A Review of Resilience within the UK Food Manufacturing Sector

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Abstract. Research on food security and resilience has focused primarily on improving production of traditional crops and livestock (agriculture, crop science, genetics etc.). However significant losses occur after this initial production phase during storage, transportation, processing and preparation. Whilst increased competition and margin pressures within this sector are constant drivers for efficiency improvements and waste reduction, they can also have unintended consequences on the resilience of food manufacturers and their supply chains. This paper examines how current trends and initiatives could impact the resilience of the UK food manufacturing sector and their wider impacts on UK food security.

Keywords. Food Security, Resilient Manufacturing, Food Supply Chains, Sustainability.

1. Introduction

As a country, the UK with its strong developed economy enjoys a high level of food security with efficient and stable national production, supplemented by relatively cheap imported goods [1]. In addition to the obvious diversity and abundancy of food available in its stores and markets, this is reflected in the UK having one of the world's lowest spends on food as a percentage of household expenditure [2]. A large part of this success can be attributed to improvements in efficiencies achieved across the supply chain. When we consider that in the last 75 years the population in the UK has increased from 49million to 65 million and calorie consumption from 2,500 to 3,500 per person, whilst the relative levels of imports and total arable land area have remained constant [3]. This seemingly impossible statistic is understandable when we consider that in the same period crop yields have doubled and productivity has increased 6 fold [4]. Today less than 1% of the UK's population is employed in agriculture and fishing compared to around 6% in 1940 [5]. These levels of efficiencies have not been confined just to the agricultural sector. The whole supply chain has seen significant investment in new materials and technologies that have transformed the UK food processing industry. However more recently the sector has had to respond to wider environmental and social demands which will require more radical changes to meet the sustainability objectives. So far the UK food supply chain as a whole has been

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fairly resilient to past disruptions due largely to the huge diversity, flexibility and capacity of the system to absorb these shocks. This paper examines how current trends and initiatives could impact the future resilience of the UK food supply chains and in particular the food processing sector and how this could have wider impacts on the UK's food security.

2. Current Trends across the food supply chain

There has been an increasing realization in recent years about the magnitude of potential problems if food supply was damaged [6], [7], [8]. The concept of Resilience can be traced back to Holling (1973) [9]. This thinking was associated with supply chains by Christopher and Peck, (2004) [7] and Naylor (2009) [10]. Supply chain trends are dominated by the study of risk and how this can be eradicated or diminished [11], [12]). Risks of the operation relate to unpredictability of demand and the related implications of costs. Problems outside the operation may arise due to factors that include terrorism, natural disasters, transport and economic to name but four. There are several trends that are impacting the food supply chain. These trends are related to production, distribution, manufacturing, retail, and consumer/market.

2.1. Production Trends

There is a need for a more environmentally friendly food production and raw material usage [13]. This is not only because food production depends on non-renewable fossil fuel, but also due to the upcoming water scarcity [14]. It has been estimated that by 2025 energy, water and food shortages are expected to be impacting the food supply chain [15]. On the other hand, there is high need to increase food production in order to feed the increasing population which is estimated to be 9 billion by 2050 and this will require a 70% increase in food production [14]. It has been estimated that even if productivity levels remain at current levels the UK would need all its land resources to be farmed to meet it nutritional needs by 2050 [16].

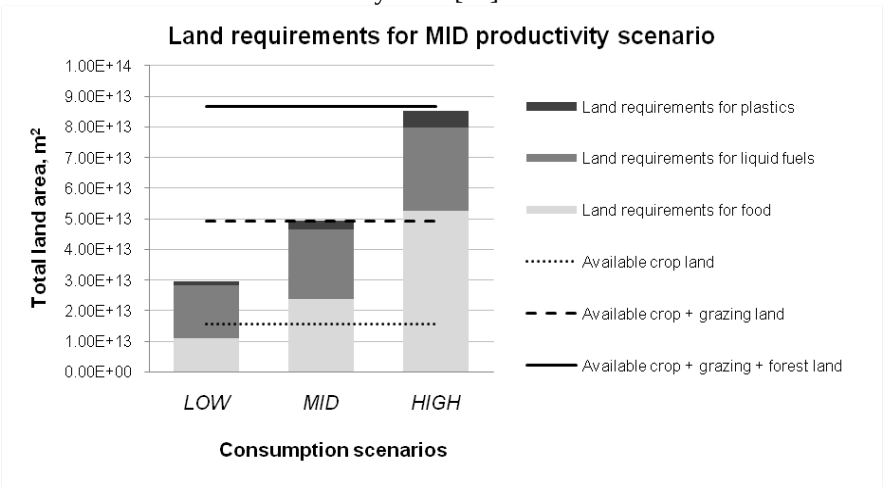

Figure 1: Land use requirements across 3 consumption scenarios [16]

However, climate change and extreme weather incidents put limits to growth in agriculture and food production, which means that a 70% increase in food production to feed 9 billion people might be impossible to achieve [17]. Climate change also has and will continue to have in the future severe negative consequences to the FSC [18]. Weather changes in the form of extreme weather events, the rise of global temperature and the increase of green house gas emissions are the main causes of climate change that will impact significantly the food production [19].

