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# **A SOCIO-ECONOMIC INVESTIGATION OF PRE-HARVEST AND POST-HARVEST CROP LOSS BETWEEN PRODUCERS AND RETAILERS IN FENLAND**

**Henry R. W. Fenn<sup>5</sup> and Elizabeth Laycock**

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This paper presents the results of an investigation which identified causes of both pre- and post-harvest crop losses and retail-induced crop losses within Fenland, Cambridgeshire. This study used semi-structured face-to-face interviews with local fruit and vegetable producers. Constructivist grounded theory was utilised for data analysis which revealed aspects not previously identified within academic literature. The causes of crop loss are heavily influenced by external forces situated near the consumer-end of the food supply chain in addition to natural factors, such as weather events, were identified to form a small percentage of loss. While crop loss cannot be totally mitigated; producers appear to use a plethora of strategies including the use of technology to minimise these losses. Producers were found to be directly affected by the high demands of retailers and consumers, however, the significance was found to be dependent on the scale of production and the crop grown. This study establishes the need for new future policies to ensure equality for producers in the UK fresh food supply chain, in addition to the promotion of sustainable food production.

Keywords: Crop Losses, Producers, Food Supply Chain, Sustainability.

## **INTRODUCTION**

The issue of waste has gained significant status in recent years as a considerable problem within sustainable growth and development policies. One of the largest waste issues present in the UK is food waste. WRAP (2008) identified the scale of food waste in the UK at approximately 6.7 million tonnes per year, 40% of this waste originates from fresh fruit and vegetables. Transitional changes within the food supply chain have been seen since 1945 (Bourlakis & Weightman,2003; Ramsay,2000) wherein agri-food networks have significantly expanded from globalisation and thus have contributed to the rise of retailers

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and supermarkets. This expansion has led to a significant change in ‘market power’ and thus additionally increased the excess margin, directly affecting the prices received by producers (Zachariasse & Bunte, 2003) through asymmetrical price transmission.

Situated in north Cambridgeshire, bordering with Norfolk and Lincolnshire, Fenland covers an area of approximately 200 square miles (Cambridgeshire Fens, 2017) and makes up a small part of the wider area known as ‘The Fens’. The Fens is renowned for its high quality grade 1 soils, accounting for 50% of the total grade 1 soils in England (Fens for the Future, 2017). Fenland was chosen as the area of study for this research paper due to its relatively small area and high agricultural output of wheat, root crops, vegetables and fruits (Natural England, 2015, p.7).

## **RESEARCH METHOD**

The formulation of research objectives identified below arose from omissions discovered within academic literature relating to the research aim. The aims seek to investigate the causes of both pre-harvest and post-harvest crop losses and the socio-economic implications producers face arising from such losses.

- Investigate the causes of pre-harvest and post-harvest crop loss in Fenland.
- Investigate whether retailers are a direct cause of crop loss within the food supply chain.
- Identify the socio-economic impacts of crop loss faced by producers.

Due to the investigative nature of this dissertation topic, a qualitative approach has been chosen as the main methodological approach over a quantitative approach. As highlighted by Thorne (2000), qualitative research studies utilise an inductive reasoning approach as opposed to deductive reasoning processes. A process of inductive discovery is used for qualitative research (Gray, 2014, p.16), whereby data are collected and then analysed to distinguish emerging patterns, consistencies and meanings. Thomas (2006) highlights the emergence of patterns, consistencies and meanings may include frequent, dominant and significant themes emerging from the raw data through the interpretations made by the researcher. In light of this, the inductive approach is closely linked to exploratory research, within which the objective of the research is to “develop a hypothesis rather than their testing” (Kothari, 2004).

The research methodology for this study follows a guide illustrated by Gray (2014, based on work by Crotty (1998)). For this research study, a constructivist grounded theory was employed which utilises multiple accounts to construct reality and meaning through the interaction between the researcher and the respondent, whilst acknowledging that the positionality of the researcher may lead to a form of bias (Charmaz, 2008, p.402). Constructivist grounded theory has been chosen over other grounded theory methods, due to the recognition that a study cannot be devised without prior knowledge and theories of the topics (Charmaz, 2008) and that a literature review should be used at every stage to enable theory to be constructed.

As there was little theory based on the relationship, and causes of, post harvest losses and the effects on producers within academia and industry, qualitative data collection was utilised in accordance to the constructivist epistemology with interviews as the primary data collection tool. Theoretical sampling was undertaken, whereby participants were

selected as the construction of concepts and theory began to occur. Finally, there was an element of judgemental sampling which occurred within the study, whereby a snowball sampling strategy (Marshall, 1996) was used. Eleven individuals were identified and invited to participate which recruited a total of six interviewees. Prior to the commencement of interviews, a pilot study was undertaken, conducted in an informal environment on a voluntary participant with prior experience of the subject under study. A number of ambiguities were identified within the initial pilot study so minor changes were made, including the addition of open ended questions, in order to satisfy the requirements of the study. All work was undertaken within the SHU guidance for undergraduate studies.

As noted by Charmaz & Belgrave (2012), studies utilising grounded theory approaches combine data analysis with data collection. Memo writing was undertaken immediately after interview, to explain concepts and create links to data whilst relatively fresh. Prior to data analysis, the interviews were transcribed with any uncertainties arising from poor recording marked as “unintelligible word”. Coding was undertaken immediately after the data were transcribed. A coding framework was followed as suggested by Starks & Brown Trinidad (2007) and Charmaz & Belgrave (2012) initially using open coding and later selective coding. This ensured the constant comparison of categories and codes between interviews, highlighting key themes which were then explored in other interviews as part of a reflective process (Scott, 2004).

## **LITERATURE REVIEW**

Food waste is an increasing problem both globally and within the UK. Bond, Meacham, Bhunoo & Benton (2013) recognise the definition of food waste as: “edible food products which are intended for human consumption but have been discarded, lost, degraded or consumed by pests”.

Lipinski et al. (2013) identify areas within the food supply chain where food loss occurs, including:

- Production,
- Handling and storage,
- Processing and packaging,
- Distribution and marketing,
- Consumption.

Although food waste has two sub-definitions, the UK uses food waste as a generic term, covering all food and drink waste/losses throughout the entire food supply chain (Parfitt et al., 2010 and Bond et al., 2013). Food waste can be classified into three different categories: avoidable, possibly avoidable and unavoidable (WRAP, 2009). These categories can be associated with the consumption stages of the food supply chain system and literature from The Economist (2014) identifies 5 stages of the food supply chain system, albeit with subtle differences present with reference to ‘food loss’ and ‘food waste’, where the latter is associated with consumerism and behavioural issues (Parfitt et al., 2010).

