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LNN BUSINESS FEASIBILITY PROJECT FINAL REPORT

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LNN Business Feasibility Report

Executive Summary

This report aims to identify the business opportunities for, and constraints of, relocating food processing for tomato paste and bread. The report explores the existing literature on food manufacturing, local food and sustainable supply chains, as well as the recent work on Re-distributed manufacturing (RDM). The work focuses on two specific locations Oxford (retrofit) and Northstowe (new development).

Data was collected using a questionnaire. Overall, in the case of Oxfordshire, our findings suggest that firms are already very much relying on local and regional suppliers and customers and that they have reached the limit of what they can source locally in terms of variety, quality and cost, but also that there might be glass barrier blocking further demand expansion due to competition especially from large retailers.

In order for RDM to be feasible we present the following business case:

There must be available resources in order for businesses to invest in RDM. These resources extend from environmental e.g. water, land; labour with the necessary skills to carry out a job within RDM, a market demand for the product whether this is the local market or national market. The suitability of Redistributed Manufacturing in the food sector is dependent on each specific product.

From our extensive literature search and the data collected we present the following key future research questions:

1. How do we create dynamic Business models to take account of: incremental changes that could take place over 5 years; medium term changes 5-10 years; and, long term changes over ten years?
2. What are the trade-offs of re-distributing food manufacturing for the entire supply chain of specific products in terms of economics, social, environmental, and cultural factors?
3. Could re-distributed food manufacturing alter the flow of power across food supply chains and provide opportunity for local and regional economic development?
4. How can re-distributed food manufacturing address the triple bottom line in any business model (firm, industry, or value chain)?
5. Re-localising food manufacturing may enable the re-localisation of other actors within the value chain, what are the knock-on resource effects of this process?
6. What are the effects of changes in the political dimensions of the UK which could affect business decisions in relation to re-distributed manufacturing?
7. How should RDM be implemented in a low margin sector (exclusion of artisan and specialist products) there would need to be a clear business case in terms of costs and returns on investment particularly for smaller enterprises. How can this be addressed for smaller firms, what business model is needed?
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1. Introduction

This report is part of the Local Nexus Network (LNN) project on redistributed manufacturing (RDM) in the food sector and the opportunities and challenges of RDM for the Food-Energy-Water nexus. ‘Local nexus’ refers to decentralised food, energy and water systems which interact with each other within the context of local livelihood and environment. The report focuses on presenting the work from the business models feasibility study and along with the other feasibility reports (food, water and energy) develops a business focused research agenda around the RDM for the food value chain.

Source: LNN presentation March 2016.

The sustainable development of local nexuses, focusing on how RDM could affect local production, resources available and support for the local economy and communities through the potential to contribute to the idea of ‘shared prosperity’ by which we mean between business and community and between human society and natural ecosystems. Food water and energy represent basic needs for society and thus their sustainability and availability are crucial. Addressing this calls for a combination of “smart” engineering (smaller scale technologies, integrated processes) and driving forces from businesses, communities and policy makers.

The main research aim of this Feasibility Project is to identify the business opportunities for, and constraints of, relocalising food processing for tomato paste and bread: in other words from grate to place in 0 miles. The sustainability of local food supplies is becoming a concern for policy makers in relation to issues including traceability, quality, customer safety and the resilience of the rural economy. This feasibility project will focus on understanding the opportunities for, but also the bottlenecks of, shortening the value chains of tomato paste and bread both processed food products. This means exploring under what conditions localised food processing chains are desirable as well as feasible. We explore the possibility of relocalising food processing in the areas of Northstowe (new development) and Oxford (retrofitting), where we apply a broader
conceptualisation of short food value chains. The emphasis is on the design and management of food value chains and specifically the design of business models for sustainable relocalised food manufacturing.

Objectives:

1. Examine the opportunities and implications of the growing demand for re-localising food processing (food security along supply chain, greengrocers and farmer’s market) and those of localised energy supply for small businesses including community-based initiatives, local operations of large companies and clusters of small firms.
2. Identify new/alternative business models required to reconcile various environmental, social and economic objectives within a localised value chain, including service-oriented approaches.
3. Explore potential strategies and important trade-offs faced by value chain players with respect to resilience, efficiency, and sustainability.
4. Develop an understanding of the interactions between local value chains and value chains that present a mix of local and more centralised business activities.

The literature review examined the development of national and local food chains in the UK and the multiple dimensions that affect the sustainable provision of foodstuffs. The main dimensions of concern were: economics, social, human health, and environmental and ethical sourcing. The key in understanding the potential to establish a sustainable food chain in the future is the extent to which market demand and supply will fluctuate and the level of resilience in any given food commodity chain. It was important to evaluate the strengths and weaknesses of the food chain under investigation to establish its reliability and potential for sustained development.

The literature review focused on the dynamics and performance of food chains in the UK and the particular characteristics of the two case studies: tomato paste and bread. The key literature sources included: market reports, policy documents, and academic journals, such as the Journal of Supply Chain, International Journal of Agricultural Sustainability, Agriculture and Human Values, British Food Journal, Journal of Food Engineering, and Food Policy. The review aids our understanding of the challenges involved in creating a local sustainable food supply chain and informs the framework of analysis that will compare and contrast the sustainability of the chosen case studies. The literature review also presents future research questions in relation to RDM.

The literature review has covered a number of different areas see figure 2 below and we provide a table of search terms and results in the Appendix see table 1 page 91.
Figure 2: Map of the literature explored.


The report is structured as follows: we present the findings from an extensive literature search, then detail the value chain of each product before presenting the location case studies and data collection methods, we then present our findings and finally draw conclusions from our discussion.
2. **Redistributed Manufacturing (RDM)**

RDM is a relatively new concept that has to date received little scholarly attention, although recent interest from funding councils has engaged research in a number of diverse areas from medical devices, digital printing, sustainable cities and more recently the food, water and energy nexus. The food, water and energy nexus specifically explores the implications RDM has for distributed regional growth and resilience, as the impact of implementing RDM technologies, systems and strategies are not fully understood. RDM has the potential to open up new possibilities (and implications) for both existing and new actors within the food supply chain, its full potential and implications are not yet well understood in any area of manufacturing (Gao et al., 2015; Ivanova et al., 2013; Kietzmann et al., 2014; Thiesse et al., 2015). The focus of this project is on the re-localisation of food production. In this section we explore the concept of RDM and report on the limited research to date.

"Re-distributed manufacturing epitomises an on-demand economy with local manufactories (however they may look) reshaping and redefining markets and supply chains, requiring new decentralised business models and having wide ranging challenges and implications. Redistributed manufacturing may be characterised by greater personalisation of products. Concurrently there are a wide range of engineering, materials, computing, infrastructure and chemical challenges" (Noble et al., 2013: 3).

"EPSRC and ESRC have developed a working understanding of re-distributed manufacturing as encompassing: technology, systems and strategies that change the economics and organisation of manufacturing, particularly with regards to location and scale”

(Pearson et al., 2013: 5).

Therefore, RDM can encompass any technology, systems and strategies (or combination of) that enables change in relations to economics and organisation of manufacturing with specific reference to scale and location.

The interest in redistributed manufacturing (RDM) has derived from the changing nature of the manufacturing sector and the resultant implications of the need for a new manufacturing model. Recent scholarly debate has been unpacking this ‘production organisation revolution’, with the result that now it is timely and crucial for policy impact, to understand in depth what form this new manufacturing model will take and how it can contribute to local/regional growth and jobs agenda. Firstly, Technological change has always altered economic activities by introducing new ways of organising production inside and between firms, the use and composition of new resources, and new skill requirement, but it also forces new constraints. The new manufacturing model coincides with locally embedded small-scale manufacturing firms addressing significant and expanding market niches of uniquely customised or small batch demand. Such productions rest not on scale economies but on other forms of firm efficiencies able to ensure adaptability, responsiveness and innovation. Secondly, a new emerging demand, there are untapped market niches for personalised, customised and innovative products. These need to be produced in small batches or even as unique pieces. Such demands cannot be satisfied by the mass standardised products that low cost economies have completely captured. Such niche markets require customers to co-innovate or even co-produce with
the manufacturer or the maker. Closer interaction between manufacturers and customers translates into more distributed consumption of distributed manufacturing, whereby customers source or commission the-making-of-products locally.

In the production of food key drivers underpin the need for exploring RDM and its impact on regions ranging from resource usage (water, energy and other natural resources), the need for greater sustainability on three levels – environmental, economic and social. Another driver is the potential for consumer driven needs for more ‘locally produced’ food, food security and shorter food supply chains; tailor products to the needs of consumers (RIHN, 2015) and what this means for RDM. The drive towards smaller-scale local manufacturing is also caused by changes in transport and labour costs, the availability and cost of small-scale equipment, and access to information (RCA, 2016), new technologies, flexibility in manufacturing and new processes. There is also the argument that redistributed manufacturing includes manufacturing in the home which present further manufacturing opportunities but not necessarily local. There are, however, a number of challenges that present themselves including maintaining supply for demand, ensuring the optimal use of resources and the definition of key constructs.

Developments in RDM will have diverse effects on the UK economy and society (both positive and negative), and requires a radical change in the organisation of labour and production. This could potentially offer business creation opportunities for entrepreneurs. These will ultimately effect local communities and economies, food supply chains, as well as wider political and international implications for changes in monetary, resource and labour flows as the potential for more regionalised, inclusive economies is possible (Pearson et al., 2013). These changes are also driving the need for the development of new business models and supply chains, changing dynamics of work and communities, and have immediate implications for industrial and social policy.

For manufacturing firms, localising production (through RDM) brings them closer to customers with the potential to reduce supply chain costs and cut out specific risks and waste. These reductions in cost and risk may be shared by firms (increased profit margins) and consumers (cheaper products). Localising production can also enhance a firm’s ability to respond to unforeseen demand and changing requirements. RDM encapsulates a range of disruptive technologies and a trend towards the adoption of smaller-scale localised manufacturing units through these processes RDM has the potential to transform industries including food production and manufacturing, as well as the organisation of other industries, which require rapid and flexible products on-demand (e.g. aerospace parts and medical devices) (Liu et al., 2014; Kumar, 2014), and can support Business2Business and Business2Consumer markets in new ways. RDM has the ability to reverse the trend towards further centralisation and globalisation of food supply chains.

In terms of sustainability, RDM has the potential to offer greater resource utilisation, reducing the carbon footprint of the supply chain through local production and local markets as well as the ability to create models which address the need for re-use and re-manufacturing of components, and factor in ethical practices (Foresight, 2013; Garetti and Taisch, 2012). RDM could provide an opportunity for policy makers seeking a way to increase levels of manufacturing in the UK through re-shoring and as a way to increase regional development and resilience through providing employment. It could also offer the potential for the production phase of the supply/value chain to
consider also manufacturing products to add value to commodities such as milk, wheat etc. and retain some of the value for themselves rather than it being captured further down the chain.

### Key Questions

- What could RDM look like for the food industry?
- Where does RDM take place? Small factories, people’s home, kitchen garden enterprises
- What opportunities does RDM provide for community based enterprise and not-for-profits as well as commercial enterprise?
- Is there a demand for RDM in food manufacturing?
- What will RDM mean for local employment and regional development?
- How will RDM affect the products available?
- How will RDM affect the value chain and what does this mean for the future of the food manufacturing sector?
- What is the business case for RDM in a low margin sector – what are the costs and the expected returns?

3. Manufacturing and Food manufacturing in the UK

3.1 Manufacturing

The manufacturing landscape is ever-changing (Ford and Despeisse, 2015). The general trend of manufacturing corporations appears to be one where global supplies (often less expensive having lower input costs comparative to the UK) are sought in order to increase competitiveness (Lang and Heasman, 2004). However, Ford and Despeisse (2015) argue that one of the most significant drivers of recent changes is the emergence of advanced manufacturing technologies that are enabling more cost- and resource-efficient small-scale production. This is a key facet of RDM – small scale efficient production.

Manufacturing is a diverse sector of the UK’s economy. It includes activities ranging from aerospace and steel production to textile manufacture and the production of food and drink. In 2010, manufacturing accounted for 11.8% of employment in the UK, 14.1% of enterprises, 18.2% of turnover and 19.4% of gross value added (GVA) (Bryson et al., 2013: 5). However, from 2008-10 employment in manufacturing declined by 8.1%, the number of manufacturing firms declined by 11.1% with an increase in turnover of 2.5% and GVA by 0.9% (Bryson et al., 2013: 5). Rusten and Bryson (2010) suggest that a balanced approach is required for any discussion on regions and
manufacturing with consideration for multinational organizations, SMEs, micro firms and not for profits.

In exploring relocalising manufacturing, the adoption of additive manufacturing (AM) and other advanced manufacturing technologies appears to enable value chains to be shorter, smaller, more localised, more collaborative, and offer sustainability benefits (Gebler et al., 2014). Localised manufacturing could radically transform supply and distribution networks (Ford and Despeisse, 2015: 20), as local manufacture could also involve raw materials being sourced locally.

"The factories of the future will be more varied, and more distributed than those of today [...] The production landscape will include capital intensive super factories producing complex products; reconfigurable units integrated with the fluid requirements of their supply chain partners; and local, mobile and domestic production sites for some products. Urban sites will become common as factories reduce their environmental impacts. The factory of the future may be at the bedside, in the home, in the field, in the office and on the battlefield" (BIS, 2013 cited in Ford and Despeisse, 2015: 20).

The business model for this activity will be concerned with how companies create value, who they create value for, and how they capture that value (Andries et al., 2013) and will have to take into account the changing configuration of value chains. It is a “structural template of how a focal firm transacts with customers, partners, and vendors. It captures the pattern of the firm’s boundary spanning connections with factor and product markets” (Zott and Amit, 2008: 5).

It is through the digital technology revolution that it is economically feasible for manufacturing activity to be re-distributed at a local level (Pearson et al., 2014). This offers enormous potential for changing the distribution of manufacturing and manufacturing supply chains, as well as society as a whole (Huang et al., 2013; Lipson, 2012). In re-localising manufacturing through RDM, there could be impacts on regional economies. There are different approaches to exploring regional economies. First, the identification of local clusters (Taylor, 2010); second, development of knowledge and creative economies (Florida, 2005; Peck, 2005); and third, Christopherson and Clark (2009: 35) have argued that the ‘core characteristic of competitive regions is a willingness and capacity to absorb and adapt to the “three R’s” of shifting firm strategies – relocation, restructuring, and redistribution’. According to Bryson et al. (2013) these “three R’s” refer to the relocation of production, the restructuring of work and the redistribution of costs and work. The argument is based on the assumption that ‘the regional scale becomes the dominant scale for innovation and production through the demand for (skilled) labour’ (Christopherson and Clark, 2009: 34), whilst global scale is driven by economics (Bryson et al., 2013).
3.2 Food Manufacturing

First, the manufacture of food products (SIC 10) is spread throughout the UK, but there is significant localisation of fish products in Scotland (SIC 102) and noticeable underrepresentation in the West Midlands and the South East (Bryson et al., 2013: 28).

The LQ analysis of the food industry hides concentrations related to local specialisations. There is localisation, for example, in London of the manufacture of vegetable and animals oils (SIC 104) and dairy products (SIC 105) and in the South East for the manufacture of grain mill products (SIC 106) and bakery products (SIC 107) (Bryson et al., 2013: 28). It is worth noting that food manufacturing is the largest contributor to employment, but employment declined by -1.7% between 2008 and 2010 while exports increased by +34.7%. The production of food products represents a valuable opportunity to combine cost control with non-price based aspects of the product related to quality, heritage brands, locally sourced foods, associations with British manufacturing and quality (Bryson et al., 2013:29).

