 coastal countries ended up as marine debris in 2010. Increases in this plastic debris are of course correlated with the increasing occurrence of single-use products and disposable packaging (Thompson et al., 2009). As recycling only treats the symptoms and is rather costly due to separation and sorting of waste materials, prevention and re-use has the
highest priority in literature and legislation\(^3\) (Bartl, 2014; Emblem and Emblem, 2012). WRAP and major UK grocery organisations have agreed upon the Courtauld Commitment, setting a voluntary target for the grocery sector to reduce food, product and packaging waste by 1.1 Mt by 2015 which could potentially save the industry and consumers £1.6 billion (DEFRA, 2013; WRAP, 2015).

The protection provided by food packaging serves an important function. Figure 2 shows the total energy inputs for a person’s weekly consumption of food. While packaging accounts for approximately 10% of the total energy input, it ultimately protects the other 90% that could have gone to waste without protective packaging (Verghese et al., 2015).

![Figure 2 Relative energy consumption for a person’s weekly food intake](image)

Source: Adapted from Verghese et al. (2015)

### 2.2 Social impacts

Food production and consumption have several direct impacts on society. On the supply side, cheap food prices in Europe may have negative impacts on the livelihoods of small-scale producers in developing countries. Ethical trade initiatives exist to counteract this issue (e.g. the UK Fairtrade Foundation), ensuring fair prices for producers in developing countries (Baldwin, 2015). Yet, small-scale farmers in developed countries also suffer from market powers of large supermarkets\(^4\). For example, only four large retail companies make up about three quarters of the UK market (Steedman and Falk, 2009). These large market players use economies of scale to exert downward pressure on prices.

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\(^3\) European directive 94/62/EC on packaging and packaging waste introduces minimum recovering (at 60%) and recycling (at 55%) targets to be achieved by 2008, which have been revised subsequently.

\(^4\) In the UK, as of January 2016, one of the large supermarkets is being investigated for deferral of payments to its suppliers, breaching the industry’s code of conduct to protect grocery suppliers (http://www.bbc.co.uk/news/business-35408064).
As a result, energy-using machinery has in many cases substituted human labour. Not only does this increase food-related energy use, but it also creates further pressures on small-scale farmers all over the world as they cannot afford investments in new technologies (Canning et al., 2010; Pimbert et al., 2006). Whilst a lack of data does not allow the UK government (in particular Department for Environment, Food and Rural Affairs, DEFRA) to identify structural changes in the UK agribusiness (Langton, 2015), Germany has seen a decrease in the number of farms of 20.6% between 1999 to 2007 while the number of employees reduced by 12.9% (BMELV, 2010). Concentration of market power at few major food corporations and retailers means they gain the most profit in the FSC (Pimbert et al., 2006).

Concerns about food safety have also been increasing. In 2006, approximately 450 people died from foodborne illnesses in the UK (DEFRA, 2006). Food safety can be increased by providing physical protection through packaging. This prevents contamination while the protective atmosphere surrounding the food inhibits bacteria growth (Davis, 2013). Food safety is furthermore impacted by complex supply chains which make it difficult to trace individual product inputs (Wognum et al., 2011). This lack of transparency is an important issue for customers, 84% of whom mistrust the products they buy and are willing to pay more for ethical and safe alternatives. They are concerned about the correctness of certification (fair trade, eco, UTZ, rainforest alliance, etc.), treatment of animals, conservation of natural resources and minimising pollution and packaging (Co-op, 2004).

Another issue relevant to both policy makers and consumers is over- and undernourishment. While over 1.5 billion people are either overweight or obese globally, one billion are hungry and malnourished (Baldwin, 2015). Focusing on the nutrition in developed countries, in the UK for example, 65% of men and 56% of women, equal to 24 million adults, are overweight or obese. An unhealthy diet consists of high consumption of saturated fat, salt and sugar, which are especially found in processed foods, and low intake of fruits and vegetables. There are various obstacles to maintaining a well-balanced diet.
Even in Western societies many people live in poverty and cannot afford a healthy diet. Food labelling and marketing is incomprehensive and misleading, inhibiting truthful education and information transfer. A consumer survey showed that the majority of Europeans find eating healthy challenging and 90% of Britons would appreciate retailers to simplify a healthy diet (Mwatsama and Stewart, 2005; Smith, 2008).

2.3 Positioning of zero-packaging stores

There are several well established alternative food retail concepts that aim to address the aforementioned environmental and social impacts. In addition to conventional supermarkets, these alternative retail concepts include organic food, ethical sourcing and fair trade, regional sourcing, and also neighbourhood or local stores. As mentioned, conventional supermarkets carry large product assortments, e.g. potentially up to 90,000 stock keeping units (Wood, 2015), and the associated distribution activities depend on food packaging in order to facilitate trade and transport of food products (Risch, 2009). Organic food is characterised by particular production standards, i.e. more natural methods of growing and harvesting crops as well as avoidance of chemicals, and is generally certified by a certification authority (ISTF, 2016). Ethical sourcing and fair trade aim to embed improved environmental and social standards into production and distribution and compensate the producers fairly (Raynolds, 2000). Regional sourcing is primarily concerned with established local food supply chains, thereby reducing transportation requirements and supporting local producers (Smith, 2008). Lastly, neighbourhood or local stores emphasise proximity to the final customer and hence convenience. Proximity to the end-customer may reduce the ‘last mile’, which is generally associated with a significant environmental impact (Edwards et al., 2010).

A classification framework of these different food retail concepts is developed in Table 1 which identifies the core attributes commonly connected to each of the food retail concepts introduced. These attributes can be likened to the decisive competitive criteria that a store concept exhibits, i.e. order winners. These criteria can win customer orders against competitive offerings in the same
market (Hill and Hill, 2012). It needs to be emphasised that the connections drawn here are indicative and cannot capture the unique characteristics of individual stores. Actual stores may in fact exhibit the attributes from multiple concepts and hence appeal to customers through multiple order winning criteria. Nevertheless, it offers an insightful overview that captures essential attributes of different store concepts.
Table 1 Indicative summary of core attributes of alternative food retail concepts

<table>
<thead>
<tr>
<th>Store Concept</th>
<th>Convenience</th>
<th>Ethical Sourcing</th>
<th>Environmental Protection</th>
<th>Health Benefits</th>
<th>Packaging Reduction</th>
<th>Product Selection</th>
<th>Transport Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Supermarket</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethical / Fair Trade</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Stores</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic food</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Regional Sourcing</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Zero-packaging</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

3 Methodology

Porter and Kramer (2006) and Wognum et al. (2011) argue that it is inefficient for businesses to deal with their business strategy and their economic and social performance separately. The integration of these impacts into their strategic long-term goals would unfold "opportunity, innovation, and competitive advantage" (Porter and Kramer, 2006, p. 1) which are the guiding principles of zero-packaging grocery stores. Hence, in analysing how zero-packaging grocery stores integrate their environmental and social performance into their business concept, we follow Porter and Kramer’s (2006) strategic framework. Their strategic framework aims to enable businesses to identify their externalities, integrate them into their strategic long-term goals and quantify their benefits. They separate the business activities into primary (Inbound Logistics, Operations, Outbound Logistics, Marketing and Sales, and After-Sales Service) and support activities (procurement, technology development, human resource management and firm infrastructure). In this study, inbound and outbound logistics are combined due to the small scale of the stores under investigation. Furthermore, firm infrastructure and human resources can be regarded as less relevant at this stage. After-sales service in a conventional sense does also not apply and is not included in the study. Excluding these areas will not necessarily reduce the value of utilising the framework as Porter and Kramer (2006) recognise that companies cannot target each of these
areas. Instead they could select a few social initiatives such as customer information, truthful advertising, emissions and waste that benefit both society and their own competitiveness. In our analysis, we separate identified benefits into social and environmental categories as the former refers to favourable impacts on people whereas the latter to those on the planet. Using Porter and Kramer’s (2006) value chain framework (Figure 3) we analyse through which processes zero-packaging stores provide social and environmental benefits whilst achieving gains for their business.

