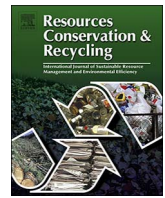


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## Food waste and losses in primary production: Qualitative insights from horticulture

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## ABSTRACT

Food waste is recognised as being one of the major global challenges in achieving a sustainable future. Currently very little is known about how much food is wasted in primary production. This study uses a qualitative approach to examine farmers' views on food waste and losses occurring on soft fruit and vegetable farms. Semi-structured interviews were conducted with 12 fruit and vegetable farmers in Scotland to gain information about 1) farmers' attitudes to food waste, 2) how much food waste is generated on farms, 3) what are the causes of food waste, 4) what happens to the waste, and 5) what strategies can be used to reduce food waste on farms and add value to how waste is used. Thematic analysis was employed to analyse data from the interviews. This study revealed that farmers do not consider food waste to be an issue of primary concern and perceive food waste to be an intrinsic part of farming. Farmers do not routinely record waste and have difficulty in providing estimates for food waste and losses. Many of the causes of food waste identified in this study are due to factors further along the food supply chain, including cosmetic specifications by retailers, and a lack of processing facilities. Farmers expressed an interest in adding value to how food waste is used on their farms, but identified several barriers in relation to using food waste for energy production through anaerobic digestion.

## 1. Introduction

Food waste is recognised as a major global challenge in achieving a sustainable future. The most widely cited figure for global food waste and losses comes from a study by the Food and Agricultural Organisation (FAO) which estimated that one-third (by weight) of all food produced in the world in 2009 was lost or wasted (FAO, 2011). Food waste and losses can occur at each stage of the food supply chain (FSC), in primary production, processing, retail and consumption. The terms food loss and food waste are used either in tandem or separately in the literature (FAO, 2011; Franke et al., 2016). Generally, food loss is referred to at the earlier stages of the FSC, in production and processing (FAO, 2011; Kummu et al., 2012; Parfitt et al., 2010). The term food waste is generally applied at the later stage of the FSC in retail and final consumption. It is often associated with “wasteful behaviour” and a conscious decision to throw away food (FAO, 2011; Kummu et al., 2012; Parfitt et al., 2010). However, a distinction between wasteful behaviour and other reasons for food losses can be difficult to perform (Beretta et al., 2013). Accordingly, to depict food lost/wasted at all stages of the FSC starting with primary production, we employ them in a similar fashion in this paper.

Generally, food waste and losses refers to plants and animals produced for human consumption but not ultimately consumed by people (Lipinski et al., 2013). This excludes materials for “non-food” purposes such as crops for biofuels (FAO, 2011). The point at which material becomes ‘food’ is when it is ready for harvest or slaughter, which means yield losses due to weather events or diseases are often excluded (Lipinski et al., 2013). When a commodity intended for human food consumption is directed to a non-food use such as animal feed, bio-energy or disposal in landfill, it is often considered as food waste (Beretta et al., 2013; FAO, 2011; Lipinski et al., 2013). However, food that was intended to be consumed by people but is instead diverted to animal feed may be excluded from the food waste definition, as the animals remain part of the human food chain (Fusions, 2016).

Quantifying food waste and losses in primary production is difficult as the sector has not been investigated to the same extent as other stages of the FSC (Fusions, 2016). The sector is also very heterogeneous with regards to what it produces, and consequently waste levels vary. Classifying food waste is more difficult earlier in the FSC when dealing with unprocessed products such as crops and livestock (Fusions, 2016). In Europe, it is estimated that as much as one-third of all food waste

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occurs in primary production (Bräutigam et al., 2014; European Parliament, 2013). Fruit and vegetables, along with roots and tubers, have the highest wastage rates of any food (FAO, 2011). Losses in developed countries mainly occur in agricultural production (FAO, 2011). Waste is also significant at the end of the FSC, due to unpredictability of demand and high perishability of fruits and vegetables (Beretta et al., 2013). In the UK estimates of waste for fruit and vegetables in primary production range from 1 to 30 percent (Farming Online, 2015; Tesco, 2014; WRAP, 2011).

### 1.1. Causes of food waste and losses in primary production

Pre-harvest conditions and actions in the field can lead to losses later in the FSC, due to differences in the quality at harvest and during subsequent shelf-life (CFS, 2014). For fruit and vegetables, agronomic practices during the field stage greatly contribute to the product's visual and nutritional quality (CFS, 2014). Pre-harvest factors that affect post-harvest losses include choice of crop variety and agronomic practices such as pest/disease management and fertilisation (CFS, 2014). Poor harvest scheduling along with careless handling of produce contribute to food waste and losses along the FSC (CFS, 2014). Produce can be lost at harvest because mechanised harvesters cannot retrieve the entire item or because machines cannot discriminate between immature and ripe produce (Kantor et al., 1997). Often these losses are viewed as an acceptable trade-off between field efficiency (i.e. lower production costs and faster operation) and increased yields (Kantor et al., 1997).