Post-harvest food losses (PHL) are the first stages of food loss within the FSC and directly link back to the agricultural production of food food (Lipinski et al., 2013; The Economist,

2014; Parfitt et al., 2010 & Aulakh & Regmi, n.d.). PHL may arise from human-induced factors or from natural factors including drought or excessive rainfall (Segre et al., 2014) which can affect soils, growing conditions, harvesting and planting conditions (Benton et al., 2012). Imperfections arising from poor climatic conditions may cause PHL as crops are not harvested due to a commercial decision. Plant and crop diseases are responsible for the loss of between 10% (Strange & Scott, 2005) and 20-40% (Ficke, Aubertot & Hollier 2012) of global food production.

Amani & Gadde (n.d.) highlight the potential for food spoilage to occur when food reaches its “best before” or “saleable date”. Parfitt et al. (2010) establish the cause of food spoilage can be traced back to whether the product is perishable or not; where horticultural crops (fruits, vegetables, roots and tubers) tend to be much more perishable than cereal and oilseed products (FAO, 1981). Kader (2005); Kiaya (2014) and Parfitt et al. (2010) all confirm that fresh fruit and vegetables are subject to a higher level of perishability than cereals.

A number of advances in technology have enabled PHL to be reduced significantly within ‘developed’ countries. Such methods include: advanced agricultural machinery, cold chain storage systems (Gustavsson et al., 2011; Hodges et al., 2010; Bond et al., 2013; Parfitt et al., 2010; Lipinski et al., 2013 & Kummu et al., 2012) and sophisticated management techniques within logistics (Parfitt et al., 2010; Hodges et al., 2010). Gustavsson et al. (2011) indicate that mechanical damage and spillage are the primary causes of PHL in the UK. Other significant areas of crop loss include grading (Kader, 2005; Kummu et al., 2012) which can be directly linked to quality control procedures set by retailers and losses from poor handling (Kiaya, 2014) where degradation occurs between the farm and distribution stages (Gustavsson et al., 2011).

## **Supermarkets & Globalisation**

Hingley (2005) illustrates the success of supermarkets within the UK, where sales have reached approximately £118 billion. Oosterveer & Sonnenfeld (2012) identify Tesco, Sainsburys, Asda and Safeway (now mostly Morrisons) as the four major retailers operating as oligopolies, accounting for over two thirds of the UK food sector sales (Hingley, 2005, p.65 cited IGD 2003). The buyer power of supermarkets can be used to obtain terms which are more favourable than those available to other competitors (Mills, 2003, p.145) and is linked to economies of scale (Burt, 2000). Supermarket supply chains offer a network for the sale of goods to consumers (Dobson, 2002) with producers being chosen by their willingness to produce under the retailer’s specification at a set price (Burt, 2000).

According to Burt (2000) this is a change from traditional supplier-retailer relationships based on trading principles of negotiation and conflict towards more co-operative and constructive relationships with suppliers. Dobson (2002) however notes that these demands significantly favour retailers at the expense of the supplier or producer, as bargaining power can be used to pressurise suppliers to make concessions on behalf of their customers. The power of information regarding customer purchases has been strategically utilised by retailers to manage the “distribution channel,” (ibid:881), with an emphasis on price to create differentiation in the marketplace (Burt, 2000), shown in Figure 1. Fragmentation of the supply chain significantly affects agricultural producers as

the bargaining power of retailers and supermarkets is increased due to the trade of non-branded products including fresh fruit and vegetables (Consumers International, 2012).

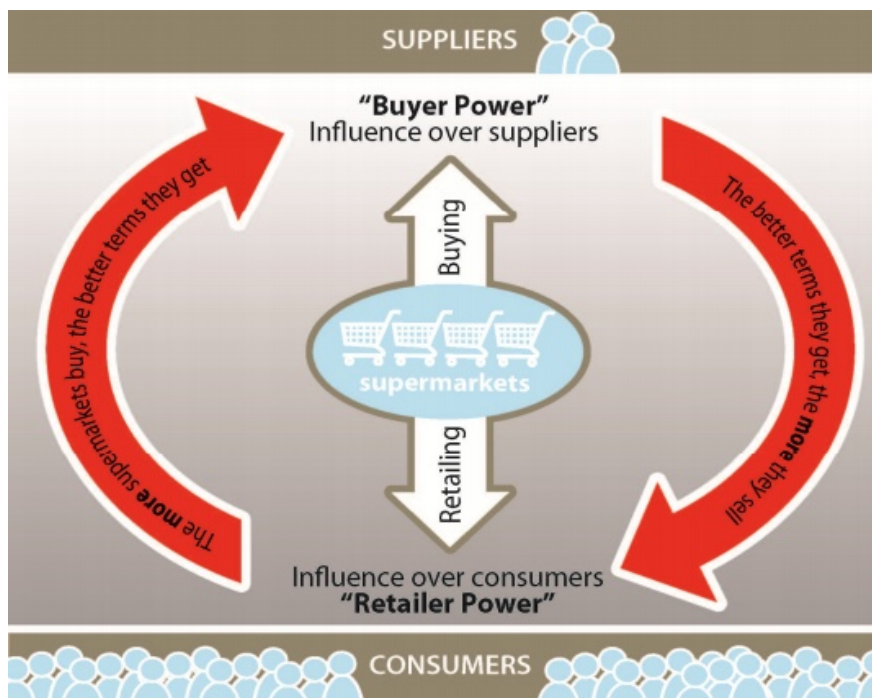


Figure 1: Buyer and retailer power differentiation (Consumers International, 2012).

## Promotions & Discounts

Simpson (2006) and Mohr & Low (1993) stated that the aims of retailers are to “develop a low-price image and short-term sales increases”. The resulting disparity in terms of profit margins is shown by Mills (2003) whereby retailers make approximately 5-8% profit on sales, whereas the producer and suppliers operate on a 2-3% profit margin.

## Buying Power Abuse

Buyer power can affect the producer or the supplier considerably, particularly small suppliers, whereby they may sell all of their output to a single chain or retailer (Mills, 2003). In addition to buyer power and globalisation, Dobson (2002) recognises that producers and suppliers are competing on an international scale for the supply of goods to retailers. Furthermore, Howard (2016) and Fishman (2003) highlight that supermarkets and retailers can use international competitors as a bargaining chip to threaten suppliers and coerce them to conform to demands.