Figure 3 Social and environmental value maximising business concept of zero-packaging stores
Source: Adapted from Porter and Kramer (2006)

The methodological approach followed is depicted in Figure 4. In order to identify zero-packaging grocery stores, a documentary analysis of websites, videos and newspaper articles was undertaken. In parallel, a literature review was targeted at understanding the environmental and social impacts of current FSCs and at identifying key research questions and knowledge gaps related to
a more sustainable food industry. Semi-structured interviews with store owners and managers as well as domain experts were conducted in order to capture a wide range of views whilst generating comparable results. Interviews with the FSC experts were used to contextualise the findings of the store interviews and identify the barriers and drivers that zero-packaging stores are facing.

**Figure 4 Methodology and key research question**

**3.1 Store interviews**

In order to identify zero-packaging stores operating in Europe and North America, a web-based search in English and German was performed. As of July 2015, 19 operating stores were found that are located in Europe and North America. Seven are about to open and there are various stores with departments that offer unpackaged products. It should be acknowledged that a number of unknown cases are likely since many stores may not have a web presence or were not found due to language barriers. A detailed list of the identified stores is provided in Appendix A. While one store dates back to 1885, the rapid emergence of the stores started in 2014. One reason for the recent development is that these stores use crowdfunding to raise initial financial
capital. Hence, the concept received worldwide attention and motivated people to open their own store. Due to their innovative business models, two stores that had not yet opened were also included in the study. Altogether, 21 stores were asked to participate in the research in a personalized email request, including a short information sheet and the questionnaire. Seven stores, located across Germany, Austria and Italy, agreed, yielding a participation rate of 33.34%. Six respondents are store owners, while one respondent belongs to the store management team. Several stores cited lack of time as a reason for non-participation. Four phone interviews were conducted, while three stores preferred to complete the questionnaire in written form. It has to be considered that qualitative research is generally not about representativeness but rather aims to “generalize from and about cases across a range of cases” (Sandelowski and Barroso, 2007, p. 5). The interviews were guided via a questionnaire framework, but additional, non-predefined questions were raised for clarification and more in-depth information. The interviews were recorded, translated to English (if necessary), and transcribed. It was furthermore checked whether questions were neutral and that the interviewer did not influence answers through implied opinions or judgements. As the majority of the interviews were performed over the phone, non-verbal behaviour could not be observed (Robson, 2002). The interviews were analysed using thematic coding as explained in Rubin and Rubin (2005). There was one main analyst and results were double checked with two more researchers. In the results, the store respondents will not be further classified as it could compromise their anonymity.

3.2 Expert interviews

An expert was defined as someone who has been working in the food industry or conducting research about food sustainability or FSC management for at least seven years. The experts were identified through relevant literature, web based search and snowballing method. 22 experts were contacted with a personalized email request, including a short information sheet and the questionnaire. Six experts agreed to participate in the research. They have 7 to
23 years of experience in research and/or the food industry (Table 2). The interviews took between 45 and 60 minutes. One interview was shortened to 15 minutes because of time constraints. The interviews were analysed with the same method as those with store owners.

Table 2 Key characteristics of experts

<table>
<thead>
<tr>
<th>Field of Research</th>
<th>Years of Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative and sustainable supply chain management</td>
<td>✓</td>
</tr>
<tr>
<td>Agri-food supply chain management</td>
<td></td>
</tr>
<tr>
<td>Work experience in the food industry</td>
<td>✓</td>
</tr>
<tr>
<td>Optimisation of supply chain management</td>
<td>✓</td>
</tr>
<tr>
<td>Supply chain management</td>
<td></td>
</tr>
<tr>
<td>Food supply chain management</td>
<td>✓</td>
</tr>
<tr>
<td>Food supply chain management*</td>
<td>✓</td>
</tr>
<tr>
<td>Food Science and Supply Chain Management</td>
<td>✓</td>
</tr>
</tbody>
</table>

*10 years of experience was reported in food supply chain management

4 Results

In order to analyse the zero-packaging stores' business concepts and their social and environmental impacts holistically, we present our findings using Porter and Kramer (2006)'s framework. Findings from the store interviews are followed by those from the domain experts.

4.1 Store interviews

4.1.1 Operations

The seven stores that were interviewed for this study offer products free from disposable packaging: dry products (wheat, pasta, rice, lentils, etc.) in bulk bins; yoghurt, milk or jam in reusable glass jars or bottles and some also offer soap, shampoo, etc. Except for two stores, all offer fruits and vegetables. Some stores offer cheese, meat and fish at a refrigerated counter by trained staff, which is too expensive for other stores. Others are located next to a butcher or cheese
shop. The customers bring and weigh their containers and pay for their purchase based on its weight. Generally, store owners mentioned that in-store operations are more time-consuming and ideally customers need to plan ahead and provide the different containers they will need for their purchase. However, store respondent (SR) 1 argued that this is not necessarily a weakness but rather a strength of the store concept as it increases the appreciation for the food.

Product variety is considerably smaller than in conventional supermarkets, ranging from 300 to 1500 products. They offer some convenience products such as jam, pasta, sweets and sauces, but generally do not sell processed or frozen food. Overall, they want to “correspond to the day-to-day needs of the customers” and claim that “the combination (of different produce in the meals) is the diversity” rather than the mere number of products stacked in the shelves (SR 1 and 4). SR 6 highlighted the importance of offering products that are consumed frequently to avoid food waste.

Five stores claimed to offer a very different shopping experience compared to conventional food stores: less stressful, better consultation and customers see and try the product. They “want to prioritise the human again” (SR 2). Three stores also have a small coffee or a snack counter in the store.

One store offers exclusive nutrition counselling, cooking workshops and ‘recipe boxes’, containing assembled raw materials for further preparation at home. The owner emphasised that by buying the recipe boxes, the customers would notice how big a portion actually is.

Another core characteristic of the stores highlighted by all correspondents is the small amount of food waste they produce, which is often included in their business pillars. The stores either i) donate perishing foods ii) process unsold food and sell their products for example in a counter lunch, café or catering, or iii) process it for personal use:

“Ultimately, we are deciding which products are used in the counter lunch as well as in the recipe boxes. That is why we are able to steer the product
demand, even if products are not purchased by customers. This is another aspect, where unpackaged is a benefit. We are able to use the food products from our supermarket. Our model is a building block system. Large supermarkets cannot or are not allowed to do that” (SR 4).