Food companies need to continually adapt to the changing environmental conditions as failure to respond timely in the latter trends will have significant negative impacts in their business operations [15] The production processes need to be changed by radical modifications of the traditional production systems to sustainable systems (e.g. organic farming). Therefore, food production should be done in a more sustainable way in order to preserve natural resources and be able to increase the future food production by adapting appropriately to climate changes and extreme weather events. In terms of operations management, Gunasekaran and Ngai (2012) outlined a number of issues for supply chains that included collaborative networks, sustainability, technology integration and connected operations [20].

2.2. Manufacturing trends

Many of the initiatives undertaken by food manufacturers to improve their sustainability through increased efficiencies and reduced environmental impacts, such as reduced stock holding and centralized production, have the potential to reduce their operational resilience, particularly to acute shocks. The closure of the McVities biscuit factory in Cumbria in 2016 due to flooding resulted in a number of their key brands being unavailable in the UK for weeks. In a highly competitive market, where the consumer has so much choice, the inability to maintain supply can result lost sales long after the products return to the shelves.

Other manufacturing trends with the potential to impact resilience include increased complexity of product and number of ingredients, the move away from shelf stable, ambient foods to more perishable items such as prepared meals, chilled foods and fresh produce and the sourcing of components from multiple countries and suppliers. As the manufacturing complexity increases and the operational flexibly reduce, the company becomes more vulnerable to even minor disruptions taking longer to recover and seeing the frequency increase. To some degree these chronic impacts have been partially offset by improved management and planning supported by software and technology advances. However this reliance on software and technology could itself bring problems as has been seen in other sectors such as finance and banking.

Future sustainability initiatives are looking to address both the long term sustainability of the food system as well as improving its resilience. Distributed manufacturing, seasonal produce and local sourcing have a role to play in achieving both goals. However, the need to ensure traceability, reduce costs and maintain segregation of ingredients - particularly where allergens are involved will not help in these endeavors. The numbers of food ingredients which can cause an allergic reaction and must be controlled by manufacturers have increased tenfold in the past decade and it is estimated that over 50% of children in the UK are now diagnosed with an allergic condition [21].

2.3. Retail trends

There is a strong development of modern retail in EU with discount stores experiencing the strongest growth [22]. Retailers aiming to expand globally and to source cheaper raw materials are adopting new ways of collaboration [23]. New forms of relationships are formed i.e. strategic alliances, horizontal, vertical cooperation and forward and backward integration [24]. Different channels and retail formats will continue to emerge and global retailers will need to decide the right channel and format at regional level [25]. However, it is argued that extended supply chains are crucial for the food industry as localism does not always work as some products cannot be produced by all countries [26]. On the other hand, the extension of supply chains increased their complexity because of the number of actors involved and the risks of managing them. Thus, food supply chains are becoming more and more complicated in terms of the different retail channels and formats.

2.4. Consumer / Market trends

Consumers' needs and wants are evolving all the time. In particularly, consumers require healthy products that are according to their particular dietary needs and environmentally friendly products e.g. fresh products, organic food, gluten-free products [27]. Also, the busy life-styles of consumers lead to an increase in food innovations such as the ready prepared meals [28]. All those consumer trends in the food sector are accompanied by consumers' continuous search for lower price products which is mainly a result of the ongoing economic crisis [29]. This means that food manufacturers should continuously seek for product innovations that will both satisfy the particular product requirements of consumers, but also their demand for lower prices.

3. Future resilience 2050

A resilient Food Supply Chain (FSC) is essential for ensuring a secure and resilient society in the UK [30]. Whilst significant resources have been expended on improving the sustainability of food production through reduced wastage and resource efficiency, it could be argued that often this is done at the expense of the overall systems resilience. Meanwhile climatic changes are impacting yields, altering weather patterns, and increasing uncertainty and the likelihood of disruption and food loss due to the impacts from severe weather events [18]. Due to ongoing climate change the frequency and severity of extreme weather events, both in Europe and globally, are predicted to increase annually [19]. This will have severe socioeconomic impacts [31] as well as affecting the production and distribution of food. FSCs are significantly affected by extreme weather incidents [30]. Recent weather incidents have demonstrated that FSCs are not always able to respond appropriately in times of crisis resulting in lost production, lost sales, non-availability of essential food supplies, and even the breakdown in civil order (Hurricane Katrina in the US 2005, heavy snow falls in the UK 2010). Thus, the ability of FSCs to recover and adapt to extreme weather events and climatic changes is questioned. Ensuring adequate food and water supplies during a climate born crisis is therefore essential for maintaining secure and resilient societies. A better understanding of the impact of extreme climate and weather events on FSCs is

therefore needed [32]. By understanding the FSC risks, vulnerabilities and capabilities a resilient FSC could be achieved [33]. Resource efficiency is an emerging issue that FSC supply chain managers have to address. This is because of the scarcity of natural resources and their implications to economic, industrial, and political systems [22]. Food manufacturers in particular need to find new ways of producing food in order to achieve resource efficiency and continue their production for now and for the future [34]. Food manufacturers need respond to these disturbances by building resilient supply chains. One way of achieving supply chain resilience is to be more productive by using fewer resources in production [35].

4. Conclusions

To be sustainable in the long term the food supply chain must also be resilient in the short term. Both of these aspects need to be considered as part of a coherent food security strategy. Many of the initiatives aimed at improving the sustainability of the food supply chain have the potential to weaken its resilience in the short term. Identifying how UK food production, manufacture, distribution and consumption is likely to change in the future and how this will perform across different future environmental, social and economic scenarios will be essential for maintaining our current levels of food security and maintaining a resilient supply chain.

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