## The Power of Consumer Demand

The on-site interaction with customers means that retailers are much more connected to customers than producers and manufacturers (Simpson, 2006). This enables the generation of knowledge with reference to consumer preferences and thus enables retailers to predict shifts in consumer purchasing behaviour, heavily influencing the promotion of ‘popular’ products (Simpson, 2006 cited Kahn & McAllister, 1997). Oosterveer & Sonnenfeld (2012, p.202), Dobson (2002) & Mills (2003) recognise supermarkets have considerable influence on the consumer in addition to producers and suppliers. As suggested by

Oosterveer & Sonnenfeld (2012) cited Hawkes (2008), the result of technological has enabled suppliers to “create consumer demand, not just meet it,” thus demonstrating the dominance of control of the FSC.

Burt (2000) state that both price and quality perceptions form a special link within the FSC, whereby these affect the retailer’s brand quality in the eyes of the consumer. Within the FSC, buying and retailing power has been associated with the rise of private food safety and quality standards (Henson & Reardon, 2005; Fulponi, 2006 & Reardon et al., 2001). Henson & Reardon (2005) note that such standards are run alongside regulatory systems, however, they are not legally binding and therefore are voluntary. Henson & Hooker (2001, cited Henson & Reardon, 2005) recognise a shift of drivers in the FSC, whereby private standards are gaining dominance over public standards. Stuart (2009, p.102), notes that supermarket standards exacerbate waste and are directly responsible for the rejection of up to 40% of British grown fruit and vegetables, with one cause for rejection including the non-conformity to supermarket cosmetic standards, in addition to surplus stock.

## **RESULTS & DISCUSSION**

Results are initially presented as a series of themes as raised by the respondents during the interviews and summarised into conceptual frameworks.

### **Crop Losses Pre-Farm Gate**

When asked about the causes of crop loss prior to the crop or product being taken off the farm, all participants identified and stressed that natural causes are one of the main issues for them. Unsurprisingly, weather and climate conditions were a commonly discussed issue for all producers interviewed, whereby incidences of particular weather patterns have directly led to the loss of their crop. One individual recognised the severity of the weather such as hailstorms as an important factor, whereby this can change the extent of the loss from between 5-100% of the total crop. One respondent explicitly stated that such events of inclement weather are rare, however, instances of hail were found to be a cause of crop loss for leek and onion crops particularly when the plants are small. Extreme cases of hail were said to cause “complete write-offs,” of crops.

Cold weather events including frost affecting the crop yield were identified by 3 individuals as an issue for fruit growers, affecting the quality by formation of “rings on the fruit”, while one further added that cold weather periods can lead to the entire crop being wiped out or affected by rots. Higher temperatures were also problematic and one respondent raised “growth cracks where the potato grows very quickly and then it gets a crack in it and there’s nothing you can do about that”. Pathogens were raised by 2 respondents as occurring independently of weather and affecting fruit crops and one interviewee stated “there is just a natural rot which occurs within the orchard”. Fungal disease for strawberry plants such as *Phytophthora* were said to create a significant impact on the yield of the crop and led to reduced resistance capabilities of the plant to further disease.

Disease was revealed to be a common cause for the loss of both fruit and vegetable crops. The extent of loss due to potato blight reduced yield in one case from 22-23 to about 14 tonnes per acre. A level of natural mortality was widely spoken of within interviews. Two participants who noted this described mitigation through the calculation of waste budgeting

with the extent of loss occurring between seed and harvest estimated to be around 50%. This extent of loss is considerably higher than figures suggested by Garnet (2006), stating average losses of approximately 10%.

In this study, human-induced losses were identified within a number of interviews as responsible for harvesting losses which aligns with the findings of Kiaya (2014). However, one interviewee believed that if correct procedures are in place the weather is the leading cause of loss. Hodges et al., (2010) identified that poor storage conditions may result in both quality and weight losses and this was mirrored by one respondent on the impact to potato crops from poor (too cold) storage. The need to meet retailer standards was mentioned frequently, and while no figures were specifically obtained, Stuart (2009, p.102), recognised retailer standards may lead to the rejection of up to 40% of harvested crop. This hierarchy of loss is evident within the account of one interviewee.

## **Loss Mitigation**

Another commonly occurring theme arising from the interviews with producers was the mitigation of losses both pre-harvest and post-harvest. Axial coding of loss mitigation revealed seven contributing sub-categories to loss mitigation measures, including:

- active management,
- consumer education,
- alternative markets,
- growing procedure,
- technology,
- natural loss, and
- producer-retailer relationship.

Interviews revealed that active management strategies were frequently used by producers to counteract natural and human induced losses both pre-harvest and post-harvest. Open codes for active management strategies include a number of technical procedures including:

- Orchard design
- Bio controls
- Planting efficiency

Additionally, other codes associated with active management strategies were also identified within interviews linking to managerial procedures:

- Quality assessments
- Procedure re-evaluation
- Time management and efficiency

One interviewee noted the use of quality assessments for the reduction of PHL during picking, particularly for bruised and undersized fruits which do not meet the specification. Procedural re-evaluation strategies were noted within interview 6, whereby producers re-



evaluate their methods of growing crops with the aim of reducing crop and financial losses. However, Costa (2015) illustrated the development level of producers will subsequently affect their ability to use mitigation strategies. This is evident, particularly with smaller producers. The possibility for automation to reduce losses in the future was also briefly discussed. A number of growing procedures were indicated by producers to mitigate loss. A majority of producers highlighted the use of fertilisers and chemicals as well as pesticides and fungicides as a form of crop protection and enhancement. Other methods included the use of 'growbags' to control fungal disease within a strawberry crop.

Interestingly, producers highlighted a variety of alternative markets to which they could send their crop to as an alternative to the retail markets in order to prevent total loss. Unwanted crop used as stock feed was mentioned by 2 interviewees, and a further 2 discussed the use of an anaerobic digestion plant to turn crops into a source of energy. In this case 120 tonnes of feed stock are required to produce 0.5 MWh of energy per day. For fruit growers the juicing industry and cider industries are loss mitigation strategies although relatively small volumes of crop went to juicing in comparison to the volume going to retail sales.

## **Technology**

Throughout all interviews with producers, technological innovation was identified as a crucial crop loss mitigation tool. Unsurprisingly, a majority of producers deploy low-tech solutions including manual labour to harvest their crops and to prevent loss from occurring; a laborious and labour intensive process. Where process mechanisation was used (in this case for harvesting rigs and mechanical pruning) losses were reduced. While Bond et al. (2013) noted the benefits of mechanisation, there was little literature to highlight innovation in technology. While technology was seen by the participants to have some positive outcomes, it was also felt that the waste would occur not in the fields, but in the pack-house, resulting in higher transport costs.