Furthermore, people are more likely to buy only the amounts they need which, according to the store owners, reduces food waste at the consumer-end. SR 4 also suggests that fewer customers buy goods ahead of time nowadays. The stores with gastronomy stated that they generate little food waste. Their focus is on preventing the disposal of food due to reaching their best-before date, even though they are still edible.

Regarding food safety, all stores follow the hygiene regulations applicable. Meat and cheese require refrigeration and only some stores are thus able to offer them. Several stores mentioned that they work closely with hygiene regulation offices. Furthermore, they generally have to pay closer attention to the condition of products on offer. Most of the stores also remind customers on their websites to clean their containers in order to prevent contamination.

4.1.2 Logistics

For most zero-packaging stores, products are delivered by different suppliers and they do not manage the inbound logistics. Only one store is planning to pick up some of the fresh products from small and medium size suppliers with their electric vehicle. Several stores are designed as a franchising concept, yet only one had already established multiple stores. Managing a central and a local warehouse for their distribution, they do not focus on regional products. Four other stores offer delivery services, which are mainly run by bicycles, electric bicycles and electric cars.

The main difference from the conventional grocery stores is the prevention of packaging waste at the consumer-end. Packaging waste will be discussed in detail in the section on Procurement (4.1.4). Overall, disposable packaging is limited to paper bags which are available in most of the stores for customers not bringing their own containers. One store uses stronger paper bags which can
be reused 10 to 20 times. Regarding packaging waste, the stores mainly generate paper and carton waste and some plastic foil. The focus is on reusable containers to avoid resources and emissions for the production, recycling and disposal of the packaging material. In case of suppliers that do not reuse containers, several store operators reuse them internally or endeavour to find alternative use.

Only one store had already collected data about their packaging savings, but most stores are planning to do so in the future: “In one year, the elimination of the packages on the sales of wine and detergent brings an overall saving of resources equal to 104 290 kWh of energy, 34 tonnes of CO₂ emission in the atmosphere and more than 9.8 million litres of water that were not used for the production and disposal of packaging in excess” (SR 5).

4.1.3 Marketing and sales

Another key difference to conventional supermarkets is that none of the interviewed zero-packaging stores offer different brands of the same product as “Products have to be protagonists. There are no labels and no brands” (SR 5). SR 4 expressed that “today’s grocery shopping is just not contemporary anymore. It does not respond to the individual needs of the customer. No packaging helps to respond to their needs by reducing the ‘food confusion’ caused by brands, packaging, product information and false advertising.”

One store explicitly said that their advertisement is honest compared to conventional stores. Store 7 advises their customers to wisely choose the portion size and rather come back for more. Jointly with their suppliers, they organise events like lectures on sustainability and cooking workshops to increase customer awareness. Being consistent with their priority to be transparent, they provide information about their suppliers. One store plans to reveal how much the producer eventually receives of the product price.

Two stores aim to inform their customers about the emissions they have saved by renouncing disposable packaging via an application run on mobile devices or
a sustainability index on their website. By offering these services they claim to
increase the environmental awareness of their consumers.

The price difference to conventional supermarkets varies. Some stores
mentioned a price reduction of up to 12€/kg due to buying the products in big
bags. The producer saves packaging and marketing costs. Therefore, most of
them can sell their products cheaper than organic supermarkets. Yet, this was
contradicted by one store who said that they could not observe a great price
difference to packaged products. Yet, another store which does not focus on
regional products said consumers could save between 30-70% on average
compared to buying an equivalent packaged product. By purchasing only the
amounts needed, customers are flexible and can buy a greater variety of
products with the same or lower expenditure. Different stores embrace their
social goals by i) helping people to maintain a healthy diet at a reasonable cost,
ii) making organic products accessible to a wide range of consumer groups, and
iii) trying to offer products for every class of society. Therefore, one store offers
basic products at competitive prices, made possible by the direct transfer of
material and transportation cost savings onto the product price. Remaining
products are more expensive and consist of delicacies, such as self-developed
baking goods. When asked about the price comparison, one SR argued that
avoided environmental costs should be considered as well.

4.1.4 Procurement

Different criteria dominate the supplier selection on packaging, organic
production, regional origin and fair-trade.

Zero-packaging stores save disposable packaging at the consumer end, but
three of the stores stated that due to their small purchasing power, they do not
have an impact on packaging practices of the suppliers. They receive their
products in big bundles and bags (e.g. 25kg for rice or 1kg for spices). The
majority has a mixture of reusable and recyclable waste (cardboard, paper) and
some a minimum amount of disposable plastic foil, which is wrapped around the
pallets due to transportation regulation, or plastic bags for products such as
chocolate and nuts. Still, most SRs claim that having a little disposable
packaging waste from the suppliers does not balance out the immense
disposable waste savings at the consumer end. Yet, one SR is adamant not to
accept any products delivered in disposable packaging:

“Every time they get the feeling that it [the negotiation] is getting strenuous or
that the supplier does not want to change their logistics, they should leave. [...] 
And they [the suppliers] return on their own or they are just not the right supplier
for you. I rather renounce a product, before it is getting strenuous” (SR 1).

While two respondents acknowledged that many suppliers are actually already
working with reusable packaging, others highlighted this as a barrier as there
are not many suppliers that can deliver the products in big bags. Especially
organic products are not available in big bundles. Therefore, the range and
quantity of suppliers depends on the region and the criteria stores impose upon
the suppliers, e.g. no plastic packaging, being in direct vicinity, using fair trade
products or organic production methods.

Two of the interviewed stores offer only organic products while the other five
also provide non-organic ones. The former group think organic products to be
ecologically valuable and healthier for both the consumers and the farmers.
Stores in Germany and Austria in particular emphasise organic products.

In general, the stores procure from smaller and medium farms directly as they
are not only more likely to change their packaging practices but will also help to
keep the transport distances as short as possible. Using regional products is a
priority for five stores with one store procuring products only within a 100km
radius:

“We would like to offer an extensive vegetable and fruit assortment all year
long. But this is, for us and our philosophy, in no relation to the distances and
the effort that would have to be undertaken to offer it. This is why we decided to
offer seasonal fresh produce. Then, you cannot compete with the big
supermarket chains, but in return we are honest” (SR 2).

Despite the aim to procure from the closest suppliers possible, in practice many
stores cannot completely adhere to this criterion as they do want to offer
specific products such as bananas (if offered, mainly organic and fair-trade) or tomatoes during winter season.

4.1.5 Technology development
Removing packaging requires innovative ways of weighing and paying for goods. One of the interviewed stores invented a paper made from used material to wrap fish and meat. Another store developed a new, more convenient scale, with the weight and size of the containers already programmed into. Thus, customers only select the type of container being used and weigh it including the product. The purchase is saved on a card and customers only need to show the card during payment. The interviewed store also invented a beverage refill-system with stainless steel containers that can be filled without contaminating the content with oxygen, which could lead to shorter shelf lives and generate food waste. Additionally, they designed plastic-free bulk bins that they also sell to other stores.