Food manufacturing a brief history summarised from (Toops, 2010) - the 1940s was focused on the war rations, providing basic nutrition and ensuring enough food to feed the nation. After the war in the later part of the 1950s there was a sharp rise in consumption of meat, poultry and dairy. Refrigeration makes keeping food easier in the home and changes in the role of women also changed how food was sold, with sharp increase in prepared foods and convenient packaging reducing food preparation time. Changes in how people live and the make-up of towns also led to the birth of the supermarket. During the 1960s, developments in the use of alternatives for things such as sugar (e.g. high-fructose corn syrup) which helped to lower cost of production for food producers, coupled with increasingly efficient food supply chains reduces food prices. Marketing on the television plays a role in advertising value added food to consumers. In the 1970s, things start to turn towards the nutritional benefits of food and the need for disease prevention. Food manufacturers were required to label foods with their nutritional values. As packaged food boomed consumers became disjointed from the concept of cooking at home with raw, seasonal ingredients. Computer technology began and large scale market research tracking consumer purchases began. In the 1980s microwave ovens transformed home cooking and lead to food manufacturing of frozen meals in plastic containers, the industry suffers heightened concerns over nutrition, obesity and health responding by developing low calories ranges. The 1990s saw a move towards health products including fortified drinks, low fat, fat free, and energy bars. Technology progressed with microwave ovens as convection ovens became available. The 2000s saw a shift in consumer demands as brands became less popular in favour of cheaper supermarket own brands; marketing of food changes, with emphasis on health concerns such as low sugar and low salt as well as targeting specific consumer segments for example children, adults and elderly.

A key point to make is that consumers have come to expect, demand year round availability of products, including seasonal produce, as the supply chain became increasingly efficient (Sibbel, 2012). Changes in social constructs particularly the changing role of women from staying at home to seeking employment drove the need for food manufacturing to provide products that released women from food preparation tasks (Darling, 1983), but some scholars argue that it drove the
change because it “unintentionally has produced a lot of underemployed housewives and led them to seek employment outside the household” (Sibbel, 2012). As McKenzie (1982: 15) simply states that food companies were merely taking over “many functions previously handled by the housewife” allowing her to participate in the workforce (Sibbel, 2012). Choosing to work outside the home “forced (women) [. . .] to delegate food preparation to the manufacturer” in order to meet responsibilities for feeding the family (Jackson, 1983: 84). Sibbel (2012) suggests that another perspective, it was simply “fortuitous” that the capacity of the food processing industry to produce ready to eat or partially prepared foods had coincided with the greater workforce participation by women, and associated greater discretionary income for purchase of these products (Olson et al., 1982: 56). In line with increased manufacturing led to processed foods becoming more part of the staple diet which led to growing criticism levelled by dieticians, nutritionists, consumer organisations and even regulatory agencies (Hudson, 1994), in response to this food manufacturers made nutritional value a much more important consideration in product development by the 1990s (Sibbel, 2012).

In response to some of the recent scandals in the food industry (horse meat being sold as beef in processed meals as one example) food manufacturers have to recognise that they rely on consumers’ trust which requires managing risks and communicating information about those risks along the food chain (Barling et al., 1999; Vasileiou and Morris, 2006; Wognum et al., 2011). These concerns also raise the issue of the relevance of digital manufacturing and in particular 3D printing in terms of their applicability to food manufacturing especially given some actors in the supply chain having concerns about the level of processed food and its impact on individual’s health. There is also, within the local food movement, a trend towards promoting organic, fresh food which commands a premium price.

### Key Questions

How will RDM change the landscape of food manufacturing?

What will this mean for local resources and local enterprise?

How will advocates of RDM present the business case to food manufacturing businesses given the low margins?

What are the risks of RDM use for food manufacturing particularly in relation to food safety?

Is there a skills and knowledge base to support RDM and if not what policy measures are needed?

**4. Food Supply/Value chain**

The food industry is dynamic with constant changes in customer demands (van der Vorstandbeulens, 2002; Wiengarten et al., 2011; Trienekens et al., 2012), as well as other factors related to the environment and production, for example drought, floods and so on. As a result the industry must
be able to adapt strategies quickly (Teece et al., 1997; Barreto, 2010; Foerstl et al., 2010; Zhu et al., 2012). For some products where the lead time between initial conception and maturity can stretch into years (e.g. dairy production) this can present additional challenges. Crops are also planned years in advance with cropping rotations. Food supply chains have other unique characteristics including but not limited to: stemming from product storage and transportation specifications for perishable goods, food safety, reliability, seasonality, short shelf life, weather patterns, price variability and more recently sustainability (Ahumada and Villalobos, 2009; Georgiadis, 2005; Hagelaar et al., 2004; Hobbs and Young, 2000; Luning and Marcelis, 2006; Salin, 1998; Srivastava 2007; Van der Vorst et al., 1998; Van der Vorst and Beulens, 2002). Another feature of food chains is that few products are transformed from commodity to differentiated branded foods, while others undergo packaging but remain essentially intact in character (Georgiadis, 2005). This poses the question as to how relevant RDM is to the food sector. The supply chain of agri-foods is also characterised by very long lead times sometimes as long as two years, as well as significant supply and demand uncertainties (Lowe and Preckel, 2004). This creates uncertainty across the supply chain, in particular, for perishable goods meaning producers and buyers have to continually move products along the supply chain and are unable to store and wait for favourable market (price) conditions (Georgiadis, 2005).

Figure 3: Generic food supply chain Source: Adapted from Barling et al. (2009)
The restructuring of the agri-food supply chain (horizontal and vertical integration, changes in the level and distribution of power) has had far-reaching effects on all the actors in the chain, from the input supplier who sells seeds, tractors, and fertilizers, to the farmer and food retailer, to the consumer (Burch et al., 2013; Clapp and Fuchs, 2009; Oosterveer and Sonnenfeld, 2012; Weis, 2007). The integrated supply chain has emerged as an increasingly dominant model, where the agri-food system sparks controversy concerning the fairness of returns among the supply chain members, discussed later (Peterson, 2002). International trade in food and agricultural products over recent decades (Hawkes et al., 2010; Nugent, 2004), highly concentrated food manufacturing, processing, distribution, and retail (Hawkes and Ruel, 2006; Hawkes, 2009; Hawkes et al., 2012), tighter vertical coordination of supply chains for food safety, quality, and traceability concerns (Burch and Lawrence, 2005, 2007) have together been credited with delivering broad improvements in food availability, variety, and safety (Hattersley, 2013; Reardon and Berdegué, 2006; Dixon, 2007; Reardon et al., 2010). This integrated food supply chain has developed into an international, fossil fuel dependent operation, often requires refrigeration and the just-in-time processes used by retailers, whilst ensuring flexibility in meeting consumer demand, can place particular strains on transportation. The challenges faced touch on multiple sectors in addition to food and energy production, and include construction (e.g. of storage facilities and retail environments) and manufacture (e.g., of agricultural equipment, refrigeration equipment, alongside food manufacture). RDM could not only change the face of food manufacturing but it could also re-shape how food is transported and stored.

### Key Productivity Statistics for Food Sector

Productivity beyond the farm gate increased by 0.5% as opposed to productivity in the wider economy increasing 0.1% benchmarking against the wider economy the food chain between 2004-2013 0.5% compared to 0.1%. Productivity in food wholesale had the highest increase at 1.1% since 2012, retail 0.6% catering saw a decrease of 0.8% in 2013 but over the last 10 years annual growth was unchanged (DEFRA, 2013: 2).

Total factor productivity is an indicator of the efficiency and competitiveness of the United Kingdom food chain. Food sector plays significant role in UK economy, accounting for 7% of national gross value added. Four sectors make up the food chain: retail, manufacture, wholesale and non-residential catering (DEFRA, 2013: 2).

Food manufacturing productivity increased by 0.5% in 2013 and in last 10 years average annual increase of 0.7%. Food retail in 2013 was 0.6% higher than in 2012 (DEFRA, 2013: 3).

In the modern food industry, processes have become industrialised, characterized by mass production from highly integrated global food supply chains (Manning et al., 2005; Roth et al., 2007; Trienekens et al., 2012).

These are defined as “a set of interdependent companies that work closely together to manage the flow of goods and services along the value-added chain of agricultural and food products, in order to realize superior customer value at the lowest possible costs” (folkertsandkoehorst,1998 cited in Beske et al., 2014: 134).
The changes and key issues for the food supply chain are summarised as:

Porter (1985) developed the value chain model as a way to explore competitive advantage which is derived from a set of activities (adding value). These activities include: designing, producing, marketing, delivering, and supporting products and services. It is worth noting that food value chains are unique and differentiated from other product value chains largely due to the perishable nature of inventory, which significantly affects the logistics of each stage involved in the value chain system (Yu and Nagurney, 2013).

Figure 4: Source GVC seminar presentation March 2016

![Image of the food production chain]

Key changes that have been seen in food supply chains in conjunction with the process of globalisation: the development of flexible, ‘just-in time’, modes of food production and distribution; the emergence of new health foods and functional foods associated with issues of nutrition and diet; the sale of convenience foods, reflecting social changes in work patterns and ‘time-poor’ lifestyles; the homogenization and standardization of tastes and diets; the emergence of new forms of regulation and quality management in response to food ‘scares’; and, growing consumer concerns about the safety of imported foods (Burch and Lawrence, 2005; Busch and Bain, 2004; Carolan, 2011; Dixon, 2002; Lang et al., 2009; Rosin et al., 2012) (Burch et al., 2013: 215-216).

It is generally accepted that final consumers (who ever these may be) have exclusive rights to the definition of what constitutes value in a product or service (Slater and Narver, 1992). As such, in order to create successful value propositions a firm must understand what it is that consumers value in the product and service they offer (Soosay et al., 2012). This is a key point in terms of customisation and the business demand for RDM, what is it in the product produced by RDM that consumers value.
Ratner and Markley (2014) identify a wealth creation value chain as a business model based on shared economic, social, and environmental values in which buyers, processors, producers and others work together for mutual benefit to create value in response to market demand (p.346). In addition to being demand driven, wealth creation value chains are based on satisfying the self-interests of participants (Ratner and Markley, 2014: 346). Product differentiation and value-added products or services create a competitive advantage for the value chain (Bloom and Hinrichs, 2010). For example, farmers grow crops and sell them to restaurants that in turn create dishes that are sold to consumers. In this way, the farmers maximise value by using best growing techniques, and the restaurant maximises value through expertise in food preparation. The end consumer realises the value through their purchases (Christopher, 2010; Kline et al., 2016).

Sustainability activities in food supply chains has focused around consumer demand for increased information on the origins of food, how it has been processed and the safety of the product (Verbeke, 2007; Wognum et al., 2011). Consumers want to know about farming practice including animal welfare, use of pesticides etc., as well as food manufacturing processes. Interestingly, “the manufacturing sector has always been adding value to products to increase market share and profitability. Once value-adding was associated with the use of alternative or extra ingredients or processing to modify properties for greater convenience or palatability or nutritional value” (Sibbel, 2012: 791). Consumer concerns about sustainability call for new ways of value adding. This is where RDM could offer opportunities. If food manufacturing is to take advantage of RDM then there also needs to be consideration as to how this could be applied to the organic market, particularly at a time when some consumers are becoming more wary of manufactured food products and are seeking fresh produce instead.

Key Questions

What is the value of RDM?

What does RDM mean for value capture across the supply chain?

New business models for RDM would need to consider the economic, social and environmental factors of production

Could RDM offer an opportunity to reverse the trend of consolidation and allow small firms to integrate production manufacture and retail on a small scale? Could this be more sustainable and retain value capture in the local economy

Could RDM advance customised health foods for those with intolerances?

Could RDM be more efficient than centralised manufacturing factories?
5. Local Food

One opportunity for RDM in the food sector, depending on the form RDM takes, the scale of the manufacturing operation and the location is the local food movement and opportunities to contribute to this growing trend.

Kirwan and Maye (2013) argue that the development of the local food sector in the UK has been visible for many years, for example, in the growing interest in farmers’ markets, box schemes, local food directories, community orchards and gardens, and community supported agriculture (CSA), often promoted and facilitated by the actions of Local Food Links groups (FCFCG, 2011; Sustain, 2011).

The growing interests in “local food” in recent years across the globe highlight its significant importance. Its popularity is now clearly visible in many best-selling books, newspapers and magazine articles, and TV programmes. Local food has also gained a considerable focus across multiple disciplinary fields in research and practice. It extends now to various domains of social, cultural, environmental, ethics, public health and nutrition, governance, economic and others (Ghosh, 2014: 34).

5.1 Local Food Movement

As argued by Pearson et al. (2011) before undertaking any discussion of “local food” it is important to recognise that there is no legal stipulation of what constitutes local food. Defining ‘local food’ is something which is subject to debate in the literature, and is problematic since there is no consensus amongst academics, policy makers and industry stakeholders as to what constitutes local. The most commonly used approach defines local food on the basis of the distance that the food travels from production to consumption. Within the UK, definitions using this geographic proximity approach range from distances of 30 miles (as used for Certified Farmer’s Markets), within a county (an example of this being “Direct from Dorset” (Pearson et al., 2011: 887). Using a purely geographic definition (i.e. food that is sold within 30 miles of where it is produced) the local food market has been estimated at around 1.5 per cent of the total food market (Brown and Geldard, 2008).

Local food movements have become a particularly strong feature in some large cities, where urban agriculture is now viewed as an important source of local food and form of engagement (Newmann et al., 2015: 102). Scholars have identified multiple benefits of urban agriculture for shaping and building communities (Patel, 1994), health (Wakefield et al., 2007), through increasing fresh fruit and vegetable consumption (Alaimo et al., 2008), and meeting food needs (Block et al., 2011), as well as contributing to food security and resilience (Barthel and Isendahl, 2013). The movement towards localising food systems has become a global phenomenon as social institutions are responding to concern about the way we interact with our food (Bauermieister, 2015; Bianchi, 2004; Gupta, 2013; Shiva, 2000), this also applies to processes involved in relocational food production and manufacture.

Brown and Geldard (2008) propose a working towards a definition that encompasses the wide range of expectations that consumers have about local food. These include that it is from the UK, produced in season, produced in a specified area, and finally sold within a limited distance of that area. A complication for local food emerges with processed and multi-ingredient products. This raises the
question of what percentage of all the ingredients and/or processing needs to be deemed “local” for the final product to maintain its status as a local food (Pearson et al., 2011: 888).

There is increasing evidence in the literature that demand for local food has risen, and that local food continues to be a product in demand (Penney and Prior, 2014; Jones et al., 2004; Morris and Buller, 2003). This demand stems from consumers wanting to know more about how their food is produced including effects on the environment, health related factors amongst others (Autio et al., 2013; Arsil et al., 2013). In line with increased consumer awareness of local food Governments are also showing increasing interest in supporting and promoting local foods which suggests that this sector will continue to grow in the future (Ilbery et al., 2006; Coderre et al., 2010). Some retailers and culinary experts have better understood this opportunity and have invested heavily into sourcing locally produced food as a way to connect with consumers and increase profits (Darby et al., 2008; Bianchi and Mortimer, 2015: 2282). Localised food networks can make a significant contribution to rural development, helping to mitigate the crisis of conventional intensive agriculture and the global supply chain, building up the local economy by increasing the circulation of money locally (the economic multiplier) (Renting et al., 2003, Ward and Lewis, 2002).