Two interviews highlighted genetic enhancements to have led to the reduction in pre-harvest and post-harvest crop loss, and while adoption of new varieties can be a viable business strategy, the limitations with new varieties include reduced pest and disease resistance. Mitigation of loss through genetic enhancements was not identified within literature studied related to this topic, although this may occur within more specialised journals. Changes to storage were identified by all producers as having a positive impact on reducing PHL. The use of cold storage or controlled atmospheres was identified by 5 of the interviewees. Controlled atmospheres can extend the life of a crop from 4-6 weeks (leeks) and for fruit up to a year. The major limitation to more extensive use is cost, both in capital expenditure and running costs. Parfitt et al. (2010) demonstrated a similar viewpoint, noting the substantial investment required to eradicate PHL.

## **Relationships**

Relationships between producers and retailers were highlighted as a cause of both pre-harvest and post-harvest crop losses occurring. Retailer buying power was a frequently discussed issue amongst the interviewees, with one noting the supermarkets' preferences to work with larger, more commercialised growers where economies of scale are used by larger producers to gain contracts with retailers and supermarkets over smaller producers, as noted by Burt (2000). One respondent stated instances of one-sided communications

with supermarkets regarding specifications and waste as a cause of increases of crop loss and waste pre-farm gate. As Dobson (2002) found the supermarket specification significantly favours the customer over the producer. No other producers displayed a negative image of the producer-retailer relationship to the extent demonstrated above, rather stressing the requirement for “healthy relationships,” with retailers and marketing companies to ensure a yearly supply. The interviews demonstrated key merits between the producer-retailer relationship in regards to crop loss, whereby extensive communications and information sharing is used to reduce losses. It was suggested that further work could be done with supermarket staff to mitigate losses, a point not identified within the review as being a supermarket operating procedure issue.

### **Retailer Specification**

The specifications set by retailers were identified to be a cause of both pre-harvest and PHL. A common finding arising from interviews was the specification variability between the retailers, although the sentiment was that supermarkets were all in competition so wished to avoid having markedly lower quality produce for sale. Interviewees identified different specifications existing for different markets, particularly higher end supermarkets such as Waitrose, Marks & Spencer’s. The interviews also revealed the flexibility of specifications set by supermarkets, whereby the specification is based on the supply and demand for crops. This was identified for both fruit and vegetable markets within 3 separate interviews, although is absent from the literature.

“Supermarkets will relax their standards in situations where they are short of fruit; if we are talking about the size or shape, they might relax ... [ their standards] ... for a couple of weeks and then they will re-introduce their normal specification after that.”

Size grading was identified as a source of loss for onion crops and reduced payments, due to the requirements for pre-pack produce. This was said to have led to increases in waste in recent years as specifications have evolved. Size grading affected both under and oversized crops. Production audits, including unannounced audits, were used to monitor and compare the performances of producers. The use of such audits was not identified within literature, despite mentions of retailer power. This was linked to the supermarket specifications being loosely based on the DEFRA standards system for the cosmetic quality of the produce. These requirements to meet size and cosmetic requirements of the retailer, and the use of audits illustrate the power of the specification on the producer. Hatanaka et al. (2005) also found that the specifications set by retailers were significantly higher than bodies such as DEFRA.

Interestingly, no literature identified differences in specifications for differing markets, although a majority of the literature looks at the impacts of retailer and processing specifications. All drivers of cause and the impacts arising from the retailer specification can be seen in the conceptual model Figure 2.

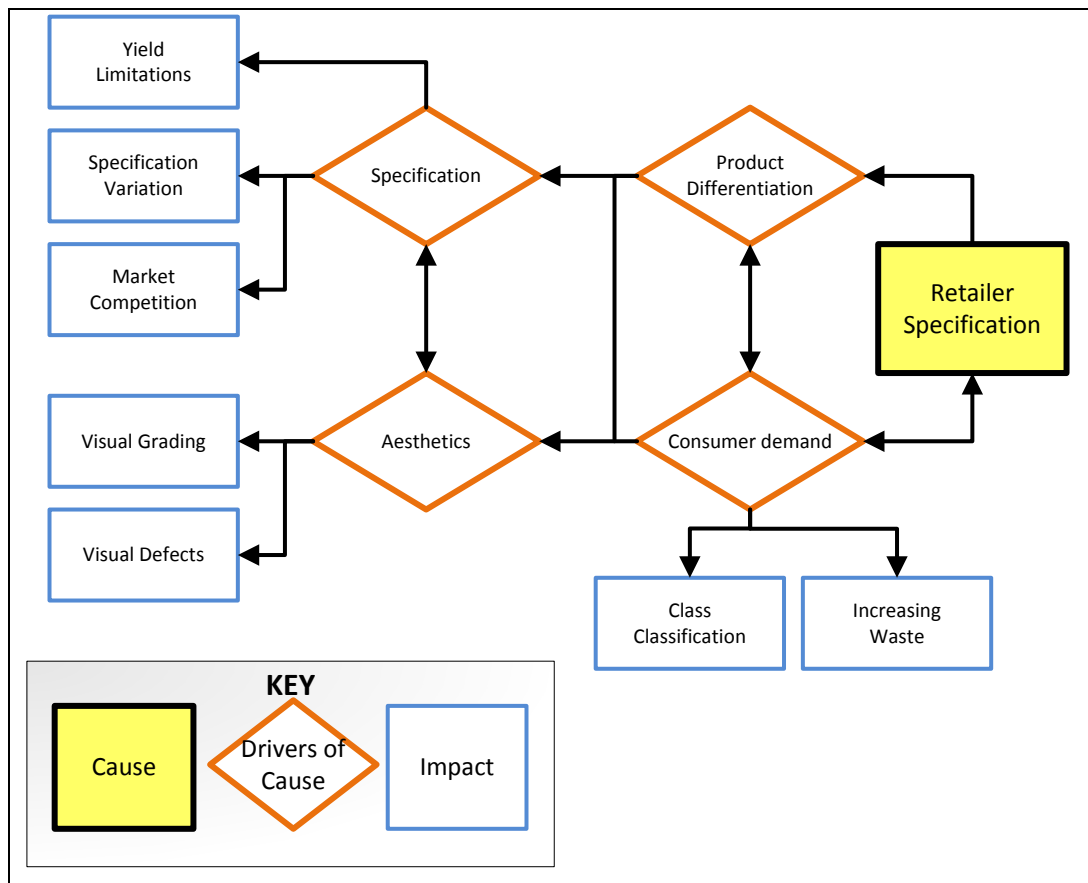


Figure 2 Conceptual Model of the Retail Link to Post-Harvest Losses (Authors Own)

## Consumer Expectations

The expectations of consumers was a frequently discussed topic within all interviews. One aspect which frequently arose was the aesthetic demands and expectations of consumers for both fruit and vegetable produce. As one interviewee stated “We buy with our eyes. We do expect to have the right shaped product, the right coloured product and the right eating quality.”