4.2 Expert Interviews
Regarding the environmental impacts of the FSC, one expert acknowledged that even though packaging is not the biggest emitter, it “is the easiest element that we can work on. Because you need to grow food, those emissions are unavoidable” (Expert 12). The experts described that large retailers decide upon the packaging design to optimize promotion and distribution. Marketing can cause more material use than actually necessary for protecting the food. Expert 12 suggests that conventional stores are externalising their problems since customers have to dispose of packaging and pay a council tax for waste management. Moreover, suppliers have to comply with standardized packaging guidelines of conventional supermarkets, limiting process innovation.

4.2.1 Operations
Several experts reflected on inconveniences zero-packaging grocery stores place on their customers. This inconvenience stems from a more time-consuming shopping experience, limited product range and that containers would have to be carried around all day if people wanted to shop after work.
The experts identified further risks that can arise from shopping practices in these stores. Customers not cleaning their containers properly and cross-contamination were mentioned as potential food safety risks. However, these could be prevented by educating people. Considering the store management, an expert concluded that there are no concerns that could not be solved with technology development.

4.2.2 Logistics

Supply chain experts emphasized that the efficiency of distribution does generally not depend on the size of the store but rather on the logistics system. Hence, different packaging design or less packaging would influence transportation and distribution related emissions. Less packaging would make the transport lighter and enable the distributors to ship more products, reducing overall energy consumption per unit. However, the missing protective function of packaging during transport and distribution needs to be addressed.

4.2.3 Marketing and sales

Various experts view the stores’ claim to reduce food waste at demand side to be very profound in particular. This is because they do not tempt customers to consume more than required with promotional activities used by conventional supermarkets such as “buy 1, get 1 free” or larger family-packages. Nonetheless, the experts cautioned against other potential sources of food waste: Firstly, fruits usually perish earlier if they are not packaged and are exposed to other perishing fruits. Secondly, consumers are used to products with a long shelf life. Consumers would have to adapt accordingly as they will otherwise generate more food waste.

While three experts did not see a direct influence of zero-packaging grocery stores on the diets of the costumers, two experts identified positive impacts. They highlighted the substitution of processed foods with self-cooked meals, the different shopping experience, marketing and engagement with the food:

“If they sell the right foods and people know how to cook, there are enough products there to be able to provide good and healthy meals. Probably we
would avoid obesity and problems like that. [...] And I think [...] they won’t be influenced by the offers, the pressure and the end-of-peer promotions, etc., they won’t take home food they don’t need.” (Expert 11).

4.2.4 Procurement

The ‘dysfunctionality of the supply chain’ (Expert 13) where retail practices generate food waste on the supply side was explained via an anecdote by Expert 11: a befriended farmer has to plough back in 40% of their produced leeks because they did not comply with the packaging guidelines set by the retailers. Further, the farmer was also not allowed to sell it to other supermarkets. In addition to avoiding potential food waste due to such packaging guidelines, procurement of products from small farmers offers further social and environmental benefits, such as independence from large retailers, secured supply, and shorter delivery routes. Stronger ties with local/ regional suppliers could possibly diversify the local agricultural production in some areas and thus counteract habitation and biodiversity loss. Further, the retail market would be more diversified and market power more distributed among the players.

4.3 Contextualising social and environmental impacts of zero-packaging stores

Expert 14, also working on climate change, explained three key considerations for a sustainable food system: climate adapted production of food, reduction of food waste along the supply chain and shifting towards a low-emitting consumption. As the zero-packaging stores positively impact the two latter areas, they could potentially have a significant impact if they were able to reach scale. This would principally depend on product prices, followed by convenience and thirdly environmental benefits. This expert argued that the majority of consumers are not willing to pay more for a less convenient shopping experience because of an improved environmental performance. On the other hand, experts also noted that people are becoming more environmentally aware and that there is a consumer niche that prioritises environmental performance.
Yet, reaching scale could also lead to new barriers as “supermarkets would fight back and possibly try to persuade governments that there are food safety and technological reasons not to allow it” (Expert 11). However, Expert 14 emphasised that the expansion of small stores is not going to be sufficient and that large retailers need to adapt zero-packaging practices as well. As this system fundamentally changes consumer-brand relationships and operations of large retailers, government incentives and regulations are needed to convince large retailers. For example, since May 2015 France forces retailers to donate or process unsold food (N24, 2015). Also, UK supermarkets reported significant reductions in plastic bag usage since the introduction of a 5 pence charge for all single-use plastic bags in October 2015 (The Guardian, 2015).

Overall, experts have highlighted many positive outcomes these stores stand to provide by offering products without packaging, enabling consumers to control product portions and focusing on healthier nutrition. Yet, the scope and significance of these benefits would depend on them being distributed more widely.

Table 2 presents a detailed overview of the environmental and social impacts of zero-packaging stores, as articulated by the experts and store respondents, reflecting on the performance of the food industry regarding emissions, energy and water use, packaging and food waste, nutrition, ethical trade, food safety and consumer convenience.
Table 3 Impact of zero-packaging grocery stores on environmental and social performance of food industry based on expert interviews (Green Arrow = positive impact, Red Arrow = negative impact, ↓↑ = inconclusive / positive and negative impacts)

<table>
<thead>
<tr>
<th>OPERATIONS</th>
<th>Emissions</th>
<th>Electricity</th>
<th>Water</th>
<th>Packaging Waste</th>
<th>Food Waste</th>
<th>Healthy Nutrition</th>
<th>Ethical Trade</th>
<th>Food Safety</th>
<th>Customer Convenience</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No disposable packaging</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
<td>-</td>
<td>↓</td>
<td>-</td>
<td>Customers see and try the product / Portion control / Time-intensive / Higher risks for food contamination</td>
</tr>
<tr>
<td>No processed or frozen food</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
<td>↑</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Cooking skills required / Shorter FSC / Less refrigeration needed / Lifestyle change needed</td>
</tr>
<tr>
<td>300-1500 Products</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>↑</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Smaller stores -&gt; less emissions / inconvenient</td>
</tr>
<tr>
<td>Perishing foods are donated or processed into meals</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
<td>-</td>
<td>↑</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Stores with catering steer product demand / Portion control might reduce food waste in households</td>
</tr>
<tr>
<td>Trained Staff</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>↓</td>
<td>↑</td>
<td>-</td>
<td>-</td>
<td>Increased customer knowledge about nutrition, balanced diets and handling of food</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOGISTICS</th>
<th>Emissions</th>
<th>Electricity</th>
<th>Water</th>
<th>Packaging Waste</th>
<th>Food Waste</th>
<th>Healthy Nutrition</th>
<th>Ethical Trade</th>
<th>Food Safety</th>
<th>Customer Convenience</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Warehouses</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Only one store-chain has warehouses</td>
</tr>
<tr>
<td>Delivery Service by Bike or E-Vehicles</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Reduces fossil fuel consumption</td>
</tr>
<tr>
<td>5 stores focus on regionality</td>
<td>↓↑</td>
<td>↓↑</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>↓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Shorter Distances / non-seasonal foods need refrigerated storage or energy-intensive greenhouse production</td>
</tr>
<tr>
<td>Transport of big bags or reusable containers</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Prevention of packaging waste at end-consumer and partly-fully at retail-level / Could increase truck load but reusable containers might weigh more</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MARKETING AND SALES</th>
<th>Emissions</th>
<th>Electricity</th>
<th>Water</th>
<th>Packaging Waste</th>
<th>Food Waste</th>
<th>Healthy Nutrition</th>
<th>Ethical Trade</th>
<th>Food Safety</th>
<th>Customer Convenience</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No brands</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>↑</td>
<td>↑</td>
<td>-</td>
<td>-</td>
<td>No misleading marketing / No promotion of more consumption / No information about cooking or storage</td>
</tr>
<tr>
<td>Honesty and Transparency</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td>-</td>
<td>Increases trust of customers / Facilitates food safety</td>
</tr>
</tbody>
</table>