Food consumption is a complex interplay of cultural, economic and social forces (Kniazeva and Venkatesh, 2007; Lang et al., 2014). Work exploring consumer perceptions and behaviours in relation to local food has been explored through different context including local food consumption (Arsil et al., 2013; Autio et al., 2013; Bianchi and Mortimer, 2015; Mirosa and Lawson, 2012; Rainbolt et al., 2012; Zepeda and Leviten-Reid, 2004); motivations for purchasing local food (Weatherell et al., 2003); food systems, policies and distribution (Alonso and O’Neill, 2010; Coderre et al., 2010; Duffy et al., 2005; Hinrichs, 2000; Ilbery et al., 2006; Pearson et al., 2011); place of purchase namely supermarkets (Alonso and O’Neill, 2010; Bianchi and Mortimer, 2015; Lang et al., 2014); quality perceptions and freshness of local food (Jekanowski et al., 2000; Tippins et al., 2002); as a mechanism to support the local economy, generate local jobs and support small scale producers (Morris and Buller, 2003); and Seyfang (2006: 7) found that a third of consumers saw local food as a way of “preserving local heritage and tradition”. However, further work needs to consider different cultural backgrounds of consumers (Campbell, 2013). This increased awareness of local food offers opportunities for RDM to create a ‘locally manufactured’ market for food products.

For businesses there remains a number of issues in deciding whether to engage in local food production or not and more often than not producers will supply both local and conventional markets.

5.2 Re-Localisation of Food

The growing movement for localising (or re-localising) food systems has gained in popularity as a means to address these problems and foster alternative food systems (Cleveland et al., 2015: 282). Re-localising food is giving rise to different strategies in specific contexts, but social values and relationships, emblematic of the social economy, appear to be essential building blocks (Beckie et al., 2012: 343). The term “relocalisation” has been used to describe the movement away from a “globalised” food system and towards what Kloppenburg et al. (2000) describe as a food system that is relational, proximate, diverse, ecologically sustainable, economically sustaining, just/ethical,
sacred, knowledgeable/communicative, seasonal/temporal, healthful, participatory, culturally nourishing, and sustainably regulated (Hills et al., 2013: 366). “Relocalisation” is described by Hendrickson and Heffernan (2002: 363) as a “connection of people to place through food. Food in a local system is rooted in a space that enables and constrains production and consumption through its own unique characteristics.” As Ilbery et al. (2006: 214) state that reconnect farming with the rest of the food chain, the rural economy and consumers was emphasised earlier in what Ilbery and Kneafsey (2000a) defined as a process of food relocalisation.

Re-localising food chains has been put forward as a strategy for sustainable consumption due to the apparent benefits to local economies, communities and environments (Jones, 2001; Taylor et al., 2005). Consequently, the recent revival of localised food supply chains and the rise in demand for specifically local organic produce have been described as a move towards a more sustainable food and farming system in the UK (Pretty et al., 2005; Saltmarsh, 2004; Norberg-Hodge et al., 2000; La Trobe, 2002). These can also be alternative and relocalised food systems (Hinrichs, 2000; Mormont and Van Huylenbroeck, 2001; Renting et al., 2003; Goodman, 2004; Ilbery et al., 2004).

In all these initiatives there is an emphasis on re-localisation of the food system, with the risk of letting “local” become a proxy for sustainable (Torgusen et al., 2008: 190). While there is a recognition of the false dichotomy between the local and the global (Feagan, 2007, Hinrich 2003), and risk of the local becoming an arena for reactionary politics (Hinrich 2003), many authors hold the opinion expressed by DuPuis and Goodman (2005: 365) that “Place has a role in the building of alternative food systems.” Madgwick and Ravenscroft (2011: 118) suggest that bringing producers and consumers closer together is not an authentic gesture for many people; their cultural connections are not to farmers and growers, but to areas of the city, shops, shop-keepers, markets and market traders. Bringing more fresh food back to the traditional market areas of the city is, therefore, likely to have a bigger impact on access and consumption that trying to reduce the length of the food supply chain per se. This may seem counterintuitive to the relocalisation debates that are commonly taking place (Guthrie et al., 2006). Within the local food debates little attention is given to the notion of scale with respect to production activities. In linking local food to the concept of RDM, further consideration would need to be given to the scale of operation e.g. micro factories and their location whether that is in cities, rural areas or suburbia, and how disperse these would be. In order to enable RDM there may also be a need for food specific technologies, further information on this specific topic can be found in the LNN Food Technology Feasibility Report.
There has been growing interest amongst many stakeholders to re-address the globalisation of food supply chains. Debates have centred on illustrating innovative re-organisations of food supply chains with the aim of re-connecting producers and consumers. Part of these re-organisation has involved the re-localisation of agricultural and food manufacture. To do this, stakeholders have explored short supply chains, alternative food networks, local farming systems and direct sales (Kneasfesy et al., 2013). For this report, we define short food supply chains in relation to the geographical distance between different parts of the value chain and between processing and consumption.

SFSCs can represent traditional and/or alternative ways of producing, distributing, retailing, and buying food and they have served as niches for those food system actors, mostly producers and consumers, who look for alternatives to the dominating agro-industrial model (Galli and Brunori, 2013), some of these issues are discussed later in this section, alternative food networks are discussed in a separate section. SFSCs emerged out of the broader debate on ‘Alternative food chains’ (Ilbery and Maye, 2005), ‘Alternative food networks’ (Goodman and Goodman, 2009) or ‘Sustainable food chains’ (Roep and Wiskerke, 2006). The point of departure of this debate is that, given that the prevailing trend in the agro-food system is the development of ‘global value chains’ dominated by retailers (Gereffi, 1994) and characterised by unequal distribution of power between the different actors, long distance trade and industrialised food, SFSCs are analysed and interpreted...
as a strategy to improve the resilience of the family farms with the support of concerned consumers, local communities and civil society organisations. SFSCs are increasingly taken into consideration by rural and food policies as a driver of change towards sustainability both in agro-food system and rural areas (Galli and Brunori, 2013).

This contrasts to ‘Short Supply Chains’ where the number of intermediaries is minimised therefore reducing the length of the supply chain and the number of actors involved, the ideal being a direct contact between the producer and the consumer. As Kneafsey et al. (2013: 18) states “The foods involved are identified by, and traceable to a farmer. The number of intermediaries between farmer and consumer should be ‘minimal’ or ideally nil.”

Marsden et al. (2000) conceptualise SFSCs as creating different relationships between consumers and producers, emphasizing the role of the relationship itself in constructing value and meaning (rather than solely the type of product) (Bowen and Mutersbaugh, 2014). Scholars (Bowen and Mutersbaugh, 2014; Kneafsey et al., 2013; Marsden et al., 2000; Renting et al., 2003) argue that when SFSCs are compared to the global food system; local food relations are built on cooperation, interdependence, shared interests, and civic engagement as opposed to the profit motivations of global food supply chains where relations between producers and consumers are distant and anonymous (Lyson and Green, 1999).

Renting et al. (2003: 394, 398) “SFSCs [short food supply chains] on the one hand ‘short-circuit’ the long, anonymous supply chains characteristics of the industrial mode of food production. On the other hand, producer–consumer relations are ‘shortened’ and redefined by giving clear signals on the provenance and quality attributes of food and by constructing transparent chains in which products reach the consumer with a significant degree of value-laden information. Lastly, SFSCs are an important carrier for the ‘shortening’ of relations between food production and locality, thereby potentially enhancing a reembedding of farming towards more environmentally sustainable modes of production.”

Marsden et al. (2000: 424–425) “[...] resurgence of interest in ‘more natural’ or ‘more local’ foods [...] offers potential for shifting the production of food commodities out of their ‘industrial mode’ and to develop supply chains that can potentially ‘short-circuit’ the long, complex, and rationally organized industrial chains. [...] A key characteristic of short supply chains is their capacity to re-socialize or respatialize food, thereby allowing the consumer to make value-judgements about the relative desirability of foods [...]’Short’ supply chains seek to redefine the producer–consumer relation by giving clear signals as to the origin of the food product. [...] A common characteristic, however, is the emphasis upon the type of relationship between the producer and the consumer in these supply chains, and the role of this relationship in constructing value and meaning, rather than solely the type of product itself.”

Traditional SFSCs are often seen as farm-based, run by family businesses, using traditional and artisan production methods. On the other hand Neotraditional SFSCs consists of more complex collaborative networks, often off-farm (delivery schemes in particular, CSA), located in urban or peri-urban areas, these are built on strong social and ethical foundations and may be not-for-profit organisations. Traditional and neotraditional SFSCs can be equally innovative and dynamic chains and many individual cases combine characteristics of both of them in a ‘hybrid’ manner (Kneafsey et al., 2013).
SFSCs operate to short-circuit the long, anonymous chains of interchangeable actors (Renting et al., 2003), this has become the norm across food supply chains. They are becoming increasingly popular in rural development debates in their emphasis on re-connecting farmers with consumers. Marsden et al. (2000) have identified three distinct types of short food supply chain: 1) face-to-face (i.e. direct marketing and sales so consumers buy a product direct from the producer/processor, for example farmer’s market); 2) spatial proximity (products are produced and sold in the place of production, for example farm shop); 3) spatially extended (product and place laden information is translated to consumers outside the region). The key feature is that the number of intermediaries in SFSCs should be ‘minimal’ (e.g. Ilbery and Maye, 2006). Aubry and Kabir (2013) state that SSFCs induce forms of food relocation through the shortening of supply chains. SFSC are a way to conceptualise alternative supply chain metrics and values where agri-food networks are scaled-up while still transmitting desired product qualities and achieving the intended impacts (Clark and Inwood, in press).

Therefore, it could be argued a that short food supply chains are a means of scaling up alternative food networks, however, the idea and value of what it means to be local food production may be brought into question depending how the scale-up is handled.

Community supported Agriculture (CSA) is an example of SFSCs, (see separate section on CSA). There are many other types of routes to market based on-farm including farm shops, farm based hospitality e.g. tearooms, roadside sales (e.g. produce at the end of the farm drive), pick your own amongst others. In these cases the consumer travels to collect producer unlike other routes to market where farmers transport the goods to a place where they are sold to the consumer who may also have travelled e.g. taking produce to neighbouring farm that has a shop, farmers markets, local community shop, farm –based delivery schemes, food festivals and fairs, or farmers can sell to cooperative shops, specialist food shops, wholesalers, catering and supermarkets (Galli and Brunori, 2013; Kneafsey et al., 2013). Farmers could also sell direct to public institutions such as schools, hospitals, universities etc. These diversities and particularities have attracted a growing interest from academia and policy-makers due to the nature of these initiatives, as well as for the socio-economic, territorial and environmental scope (Galli and Brunori, 2013).

SFSCs have established in parallel to conventional food chains, playing a key role in the emerging food networks that are continuously arising as an alternative to the globalised agri-food model (Galli and Brunori, 2013). Aubry and Kebir (2013) suggest that SSFCs may in fact be a way of both maintaining, even developing local agricultures, particularly specialised activities such as market gardening and fruit farming, but also in their ability to supply cities. This could also be extended to customised food manufacturing.

**Key Questions**

If RDM creates SFSCs what will be the implications on the global supply chain?

SFSCs involving RDM could allow manufacturers to reach (inter)national markets

Could RDM offer a more viable option for producers to process and sell direct?
5.4 Examples of Short Food Supply Chains

Alternative food networks (AFNs) seek to localize food systems and to encourage contact between food producers and consumers, seeking to respatialise food systems perceived to have become “placeless” (Harris, 2010: 355). Goodman et al. (2012: 48) explore AFNs as: . . . “processes that integrate new complexes of production-consumption, with their distinctive material, cultural and moral economies – organic, local, fair trade, or animal-friendly foods, for example – into the practices and routines of daily life”. As Tregear (2011) points out that AFNs provide opportunity for economic viability for the actors involved, therefore farmers may benefit from involvement in AFNs through increased product margins (La Trobe, 2001; Pretty, 2001), opportunities for diversification and entrepreneurship (e.g. farm shop, tourism, food outlets (Morris and Buller, 2003; Bentley et al., 2003) or building of new skill sets (Brown and Miller, 2008; Higgens et al., 2008), whilst consumers may gain via more reasonably priced fresh, healthy food (La Trobe, 2001; Little et al., 2009). AFNs could provide outlets for increased use of RDM in the local food sector.

Multiple AFNs may coexist in the same territory and concur to re-define the food regime and the relationships among food production, distribution and consumption, and territory (Dansero and Puttilli, 2014: 626). Carson et al. (2015: 1-2) define a farmers’ market (FM) as a regular gathering of people in an established location for the purchase and sale of locally produced items, particularly food. Farmers’ markets were the way farmers marketed most food to consumers before the rise of the modern grocery store and large supermarket (Atkinson and Williams, 1994; Clancy, 1997). In many towns, farmers’ markets occurred at street side or sometimes in special buildings, usually on designated days at set times (Hinrichs, 2000: 298). Farmers markets are traditionally seen as an alternative route to market for many agricultural producers and some argue a traditional way of retailing food (Gurthries et al., 2006); as opposed to mainstream food outlets where convenience, low price and vast availability of food regardless of seasonality and distance have prevailed (Weatherell et al., 2003). Farmers’ markets are becoming a prominent way for direct marketing of local food and have become increasingly important in the alternative food networks movement in Canada, the US, the UK, Australia, and New Zealand (Beckie et al., 2012; Gillespie et al, 2007; Guthrie et al., 2006; Lawson et al., 2008; Smithers et al., 2008).
These are arguably seen as “good food choices” (Connell et al., 2008: 174). The increased returns from farmers’ markets can lead to enhanced economic opportunities (Griffin and Frongillo, 2003) and local economic development through the creation of creating vibrant, local, morally embedded economies (Alkon, 2008). Carson et al. (2015) suggest that through influencing customers purchasing behaviour can increase sellers incomes and further retain money in the local economy. This provides the opportunity to revive local food production, create new networks and preserve small-scale family farms (Adams, 2002; Oberholtzer and Grow, 2003; Svenfelt and Carlsson-Kanyama, 2010), enhancing their ability to survive (Gurthries et al., 2006). Gillespie et al. (2007) concluded that farmers markets are the “ keystones” for rebuilding local food systems, serving as business incubators that then “increase the density of local food networks and relations”.

Organic farming is often classified as an ‘alternative’ form of food provision with potential to contribute to the development of regional food networks Ilbery et al. (2016: 111). Organic agriculture is a defined and certified system of agricultural production that seeks to promote and enhance ecosystem health whilst minimising adverse effects on natural resources (Morison et al., 2005: 25). Organic food consumption is part of a way of life for regular organic food consumers (Vieira et al., 2013), resulting from an ideology, connected to a particular value system that affects consumption behaviour (Hughner et al., 2007). Organic products are considered value added products in agriculture and food markets, especially in a developing country context, where the availability is still low and restricted by consumers’ income (Vieira et al., 2013: 1456).

6. Business Models

Teece (2010: 172) defines the role of a business model as “the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit”. Whereas Afuah and Tucci (2001) states a business model can be viewed as a “system that is made up of components, linkages between components, and dynamics” (Afuah and Tucci, 2001: 4).
Osterwalder and Pigneur (2005, 2010) describe a business model as a series of elements: the value proposition (product/service offering, customer segments, customer relationships), activities, resources, partners, distribution channels (i.e. value creation and delivery) and cost structure, and revenue model (i.e. value capture). Building on these four interlocking elements Lee et al. (2015) propose that a business model is in fact the product of four submodels: 1) Value Model, 2) Stakeholder Model, 3) Process Model, and 4) Financial Model. So in essence, and in the spirit of Magretta (2002), the business model tells a logical story explaining who your stakeholders are (Stakeholder Model), what they value (Value Model), and how you'll make money (Financial Model) providing them that value (Process Model) (Lee et al., 2015).