Consumers are selective with regards to blemishes, despite produce conforming to the class 1 standards. They want to buy something which represents value for money, and in a condition which will last a reasonable time so that they can eat it without it going to waste. This emphasis on perfection and value for money are inextricably linked to consumer behaviour and buyer power and this can be considered alongside the retailer specification as a cause of crop loss both pre-harvest and post-harvest. Consumer selectivity and demand were also found to be linked to PHL for undersized potatoes, where specifications and oversupply have led to the collapse of prices. In contrast there is the emergence of secondary grade products such as “wonky fruit,” within the retailer markets due to consumer demand and frustration. This was not identified within literature, due to the recent adoption of such produce by retailers and offers a potential area of research for future studies. Producers also noted instances of selling a percentage of their produce directly through consumer-producer networks in addition to retail sales. Interviewee 5 mentioned this network, through the sales of soft fruits to the catering industry and the

general public as a sub-business. The diversity of markets can be seen as a mitigation tool for producers, enabling produce of varying qualities to be sold on, thus reducing PHL.

Two interviewees suggested that losses associated with consumer expectations and demands would be reduced through educational means. Parfitt et al. (2010) found consumer education is required to reduce PHL within the FSC. A conceptual model is illustrated in Figure 3 highlighting the relationships between the recognised causes of pre-farm gate losses identified within the interviews.

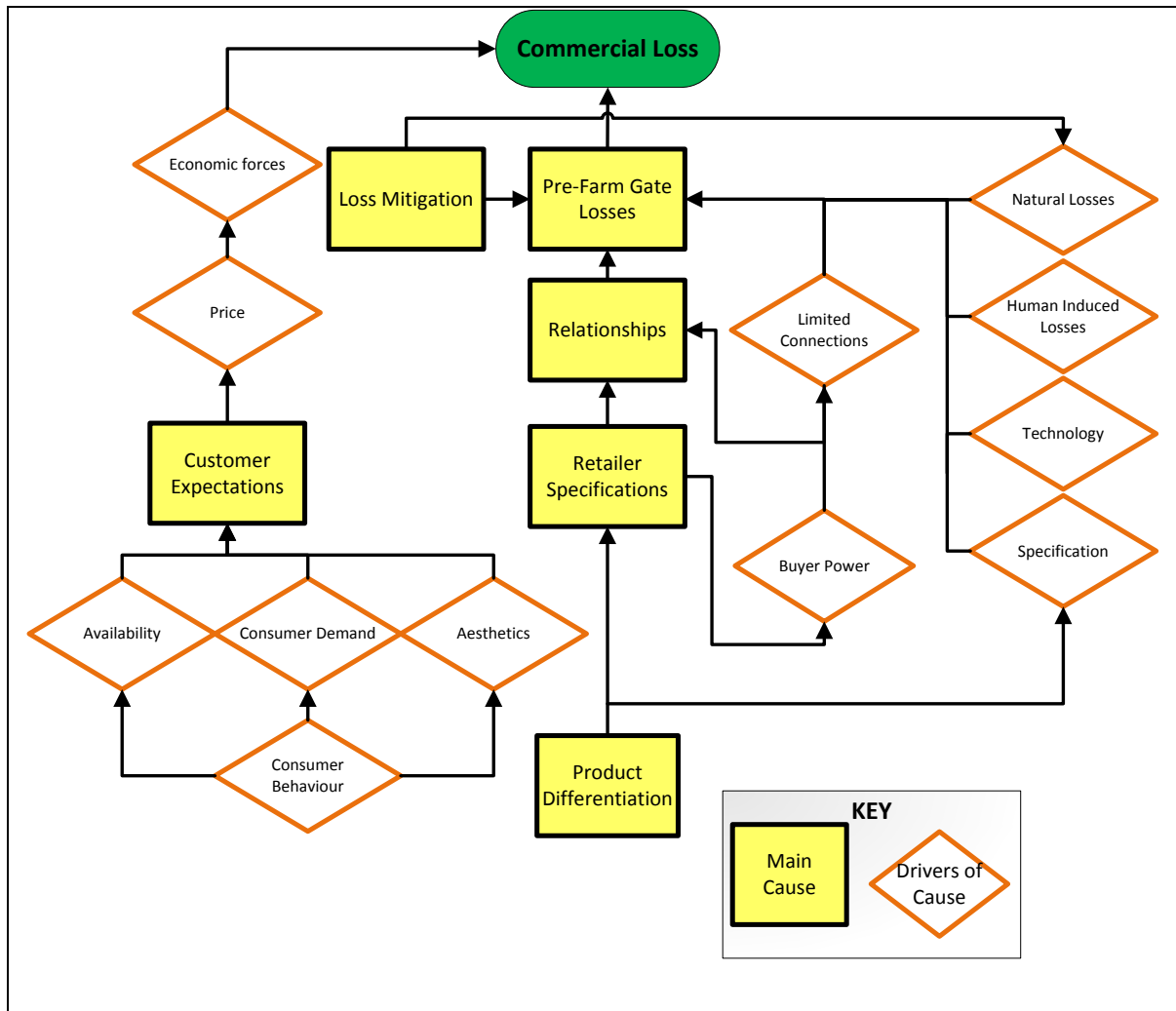


Figure 3 Conceptual Model of Causes of Commercial Loss (Authors Own)

## Commercial Loss

A number of commercial losses have been identified throughout the interview process arising from crop losses pre-farm gate and also PHL, these have been broken down through four axial codes:

1. Business strategies,
2. Economic forces,
3. Financial cost,
4. Social cost.

Furthermore, due to a lack in literature around the financial and social costs associated with crop loss, no comparisons could be made to other studies looking at the issue. A conceptual model (Figure 4) demonstrates the links of commercial loss, leading to the financial and social costs faced by Fenland producers.

## **Business Strategies**

Three interviewees identified measures of cost mitigation in reducing commercial losses. The reduction of hired casual labour was stated by 1 interviewee as a strategy to reduce costs, and it is likely this can be associated with the nature of business in small, family producers where profit margins are likely to be tighter than those of larger more commercialised businesses.

## **Economic Forces**

Economic forces were identified to be a significant cause of commercial loss for producers as ex-situ factors. The deflation of food prices within the previous 20 years was identified as significantly contributing to the commercial pressure faced by producers. Additionally, consumer demand was highlighted as an ex-situ factor leading to commercial losses within an interview which illustrated the extent of commercial loss associated with undesirable produce:

“But the thing is that he couldn’t sell ... [the undersized produce]... he sold 7 bags out of 20 in 3 weeks and he said he couldn’t get people to buy them when each 25kg bag was priced at £3.”