27
| Price Comparison                                                                 | ↑ | - | - | - | - | - | - | - | ↑ | Same/Cheaper than organic or conventional stores (30-70%) |
| Information on Websites and Events with Suppliers                              | ↑ | - | - | - | - | - | - | - | ↑ | Increases trust and knowledge of customers |

**PROCUREMENT**

| In Big Bags or Reusable Containers                                              | ↓ | ↓ | ↓ | ↓ | - | - | - | - | - | Reduces long-term material use and emission of production / No packaging or product standards for farmers and suppliers |
| 2 fully and 5 partly organic stores                                             | ↓ | ↓ | ↓ | - | - | - | - | - | - | (Arguably) decreases environmental impacts of agricultural production |
| 1 fully and 4 partly regional stores                                            | ↓ | ↓ | ↓ | ↓ | - | - | - | ↑ | - | Support of local small farmers / Possible agricultural diversification/ Shorter FSC |
5 Discussion

This study aimed to analyse the operation of zero-packaging grocery stores; find out their interactions with FSC actors and influences they have on them; and ultimately assess their environmental and social impacts. We extended Porter and Kramer’s (2006) value chain framework in order to identify processes through which social and environmental benefits emerge. The study considered the operation, logistics, marketing and sales as well as procurement functions of zero-packaging stores in order to assess their social and environmental performance in comparison to conventional supermarkets. Following a discussion of their performance to reduce food and packaging waste, resource use and increase social benefits, we analyse their unique characteristics compared to more established food retail concepts such as ethical and organic food. Then we identify alternative pathways through which zero-packaging could become more mainstream and thus drive more sustainable consumption and production patterns. While we recognise the importance of regional contexts in shaping the emergence and success of potential pathways, the broad similarities in impacts of FSCs in different markets (see e.g. Stenmarck et al., 2016) give confidence that the conclusions drawn here are applicable across a wide range of international contexts.

5.1 Food and packaging waste

Their most obvious positive environmental impact is the material and emissions savings through renouncing disposable packaging – not only at consumer and retail end, but also by influencing the packaging practices of suppliers. Yet, packaging does not significantly contribute to the greenhouse gas emissions of the food industry (Garnett et al., 2003). Moreover, Verghese et al. (2015) claim packaging saves considerable emissions due to the prevention of food waste, which is the most effective measure for minimising the environmental impact of the food industry (Schmidt Rivera et al., 2014). Although not all the products
available in conventional supermarkets can be offered without packaging or reusable packaging, some zero-packaging stores offer up to 1500 products. On the one hand, unpackaged fruits and vegetables might perish faster. On the other hand, zero-packaging stores enable consumers to control the product amount they buy, whilst also being less restrictive on size or form standards for fruits and vegetables that farmers usually have to comply with. Hence, some experts suggest that packaging standards might even lead to more food waste than no packaging; thus, contradicting the argument that packaging is preventing food waste. Furthermore, some of the interviewed stores are able to avoid food waste by processing and serving unsold food at integrated snack counters or catering services. This not only allows them to offer a greater variety of products that are not consumed regularly but also extends the potential reduction of food waste from consumer end to include retailer and suppliers. In summary, comparing the pros and cons of zero-packaging stores becomes rather complex and hence demands further investigation.

5.2 Resource use and emissions

Selling of fresh, limited refrigerated, less processed and more seasonal food should lead to a significant reduction in energy and water consumption and emissions, not only in the retail stores but also along the FSC as many of the manufacturing processes are excluded. While Schmidt Rivera et al. (2014) suggest home-made meals consume less energy and resources, differences in cooking practices and lifestyle choices (e.g. cooking vs roasting) make the calculation of energy needed for home cooking rather difficult. Products from small-scale producers possibly have higher emissions than products from large producers due to economies of scale, potentially reducing the benefits of these stores. On the other hand seasonal products might balance out this effect. Despite seasonal food potentially causing lower emissions, consumers are accustomed to products being available all year round. Geographical differences in climate and soil types/quality mean that the products zero-packaging stores can offer become limited if they opted to offer only seasonal and regional products. The majority of interviewed stores understand that
regional products are only environmentally beneficial if they are not produced in greenhouses or require excessive refrigerated storage.

Another factor impacting emissions is the efficiency of logistics. On the one hand emissions might decrease, if less packaging results in increased truckloads but could also increase due to heavier reusable containers and increased backhaul transportation. Additionally, any adverse effects of missing product protection, e.g. damages and food waste, need to be considered. Regional products lead to shorter distances from the supplier to the store. Besides lower emissions, a short supply chain enables easier and faster communication and quicker response times to fluctuating demand (Reiner and Trcka, 2004). However, it should be considered that the procurement at suppliers was not explicitly investigated here. Hence, supply chains might actually be longer than articulated by SRs and there was no data with regard to the frequency of deliveries.

5.3 Social impacts

Zero-packaging stores return power to consumers by offering better portion control and to suppliers by presenting an alternative to their conventional consolidated buyers. Portion control is not only an environmental but also a social benefit, as it reduces costs and avoids overconsumption. While conventional supermarkets may also offer smaller portions, they simultaneously introduce more packaging and charge a higher unit price. Monkhouse and Dibb (2011, p. 22) argue that people need to be enabled to “do the right thing more easily”. If people are trying to renounce plastic in their lives, zero-packaging stores will indeed simplify the process and provide an alternative and empower people to have a more sustainable and healthy lifestyle.

Another customer benefit is the improved customer service in stores and transparency about their suppliers, which could improve consumers’ understanding of FSCs. Coupled with the provision of recipe boxes, these stores aim to facilitate a healthy diet. A disadvantage of unpackaged food is the lack of information regarding cooking, storage and ingredients which is usually provided on the packaging. Customers need specific knowledge and cooking
skills in order to handle and prepare the food properly. Interestingly, neither store owners nor experts identified missing ingredient information as a problem for allergies. Compared to conventional stores, zero-packaging stores have a greater need to focus on hygiene and prevent food contamination. However, several bulk stores have been successfully operating for years and meeting food safety standards does not seem to emerge as a particular challenge.