Richardson (2008) based on a wide range of literature, proposes a consolidated view of the components of a business models as: the value proposition (i.e. the offer and the target customer segment), is typically concerned with the product and service offering to generate economic return, in a sustainable business this would be extended to cover other aspects such as environmental and social value alongside economic value (Boons and Lüdeke-Freund, 2013); the value creation and delivery system is fundamental to business models and can be achieved through new business opportunities through new markets or new revenue streams (Beltramello et al., 2013; Teece, 2010); and the value capture system which is about earning revenues from the provision of good, services or information to users and customers (Teece, 2010).

To summarise:

Osterwalder (2004) and Doganova and Eyquem-Renault (2009) distinguish the following elements of a generic business model concept:

1. Value proposition: what value is embedded in the product/service offered by the firm;
2. Supply chain: how are upstream relationships with suppliers structured and managed;
3. Customer interface: how are downstream relationships with customers structured and managed;
4. Financial model: costs and benefits from 1), 2) and 3) and their distribution across business model stakeholders.

Business models need to be development and maintained Achtenhagen et al. (2013) have identified three critical capabilities that underpin these processes: an orientation towards experimenting with and exploiting business opportunities (opportunity recognition); a balanced use of resources (resource allocation); and coherence between leadership, culture, and employee commitment (relationship development).

One of the key challenges is designing business models in such a way that enables the firm to capture economic value for itself through delivering social and environmental benefits (Schaltegger et al., 2012).
Although economic value is recognised as the principal value concern to business, it is only one of a number of possible value regimes. Taken together these ideas call for both a system and firm-level perspective on value creation (and the avoidance of value destruction) and the ability to think of value in a broader sense than is captured by conventional metrics. Business models that are developed for sustainability must take into account all contributing factors, for example a focus on eco-efficiency and eco-design (Bocken et al., 2014; Lovins et al., 1999) or products and services innovation (Amit and Zott, 2012; Johnson and Suskewicz, 2009) is important, but this is not sufficient to developing a systemic business model (Roome and Louche, 2015). This is important because while these approaches may help to reduce the use of energy or other resources in the short term they may also cause a rebound effect that increases the consumption of products and services by making them more affordable and accessible (Bocken et al., 2014). Therefore, in designing new business models there needs to be engagement with a wider set of actors (Clarke and Roome, 1995) and a broader value-network perspective (Bocken et al., 2014; Zott et al., 2011; Breuer and Lüdeke-Freund, 2014).

Key Question
How would RDM contribute to creating new sustainable business models?

7. Products in depth: Tomato Paste

7.1 Tomato Paste

In this section we provide a brief overview of tomato paste, the supply chain and key challenges for implementing RDM for this product. For a more detail account of the manufacturing process of tomato paste please see the LNN Food Feasibility Report and for water and energy use see the respective LNN Feasibility Reports. For more information on Food Technology see the LNN Food Technology Feasibility Report.

Tomato paste is used in pasta sauces, stews, casseroles and soups, or fish, meat and vegetables before grilling them amongst other food products. It can be used by consumers or it can be used by other food manufacturing organisations such as catering services, restaurants, pubs and so on. An example of the ingredients found in tomato paste Rehydrated Sun-dried Tomatoes (53%), Sunflower Seed Oil, Wine Vinegar, Sea Salt, Natural Flavourings, Garlic, Sugar, Cracked Black Pepper, Acidity Regulator: Citric Acid (Sacla, 2016). Another example is an organic ‘free from’ paste which contains - Water, Vegetable Oil, Sun Dried Tomatoes (28%), Red Wine Vinegar, Salt, Herbs (Zest, 2016). There are alternatives to tomato paste, including tomato sauce and tomato puree. Tomato sauce can be bought ready-made or it can be made from scratch in the home. These sauces can also be used in the same way as puree in paste sauces, stews, soups etc. (Delia online, 2016).
In the UK, we do produce tomatoes, and growers are represented by the British Tomato Growers Association (BTGA) representing over 90% of tomato growers (200 Ha). The largest UK tomato glasshouse covers 26.5 acres and is being extended to 44.5 acres (BTGA, 2016). The majority of tomatoes are grown in glasshouse. Nutritionally tomato growers are a good source of Vitamin A, C, E and carotenoids (beta-carotene and lycopene) and flavonoids as well as potassium and calcium (BTGA, 2016).

The growers in the UK use natural means for pest control and many have bees living in the glasshouses for pollination. British growers pioneered the use of natural pest control which are raised and supplied through specialist biological control companies, this means that pesticide and insecticides resistance is no longer a problem and workers are no longer exposed to chemicals. Growers are highly skilled in recognising pest attacks early and knowing the level of control required in order to maintain their glasshouse ecosystem. In terms of supply of tomatoes to British supermarkets most growers are within a 100 km of a supermarket or distribution centre (BTGA, 2016).

Alongside home production the UK also imports tomatoes the majority of which are from Holland, Spain, Canary Islands, Israel and North Africa (BTGA, 2016). Traditionally this was during the winter months but the season for imports is being increasingly extended through the rest of the year. Tomatoes from this supply chain can be seven days old before arriving on the supermarket shelf.

7.2 Tomato Paste Supply Chain

We have explored the supply chain for tomato paste based on production in other countries and also demonstrate the level of change that would be required if it were possible to introduce tomato paste production to the UK. There is not a definitive supply chain for tomato paste in the UK with the majority of the product being imported from Europe and the rest is from China. The supply chain consists of agricultural inputs, agriculture (tomato growing, outdoors owing to the type of tomato required for paste), manufacturing, distribution, retail and finally consumption. Tomato paste will also be part of other food supply chains as an ingredient, for example, pizza, ready-made pasta sauces amongst others.

Figure 5: Simplified Tomato Paste supply chain Source: LNN Interim Business Feasibility Report
A more detailed diagram of the tomato paste supply chain can be found in the appendix.

The EU accounts for one third of world output of processing tomatoes. Major production regions outside Europe include: California (US), Turkey, China and Thailand (Pritchard and Burch, 2003). California is historically the most important competitive threat for the European supply chain (Bunte and Roza, 2007: 25) although China and Turkey have been identified as emergent threats. The processing tomato supply chain is a large sector in the Mediterranean countries and to a lesser extent in new member economies such as Poland and Hungary. The European tomato processing industry processed more than 11,000,000 tonnes of raw tomatoes in 2004. Italy has a 53% share of European production followed by Spain (22%) and Portugal and Greece (10% each). The production of processing tomatoes still grows fast, notably in Spain and Italy. Processing tomatoes are produced on relatively large farms specialised in extensive production of arable crops and vegetables (Bunte and Roza, 2007: 9). The EU subsidised the tomato processing industry through a quota system provided the industry paid minimum prices to growers (Bunte and Roza, 2007). Italian and Spanish production is expanding.

Processing tomatoes are produced on relatively large farms specialised in extensive production of arable crops and vegetables (Bunte and Roza, 2007: 26). They will be highly mechanised and other crops grown alongside processing tomatoes will range from oil seeds, sugar beet, cereals, olives, grapes and other vegetables, all in the open field.

The average size of the tomato growing area in Northern Europe is larger (16-20 ha) than in the South (less than 8 ha) per farm holding. In the North, mechanisation is more widespread and producer organisations are more effective. This gives the North a comparative advantage over the South. Across Northern Europe there are only about twenty processing factories, whereas in the South there are more than 120 smaller factories (Bunte and Roza, 2007).

7.3 Key Challenges for RDM of Tomato Paste in the UK

This would require localising a European / Global product. This poses even greater challenges to those for relocalising a nationally manufactured product with the majority of the business activity taking place at a European or Global level. For further diagrams detailing the tomato paste supply chain and possible alternatives please see the Appendix. It may be feasible to relocalise the manufacturing of tomato paste to the UK as presented in the model below, but this would have implications for energy consumption and water given the nature of tomato processing as described in LNN Food Feasibility Report, and the costs of transporting tomatoes.
Reallocising the entire supply chain for tomato paste presents additional challenges would include – resources, suitability of crop to the UK climate, lack of infrastructure for manufacturing and capital investment costs for machinery and return on investment. Other things to consider in relation to tomato paste production in the UK include:

- People grow their own tomatoes and make their own paste, people buy imported tomatoes and make their own paste
- Instead of tomato paste look to tomato juice – more high end product
- Instead of tomato paste look at tomato puree
- Instead of tomato paste look at tomato soup (there is a scheme in Oxford that takes waste food and makes soup for homeless vulnerable people etc.)
- Import tomatoes and make paste locally – transport costs and energy implications
- For RDM how do you overcome minimum volumes to make investment in machinery work
- Land taken for factories which might be better put to use for other food stuffs at production level

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<td>Questions for RDM in relation to UK tomato paste production are based on the premise that a variety of tomato is available to be grown in the UK or the UK climate changes in such a way that it is suitable for the current variety Roma to be grown. How would RDM of tomato paste assist in the creation of a production system in the UK?</td>
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<td>RDM for tomato paste production would require building a supply chain and appropriate business models starting from resolving the agricultural constraint. How would new manufacturing sites be identified and what would be the affect on local resources?</td>
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<td>What would be the business case for tomato paste production in the UK and what would be the opportunity costs?</td>
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8 Products in depth 2: Bread

In this section we provide a brief overview of bread, the supply chain and key challenges for implementing RDM for this product. For a more detailed account of the manufacturing process of bread please see the LNN Food Feasibility Report and for water and energy use see the respective LNN Feasibility Report. If you would like further information on bread and food technology please see LNN Food Technology Feasibility Report.
8.1 Bread in the UK

Bread has long been a staple food in the UK. There are three basic types: white, brown and wholemeal; there are over 200 different varieties of bread made in the UK (Bakers Federation, 2016; Barling et al., 2009; Sharpe et al., 2008). The industry is worth £3.5 billion at retail sales value and employs over 20,000 people supplying the majority of the nation’s bread (Bakers Federation, 2016), over 80% of bread is sold through chain retailers (supermarkets, co-ops and convenience stores (Bakers Federation, 2016) of their own brands accounts for 36% of the market in wrapped bread (Mintel, 2005; FoB, 2006; Lepard, 2006). It is one of the largest sectors in the food industry (Sharpe et al., 2008). The basic ingredients for bread are flour, yeast, water, and salt; other ingredients can be added such as fortifiers, preservatives and stabilizers (Bakers Federation, 2016). Bread contains protein, complex carbohydrates, calcium, iron and the B vitamins – thiamin, niacin and a little riboflavin. Affordability of bread and food security issues interact with nutritional quality and healthy diet demands (Capacci et al., 2012). Three quarters of all the bread consumed in the UK is wrapped and sliced – for convenience, for keeping qualities and value for money (Bakers Federation, 2016).

The Flour Advisory Bureau

- 99% of households buy bread
- The equivalent of nearly 12 million loaves are sold each day
- Men eat bread more frequently than women: 44% of men eat bread twice a day compared with 25% of women
- White bread accounts for 76% of the bread sold in the UK
- Large bakeries, which produce wrapped and sliced bread, account for 80% of UK bread production
- In store bakeries produce about 17% of bread
- The remainder is made by high street bakeries
- Breadmaking flour accounts for just over 60% of UK flour production

Source: www.fabflour.co.uk

8.2 Bread Supply Chain

The bread supply chain involves both global and local phases, from input production to consumption. The production process involves wheat grinding and baking; both processing stages can occur in small scale (artisan) or large scale (industrial) plants. Apart from the difference in scale (amount of raw material and end-product handled and delivered) the artisan production systems normally differ from the industrial ones for technology and environmental impact (Espinoza-Orias et al., 2011; Andersson and Ohlsson, 1999; Mondal and Datta, 2008).

The predominant UK wheat-flour bread chain is highly intensive, industrial and, beyond the farm gate, very centralised. Over the years, as centralisation has taken hold of the industry small artisan bakeries present in every village, town and city were displaced by large scale centralised bakeries using high-tech methods to produce bread for the mass market with productivity the key driver for success (Decock and Capelle, 2005; Sharpe et al., 2008).
Most bread nowadays is the product of intensive cultivation and a concentrated and highly industrialized manufacturing and distribution system with 80% bread produced in bread factories otherwise known as plant bakeries (Barling et al., 2009: 264). The UK industrial bread sector is dominated by 11 companies, operating 51 factories (Sharpe et al., 2008). There is strong vertical integration between millers and bakers, with the two largest plant bakeries, Allied Bakeries and British Bakeries, owned by millers: Associated British Foods and Rank Hovis MacDougall respectively (Barling et al., 2009; Sharpe et al., 2008). The three largest manufacturers in the plant sector are Allied Bakeries (Kingsmill), Premier Foods (Hovis) and Warburtons. The largest of these is Warburtons, which has seen rapid expansion, moving from third to first place in the last 5 years. These three manufacturers account for almost ¾ of the bread market by value (Bakers Federation, 2016). 17% of bread is produced in an estimated 1,500 ‘in-store bakeries’ (ISBs) with all the large multiple retailers have one in all or most of their stores; these are located in retail outlets, such as supermarkets, and may either bake bread from scratch or use factory-made dough, supplied frozen, partly or fully baked, which is then given a final baking on-site called ‘bake off’ products (Bakers Federation, 2016; Barling et al., 2009). The expansion of in-store bakeries has been at the expense of the smaller artisan bakery.

Coexisting with this dominant chain (and dependent on it for some inputs and services) is a comparatively small ‘craft’ chain (or series of chains) characterized by smaller production units just 3% of bread by volume is made using traditional methods and baked in small ‘craft’ bakeries (Barling et al., 2009; Mintel, 2005; FAB, 2006; Fabflour, 2016; Federation of Bakers, 2016; FoB, 2006; Sharpe et al., 2008). Since their decline as a result of competition from plant and multiple retailers independent bakeries are just beginning to re-emerge using local produce, employing local people and boosting regional economic development (Sustain, 2016). These ‘craft’ bakeries are less mechanized and use more time-consuming, traditional manufacturing methods, using fewer inputs or additives to facilitate production (Barling et al., 2009; Sharpe et al., 2008). Another important avenue for bread sales is the food service sector with around 5%-10% being sold for consumption outside consumers home (Bakers Federation, 2016). In terms of bread exports these represent a small amount of the market but there is an increased demand from the European market for fresh sliced bread (mainly for sandwich making) and part-baked and frozen products (Bakers Federation, 2016). Less than 1% of bread consumed in the UK is imported (Mintel, 2005; FoB, 2006; Sharpe et al., 2008).

The wheat-to-bread supply chain is interesting because of the variety of different scenarios in terms of where production, manufacture and retail takes place across the global to local. The global chain is characterised by large multinational corporations and large wheat buying co-operatives whereas the local chain is smaller and focuses on small scale niche products where wheat is often milled, turned into bread and retailed within a particular locality. This has implications when assessing the sustainability performance of these food supply chains (Gava et al., 2014). The UK wheat-flour-bread chain has various systems in place for tracing goods or procedures. In some cases, these systems predate and exceed the ‘one step back, one step forward’ traceability required by EU law since 2005 (EC178/2002) (Barling et al., 2009; Sharpe et al., 2008). When wheat or flour is blended for storage
and transport it means that wheat/flour from various sources has been stored together making traceability back to farm difficult and costly (Barling et al., 2009; Sharpe et al., 2008), this has implications for large scale ‘local produce’ if traceability and standards are to be introduced.