Poor consumer demand and the price reductions needed to sell them leads to financial loss. Two interviewees noted the difficulty in balancing the cost of production and the price of produce, expressed as a “juggling act,” whereby “if you bring down the quality too low and you bring the price down, there’s no money in it”. The tight cost margins faced by producers are the likely cause of this difficulty.

## **Financial Cost**

A frequently shared issue amongst producers was the increasing production costs as rates for energy and labour costs rise. While production was noted to account for a small percentage of financial costs incurred in a larger business, two thirds of the total costs were associated with the processing, marketing and distribution. For smaller producers the cost of labour was identified to account for 45% of total costs. Labour costs may mean it is not economical to harvest lower grade fruit, for example, as it would cost more to pick it than they would get for it. At worst this may lead to the threat of crop rejection as stated by 2 interviewees. The implication of rejection by a retailer due to failure to meet the specification includes the disposal of hundreds of tonnes of waste crop. This rejection of crop is deemed legal since it does not feature on the abusive buying practices listed by Consumers International (2012). The reduction in prices for both undersized and oversized produce may be seen as a punishment resulting from non-conformity to the specification and thus illustrates the power of retailers over producers.

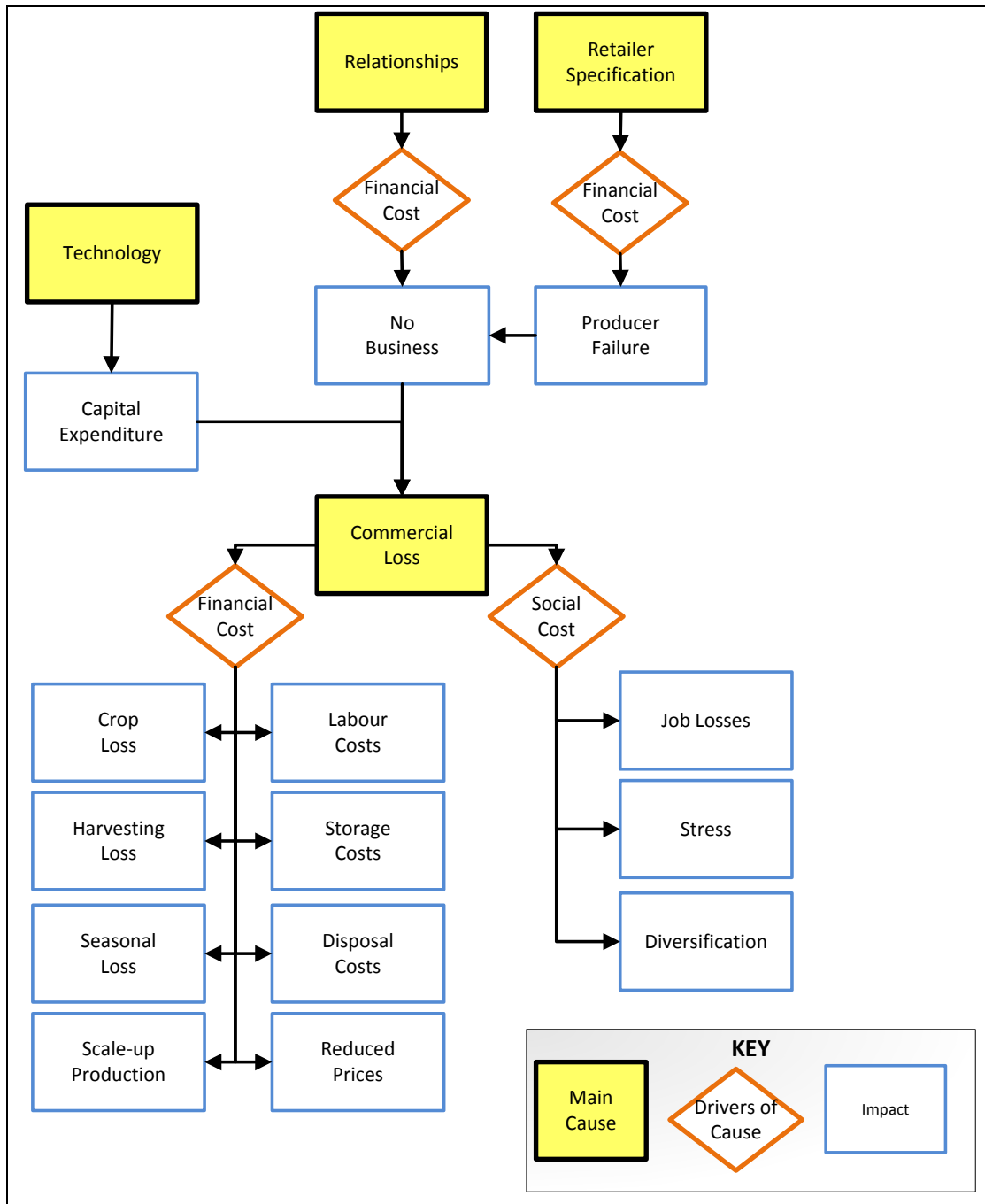


Figure 4 Commercial Loss to Producers Conceptual Model (Authors Own)

## Social Cost

The social costs associated amongst commercial losses to producers as a result of both pre-harvest and post-harvest losses were also identified within the producer interviews. One interviewee identified the need for diversification into additional sources of income as well as to scale-up production; another in contrast presented additional stress factors associated with commercial losses and pre-farm gate losses. This can be linked to ex-situ factors such as the retailer specification and consumer demand (Figure 4), whereby there is demand for

aesthetically perfect crops. Furthermore, job losses were identified as potential social costs by 2 interviewees whereby mechanisation and the use of automation would eradicate jobs.

## **CONCLUSIONS**

Interviews with producers found natural causes to be a significant cause of crop loss, particularly from disease and rots as a result of poor weather conditions, identifying up to 100% crop loss. Producers identified the extensive use of mitigation measures including managerial and technological measures to reduce crop loss. Furthermore, the study found human-induced losses to be rather insignificant in scale in comparison to natural losses. These were seen to be mitigated through the use of active management and staff training.

This study found the role of the retailer to be a significant cause of both pre-harvest and post-harvest crop loss. Previous literature has predominantly looked at the consumer causes of post-harvest crop loss, however, this study found a clear link between the retailer and crop loss arising from retailer buyer power and product differentiation.

Furthermore, the study identified the need for greater producer-retailer communication to reduce the asymmetrical relationships currently present within the FSC. Interviews identified that the preferential treatment towards consumers by supermarkets is detrimental to producers, and is related to the demand for higher quality produce to outperform other retail competition. This competition and differentiation was identified as a direct cause of post-harvest crop loss and the creation of waste arising from aesthetic quality, accounting for 25% of crop loss in some cases.

