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The environmental effects of seasonal food purchase: a raspberry case study

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ABSTRACT

The environmental effects of seasonal food supply have been explored through a Life Cycle Assessment (LCA) study of raspberries supplied to UK consumers at different times of year. Supply of raspberries at different times of the year draws on different production systems and locations. Despite that, the results of this LCA, based on data from individual producers, reveal relatively small differences in impacts for different times of supply, except in the case of the water footprint measures. LCIA results are very sensitive to fruit yield. So in this case, yield and agricultural practice appear stronger drivers of the environmental burden of food production than is time of supply. In such situations a strong focus on "seasonality" in sustainable food provisioning is unlikely to deliver large environmental benefits. Using LCA to establish what benefits might be available from a more general shift to "seasonal" food consumption, often advocated as more "sustainable", will require a multi-product approach. Such an approach could take current food consumption patterns or environmental targets as its starting point.

1. Introduction

As urbanisation progressed in the second half of the 20th Century and the agricultural workforce shrank, so Western European citizens disengaged from food production, losing their connection with its seasonal patterns. From the 1960's onwards, seasonal variation in the availability of certain foods reduced, leading to the commonly-described position of "all-year-round availability" for many foods. Recently, interest in seasonal foods has been resurgent; Dibb et al. (2006) state that two-thirds of people in the UK are now "taking steps to buy seasonally". This trend has various drivers but – as Dibb et al.'s title suggests – some see implications for the environment in it. In line with this, advice on "sustainable diet" often advocates consumption of seasonal food. Seeking additional evidence relevant to such recommendations, the UK's Department of the Environment, Food and Rural Affairs commissioned a research project exploring the environmental implications of seasonal food purchasing (DEFRA research project FO0412). This paper reports some findings of the project, focussing on environmental implications of seasonal food supply explored through a raspberry LCA case study.

1.1. "Seasonal" food

A review of literature and consumer research demonstrated that clearly identifying seasonal food is in fact quite difficult. Few commentators take the trouble to define the term "seasonal", while consumer research found that UK consumers "have only a vague definition of seasonal food". In essence "very different definitions and perceptions of what is seasonal are applied by different parties" (Brooks and Foster, 2011). To inform the project noted above, two working definitions of seasonal food were used – one derived from discussions with industry and policy makers and one informed by consumer research reported in ADAS et al. (2012). The first was a production-oriented or "global" definition: food that is outdoor grown or produced during the natural growing/production period for the country or region where it is produced. It need not necessarily be consumed locally to where it is grown.[1] The second was a consumer-oriented, more "local" definition: food that is produced and consumed in the same climatic zone, e.g. UK, without high energy use for climate modification such as heated glasshouses or high energy use cold storage. Inevitably, these definitions are themselves open to interpretation. The LCA research on which this article draws covered a number of food items meeting one or the other (or both) of these definitions.

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[1] This was originally suggested in Defra's project specification.

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1.2. Food, seasonality and the environment

The timing of agricultural activities in any one place can change the effects of those activities on the wider environment, even if the activities remain the same. Thus changing the timing of pesticide applications can result in increased or reduced effects on non-pest susceptible species, simply because these will be present in different numbers, variety and development stage; moving nitrogen fertiliser applications to times of higher rainfall will likely lead to higher leaching rates; the presence of crop canopy in times of higher rainfall might mitigate soil erosion. So if a crop's planting-to-harvest cycle is moved earlier or later in the year and fertiliser and/or pesticide applications moved in step, then the total effects on the environment can change.

As food production for supply in a certain place is shifted further away in time from the "natural", or normal time of production there, so one or both of two additional changes occurs: either the nature of the producing activity changes (e.g. through the use of protected growing environments) or the place of production changes (change can include division, as in the case reported below). Furthermore, preservation and storage allow the time of production and the time of supply to be separated, introducing further flexibility into the supply system. Finally of course, consumers also have access to preservation and storage, so can separate the time of supply from the moment of consumption.

Each of these adjustments changes the interaction between the food system and the natural environment surrounding it: different production systems for the same basic foodstuff have different yields and require different inputs, almost all preservation techniques require energy inputs, as does cold storage. The fact that these adjustments can be made at different points in a generic food production-consumption system is a strong indicator that life cycle assessment will be an effective tool to explore their environmental implications.