Figure 6: Bread Supply Chain. Source: Adapted from Barling et al. (2009).

| Inputs | • Seeds, fertilisers, pesticides  
| Wheat production | • Use inputs plus natural resources - water, sun and soil to produce wheat  
| • UK Farmers and importers of higher protein wheat  
| Grain handler | • Buy and sell wheat, some offer storage facilities for farmers  
| • Dominated by large organisations and cooperatives  
| Manufacturing | • Milling dominated by large organisations and a few smaller millers  
| • Baking dominated by large organisations and a few smaller millers  
| Distribution | • National distribution companies  
| Retail | • Dominated by large organisations (supermarkets) also small independent food retail shops, farmers market and delivery (e.g. organic boxes)  
| • Food service sector including restaurants and other food outlets  
| Consumption | • Final consumer  

The supply chain for bread is made up of seven key stages: agricultural input, agriculture (cereal growing), milling, baking, distribution, retail, and consumption. Each stage is now discussed in more detail. Almost all bread is made from wheat flour, this creates interdependency between wheat and bread linked by a complex chain that must be both flexible and reliable (Barling et al., 2009; Sharpe et al., 2008).

Agricultural inputs

Agricultural inputs include: water, energy, machinery, seeds, fertiliser and pesticides. There are currently eight seed-breeding companies in the UK with wheat programmes, only one of which is UK-owned (Sharpe et al., 2008: 133). Both the pesticides and fertiliser markets are global and dominated by multinational corporations. According to Sharpe et al (2008) the agricultural inputs, wheat has a significant proportion of the market worth £1.07 billion. Almost all UK wheat is grown intensively. The average crop is treated with “three herbicides, three fungicides, two insecticides, one growth regulator, plus fertilizer” (Sharpe et al., 2008: 133).

Seed supply in the UK is highly regulated for quality control purposes, beyond the requirements of the EU, there are further tests for inclusion on the UK Recommended List, produced by the UK cereals advisory body, the Home Grown Cereals Association. Varieties are selected for the Recommended List by a committee of growers, millers, bakers and academics, who look for characteristics desired by growers and processors, such as yield or suitability for breadmaking.
(Sharpe et al., 2008). The Recommended List (95% of wheat grown in the UK) includes nine varieties judged suitable for milling into bread flour (BSPB, 2006; HGCA, 2006). Most seed varieties now in use are protected by Plant Breeders’ Rights, and royalties are payable, including (at a reduced rate) when the seed is saved by the farmer for use the following year (Farm Saved Seed) (AIC, 2006; BSPB, 2006; HGCA, 2006).

Cereal production

The UK is Europe’s third largest wheat producer, behind France and Germany, accounting (in 2005) for 12% of the EU total. Production can be adversely affected by weather. There are now 30,000 varieties of wheat, of which only a few are commercially grown in the UK. It can be planted in either autumn or spring, for harvest the following summer. It has been selectively bred to favour characteristics desired by growers (such as vigour, yield and straw strength) and increasingly by processors (such as protein quality). In experiments, biotechnology has been used to improve wheat protein quality, but there is currently no genetically modified (GM) wheat in commercial cultivation anywhere in the world (Barling et al., 2009; David, 1979; Curtis, 2002; Pena, 2002; Sharpe et al., 2008), with consumers currently wary of GM food and its ultimate impact on the environment it also begs the question of how GM food can be seen as sustainable.

Wheat is the UK’s most important cereal crop, with an average annual harvest of around 15 million tonnes. Around 28,000 UK farmers grow some wheat, with between 8,000 and 10,000 growing substantial quantities. (Sharpe et al., 2008: 131). Of the average annual wheat harvest of around 15 million tonnes, the largest portion (more than 40%) is used for animal feed. Around 33% is milled into flour, and around 15% exported, mainly to Spain and other southern European countries, a small proportion is reserved for use as seed, and some used by distillers (Sharpe et al., 2008: 131).

Wheat is a standardized commodity, traded on the global market, increasingly in a speculative manner, and forms an ingredient which requires double processing to be turned into bread, pasta or confectionery. Most wheat in the UK is traded through merchants buying from farmers and then selling to millers and other users. The process is often personal as parties know each other. Farmers can check current wheat spot and futures prices on web sites tracking commodity prices (e.g. www.farmersweekly.co.uk/Prices). Farmers do sell directly to mills but this process is the exception. The UK merchanting arable crops sector is worth £3 billion (AIC cited in Sharpe et al., 2008: 134).

The UK’s relative small area, unlike in geographically larger production areas such as Canada, USA, where grain may be pooled several times between farm and mill and the consequent proximity of farms and mills, has produced a system in which most wheat is stored on farm until needed, then delivered directly from farm to mill (AIC, 2006). Even for the UK the use of locally sourced wheat as opposed to imports from distant producers poses challenges and opportunities in reconnecting staple crop producers, commercial bakers and consumers (Hills et al., 2013).

Milling wheat sells for a higher price, but feed wheat tends to give higher yields. The UK farmer’s share of the price of a white sliced loaf was 15% in 2005, down from 23% in 1988 – a fall of 35% (Sharpe et al., 2008). Recent CAP reform, which partially decouples subsidy from production, may
affect UK wheat production. The area of the organic wheat crop is comparatively tiny, at 15,000 ha, with the result that more than half of the organic milling wheat is imported (Curtis, 2002; DEFRA, 2005a, 2007a). Around 85% of the wheat used for nonorganic UK bread is grown in the UK, but less than 50% of the wheat for organic bread is home-grown (Sharpe et al., 2008: 125).

Milling

The flour milling sector remains compact and highly efficient with a total annual turnover from all sources of approximately £1 billion (NABIM, 2015: 2). Owing to the strategic importance of the wheat-bread supply the UK government requires millers to file monthly returns detailing wheat stocks and flour production (DEFRA, 2007b; Sharpe et al., 2008: 131).

A few (mainly small) mills produce flour made from entirely British or local wheat and brand it as such, for example the Watermill, in Little Salkeld, whose packaging states that the flour is made from ‘Organically grown English wheat’ (Sharpe et al., 2008). There are also windmills producing flour. Many of the smaller millers have developed niches ranging from pre-packed flours and mixes to those for specific uses such as flours for speciality or ethnic breads (NABIM, 2015: 4). There are 25 members of the Traditional Cornmillers’ Guild (TCMG), whose members operate watermills or windmills. Their output is probably less than 1% of total flour production (TCMG, 2006). Some of these smaller mills also bake and sell the bread having a farm shop on site, these can also offer bread making courses tours of the mills and thus contribute to the tourism industry and the local economy. However, whilst these seem like an idealist, environmentally friendly option, an industrial baker pointed out that committing to produce bread from regional or British flour on a large scale could be a liability in years like 2004, when the UK wheat harvest was of such poor quality that extra milling wheat had to be imported (Sharpe et al., 2008: 140).

From the 1870s, stone milling was rapidly replaced by roller milling, which uses a series of rotating steel cylinders to break open the wheat grains (Sharpe et al., 2008: 130). Roller milling produces whiter flour and improves its shelf life because the oil-bearing germ and bran is removed (van der Kamp et al, 2014), and the bran and germ can be sold as animal feed, adding to the miller’s profits, however, it was believed that the germ and bran contained nutrients and in removing these the flour became impoverished (Burnett, 1968; David, 1979; Nabim, 2006a). This means that nutritional value of white bread (bread made of white flour) is lower than bread made with whole meal flour bread (Galli et al., 2014b; van der Kamp et al., 2014).

With the introduction of roller milling flour milling became a highly automated and efficient part of the food industry and is the link between farmers and other food processors. It has evolved a long way from the days of water-driven and wind-driven mills. Modern flour mills rely on a combination of skills and high technology to function as continuous-flow operations. Many of the larger mills operate for more than 360 days per year (NABIM, 2015: 3). In recent years the industry has seen an expansion in capacity with several new mills being built (NABIM, 2015: 3), yet there continues to be consolidation so that there are now 30 companies operating 50 mills. The four largest companies account for approximately 65% of UK flour production with a further ten companies producing significant quantities of flour.
A large mill may produce 60 or so different blends of flour, with minute variations to suit the requirements of individual customers (Nabim, 2006a; Nabim, 2006b; NABIM, 2015). Most of the flour produced is sold in bulk to the larger bakers and food manufacturers. Smaller amounts go to craft and in-store bakeries; some is pre-packed and retailed direct to consumers. The other main products from flour milling are bran for human consumption and ‘wheat feed’ used in the manufacture of livestock feeds (NABIM, 2015: 5).

For bread flour there are nutrients that must be added are thiamine (vitamin B1), nicotinic acid (vitamin B3), iron and calcium carbonate, and these ‘statutory additives’ need not be listed on product labels (Sharpe et al., 2008: 135). Whitley (2006: 23) lists 19 vitamins and minerals which are lost to varying degrees when flour is milled to a 70% extraction rate. The UK government is currently considering adding another nutrient, folate, to the list of statutory additives, to reduce the incidence of congenital neural tube defects. The additives are usually delivered to millers premixed, and dosed into the flour at the end of the milling process (David, 1979; SI 1998:141; FAB, 2006; FoB, 2006; FSA, 2006; Sharpe et al., 2008; Whitley, 2006).

### National Association of British and Irish Millers

- Approximately 5.1 million tonnes of wheat was milled in 2011 by mills in the UK
- UK mills produced approximately 4 million tonnes of flour in 2011
- The breakdown of UK milled flour in 2010/11 was: 47.6% white bread making, 6.2% wholemeal breadmaking and 2% brown breadmaking, with the remainder being flour for cakes, biscuits etc.

Source: www.nabim.org.uk

**Baking**

The breadmaking process consists of three stages: mixing, fermentation and baking. During baking, starch undergoes a process of gelatinisation, which creates a fraction of resistant starch, not digestable. During the three stages, depending on the conditions of the process (pH, temperature, time of heating), there is a loss of vitamins. Nutritional value can change consistently whether yeast or sourdough are used (Galli et al., 2014a, Galli et al., 2014b). For further information and diagrams on bread making and bread supply chain see the Appendix.

The difference between yeast and sourdough is microbial composition, as yeast is composed only of saccharomycetes and sourdough is also composed of lactobacillus. “Sourdough fermentation can influence the nutritional quality by decreasing or increasing levels of compounds, and enhancing or retarding the bioavailability of nutrients” (Poutanen et al., 2009; Katina et al., 2005).

There are two main methods of making bread mechanically: the Bulk Fermentation Process (BFP) and the Chorleywood Bread Process (CBP) (Barling et al., 2009; Sharpe et al., 2008).

The BFP, which is used in smaller, ‘craft’ bakeries, broadly follows traditional methods, in which ingredients are mixed together to form a dough and then left to ferment for anything from an hour to overnight. During this time, the dough becomes elastic, the time taken depending on the amount...
of yeast used and the temperature. Bread made by this method typically consists of flour, yeast, salt, water and (sometimes) fat (Fabflour, 2016; FoB, 2006; Dove’s Farm, 2006a; Sharpe et al., 2008).

The Chorleywood Bread Process is used in plant bakeries and accounts for more than 80% of UK bread production (FoB, 2016; FabFlour, 2016). Introduced in 1961, having been developed by the Flour Milling and Baking Research Association (now part of the Campden and Chorleywood Food Research Association) at Chorleywood, in southern England, it fundamentally transformed the method of bread-making (Sharpe et al., 2008). Originally devised as an aid to small-scale producers, the CBP was widely adopted in plant bakeries, because it enabled large scale production of loaves of uniform quality, and reduced costs (Fabflour, 2016; Sharpe et al., 2008). The system has been exported around the world, and has recently been adapted to allow the production of different types of bread, including croissants, French sticks and naan bread (Barling et al., 2009; Sharpe et al., 2008). The main difference is that is replaces the slow mixing and kneading process of traditional breadmaking with a much faster mix and a reduced first proving time (Fabflour, 2016). Bread made by this method typically includes higher proportions of yeast, salt and water than are likely to be found in traditionally made bread (Sharpe et al., 2008). After that, the dough is treated in the same way, being moulded and proved for about an hour before baking. This reduces the amount of time required to bake a loaf by about an hour compared with traditional bakeries. It also means that flour with less protein (i.e. gluten) can be used, helping the mills to use more British grown wheat, which is naturally lower in protein than Canadian or US wheat which had been used previously (Fabflour, 2016).

The National Association of Master Bakers

- There are about 4,500 small craft bakeries in the UK, each employing typically between 5 and 25 people
- 350 medium sized bakeries - employing between 25 and 100 people
- 150 large plant bakeries - employing more than 100 people

Source: www.masterbakers.co.uk

A separate sector now exists to supply bakers with their ingredients, including yeast, salt, fats, improvers, emulsifiers, preservatives, relaxants, raising agents and dough conditioners (Barling et al., Sharpe et al., 2008). The Association of Bakery Ingredient Manufacturers (ABIM) has 15 member companies, representing a turnover of £500 million and employing 3,000 people (Puratos, 2005; ABIM, 2006 cited Sharpe et al., 2008: 137).

Products

Packaged sliced bread bought in most large retail outlets. White bread being the most popular. Dewettinck et al. (2008) identify trends in bread industry: fresh-baked and artisan products are still very popular but mass-produced specialty breads are strong competitors. Breads containing whole grain, multi-grain or other functional ingredients are becoming more important (see also Van der
Kamp et al., 2014; Sumanac et al., 2013). The emergence of life stage nutrition (i.e. products formulated to reflect the nutritional requirements of particular consumer subsets, e.g. children or women) is expected to be the path of various initiatives and innovations, including bakery products (Dewettinck et al., 2008; Young, 2001).

Ready-to-bake frozen products offer ‘zero prefermentation’ process exists in many different formats and varies widely between 0% prefermentation and 30%, these products offer the marketplace ready-to-bake frozen products removing the need for the proofbox. This means low transport costs with no thawing but requires a longer bake time and steam in the oven (Decock and Capelle, 2005). Part-baked products refers to fully baked products without a crust with a second bake (in shop) to provide the crust. This technology is mainly being used for crusty baked goods such as baguettes (Decock and Capelle, 2005). This offered outlets on site baking without the need for specialised, skilled staff (Decock and Capelle, 2005). This process has higher transport costs and the final product has a shorter shelf life (Decock and Capelle, 2005). Frozen dough and part-baked allow to sell fresh bakery all day (Inoue and Bushuk, 1992). See diagram below depicting dough manufacture. Retail outlets for bread range from supermarkets, convenience stores, bakers, independent shops, restaurants, coffee shops, pubs, farmers markets, farm shops to name a few.

The locality of the bread supply chain and the different stages of the simplified supply chain, as well as figures detailing local production, artisan production, dough manufacture and the current mass produced bread can be found in the Appendix.

8.3 Key Challenges for RDM of Bread in the UK

The key challenges for RDM for bread within the UK based on the current supply chain and changing the supply chain are:

- Wheat processing, essentially milling (and associated quality control aspects) has become centralised.
- Bakeries also highly centralized
- Re-localisation of bread making would also require re-localising wheat production in some regions. This would have implications on land use in these areas.
- Can existing small scale millers and bakers up-scale to deliver more output to the local area

Key Question

What role could RDM play in further technological advancement for the milling and baking sector?

Could RDM change the CBP process to make it economically viable for small bakers?

Could RDM create customised bread factories for the local market allowing consumers to select grains and seeds for specialist multi-grain breads and so on?
The empirical analysis was carried out via multiple data collection methods (Huberman and Miles, 2002) and multiple level of analysis (Yin, 2003). We chose to utilise questionnaires as well as secondary data.

Primary data was collected via a firm survey aimed at shedding light on the extent to which delocalising food processing is currently occurring in England and Oxfordshire in particular. Survey data was collected using an email survey mailout followed by face-to-face surveys. 250 businesses were contacted via email using individual business details and gatekeeper networks. This yielded 3 responses. The face-to-face approach 344 individuals were approached and this yielded in total 96 completed questionnaires with 20 respondents being located in Oxfordshire.