Additionally, the study identified consumer demand to significantly influence retailer specifications and vice versa, wherein consumers are only willing to purchase aesthetically perfect fresh fruit and vegetables from retailers. However, despite supermarkets introducing schemes such as “wonky” produce, the study identified producers were unwilling to grow this, due to the financial loss arising from sales at reduced prices.

Instead, producers displayed a preference for growing higher grade produce despite the potential crop losses associated with this. The need for consumer education was highlighted by producers as the key for the reduction in post-harvest crop losses in the future.

Considerable financial losses were identified, arising from increasing production costs and reductions in retail prices for produce. Furthermore, social losses and commercial loss were found to be inextricably linked. Social impacts identified included stress and job losses, leading to further income diversification and scaling-up production. This illustrated the extent to which producers in Fenland are affected by the standards imposed by retailers and demonstrates the need for change.

## **Further Recommendations**

The impacts on producers arising from crop losses are still relatively unknown due to the geographical area of study and small sample size and the results generated within this study are not representative of other areas within the UK. This study has the potential to illustrate the socio-economic impacts faced by producers within other areas in the UK. Further studies are warranted to enable the comparison into the causes of crop loss amongst producers in the UK. This is needed to identify the full extent and impact of crop

loss induced by retailers, through buyer power and specifications; to reduce the impact of crop loss and move towards greater sustainability.

## REFERENCES

- Amani, P., & Gadde, L. *Shelf life extension and food waste reduction*. Retrieved from <http://ageconsearch.tind.io/bitstream/206209/2/02-Amani.pdf>
- Aulakh, J., & Regmi, A. *Post-Harvest Food Losses Estimation-Development of Consistent Methodology*. Retrieved from [http://www.fao.org/fileadmin/templates/ess/documents/meetings\\_and\\_workshops/GS\\_SA\\_C\\_2013/Improving\\_methods\\_for\\_estimating\\_post\\_harvest\\_losses/Final\\_PHLs\\_Estimation\\_6-13-13.pdf](http://www.fao.org/fileadmin/templates/ess/documents/meetings_and_workshops/GS_SA_C_2013/Improving_methods_for_estimating_post_harvest_losses/Final_PHLs_Estimation_6-13-13.pdf)
- Benton, T., Gallani, B., Jones, C., Lewis, K., Tiffin, R., & Donohoe, T. (2012). *Severe weather and UK food chain resilience*. Global Food Security. Retrieved from <http://www.foodsecurity.ac.uk/assets/pdfs/frp-severe-weather-uk-food-chain-resilience.pdf>
- Bond, M., Meacham, T., R, B., & Benton, T. (2013). *Food waste within global food systems*. Food Security. Retrieved from <http://www.foodsecurity.ac.uk/assets/pdfs/food-waste-report.pdf>
- Bourlakis, M., & Weightman, P. (2003). *Food supply chain management* (1st ed.). Ames, Iowa USA: Wiley, John & Sons.
- Burt, S. (2000). The strategic role of retail brands in British grocery retailing. *European Journal of Marketing*, 34(8), 875-890. <http://dx.doi.org/10.1108/03090560010331351>
- Cambridgeshire Fens. (2017). *Visit Fenland*. Retrieved from <http://www.visitcambridgeshirefens.org/>
- Charmaz, K. (2008). In J. Holstein & J. Gubrium, *Handbook of Constructionist Research* (1st ed., pp. 397-412). London: The Guildford Press. Retrieved from [http://www.sxf.uevora.pt/wp-content/uploads/2013/03/Charmaz\\_2008-a.pdf](http://www.sxf.uevora.pt/wp-content/uploads/2013/03/Charmaz_2008-a.pdf)
- Charmaz, K., & Belgrave, L. (2012). Qualitative Interviewing and Grounded Theory Analysis. In J. Gubrium, J. Holstein, A. Marvasti & K. McKinney, *The SAGE Handbook of Interview Research: The Complexity of the Craft* (2nd ed., pp. 347-366). London: Sage Publications. Retrieved from <https://www.dawsonera.com/readonline/9781452262031>
- Consumers International. (2012). *The relationship between supermarkets and suppliers: What are the implications for consumers?* Consumers International. Retrieved from <http://www.consumersinternational.org/media/1035307/summary,%20the%20relationship%20between%20supermarkets%20and%20suppliers.pdf>
- Costa, S. (2015). *Taking it to scale: Post-Harvest Loss Eradication in Uganda 2014-2015*. WFP. Retrieved from [https://www.wfp.org/sites/default/files/20160107%20Uganda%20PHL%20implementation%20Report\\_Final.pdf](https://www.wfp.org/sites/default/files/20160107%20Uganda%20PHL%20implementation%20Report_Final.pdf)
- Crotty, M. (1998). *The Foundations of Social Research: Meaning and Perspective in the Research Process* (1st ed.). London: Sage Publications.
- Dobson, P. (2002). Retailer buyer power in European markets: lessons from grocery supply. *Occasional Paper, 1*. Retrieved from <https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/2026/3/2002-1.pdf>