Some stores articulated that they are able to offer further benefits to consumers via competitive prices, claiming to offer some of the products cheaper than conventional stores. As the majority of the interviewed stores prefer organic products, the prices are comparable or lower than in organic grocery stores. Thus, they could make organic products available for people who usually cannot afford organic products. Although studies assert that prices of unpackaged products decrease due to lower material and marketing costs (WRAP, 2007), not all interviewed stores observe this trend. These differences might depend on the store size and the region. Additionally, only few suppliers are suitable for zero-packaging stores at the moment. If the stores reached scale and more suppliers would be able to offer bulk products, it could potentially lead to further price competition.

5.4 Distinction from existing sustainable store concepts

Zero-packaging grocery stores follow a model that offers a radical change and disruptive innovation. They operate at a scale close to a neighbourhood store with a more limited product variety than found in conventional supermarkets. A significant number of stores combine well-established, more sustainable retail concepts such as organic and regional sourcing. In addition to supporting local and small-scale farmers, some stores procure fair-trade products from developing countries which are common practices for many supermarkets. Even though they are far from presenting a homogenous set of practices, their unique and common characteristic is the prevention of packaging waste at the consumer end. Their conceptual and organisational business model sets a stark contrast to efficiency-driven conventional supermarkets. By enabling consumers to buy as much as they need without the allure of market offers and promotions
they prevent food waste and potential over-consumption whilst encouraging a varied diet. Their flexibility to use unwanted products in food counters is another practice that reduces potential food waste as reported by some of the stores. They provide not only information and transparency but also allow consumers to change their habits and simultaneously impact the operation of suppliers and producers. Indeed, in their assessment of large retailers’ initiatives to reduce consumers’ emissions, Morgan et al. (2015) report a lack of integration across individual social material contexts in order to induce change in consumer behaviour and practice. In this regard, zero-packaging stores integrate these concepts across business activities by offering individual information supported by a set of institutions along the supply chain. They stand to transform the relation to and understanding of nutrition and offer quality food products for moderate prices and with less environmental impact.

5.5 Transformative market potential of zero-packaging concept

As it stands, zero-packaging stores are a ‘niche’ concept. Our findings point to a number of alternative pathways for zero-packaging to become more widely adopted, i.e. opening more zero-packaging stores, online shopping and adoption of this concept by conventional supermarkets. On the first pathway, our analysis reveals the presence of two kinds of zero-packaging stores. The smaller ‘neighbourhood’ stores which offer comparable (but not necessarily lower) prices, portion control and an improved environmental conscience. Whereas larger stores induce innovation, impact suppliers, offer a larger product range, lower prices and are comparatively convenient. Stores in the latter category are eager to develop digital tools to inform their customers of emissions they save by renouncing packaging.

Given the expected preparedness of the consumer to bring their containers, compared to making a momentarily shopping decision on the go, online shopping (Anesbury et al., 2016; Moth, 2015) can contribute to their penetration in the market. In such a system, reusable containers can be used as part of a deposit-refund system which is shown to be effective in reducing emissions (Simon et al., 2016). Two issues might be relevant for this pathway’s success
though: Associated energy and water use to ensure the hygiene of containers and the lack of one-to-one personal interaction to provide advice to consumer on using products with shorter shelf lives.

Given large market shares of conventional supermarkets, a pathway that can be more transformative is their adoption of zero-packaging concept as previously done with organic food. In his analysis of organic food penetrating the mainstream, Smith (2006) documents how the initial conception of organic farms serving local communities with seasonal food became fragmented over time. High compatibility of organic food with technologies, materials and practices of conventional supermarkets, coupled with interests and positive perceptions of multiple actors (such as soil associations, consumers, and environmental organisations) drove conventional supermarkets to integrate organic food into their product portfolios. Cost, availability and convenience demands of conventional system have fragmented its ethos and resulted in organically produced ingredients to be imported across the globe, processed and packaged as with other (non-organic) goods. Yet, parallel to this, the more complete organic vision continued its survival at niche level via farmer markets or organic box scheme suppliers. Smith (2006) reveals that the higher the degree of mainstream compatibility of a niche, the higher the chance of it being adopted and integrated into standard routines and practices. The corollary is that this compatibility blunts the transformative potential of niche. This example can give us clues into which factors of the incumbent market regime are likely to support or limit the niche development of the zero-packaging concept for different business processes as articulated by Porter and Kramer (2006) (Table 4).
Table 4. Comparing the adoption of organic food versus zero-packaging concept by conventional supermarkets

<table>
<thead>
<tr>
<th></th>
<th>Adoption of organic food concept</th>
<th>Adoption of zero-packaging concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations</td>
<td>Handling, processing and packaging practices were able to continue as before other than changing the source of the ingredients.</td>
<td>Operations in conventional supermarkets are largely dependent on packaging. Hence, substantial changes are required.</td>
</tr>
<tr>
<td>Procurement</td>
<td>Suppliers are assessed by certification bodies.</td>
<td>Zero-packaging needs to be ensured throughout the supply chain. Appropriate certification schemes are currently non-existent.</td>
</tr>
<tr>
<td>Logistics</td>
<td>Compatible since packaging is similar to non-organic food.</td>
<td>Particular challenges for product protection and logistics activities such as transport and sorting. Changes may be required.</td>
</tr>
<tr>
<td>Marketing and sales</td>
<td>Higher costs but clear environmental and social benefits as articulated by a multitude of actors. Shorter lifetime of products as additives and preservatives are not included. No changes in the way consumers buy or use the products.</td>
<td>Might need staff in order to provide consumer advice and engagement.</td>
</tr>
</tbody>
</table>

Our analysis reveals a larger number of practices and routines of conventional retailers that are more of a limiting than supporting nature compared to the adoption of organic food. We identify in particular three issues that might significantly impede this concept penetrating the mainstream. Shopping, cooking and consuming non-packaged food requires consumers to get used to products with shorter shelf lives and no use-by-date reminders. The second issue relates to the traceability of non-packaged goods and the distribution of associated costs and benefits across the FSC. Not only were the benefits of organic food clear and supported by a multitude of actors but its introduction did also not require changes in distributor, retailer and consumer routines and practices. As the higher cost of organic food production was passed down to the consumer directly, it did not pose a threat to conventional supermarkets'
business model in terms of promotions and market offers. However removing packaging starting from the producers will require the distributors and retailers to develop new handling, processing and logistics operations. It is also likely to require more consumer facing staff to provide advice and help. Even though the system benefits of zero-packaging are relatively transparent, it is not clear which actors would actually reap the benefits or incur new costs. If it costs a producer less to send bulk amounts but the retailer incurs higher costs due to new handling procedures, should the consumer pay more or less? Currently some large retailers in the UK offer some fruits and vegetables packaged and non-packaged side by side. There are some organic stores with a bulk department\(^5\) operating in North America as well. As our research did not analyse these operations, we do not have any evidence on how these practices are aligned with the ethos of the zero-packaging concept.