As Yin (2003) also suggests surveys are useful for providing data to explore issues that are new and relatively unexplored, this being particularly important given that RDM is a relatively new concept and this is the first major study exploring RDM in food manufacturing, in this case how do you shorten the food supply chain and how does RDM play a role in this process or relocation. Our approach is consistent with other research on local food systems and short food supply chains where data has been collected via the use of questionnaires (Mikkola, 2008; Alonso and O’Neill, 2011, Broderick et al., 2011, Connelly et al., 2011, Maxey et al., 2011).

**Current Trends**

Secondary qualitative data was also collected through a search for relevant local food articles in a number of agricultural publications – Farmers Guardian Newspaper, British Farmer and Grower Magazine and The Farmer. This was then extended to an internet based search for specific types of business enterprise in Oxfordshire and Cambridgeshire. We conducted an internet search using the following search terms in order to utilise secondary data from company websites.

<table>
<thead>
<tr>
<th>Organic Boxes</th>
<th>Bakery</th>
<th>Independent shops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food outlets/shops</td>
<td>Restaurants</td>
<td>Traditional Millers</td>
</tr>
<tr>
<td>Pick your own</td>
<td>Coffee Shops</td>
<td>Artisan bakers</td>
</tr>
<tr>
<td>Farmers markets</td>
<td>Cereals Farmers</td>
<td>Flour shops</td>
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<tr>
<td>Farm shop</td>
<td>Supermarket</td>
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</tbody>
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Secondary data sources were analysed for specific themes. We were interested in the type of business activity, details of suppliers, employees and buyer if available, current business operations products and market channels. We then looked for information relating to key challenges and opportunities in relation to buying from and supplying the local area and any future business
development e.g. growing the business, new products and so on. From this we generated data source tables see table 2 in the Appendix.

10 Case Study locale A: New Development

For a full detailed account on Northstowe we refer the reader to the LNN Food Feasibility Study Report.

Northstowe has been in development and planning for around 15 years and will create up to 10,000 new homes. Northstowe will be located on the site of RAF Oakington and green field sites where developers optioned much of the land in Longstanton parish and to a lesser extent land in the parish of Oakington and Westwick (LDHS, 2016). Northstowe will be located five miles northwest of the city of Cambridge between the villages of Oakington and Longstanton. In terms of food production and food manufacturing a considerable amount of productive farm land is being consumed by this proposed development and will have an effect on the local food supply chain as well as the reduction in food production once the sites have been developed. The proposals were met with resistance from local residents and it was seen as a mechanism that would ultimately destroy local communities (LDHS, 2016). The Northstowe development will be on land that is currently being used for agriculture and horticulture (LDHS, 2016).

East Anglia has historically always been the main food producing region of England and this raises serious questions over the importance of the UK producing food and the lack of commitment to the local food agenda by planners. Planners of the project suggest that the development will lead to the creation of 11,000 jobs to the local community and the wider Greater Cambridge area, these jobs will encompass education, healthcare and retail (Northstowe, 2016a). There is no mention about manufacturing jobs or food manufacturing jobs other than there will also be office, research and development and light industrial employment opportunities. The town centre has been designed to include a mix of retail, food and drink (restaurants, pubs food outlets), health and community related opportunities. The Northstowe planners also claim that an extra 12,000 construction jobs and 6,500 from regional supply chain effects will be created through the development. They also state that these will result in employment gains through commercial development in the region of £700 million to the UK economy (Northstowe, 2016a). The project also includes the Cambridge Compass Enterprise Zone which boasts offering reduced business rates but doesn’t detail what these are and the businesses that will be supported. In terms of small firm start-up and entrepreneurially activity there is little mention other than the enterprise zone. Manufacturing is also excluded from receiving much attention.

With respect to sustainability, Northstowe will include open spaces and buildings designed to enhance biodiversity it also shows in the planning details that green corridors will be created to link Northstowe to the wider landscape. However, very little is mentioned in terms of space for food production other than a few allotments, nor do they mention how much productive farmland will be consumed by the development which raises the potential issues of flooding and loss of the environmental landscape, the planners do detail a sustainable drainage system to manage surface
water runoff (Northstowe, 2016b). Whilst detailing the aims for a low carbon community there is little attention paid to how it will create low carbon businesses.

In 2012 outline consent was given to Gallagher to progress with the first phase of 1500 homes, a primary school, road improvements and a local centre. The primary school started on site in 2015 and the first homes are expected in 2016/17 (Northstowe, 2016). In the 2015 United Kingdom budget on 18 March 2015, George Osborne confirmed the Government’s intent to create a joint venture with a private sector partner to lead development on the Government-owned part of the town location. Three-quarters of the homes started by 2020 will be constructed under a direct contract with the public sector (HM Treasury, 2015). 2015 saw outline consent agreed in principle to build a further 3,500 homes, a town centre, 3 more schools including a secondary school education campus and a link road to the A14, plus a road linking the town to the Guided Busway. The homes in phase two cannot be occupied until a major A14 upgrade is completed which starts in 2016 and finishes in 2020 (Northstowe, 2016). April 2016, Bloor Homes was named as the first housebuilder for the site with 92 new homes planned in a range of types and sizes up to five bedrooms (Cambridge news, 2016).

The closest comparison we could find in Cambridgeshire which had already begun construction was Cambourne.

**Cambourne**

Cambourne was part of Government plans to build thousands of new homes in the south-east of England, a new settlement on 400 ha of former agricultural land, nine miles west of Cambridge was considered in the late 1980s (South Cambridgeshire District Council, 2016).

Work began on building new homes during June 1998 and has continued with work on Upper Cambourne still in progress with 3,300 homes and later a further 950 homes were granted planning permission in 2011. In 2011 Cambourne had a population of 8186 according to the 2011 census. What is interesting is that as part of the initial development the only food outlet provided was a supermarket with a petrol station, pub, veterinary practice and health care facilities including doctors and dentist (South Cambridgeshire District Council, 2016). There were provisions for allotments but not consideration at this time for independent shops, manufacturing or other business operations. Later on in the development the high street in Cambourne was typical of a small town with fast food outlet, coffee shop, building society, pharmacy, bookmaker and estate agents (Cambourne Info, 2016). In 2012 plans were presented for the future development of the high street with proposals for 1) some more larger retail units next to the supermarket, 2) row of smaller shops and 3) some medium sized stores. Cambourne also has a small business park providing offices but throughout the whole planning process the provision of facilities for food and manufacturing facilities do not appear to be on the developers agenda. This echoes the process described above for Northstowe.

We suggest that there is a standard process and procedures in place for new developments in terms of facilities provided and one development appears to follow what has happened, or will happen in new town developments. From these findings we suggest that there are points for planners to consider for new settlements:
1) Planning should consider how to engage in diverse enterprise provisions to ensure a mix of independent and chain-based retail, and food service enterprises. Consideration also needs to be given to the provision of markets such as farmers markets, produce markets and makers markets.

2) There needs to be an active local food agenda to encourage entrepreneurs to engage in redistributed manufacturing in the food sector.

3) Provision of facilities to enable community-based organisations to operate.

4) Small(er) business and start-up enterprises may require assistance, for example favourable business rates, special starter units with multiple tenants in one unit.

5) Food specific issues stem from the use of green field sites and resources being removed from food production.

6) Business parks seems to focus on third sector or office space rather than manufacturing space (Cambourne business park is an example of this).

Cambridgeshire
Looking at Cambridgeshire and exploring data available it is clear that there are provisions for start-ups and business growth but these focus on specific technology-based enterprises. In total Greater Cambridge Greater Peterborough (GCGP) bid for £119 million of funding for 2015/16, with an overall funding bid of £500 million over the next six years. The bid seeks to create 70,000 new jobs and 50,000 new homes, leading to a £2.8 billion uplift in GVA across the LEP area (GCGP Strategic Economic Plan, 2016). In this plan the GCGP states that:

Our bold plan to drive further growth:
- Puts GCGP at the forefront of life and bio-science applied research, feeding an international pipeline
- Expands our cluster of global expertise and business growth in the Internet of Things and Digital industries
- Maximises our Agri-Tech strengths in Production, Research, Advanced Manufacturing and Agriculture
- Makes us the location of choice to commercialise our world-leading research base
- Delivers the skilled workforce, housing, connectivity, and infrastructure capacity to feed economic growth
- Develops the largest brownfield Enterprise Zone in southern England
(GCGP Strategic Economic Plan, 2016: 1).

What is promising about this plan is their vision on Agri-tech strengths and linking this to Advanced Manufacturing. However their ambition to deliver this is a little late for Cambourne and Northstowe. The report suggests that innovation and business hubs will be created, science park incubator units and business units specifically aimed at small start-ups. The primary aim is to develop businesses that grow.

For Cambridgeshire as a whole the agri-food sector is an important employer with the Fens containing about 50% of the grade one agricultural land in England which produces 24% of all potatoes grown in the UK (Cambridge Business, 2013). In the East of England the agri-food sector is a major employer with a labour force in excess of 375,000 people, of whom 122,000 are employed in
agriculture, food processing and ancillary businesses, 115,000 in food retail and 139,000 in the catering sector (DEFRA 2009). The food chain thus represents 1 in 7 jobs in the region’s economy. Within some Greater Cambridge districts the concentration of employment is very high, for example Fenland has 37 times the national proportion of employment in the processing and preserving of fruit and vegetables. Given the importance of the agri-food sector it seems strange that provisions for the sector are not made in new development. This is also strengthened by suggestions that the sector is having difficulties in attracting a skilled workforce as the sector is not seen as a career by many people and not well promoted as a career. This could be attributed to perceptions of low formal qualification requirements and levels of progression but there is a need for skilled scientists, technologists and managers to work in complex business operations.

Direct agricultural employment had been declining for many years, 2008 saw the first recent significant rise (+3%) in employment due to increased production. Whilst there remains scope for some further mechanisation on some farms, many larger (in particular) arable businesses, feel that the future workforce will not fall as we are approaching the limit of machinery size which can be used (Cambridge business, 2013). Therefore, there are opportunities to maintain local employment levels and also if production increases creating further jobs. For the wider agri-food sector businesses are concerned about their future workforce and have become reliant on migrant workers, this may become a particular issue post-Brexit, however, to the contrary it may also create opportunities for local employment.

Labour sourcing issues are not confined to Cambridgeshire and the decline in agricultural students and food related courses has been consistent over 20 years with only a small improvement over the last couple of years. LANTRA (2006) highlight the need to increase recruitment with Government reports suggesting that the sector needs to improve technology transfer, knowledge transfer, increase skills as well as science and innovation levels. However, this presents a challenge as many agricultural and food related research facilities have been closed and research funding for these areas have historically been cut.

In highlight these issue above, there is a question as to how RDM could change the current labour market place and whether there is sufficient labour at present to be able to cope with supporting RDM activities given the current difficulties in finding skilled labour. Local Economic Partnership may have a role to play in providing support to organisations offering the necessary training or assist with funding to create course specific to RDM requirements.

The population of Cambridgeshire is forecast to grow by approximately 25% between 2013 and 2036 (Cambridgeshire Research Group’s 2013-Based Population Forecasts), primarily driven by new developments such as Northstowe. Cambridgeshire experienced a 2.3% increase in employment during 2014 (Source: ONS). The East of England forecasting model suggests that total employment in terms of number of jobs will rise by 22% in Cambridgeshire between 2011 and 2031. The major areas of growth are predicted in engineering, manufacturing, Research and Development) R&D, science and technology, creative industries, bio-chemicals, agriculture, processing and tourism.
11 Case Study locale B: Retrofit

For a full detailed account on Oxford we refer the reader to the LNN Food Feasibility Study Report. The county of Oxfordshire (abbreviated Oxon) is located in the South East of England bordering on Berkshire (to the south), Buckinghamshire (to the east), Gloucestershire (to the west), Northamptonshire (to the north/north-east), Warwickshire (to the north/north-west), and Wiltshire (to the south-west), for further information see Oxfordshire County Council website.

The city of Oxford has a population of 155,000 (Oxfordshire County Council, 2016). Other significant settlements include Abingdon, Banbury, Bicester, Kidlington, Henley-on-Thames, and Witney and smaller settlements such as Chipping Norton, Chinnor, and Woodstock. There are also many other smaller populations such as Burford and villages and hamlets distributed across the county. Oxfordshire has a total population of 654,800 (Oxfordshire County Council, 2016). The importance of agriculture as previously discussed in the literature review has declined rapidly during the 20th century with falling profit margins and falling numbers of people employed in agriculture, this has been noticable in Oxfordshire and across the UK alike. Despite these changes Oxfordshire remains an agricultural county by land use although regional gross value added for the sector has declined over the years (Oxfordshire County Council, 2016). In Oxfordshire, a total of 196,897 hectares belongs to farmland, primarily for cereal crops (around ⅔ of the land), with fewer farms and those that are left increasing in size, a trend seen across all of England (Jacobs, 2016). Agriculture, forestry, and fishery sector contributed £67 million of the £14.2 billion Gross Value Added (GVA) in Oxfordshire in 2009, and employed just over 4,000 people, including many casual workers. The Business Register and Employment Survey shows fewer than 200 employees in the agriculture and forestry sector in Oxfordshire in 2010, down from just over 300 in 2009. The more detailed agricultural census (which includes all types of workers including casual) puts the employment in Agriculture in Oxfordshire at 4,100 (2010). Between 1990 and 2009 this agricultural labour force in Oxfordshire declined by 18%, similar to the regional and national trends. Agriculture may not employ many but it occupies the largest proportion of land in the county and so has a significant economic, environmental and social impact. The supply chain is also significant and farmers are actively taking a lead in renewable energy generation (Oxfordshire Economic Assessment, 2012b: 18).

89% of businesses in Oxfordshire are micro firms employing 9 or less people (Oxfordshire Economic Assessment, 2012b). Oxfordshire Economic Assessment (2012a) The Oxfordshire Skills Needs
Analysis looked at the take up of courses to the number of jobs in related sectors and identified gaps and areas for concern in two key areas in particular: i) low take up of training in engineering and manufacturing given the importance of this sector to the economy and Oxfordshire’s growth prospects; ii) anticipated gap in training for the care services given the projected growth of this sector in the future. There is a need to understand ‘employability’ skills required by employers and increase such skills among the workforce, particularly among young people. This would be particularly important given that RDM would require re-skilling of the workforce. Oxfordshire is well endowed with science parks and incubator space to develop and commercialise cutting edge technologies. There are more than 100 science parks 300 business incubators in the UK (UKTI, 2011). This could prove useful for developing RDM in the area.

1% of the food consumed is locally sourced – mainly from sources such as farmers markets, box schemes, allotments, and direct sale to restaurant. If only vegetables are considered, then the proportion jumps up to 3.5% sourced locally (Oxford food printing, 2016), and the rest is split between UK (51%), EU (33%), and rest of world (15%) (Food Printing Oxford, 2016). The main deficits are in dairy, fruit and vegetables (Food Printing Oxford, 2016).

Tourism is also important for Oxford and the county with links between tourism and local food production important. Oxford’s draw as a tourist destination – as the 7th most visited city in the UK by overseas visitors, attracting 9.5 million domestic and foreign visitors every year – generates £770 million of income for local Oxford businesses (Jacobs, 2016), this offers potential for food businesses as these visitors need feeding. Other important industries for the country include publishing, education and motorsport as well as increasing numbers of biotechnology firms (Oxfordshire Country Council, 2016).