- Fens for the Future*. (2017). *Fens for the Future*. Retrieved from <http://www.fensforthefuture.org.uk/the-fens/fenland-agriculture>
- Ficke, A., Aubertot, J., & Hollier, C. (2012). Crop losses due to diseases and their implications for global food production losses and food security. *Food Security*, 4(4). Retrieved from [https://www.researchgate.net/publication/257788783\\_Crop\\_losses\\_due\\_to\\_diseases\\_and\\_their\\_implications\\_for\\_global\\_food\\_production\\_losses\\_and\\_food\\_security](https://www.researchgate.net/publication/257788783_Crop_losses_due_to_diseases_and_their_implications_for_global_food_production_losses_and_food_security)
- Fishman, C. (2003). *The Wal-Mart You Don't Know / Fast Company*. *Fast Company*. Retrieved from <https://www.fastcompany.com/47593/wal-mart-you-dont-know>
- Fulponi, L. (2006). Private voluntary standards in the food system: The perspective of major food retailers in OECD countries. *Food Policy*, 31(1), 1-13. <http://dx.doi.org/10.1016/j.foodpol.2005.06.006>
- Gray, D. (2014). *Doing research in the real world* (3rd ed.). London: Sage Publications.
- Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., & Meybeck, A. (2011). *Global Food Losses and Food Waste*. Rome: FAO. Retrieved from <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- Hatanaka, M., Bain, C., & Busch, L. (2005). Third-party certification in the global agrifood system. *Food Policy*, 30(3), 354-369. <http://dx.doi.org/10.1016/j.foodpol.2005.05.006>
- Henson, S., & Hooker, N. (2001). Private sector management of food safety: public regulation and the role of private controls. *The International Food and Agribusiness Management Review*, 4(1), 7-17. [http://dx.doi.org/10.1016/s1096-7508\(01\)00067-2](http://dx.doi.org/10.1016/s1096-7508(01)00067-2)
- Henson, S., & Reardon, T. (2005). Private agri-food standards: Implications for food policy and the agri-food system. *Food Policy*, 30(3), 241-253. <http://dx.doi.org/10.1016/j.foodpol.2005.05.002>
- Hingley, M. (2005). Power imbalance in UK Agri-Food supply channels: Learning to live with the supermarkets? *Journal of Marketing Management*, 21(1-2), 63-88. <http://dx.doi.org/10.1362/0267257053166758>
- Hodges, R., Buzby, J., & Bennett, B. (2010). Postharvest losses and waste in developed and less developed countries: Opportunities to improve resource use. *The Journal of Agricultural Science*, 149(S1), 37-45. <http://dx.doi.org/10.1017/S0021859610000936>
- Howard, P. (2016). *Concentration and power in the food system: Who controls what we eat?* United Kingdom: Bloomsbury Academic.
- IGD. (2003). *Grocery retailing: The market review 2003*. Watford: IGD Business Publications.
- Kader, A. (2005). *Increasing Food Availability by Reducing Postharvest Losses of Fresh Produce*. Davis, California: University of California. Retrieved from <http://ucce.ucdavis.edu/files/datastore/234-528.pdf>
- Kahn, B., & McAlister, L. (1997). *Grocery revolution* (1st ed.). Reading, Massachusetts: Addison-Wesley.
- Kiaya, V. (2014). *Post-Harvest Losses and Their Strategies to Reduce Them*. ACF International. Retrieved from [http://www.actioncontrelafaim.org/sites/default/files/publications/fichiers/technical\\_paper\\_phl\\_.pdf](http://www.actioncontrelafaim.org/sites/default/files/publications/fichiers/technical_paper_phl_.pdf)
- Kothari, C. (2004). *Research Methodology: Methods & Techniques* (2nd ed.). New Delhi: New Age International (P) Limited.

- Kummu, M., de Moel, H., Porkka, M., Siebert, S., Varis, O., & Ward, P. (2012). Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. *Science of The Total Environment*, 438, 477-489.  
<http://dx.doi.org/10.1016/j.scitotenv.2012.08.092>
- Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R., & Searchinger, T. (2013). *Reducing Food Loss and Waste*. World Resources Institute. Retrieved from  
<http://staging.unep.org/wed/2013/docs/WRI-UNEP-Reducing-Food-Loss-and-Waste.pdf>
- Marshall, M. (1996). Sampling for qualitative research. *Family Practice*, 13(6), 522-526.  
<http://dx.doi.org/10.1093/fampra/13.6.522>
- Mills, G. (2003). Buyer Power of Supermarkets. *Agenda: A Journal of Policy Analysis and Reform*, 10(2), 145-162. Retrieved from <http://www.jstor.org/stable/43199239>
- Mohr, J., & Low, G. (1993). Escaping the catch-22 of trade promotion spending. *Marketing Management*, 2(2), 30-42.
- Natural England. (2015). 46. *The Fens* (p. 7). Natural England. Retrieved from  
<http://publications.naturalengland.org.uk/file/5742315148673024>
- Oosterveer, P., & Sonnenfeld, D. (2012). *Food, Globalization and Sustainability* (1st ed.). London: Earthscan.
- Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: Quantification and potential for change to 2050. *Articles*, 365(1554), 3065-3081.  
<http://dx.doi.org/10.1098/rstb.2010.0126>
- Ramsay, B. (2000). *The Global Food Industry: Strategic Directions*. London: Financial Times Retail and Consumer Publishing.
- Scott, K. (2004). Relating the Categories in Grounded Theory Analysis: Using a Conditional Relationship Guide and Reflective Coding Matrix. *The Qualitative Report*, 9(1), 112-126. Retrieved from <http://nsuworks.nova.edu/cgi/viewcontent.cgi?article=1940&context=tqr>
- Strange, R., & Scott, P. (2005). Plant disease: A threat to global food security. *Annual Review of Phytopathology.*, 43, 83-116. Retrieved from  
<https://www.ncbi.nlm.nih.gov/pubmed/16078878>
- Segrè, A., Falasconi, L., Politano, A., & Vittuari, M. (2014). *Background paper on the economics of food loss and waste*. Università di Bologna, Italy: FAO. Retrieved from  
<http://www.fao.org/3/a-at143e.pdf>
- Simpson, L. (2006). Enhancing food promotion in the supermarket industry. *International Journal of Advertising*, 25(2), 223-245. <http://dx.doi.org/10.1080/02650487.2006.11072964>
- Starks, H., & Brown Trinidad, S. (2007). Choose Your Method: A Comparison of Phenomenology, Discourse Analysis, and Grounded Theory. *Qualitative Health Research*, 17(10), 1372-1380. <http://dx.doi.org/10.1177/1049732307307031>
- Stuart, T. (2009). *Waste: Uncovering the Global Food Scandal* (1st ed.). London: Penguin.
- The Economist. (2014). *Reusing refuse*. Retrieved 8 December 2016, from  
<http://www.economist.com/news/business-and-finance/21613480-startups-are-tackling-food-waste-fertile-opportunity>
- Thomas, D. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, 27(2), 237-246.  
<http://dx.doi.org/10.1177/1098214005283748>

- Thorne, S. (2000). Data analysis in qualitative research. *Evidence-Based Nursing*, 3(3), 68-70.  
<http://dx.doi.org/10.1136/ebn.3.3.68>
- TNS. (2001). *In The Grocer Yearbook Supplement*. Sussex: William Reed Publishing.
- WRAP. (2008). *Helping Consumers Reduce Fruit and Vegetable Waste: Final Report*. WRAP.  
Retrieved from <http://www.wrap.org.uk/sites/files/wrap/WRAP%20RTL044-001%20Final%20report.pdf>
- WRAP. (2009). *Household food and drink waste in the UK*. WRAP. Retrieved from  
[http://www.wrap.org.uk/sites/files/wrap/Household\\_food\\_and\\_drink\\_waste\\_in\\_the\\_UK\\_-\\_report.pdf](http://www.wrap.org.uk/sites/files/wrap/Household_food_and_drink_waste_in_the_UK_-_report.pdf)
- Zachariasse, V., & Bunte, F. (2003). How are Farmers Faring in the Changing Balance of Power Along the Food Chain? In *Conference on Changing Dimensions of the Food Economy: Exploring the Policy Issues*. The Hague, Netherlands: FAO. Retrieved from  
<http://agris.fao.org/agris-search/search.do?recordID=NL2012056704>