Another issue linked to the supply chain is the quantification of environmental benefits. Whilst stricter environmental laws and regulations on the amount of waste retailers create can incentivise the supermarkets to reduce packaging waste, the fact that it is distributed across the supply chain makes it difficult to identify responsibilities. Institutional arrangements for eco-branding and third-party certification (Chkanikova and Lehneron, 2015), similar to that for organic products, can give consumers assurance and evidence on what benefits they are getting in return for a less convenient shopping experience.

Despite these limitations, even though store respondents do not view cost savings as their main message, communication of cost-saving advantages to consumers might support zero-packaging stores in gaining access to a wider customer base. Garnett (2011) points out that consumer could use their savings to purchase more expensive food (meat) or non-food products, which could possibly have a higher environmental impact (‘rebound effect’). In this regard, adherence to transparent pricing schemes and avoiding consumer confusion is

\(^5\) There are over 450 whole food stores operating in the US, Canada and the UK (URL http://www.wholefoodsmarket.com/department/bulk, accessed 15.7.2016). There are similar, but smaller independent stores operating in other European countries (Appendix A3).
paramount as breaches of consumer law can result in enforcement action\(^6\) and may influence the reputation of the retailers.

Conventional grocery stores, non-governmental organisations and government initiatives try to change consumer behaviour by providing additional information (often on packaging) whilst industry performance is usually influenced by the introduction of new laws and regulations (WRAP, 2014). Another factor that will support the growth of zero-packaging stores is the adoption of stricter laws and regulations on the amount of packaging waste generated across the supply chain.

A factor that will carry a larger weight on the expansion and adoption of zero-packaging concept is increasing consumer demand for more transparency and sustainability along the FSC supply chain and an appreciation of freshly made food over processed food. Table 5 offers a summary of the barriers and drivers zero-packaging is facing in gaining wider adoption.

**Table 5. Barriers and drivers for the expansion of zero-packaging concept**

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Lifestyle change and cooking skills required of consumers</td>
<td>- Consumer demand more transparency and sustainability</td>
</tr>
<tr>
<td>- Suppliers have to change their practices</td>
<td>- Price advantage due to avoided cost in production and disposal</td>
</tr>
<tr>
<td>- Fundamental change of marketing and consumer-brand relationship</td>
<td>- Facilitating low-impact and healthy consumer behaviour</td>
</tr>
<tr>
<td>- Establishing trust in food safety</td>
<td>- Competitive advantage regarding environmental behaviour</td>
</tr>
<tr>
<td>- Pressure of main market player</td>
<td></td>
</tr>
</tbody>
</table>

How these drivers and barriers might influence the emergence and success of the suggested alternative pathways is very much dependent on the regional context, including the regulatory framework and legislations, affluence of the

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\(^6\) Potentially misleading special offers, unit pricing, price-matching schemes and changing pack sizes were the subject of recent a review by the UK Competition and Markets authority (URL https://www.gov.uk/government/news/cma-recommends-changes-to-help-shoppers-in-supermarkets, accessed 6.7.2016).
market and customer preferences. For example, in contrast to the experts' view on customers not wanting to pay more for a less convenient shopping experience, a study shows that more than 80% of German customers would buy non-packaged goods: 35% in zero-packaging stores, 63% in supermarkets with a bulk department (PwC, 2015). The most important reason is to protect the environment, followed by portion control. A third of them would be willing to pay a higher price. To what degree similar views will be echoed in other countries is a big unknown as Germany is well-known for its discounter and cheap food prices whereas quality of food is potentially more important in e.g. France or Spain. On the other hand, our small sample size does not allow separating out the influence of regional contexts on the operation of the zero-packaging concept.

6 Conclusions and Further Research

The aim of this study was to analyse the prospects of zero-packaging grocery stores to present a resource efficient and socially valuable alternative to traditional food retailers. Zero-packaging stores renounce disposable packaging and influence suppliers to adapt reusable packaging practices. As food waste is the biggest negative externality of the FSC, the main advantage over conventional stores is their potential to reduce food waste at supplier, retail and consumer end. Utilising unsold food and focusing on seasonal and unprocessed food avoids energy-intensive storage, manufacturing, and disposal processes. By supporting small-scale farmers, zero-packaging stores may shorten supply chains and increase overall transparency of the FSC. Operating with unpackaged food requires close collaboration with hygiene regulation offices to prevent food safety issues. Barriers to healthier diets are reduced by offering portion control, healthy food for lower prices and increasing knowledge by employing trained staff and carrying out events about sustainability and food topics. Hence, the zero-packaging concept holds considerable potential to improve the environmental and social performance of the food industry. Yet, this comes at the expense of consumer convenience due to more time-consuming shopping and a limited product range.
Our analysis points to three potential pathways by which these stores penetrate the mainstream. The first pathway comprises the expansion of zero-packaging stores. We identify two distinct types of stores: small stores resembling the classical ‘corner shops’, versus more innovative ones developing new operation systems to increase consumer convenience. The second pathway involves online delivery. A third and more transformative pathway would be the adoption of this concept by conventional supermarkets.

This qualitative, exploratory research has two main limitations. Firstly, most of the stores are relatively young and therefore do not have empirical data to quantify their advantages or disadvantages in terms of avoided packaging, waste and emissions. Secondly, the expert interviews conducted provide an initial reflection on the issues at hand and might not be representative or provide full coverage. Nonetheless, this study gives first insights into the operation of zero-packaging grocery stores and the impacts that zero-packaging grocery stores have on the environmental and social performance of the food industry. Future studies can aim to shed light on which characteristics of regional contexts might support or limit the emergence and operation of zero-packaging stores and how this varies across different countries. As our study presents zero-packaging stores operating in European markets, further studies can look into other international contexts such as Asia, Australia and Africa.

Another knowledge gap is around consumer attitudes and behaviours, including how frequently they shop, their socio-economic demographics, and their motivational factors (Chekima et al., 2016). Our research did not explore whether customer loyalty is positively correlated with increased contact with store personnel. Further research can analyse how no packaging impacts the logistics along FSC and how that varies by seasons. Quantitative studies are also needed to measure the impact: e.g. generation and prevention of packaging waste and food waste (at supplier, store and consumer level), as well as impacts on local economies and small producers. This could be done through longitudinal studies in companies planning to reduce packaging or also through archival research on previously implemented changes to packaging practices. The resulting findings could be instrumental in finding the optimal
zero-packaging model for consumers and thus also support social research about changing consumer behaviour for a more sustainable lifestyle.
ACKNOWLEDGEMENTS

We would like to express our gratitude to all the stores and experts for participating in the research and providing us with all required information.

REFERENCES


FoodDrinkEurope, 2012. ENVIRONMENTAL SUSTAINABILITY VISION TOWARDS 2030 Achievements, Challenges and Opportunities.