An example of a large town in Oxfordshire is Banbury.

**Banbury**
Is a large market town and has a population of 46,853 (Office for National Statistics, 2011). Banbury is a significant commercial and retail centre for the surrounding area, which is predominantly rural. Banbury's main industries are car components, electrical goods, plastics, food processing, and printing. Banbury is home to the world's largest coffee-processing facility (Jacobs Douwe Egberts), built in 1964. It holds monthly farmers markets and also a weekly market. There is a mix of independent and high street chain shops as well as supermarkets and large convenience stores.

There are also many small towns, villages and hamlets in Oxfordshire. The Oxfordshire Cotswolds have some of the most picturesque towns and villages in England including the historic market towns of Burford, Witney, Woodstock, Charlbury and Chipping Norton.

**Thame**
A traditional English market town. The town’s boat-shaped marketplace helped farmers to showcase their local produce for 800 years with a market still held every Tuesdays, with local produce available. There is also a monthly farmers market and regular livestock market as well as September’s annual Food Festival. Local food is big in Thame, award winning food and independent shops. Local food from nearby farmers often appears on pub, tea room and restaurant menus.
Thame is also a popular tourist attraction providing additional markets for local produce.

**Burford**

Burford’s High Street is famous. This town is one of the most popular tourist destinations in the Oxfordshire Cotswolds and has an ample supply of quaint shops, inns, restaurants and tea shops. The tourist industry provides additional markets for independent shops and opportunity for local produce. There is also a community owned village shop.

### Key Question

What would the different scales of RDM look like for a village, a town, a city?

Could RDM be a community based enterprise?

### 12 Findings

For an alternative perspective on food manufacturing findings in Oxford see the LNN Food Feasibility Report.

This section demonstrates what is currently happening in Oxford and Oxfordshire in terms of local food processing. We focus this section on bread. For most of Oxford and Oxfordshire bread can be purchased in a number of ways and will have been manufactured either by centralised baking plants (e.g. sliced loaf purchased in supermarkets or online supermarket, small convenience store etc.), farmers markets, independent shop, local bakery, farm shop, or online (e.g. artisan bread). Farmers markets are held regularly in Oxford and across the county. The area also benefits from a travelling bi-weekly vegan which sells local organic produce. There are also a few pick you own farms, with one farm providing a farm shop within walking distance of Oxford town centre. In terms of local produce and local supply chains it appears that fresh produce is more readily available than manufactured goods. In terms of manufactured goods processed meat, pies and dairy products are the main products available at farmers markets with cakes, pastries and bread stalls attending some of the markets.

In terms of bakeries in Oxford and Oxfordshire bread is often sold with other baked products such as cakes, pies, pastries and so on. Within these it is very difficult to ascertain whether raw ingredients are local and whether they make the dough on site unless this is advertises as a unique selling point in the shop, which some outlets do.

### Case 1

The Old Farmhouse Bakery produces artisan British breads made in the time-honoured way - slowly - to get those deep flavours. Crusty White Oval Top loaves, wonderful Malted Brown with extra linseed, Cheese and fresh Onion Plaits, yummy Lardy Cakes, dark smooth Wholemeal (made with organic flour) that has a wonderful flavour whether plain or with sunflower seeds, wonderful light Leaven bread with no yeast - and our delicious 100% Rye packed with sunflower seeds and pumpkin seeds.
Bread Supply Chain Oxfordshire

A farmer-owned organic grain buyer located in the region sells grain to millers to make flour which is then sold to food manufacturers for use as a raw ingredient in different products. These food manufacturers can be nationally based rather than within Oxfordshire. It is difficult to track where all locally grown wheat goes, as is the final destination is not always for flour. For the conventional wheat sold this will tend to be sold to one of the large scale millers in the UK and then flour will be sold to centralised bakery plants across the UK for national distribution. There are local millers who buy local organic grain and mix this with imported grain (this is done as they require certain protein contents in the wheat) who then either bake bread on-site or sell the flour to the local market. These millers also sell their produce online and can therefore reach the national market but they are selling a niche product.

The case below details a local flour mill.

**Case 2**

One of the smallest commercial flour mills left making flour by roller milling wheat. The mill produces flour for the Craft Baker looking for consistent, strong flour. The mill uses wheat that has been grown locally, buying and collecting the wheat from local farms who produce a high quality product.

Supermarkets in the county also have in-store bakeries where part-baked bread or dough which is then ‘baked off’ in store, this dough is likely to have been sourced from centralised manufacturers rather than local ones.

Other outlets include local bakery shops: an example of an artisan baker supplying a number of outlets across Oxfordshire is the Natural Bread Company. In conducting internet searches we found seven different independent bakeries across Oxfordshire.

**Case 3**

Natural Bread is an independent Oxford based artisan bakery making breads, pastries and cakes by hand, from scratch, and fresh every day in their Botley bakery without using any additives. They specialise in natural sourdough breads made using locally milled flour, sourdough starter, water, salt and use traditional natural leaven rather than yeast. This slow fermentation technique lets the sourdough starter do its job over 48 hours giving the bread texture and depth of flavour. The business also offers wholesale supplying breads, pastries and cakes to restaurants, cafés and other stockists across Oxfordshire. There are also three bakery shops offering a selection of breads, cakes and pastries located in Oxford City, Woodstock and Eynsham. Having started from selling breads at Appleton Farmers Market, they continue to sell bread and pastries at several of the local Oxford weekend Farmers’ Markets. Our shops source produce as locally as possible.

Case complied from: www.naturalbread.co.uk assessed 300616
In terms of the smaller established settlements the small village of Burford has its own bakery which uses local produce whenever possible.

**Case 4**

Huffkins is a family business with a bakery, shop and cafe producing a huge range of freshly made produce. The heritage stretches back to 1890 when it was established in Burford by Mr Titcomb. The breads and cakes were originally delivered by donkey and cart. Whilst modernising over the years - but still baking everything by hand. Huffkins in Burford is the original institution that started the business back in 1890; still housing the old bake house in the back, the business operates across two adjacent buildings, both of which are grade II listed. Stocking a full selection of freshly made cakes made by hand in the craft bakery and delivered fresh every morning, the shop and cafe offer freshly prepared hot and cold dishes, breakfasts and afternoon teas. The bakers work through the night to create everything from the bread for our sandwiches to the fresh cream cakes in our shops. The business believes very firmly in sourcing ingredients locally wherever possible. So when, for instance, you ask for a sausage bap at Huffkins you can expect Cotswold pork sausages made by WJ Castles of Burford to our own traditional recipe in a handmade bap from our bakery made with FWP Matthew’s flour from Shipton under Wychwood, served with Huffkins spicy tomato ketchup made at our own kitchen in Stow-on-the-Wold. The business believes in real Cotswold food, even the teas, are bought directly from the finest small producers around the world are blended with local ingredients including Cotswold fruits and lavender from Snowshill near Broadway.

Case complied from: http://www.huffkins.com/huffkins-about-family-business

**Food Outlets across Oxfordshire**

For food in general Oxfordshire benefits from having annual food festivals e.g. Witney, Blenheim Palace, Wilderness Festival, and Jamie Olivers The Big Feastival held on Alex James’ farm in Kingham. This celebrity and famous chef endorsed events also help promote local food and raise the profile of local food. Farm shops sell seasonal local produce and often have cafes restaurants selling food grown and prepared on-site. Other manufactured products include smoked food, cheese, vinegars, icecream and fudges. There are also organic farm shops selling on-site produce as well as produce from neighbouring farms. The main products for farm shops are meat, eggs, dairy, fruit and vegetables. Across Oxfordshire there are a few pick you own farms. Charlbury, Witney, Chipping Norton and Woodstock have regular farmers markets as do Banbury Oxford and Bicester to name a few. Across Oxfordshire restaurants, (Gastro) pubs, cafes and tea rooms sell locally sourced produce. For example Old Swan and Minster Mill in Old Minster, Biztro in Bampton, Kings Head Inn in Bledington, The Maytime Inn in Asthall, Duke of Marlborough in Woodstock to name a few, all use locally sourced seasonal produce in their meals.

**Fruit and Vegetable Boxes Oxfordshire**

There appears to be good access to fruit and vegetable box schemes within Oxfordshire either from locally sourced produce or produce from neighbouring counties. Some schemes also offer other
products such as bread, dairy products and meat as well as other processed products such as chutneys.

**Table 3 Fruit and Vegetable box schemes in Oxfordshire**

<table>
<thead>
<tr>
<th>Fruit and Vegetable Box Schemes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business 1 Organic 15 mile radius of Chipping Norton</td>
</tr>
<tr>
<td>Business 2 Organic 15 mile radius including Oxford, Thame and Aylesbury</td>
</tr>
<tr>
<td>Business 3 Organic North Oxfordshire</td>
</tr>
<tr>
<td>Business 4 5 mile radius of Wallingford</td>
</tr>
<tr>
<td>Business 5 15 miles delivery around Banbury</td>
</tr>
<tr>
<td>Business 6 Organic Across Oxfordshire</td>
</tr>
<tr>
<td>Business 7 Organic 15 mile radius of Banbury</td>
</tr>
<tr>
<td>Business 8 Organic Oxfordshire</td>
</tr>
<tr>
<td>Business 9 Organic Oxford</td>
</tr>
<tr>
<td>Business 10 Organic Wittenhams area, Oxford, Didcot and Abingdon plus the Wallingford area</td>
</tr>
</tbody>
</table>

It is worth noting that Oxfordshire owning to its attraction as a tourist destination, famous chef’s and michelin star restaurants may have a more vibrant local food sector than other counties across the UK. The purchasing power of residents located across Oxfordshire may also play a role in their choice of food products.

**Table 4 Farm shops and Pick Your Own in Oxfordshire**

<table>
<thead>
<tr>
<th>Farm Shops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business 1 Open 7 days a week selling Deli, smokehouse, fishmonger and charcuterie attached to fabulous restaurant, hotel and farm. Eggs 24 hrs old; bread and cakes made in the village; smokehouse on-site</td>
</tr>
<tr>
<td>Business 2 Open Monday, Wednesday, Saturday and Sunday selling their own farm-reared pork and pork products. Locally sourced beef, lamb and chicken are also available. Dews Meadow sell at many local farmers' markets, supply some community village shops, and also several restaurants.</td>
</tr>
<tr>
<td>Business 3 Open Monday, Wednesday, Friday, Saturday and Sunday Selling home-made cakes, ice cream, jam; free-range eggs, garden produce; relax with a tea or coffee with stunning views over Vale of White Horse. Lunches also available</td>
</tr>
<tr>
<td>Business</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Business 4</td>
</tr>
<tr>
<td>Business 5</td>
</tr>
<tr>
<td>Business 6</td>
</tr>
</tbody>
</table>

**Pick Your Own and Farm shop**

| Business 1 | Farm shop open 7 days a week, 9am-6pm. Pick Your Own starts beginning June and runs 9am-5pm daily Large selection of fruit and vegetables plus dairy products, fish, patisserie, wine, meat, garden centre and restaurants. |
| Business 2 | Pick Your Own: Many berries, plus broad beans, cabbage, cauliflower, marrow, peas, pumpkins, runner beans, spinach. Farm Shop: As for Pick Your Own plus greater range of fruit and veg. Own lamb, poultry, turkey, eggs, game, bread, cakes, pies, honey. Organic section. Open Mon-Sat 8.30 - 6pm, Sun 8.30am - 5.30pm. |
| Business 3 | Pick Your Own: many kinds of berries and peas, also potatoes, asparagus, etc. Farm Shop has soft fruits, vegetables, cream, free-range eggs, free-range poultry, cakes, pies, preserves, fruit juices, and honey. Easy disabled access. Open Mon-Sat 9am-5.30pm (Sun 10am-4pm in June and July.) |
| Business 4 | Farm shop (9am-6pm daily), tea room (9am-4pm daily), butchers (9-6 weekdays, 9-5 weekends). Pick Your Own and ready picked fruit. Asparagus from end April - mid/end-June. Attend local farmers' markets May - September. They specialise in cherries (home of the Harwell cherry) - ready from the solstice (21st June) and also strawberries, raspberries, currants, gooseberries, plums, damsons, greengages, apples and pears. |
| Business 5 | Pick Your Own asparagus (separate site): open during season (approx mid April to mid June): Tues-Thurs 2-6pm; Fri 10am-6pm; Sat-Sun 9.30am-1pm. Main Pick Your Own and Farm Shop: May to end August: every day, 9.30am to 6pm. Café open till 6pm. Mr Finn the Butcher: 27 May - 30 September: 9.30am - 6pm (Sun 9.30am - 4pm). Pick Your Own crops: strawberries, raspberries, gooseberries, redcurrants, blackcurrants, whitecurrants, blackberries, asparagus, broad beans, carrots, beetroot, runner beans, French beans, squashes and pumpkins, globe artichokes. Lots of potato varieties. Farm shop has fresh fruit and vegetables plus butchery |
**Pick Your Own**

| Business 1 | Pick Your Own and some ready-picked produce. Asparagus and strawberries are available from around June, 7 days, 9.30am - 7pm. Also broad beans, new potatoes, carrots, beetroot, spinach, garlic, etc. |

**Supermarkets**

The two main supermarkets in Oxford are Tesco and Sainsbury’s each having one of their mega-branches on the ring road and stores across the region including another in the city centre. The Co-op also has branches throughout Oxford the Co-op do source local produce, Marks and Spencer and Waitrose also have stores in Oxford; both stores having branches across the region.

In order to explore further the role of local produce and local markets as well as the opportunities and challenges of relocalising food manufacturing we extended our search to UK wide businesses.

**Findings from Firm Survey**

The collection of primary data yielded 96 completed questionnaires across England from which we have extracted the most relevant research findings. In addition, we have pulled out the 20 responses from Oxfordshire and analysed them in more depth to mirror the project feasibility study design. For obvious reasons we were unable to collect data from Northstowe in Cambridgeshire and unfortunately no responses came from the wider county either.

**Sample description**

In terms of sector, the sample of firms surveyed ranged across dairy, bread and fresh produce and stretched along the value chain from farming to retailing. Retailers include supermarkets, farm shops, community shops, and organic boxes; while catering and hospitality would range from restaurants to tea rooms, cafes and pubs. As per ownership, most businesses are limited liability companies and partnerships.

**Business activity (in percent of respondents)**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Fresh produce</th>
<th>Dairy</th>
<th>Bread</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming</td>
<td>4</td>
<td>15</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Food manufacturing</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Food wholesaler</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Food distribution</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Food retailing</td>
<td>9</td>
<td>1</td>
<td>4</td>
<td>43</td>
</tr>
</tbody>
</table>

**Ownership (%)**

- Sole trader
- Limited liability company
- Limited liability partnership
- Social enterprise
- Partnership
In terms of firm employment, one quarter of firms are one person businesses and about two thirds have between 1 and 10 employees – both full time and part-time. Interestingly, half of the respondents claim not to rely on seasonal/casual labour.

Opportunities for local short food supply chains

The spatial distribution of their buyer and supplier network shows that they already rely on local and regional businesses to source and to sell. Up to 80% of respondents buy from businesses located in the region and just above 60% located in the local area. At the same time, around 80% sell to customers (firms or final consumers) located locally and regionally. The EU and international markets are non-existent for sourcing and selling and only 20% sell nationally.
This seems to suggest that the food processing sector is quite localised already but this does not seem to hold with the broader picture drawn of the sector with secondary data and information.