Many farmers sell their produce through “contract farming”; where products of defined quality and specification are sold to a particular retailer or food manufacturer (European Parliament, 2013). Contract farming may lead to farmers producing surpluses on purpose to ensure they do not undersupply their customers due to unforeseeable circumstances such as extreme weather or pest infestation. As a result, farmers may produce greater quantities than needed, even in “average” conditions, which may not reach market (FAO, 2011). In the UK, it has been estimated that contractual penalties, product take-back clauses, and poor demand forecasting can lead to 10 percent overproduction and high levels of wastage in the FSC (DEFRA, 2007; Parfitt et al., 2010).

Promotions by retailers are seen as a useful tool for managing waste by clearing ‘gluts’ (Terry et al., 2013) and increasing sales of fruit and vegetables near the limit of their shelf-life (Mena and Whitehead, 2008). However, it has been suggested by some producers that promotions were previously based on crop availability during peak harvest, but now are based on factors such as the number of products that are on promotion at any one time (Terry et al., 2013). Furthermore, some retailers cannot turn promotions on quickly enough to respond to surpluses (WRAP, 2011).

Cosmetic standards set by retailers have long been criticised as a major cause of food waste in developed countries (FAO, 2011; Göbel et al., 2015; WRAP, 2011). Specifications by retailers are mainly based on visual appearance: size, colour and shape, and freedom from defects (e.g. bruising, blemishes). If produce does not meet strict quality standards, it may be rejected by retailers at the farm gate (Bond et al., 2013; Stuart, 2009). For vegetables, cosmetic standards were identified as the main cause of food waste which resulted in farmers in Germany wasting a large proportion of their crop (Göbel et al., 2015). Cosmetic standards were also found to be a major cause of waste for potato in Scotland (Krzynowek and Hawkins, 2015).

### 1.2. Managing food waste and losses

The management options for food losses and waste can be ranked according to the waste hierarchy (Papargyropoulou et al., 2014), shown in Fig. 1. Research suggests that the environmental choice of waste management system from a life cycle perspective follows the food waste pyramid in many cases (Eriksson and Spångberg, 2017; Laurent et al.,

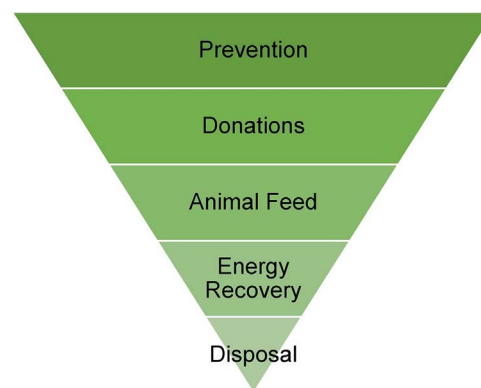


Fig. 1. The Food Waste Pyramid.

Adapted from Eriksson et al., 2015 and Papargyropoulou et al., 2014.

2013). Prevention of food waste and losses is the most favourable option in the food waste pyramid. It includes avoiding surplus food generation throughout food production and consumption, as well as preventing avoidable food waste generation throughout the FSC (Papargyropoulou et al., 2014). Priority is also given to donations to people in need, although this is limited by the fact that food waste can only be donated to charity if it is still fit for human consumption (Papargyropoulou et al., 2014). The least favourable options include disposal, i.e. end-of-life treatment without valorisation. However, since each waste management system is dependent on a local context, the waste hierarchy must still be seen as a rough generalisation (Eriksson et al., 2015).

### 1.3. Using qualitative research to understand food waste

As nobody intends to waste food, individual and outer circumstances and behaviour lead to the wastage of food (Schneider, 2008). Frequently, studies on food waste focus on the amount of waste arising and not the reasons why waste occurs (Heikkilä et al., 2016). Furthermore, much of the research addressing food waste uses methodologies that involve participants being given closed-ended questions, followed by a series of possible responses (Graham-Rowe et al., 2014). Such methodologies have limitations as they impose responses on the participant without allowing them to give their own perspective on a particular matter (Graham-Rowe et al., 2014).

Qualitative methods, such as interviews and focus groups, are a useful tool in research, as they can provide more opportunity for in-depth understanding than quantitative methods, allowing the researcher to examine complex issues without imposing limitations (Graham-Rowe et al., 2014; Williams, 2007). The goal of qualitative research is the “development of concepts which help us to understand social phenomena in natural (rather than experimental) settings, giving due emphasis to the meanings, experiences and views of the participants” (Pope and Mays, 1995, p. 43). Furthermore, qualitative research is critical to explore new research questions prior to undertaking quantitative research (Bryman, 2006; Newenhouse and Schmit, 2000).

Qualitative research approaches have been successfully used to investigate food waste at the later stages of the FSC – in retail (Heikkilä et al., 2016; Mena et al., 2011) and consumption (Graham-Rowe et al., 2014; Hoek et al., 2017; Ofei et al., 2014; Sirieix et al., 2017). However, qualitative research examining food waste in primary production is relatively scarce, particularly looking at farmer attitudes to food waste. Farmers are the key stakeholders for reducing waste and losses in primary production, and any strategy must take their attitudes and views on food waste into account.

This study examines the farmers' views on food waste occurring on soft fruit and vegetables farms. Given the open-ended nature of the research questions proposed, a qualitative approach was used in this

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