**APPENDIX A**

Table A 1 List of all operating zero-packaging grocery stores (x = all products, o = mixture, / = no information)

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Opening Date</th>
<th>Products</th>
<th>Regional</th>
<th>Organic</th>
<th>Range</th>
<th>Business Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Austria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frida</td>
<td>Hohenhems</td>
<td>01.03.2015</td>
<td>o</td>
<td>x</td>
<td>/</td>
<td>Café  incl. Breakfast and Lunch, Information about Suppliers on Website</td>
<td></td>
</tr>
<tr>
<td>Lunzers Maß-Greißlerei</td>
<td>Vienna</td>
<td>26.02.2015</td>
<td>x</td>
<td>o</td>
<td>ca. 400</td>
<td>Café</td>
<td></td>
</tr>
<tr>
<td><strong>Belgium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>Leuven</td>
<td>2014</td>
<td>x</td>
<td>o</td>
<td>/</td>
<td>Lunch corner, Café, Workshops, Lectures, Events, Information about suppliers on website Including blog, DIY products (e.g. toothpaste)</td>
<td></td>
</tr>
<tr>
<td>Robuust! The Zero Waste Shop</td>
<td>Antweerp</td>
<td>2014?</td>
<td>x</td>
<td>x</td>
<td>/</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Czech Republic</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Opobchod</td>
<td>Prague</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>First year non-profit to test the concept.</td>
<td></td>
</tr>
<tr>
<td>Bezobalpu</td>
<td>Prague</td>
<td>2014</td>
<td>o</td>
<td>/</td>
<td>/</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Germany</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unverpackt</td>
<td>Kiel</td>
<td>01.02.2014</td>
<td>o</td>
<td>o</td>
<td>&gt; 400</td>
<td>Coffee Corner, Tasting Events, Consultation Workshops</td>
<td></td>
</tr>
<tr>
<td>Original Unverpackt</td>
<td>Berlin</td>
<td>13.09.2014</td>
<td>o</td>
<td>o</td>
<td>400</td>
<td>Consultation Workshops Café with sandwiches, soups, coffee, tea / supportive community - membership fee guarantees lower prices / Get-to-Know the Supplier - Events</td>
<td></td>
</tr>
<tr>
<td>Freikost Deinet</td>
<td>Bonn</td>
<td>01.05.2015</td>
<td>x</td>
<td>x</td>
<td>300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Location</td>
<td>Opening Date</td>
<td>Products</td>
<td>Business Model</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Regional</td>
<td>Organic</td>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unverpackt</td>
<td>Mainz</td>
<td>08.06.2015</td>
<td>x</td>
<td>x</td>
<td>999</td>
<td>Talks and Events about Sustainability / Consultation Workshop</td>
<td></td>
</tr>
<tr>
<td>Lose</td>
<td>Dresden</td>
<td>01.04.2015</td>
<td>o</td>
<td>x</td>
<td>/</td>
<td>Coffee Corner</td>
<td></td>
</tr>
<tr>
<td>Annas Unverpacktes</td>
<td>Heidelberg</td>
<td>18.06.2015</td>
<td>o</td>
<td>x</td>
<td>&gt; 150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional und unverpackt</td>
<td>Schwäbisch Gmünd</td>
<td>01.07.2015</td>
<td>x</td>
<td>o</td>
<td>/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effecorta</td>
<td>Milano</td>
<td>o o /</td>
<td></td>
<td></td>
<td></td>
<td>Events with Suppliers and/or about cooking</td>
<td></td>
</tr>
<tr>
<td>Negoziolleggero</td>
<td>12 Stores</td>
<td>2009</td>
<td></td>
<td>x</td>
<td>&gt; 1500</td>
<td>Supported by Research Institute Ecologos, Bike-Deliveries</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graneria Sala</td>
<td>Barcelona</td>
<td>1885</td>
<td>/</td>
<td>o</td>
<td>/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granel</td>
<td>Barcelon/ Ibiza/ Vic</td>
<td>2011</td>
<td>x</td>
<td>x</td>
<td>/</td>
<td>Deliveries are managed by an external distribution company, Promotion of slow food concept</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beunpackaged</td>
<td>London</td>
<td>2006/2015</td>
<td>–</td>
<td>x</td>
<td>50-100</td>
<td>Started in 2007, expanded after 5 years including a café &amp; bar, but closed a year later. Reopened in 2015 in the store Planet Organic.</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Location</td>
<td>Opening Date</td>
<td>Products</td>
<td>Business Model</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
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<td>----------</td>
<td>-------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Belgium</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>Leuven</td>
<td>2014</td>
<td>x</td>
<td>Regional / Organic / Range / Lunch corner, Café, Workshops, Lectures, Events, Information about suppliers on website</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robuust! The Zero Waste Shop</td>
<td>Antwerp</td>
<td>2014?</td>
<td>x</td>
<td>x / Including blog, DIY products (e.g. toothpaste)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Canada</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strictly Bulk</td>
<td>Toronto</td>
<td>1987</td>
<td>/</td>
<td>/ / Small coffee corner</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Store Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liebe und Lose</td>
<td>Innsbruck, Austria</td>
</tr>
<tr>
<td>Holis Market</td>
<td>Linz, Austria</td>
</tr>
<tr>
<td>Tütenlos</td>
<td>Köln, Germany</td>
</tr>
<tr>
<td>LoLa</td>
<td>Hannover, Germany</td>
</tr>
<tr>
<td>OHNE</td>
<td>Munich, Germany</td>
</tr>
<tr>
<td>Louise genießt</td>
<td>Erfurt, Germany</td>
</tr>
<tr>
<td>Bag &amp; Buy</td>
<td>Utrecht, Netherlands</td>
</tr>
</tbody>
</table>
Table A3 Selection of zero-packaging departments in grocery stores

<table>
<thead>
<tr>
<th>Store Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-Laden Familie Matzer</td>
<td>Graz, Austria</td>
</tr>
<tr>
<td>Genussplatzl Wasserwald</td>
<td>Linz, Austria</td>
</tr>
<tr>
<td>Veganladenkollektiv</td>
<td>Berlin, Germany</td>
</tr>
<tr>
<td>Holtorf Feinkost &amp; Kolonialwaren</td>
<td>Bremen, Germany</td>
</tr>
<tr>
<td>12 Monkey - Vegankrams</td>
<td>Hamburg, Germany</td>
</tr>
<tr>
<td>Calenberger Bioladen</td>
<td>Hannover, Germany</td>
</tr>
<tr>
<td>Mercado Mundial</td>
<td>Schortens, Germany</td>
</tr>
<tr>
<td>Biosphäre</td>
<td>Berlin, Germany</td>
</tr>
<tr>
<td>Bittersüß</td>
<td>Hannover, Germany</td>
</tr>
<tr>
<td>Kräuterwelt</td>
<td>Würzburg, Germany</td>
</tr>
<tr>
<td>Veganz</td>
<td>Leipzig, Germany</td>
</tr>
<tr>
<td>Obgeweckt Noord</td>
<td>Groningen, Netherlands</td>
</tr>
<tr>
<td>Chornlade Idaplatz</td>
<td>Zürich, Switzerland</td>
</tr>
<tr>
<td>Chornlade Limmatplatz</td>
<td>Zürich, Switzerland</td>
</tr>
<tr>
<td>HISBE (How it should be)</td>
<td>Brighton, United Kingdom</td>
</tr>
</tbody>
</table>