1.3. LCA and seasonality

While the need to consider the whole food production-consumption system favours the application of LCA in this context, care is needed because of the way temporality is handled within LCA. For agricultural products the product system is normally defined as a full annual (sometimes multi-annual) cycle and the life cycle inventory (LCI) integrates emissions occurring throughout that cycle, dividing them equally among the total harvest. Thus few life cycle analyses of food products or systems explicitly explore seasonality. When LCA studies refer to 'seasonality', the term is associated – implicitly or explicitly – with a crop's 'natural growing season' and its 'cropping period', thus with its availability for fresh consumption. Some LCAs examine seasonal variation in impacts more explicitly, for example Williams et al. (2009). This and other studies (Blanke 2007; Blanke and Burdick, 2005, 2007, Hospido et al., 2009; Jones, 2006; Milà i Canals et al., 2007; Saunders et al., 2006) consider seasonality in the context of the supply of fresh produce to consumers in Northern Europe all year round – and thus closely connected to the 'local vs. global' or 'food miles' debate.

Examination of this literature highlights some issues that require attention if seasonal effects on the environmental impacts of food supply are to be separated from other factors that may differ between supply systems but are not directly linked to seasonality. For example, a review by Evans (2014) found the range of specific energy use (energy use per volume) in cold stores in the UK alone to be very wide for each temperature regime studied – with an eight-fold difference between the most and least efficient. Blanke and Burdick (2005), Milà i Canals et al. (2007), Saunders et al. (2006), Sim et al. (2007) and Williams et al. (2009) all report LCAs of apples; it is clear from these that the impacts associated with the different stages of the apple life cycle are of similar order of magnitude, a situation that may then reasonably be anticipated for other top-fruit. Differences in post-harvest technology, arising coincidentally, may therefore outweigh differences driven by the season of production. In cases where supply at a particular time of year requires storage, the scale of product loss or degradation during storage must be accounted for. The degree of geographical resolution embedded in impact assessment (LCIA) methods (few of which exist in regionalised form) may also limit the extent to which LCA can inform about the environmental effects of seasonal variation in food supply when that variation involves production in different places.

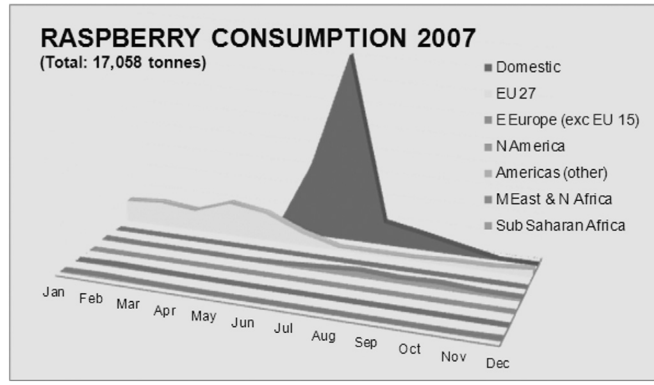

Fig. 1. UK raspberry supply 2007.
Sources: Defra horticultural statistics, UK Trade statistics.

2. Methods

2.1. Scope

The aim of the research was to explore the environmental implications of upstream changes that arise as supply of particular foodstuffs progresses through the year. Therefore a selection of individual foods was studied, rather than a sequence of "baskets". Here the raspberry case study is reported to illustrate how environmental impacts vary across the year for one food consumed in the UK. Clearly at a certain time of year raspberries are "in-season" in the UK, at other times they are not. The project considered only the effect of changing the times of production and supply in the system as far as delivery to the food retailer. In effect, we equate (reflecting mainstream economics and consumer data) consumption with purchase, and purchase with supply to the retailer. This embodies a simplification: it is possible that consumers store foods for extended periods after purchasing them. The environmental implications of this, if it occurs, were not considered in the LCA; it would make food consumption less "seasonal" than statistics would lead us to believe it is. Some of the volume captured by this data is supplied to commercial buyers (the foodservice sector or institutions) rather than final consumers, of course. This is still purchase, however, and there seems to be no reason to exclude it.

Fig. 1 shows how UK supply of raspberries changes through the year in volume and by source (data compiled from UK production[2] and import[3] statistics with quantity, in tonnes, as the *y*-axis which

[2] Department of Environment, Food and Rural Affairs Horticultural Statistics: www.defra.gov.uk/statistics/foodfarm/landuselivestock/bhs/.

[3] HM Revenue & Customs Trade Statistics: https://www.uktradeinfo.com/Pages/Home.aspx.