Drilling a bit deeper, we find as well that the **three top benefits from buying locally** are “More reliable suppliers”, “Better quality” and “Quicker response to demand” (see % of respondents below) and the **top three benefits of selling locally** are: firstly, a number of advantages mentioned by firms themselves including “known for awards, local produce as a selling point, repeat business, flexibility to accommodate demand, increased margins, rely of good tourist trade, quality of product and to serve local community”; secondly, serving “More satisfied customers”; and finally, being able to serve “Demand for more product / service customisation”.

<table>
<thead>
<tr>
<th>Benefits from buying locally</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quicker response to demand</td>
<td>67</td>
</tr>
<tr>
<td>Better quality</td>
<td>69</td>
</tr>
<tr>
<td>More reliable suppliers</td>
<td>84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits from selling locally</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand for more product / service customisation</td>
<td>13.9</td>
</tr>
<tr>
<td>More satisfied customers</td>
<td>17.2</td>
</tr>
<tr>
<td>Other</td>
<td>23.2</td>
</tr>
</tbody>
</table>

However, despite the benefits, firms seem more convinced to expand their local network of customers more than of suppliers, albeit being in both cases a minority of firms. The re-localisation of food processing seems to be on the table for businesses but not a priority to consider and to act on.
From the subset of respondents located in Oxfordshire we have been able to extract first-hand information on firms’ attitude and choices with respect to engaging in local supply chains.

We found that of the 20 respondents in Oxfordshire, 15 have declared that local and regional suppliers are very important and 18 that local and regional customers are very important as a share of their business. Buying local deliver “better quality” in terms of top benefit and selling local “increases sales” and ensures “more satisfied customers”.

Still only half of the firms are planning to expand their supplier and customer base locally in the next 1-5 years.

When asked about barriers to re-localising their supply chain, firms declared that the main barriers to sell more locally are blockages in the routes to markets: almost half of the respondents claim that “lack of alternative to supermarkets” to reach customers, “competition” and “difficulties in findings local outlets” are top barriers. Compliance with food regulations came out also as a hurdle. On the other hand, barriers to source more locally include “lack of availability of local produce”, “competition”, “existing contractual obligations” and “local produce too expensive”. Also some firms declared (10%) that sourcing more locally is not in their “business strategy”.

Overall, in the case of Oxfordshire, our findings seem to suggest that firms are already very much relying on local and regional suppliers and customers and that they have reached the limit of what they can source locally in terms of variety, quality and cost, but also they there is glass barrier to blocking access directly to customers due to competition especially from large retailers.

In order for RDM to be feasible we present the following business case:

There must be available resources in order for businesses to invest in RDM. These resources extend from environmental e.g. water, land; labour with the necessary skills to carry out a job within RDM, a market demand for the product whether this is the local market or national market.
13 Discussion

Our initial considerations from the literature suggest that when adopting a value chain approach, considerations on sustainability advocate that relocalising food manufacturing is desirable and possible but only for certain components of the value chain – for example regionally grown raw ingredients and final manufacturing. We are not suggesting that all bread consumed in a specific location can or should be manufactured by local small mills and bakeries, but that it is worth considering alternative business models in bread manufacturing that should be allowed to grow to their maximum capacity and generate local jobs. In redistributing food manufacturing and relocalising employment it is possible to create hybrid systems of work whereby paid and voluntary work contribute to the delivery of the end product. Such relocalised bread making value chains can co-exist with more centralised mass production.

Redistributed manufacturing (RDM) has the potential to open up new possibilities for both existing and new players within the food supply chain, its full potential and implications are not yet well understood in any area of manufacturing (Gao et al., 2015; Ivanova et al., 2013; Kietzmann et al., 2014; Thiesse et al., 2015). In the production of food, key drivers underpin the need for exploring RDM and its impact on regions ranging from resource usage (water, energy and other natural resources), to the need for greater sustainability on three levels – environmental, economic and social. Another driver is demand for more ‘locally produced’ food, food security and shorter food supply chains; leading to products being more tailored to the needs of consumers (RIHN, 2015) and what this means for RDM. The drive towards smaller-scale local manufacturing is also caused by changes to new technologies, flexibility in manufacturing and new processes in transport and labour costs, as well as the availability and cost of small-scale equipment, and access to information (RCA, 2016). RDM therefore offers the potential for entrepreneurs to start-up new businesses using new technology that could be highly efficient.

There is also the argument that redistributed manufacturing includes manufacturing in the home which present further manufacturing opportunities but not necessarily local. In terms of sustainability, RDM has the potential to offer greater resource utilisation, reducing the carbon footprint of the supply chain through local production and local markets as well as the ability to create models which address the need for re-use and re-manufacturing of components, and other factors in ethical practices (Foresight, 2013; Garetti and Taisch, 2012).

There are, however, a number of challenges that present themselves including maintaining supply for mass markets, ensuring the optimal use of resources and the need for high-end value products. A key driving factor of whether business will engage in RDM will be: the cost of investment and the expected returns. A business will want to evaluate whether RDM offers benefits and creates value whether this is economic, social, or environmental.

In terms of the specific products we identify opportunities and challenges specific to the manufacture of tomato paste and bread.
**Tomato Paste**

RDM could create opportunities but these would stem from creating an entire new market within the UK for this particular manufactured food product. This would have implications for resources as detailed below and would also require training a workforce as well as developing standards, supply chain arrangements and so on. RDM for tomato paste would require localising a European / Global product. This poses even greater challenges to relocalising a nationally produce product. For tomato paste there are a number of further key challenges including: resources, suitability of crop to the UK climate this would require all tomatoes to be sourced from the global market with implications for the cost of transport and the resulting environmental and energy costs, and lack of infrastructure for manufacturing.

To re-cap other things to consider include:

- People grow their own and make their own
- Instead of tomato paste look to tomato juice – more high end product
- Instead of tomato paste look at tomato soup (there is a scheme in Oxford that takes waste food and makes soup for homeless vulnerable people etc.)
- Import tomatoes and make paste locally – transport costs and energy implications
- Minimum volumes to make investment in machinery work
- Land taken for factories which might be better put to use for other food stuffs at production level

Tomato Paste would also involve a distinction between large scale industrialised mass production with artisan specialist products. For each of these the value chain needs to be shorter than for bread as a result of the nature of the raw materials (tomatoes) and the costs of transport. Any RDM would need to be located near to tomato cultivations. For customisation of tomato paste this would occur in the cultivation of tomatoes (organic) or at the processing level (e.g. seasoning, process of drying tomatoes or the consistency of the product). As a result of these findings we suggest that the RDM model is unsustainable for tomato paste and presents a good example of how products need to be carefully selected before presenting any business case for RDM.

**Bread**

There are viable opportunities for RDM in the bread sector (discussed further below), whereby RDM could co-exist with the current centralized mode of production for milling, dough manufacture and baking. However, there are a number of key challenges:

- Wheat processing, essentially milling (and associated quality control aspects) has become centralised.
- Bakeries also highly centralised.
- Re-localisation of bread making would also require re-localising wheat production in some regions. This would have implications on land use in these areas.
- Can existing small scale millers and bakers up-scale to deliver more output to the local area, by this we mean are small millers and bakers operating to full capacity and if not could they, and consideration as to how these small scale operations could be replicated across wider locations.
Looking at the whole supply chain, the bread baking is probably the most interesting process step from both the RDM as the FEW nexus perspective. Wheat cultivation requires large areas of land and milling is currently done efficiently at a large scale and redistributing offers no clear benefits. Currently, the bakeries are highly centralised and are able to produce industrialised bread at low cost due to economies of scale. It is hard for start-ups to compete on the basis of cost; however other aspects such as freshness, customised portions (i.e. less waste) and personalised ingredients (e.g. linked to health issues) might offer opportunities and also command a higher price.

If RDM can be something that small food producers can utilise to manufacture their own food products locally then it has the potential to re-shape the food supply chain through driving shorter supply chains and bringing the product closer to the consumer. This could also include having milling, dough manufacture, baking and retailing on one site significantly shortening the current global supply chain. It would be more difficult to re-localise agricultural inputs. The local value chains presented would co-exist with the current value chain presented overleaf. RDM could alter certain parts of the value chain, for instance in the figure overleaf re-distributing the baking processes to local areas with high wheat production would create a ‘shorter’ value chain in terms of food miles and offer a more sustainable business model for the firms involved along that value chain. This would also require business to recognise the environmental and social components of the value proposition, i.e. a triple proposition. This could result in demanding a higher price for products along the chain in a similar way to organic value chains.

If RDM resulted in local bakeries and local dough manufacturing it offers the potential for customers to experience the process of dough and bread making if these products could be made ‘while you wait’. The customised niche production model would however need to co-exist with the mass production model presented in the bread section. The figure below shows the new business model which could be created level 1 shows a scenario whereby beyond the grain handler all activities take place at one site where the consumer can then purchase the product this is the shortest of the value chains presented and offer the greatest value capture for an individual firm. Level 2a and 2b show an extra actor within the chain whereby manufacturers sell to retailers who then sell to the consumer this could be the final bread product or dough that consumers can then ‘bake off’ at home, or retailers ‘bake off’ before selling to the consumer. Level 3 is a shorter value chain to the global value chain having eliminated distribution, as each stage is completed locally but still involves a number of different actors along the value chain.

Another possibility for RDM in the food supply chain would be the use of technology to allow for small scale recycling of waste food; for example, taking local waste fresh produce and other ingredients then processing into ready-made meals which can be sold or run as a charitable organisation for individuals in need of food. As this is small scale and on-demand end products could be customised as to the availability of ingredients each day. This would result in an addition to the current business model whereby the value chain would include another step from retailer to a food recycling manufacturer before reaching the consumer see figure overleaf.
Demand - There are untapped market niches for personalised, customised and innovative products. These need to be produced in small batches or even as unique pieces. Such demands cannot be satisfied by the mass standardised products that low cost economies have completely captured. Such niche markets require customers to co-innovate or even co-produce with the manufacturer or the maker, for example specialist bread or customers deciding what seeds to add to grained and seeded loaves; it may also be feasible for customers to order specialised breads to their own particular dietary requirements or to suit their taste preferences and collect these from a local bakery or deliver to the food service sector. As highlighted by Dewettink et al. (2008) and Young (2001) innovations in the development of life stage nutrition and the need to develop nutritional based products are required to meet growing demands, RDM could assist in future developments of this area.

In terms of RDM and local food retailers there would need to be clear communication with the consumer as to whether the production and manufacturing of the product was local i.e. the product contained local ingredients or it is simply the manufacturing of the product that is local and the ingredients could be national or internationally sourced. Further work would need to be conducted as to the business case for such an enterprise and how it would co-exist with the current niche products available (e.g. sour dough and other specialist breads). Further work focusing on consumer behaviour would also need to be undertaken to explore the production cost of these customised breads and whether consumers would be willing to pay for these products.

Technological changes and the pervasive penetration of digital technology are enabling distributed and cross-media digital communications. Technological change has always altered economic activities by introducing new ways of organising production inside and between firms, the use and composition of new resources, and new skill requirement, but it also forces new constraints. The new manufacturing model coincides with locally embedded small-scale manufacturing firms addressing significant and expanding market niches of uniquely customised or small batch demand as found with some product available in Oxfordshire through farmers markets and farm shops, for example cakes, pies and so on. Such productions rest not on scale economies but on other forms of firm efficiencies able to ensure adaptability, responsiveness and innovation. Technological advances such as 3D printing may not be suitable as consumers move away from processed foods – concern over health implications etc. also high cost and low output which may not be desirable for business in a low margin sector.

RDM could provide opportunity to shift products from commodity to value eg providing technology and equipment on a very small but efficient scale allows food manufacturing for small scale producers so they capture value unlike commodity chains where power and profits are retained by large multinationals. In terms of trade-offs faced by value chain players RDM could shift value to the small producer and allow manufacturing to take place at the site of production significantly reducing the value chain, it could them allow producer/manufacturer to sell direct to consumer or to sell to a retailer. The benefits of this could mean that sustainable livelihoods are created for producers engaged in high value customised products.

We present the following as alternative business models as a generic model for localised food manufacturing please see overleaf. Further models can be found in the appendix section of this
report for bread. As well as the models presented in the bread and tomato paste sections which are also product specific. Currently the manufacturing system is centralised with only a few locations manufacturing food. Implementing RDM in the food sector could transform the manufacturing landscape, there could be many across the country therefore reducing the risk of lack of supply should one factory face shut down for a specific reason.

A fully relocalised system would however have implications for those small niche businesses already manufacturing food products therefore implementing RDM would need to ensure there were not negative business impacts on the current niche markets.

Fully local value chain is also dependent on the resources available within that locality production and manufacture could be local but sales could be national – they might require to have national sales if the product is a niche customised as local demand will be limited.

**Future RDM Scenarios for food manufacturing**

If RDM can be something that small food producers can utilise to manufacture their own food products locally then it has the potential to re-shape the food supply chain through driving shorter supply chains and bringing the product closer to the consumer. One possible RDM scenario would involve, for example, it may be feasible for customers to order specialised breads to their own particular dietary requirements or to suit their taste preferences and collect these from a local bakery or deliver to the food service sector. As highlighted above by Dewettink et al., (2008) and Young (2001) innovations in the development of life stage nutrition and the need to develop nutritional based products RDM could assist in further future developments of this area.

In terms of RDM and local food, retailers would need to be clear as to whether the production and manufacture of the product was local i.e. the product contained local ingredients or it is simply the manufacture of the product that is local and the ingredients could be national or internationally sourced.

Other possibilities could be mobile RDM whereby micro food manufacturing factories produce customised orders on the streets, at venues (e.g. (food) festivals, farmers markets, service stations etc.). This could potentially in the distant future involved 3D printing if there is consumer acceptance of the technology for food and the cost of production is viable. Other less technology based alternatives using RDM could involve using fresh ingredients, whereby customers use an app to place an order for hot dinner to arrive at a certain time at their house, this is made on-demand in local RDM food factory and delivered straight to the customer, this system could allow customers to pick ingredients etc. and could be beneficial to those with food intolerances. Fruit and vegetable box schemes could also offer another alternative for delivering locally manufactured produce.
Figure 7 Current Bread model

- **Input Suppliers**
  - Research and development, seeds etc

- **Wheat Farmers**
  - UK and international

- **Grain Handlers**
  - Local, national and international markets

- **Millers**
  - UK based national organisation and

- **Dough Manufacture**
  - UK based national organisations

- **Bakers**
  - UK based national organisations and traditional local

- **Distribution**

- **Retailers**
  - UK based multi-national local

- **Consumer**

Source: Regional Studies Conference Presentation 2016
Figure 8 New business model.

Source: Regional Studies Conference Presentation 2016
Figure 9 New recycling business model. This model incorporates recycling food waste into the RDM model.

Source: Regional Studies Conference Presentation 2016
In terms of developing generic food models we have developed two different RDM models. One the open loop RDM model shows how RDM could create a food chain cycle whereby waste is recycled back into the food chain cycle at each stage there will also be the use of energy and water. This model also depicts a situation where some of the actors in the chain could be local, but they could also be national or international and inputs at each stage could be global. The second is the closed loop RDM model this model is for a fully relocalised chain whereby all stages are undertaken at the local level. Each stage will also involve the use of water and energy.

**Figure 10 Open Loop RDM Model**

Source: Regional Studies Conference Presentation 2016
Figure 11: Closed loop RDM model

Source: Regional Studies Conference Presentation 2016

Key Findings

Implications - Issue of low margin sector, critical look at economics of food production. Different localities may have different demands for local produce.

Relocalisation of entire supply / value chains would require collaboration across the entire chain and an understanding of the benefits for all actors.

Niche alternatives are individual driven small markets for niche products high value products simply ethical sustainable fulfilling non-economic needs or to gain greater share of the margin.

The suitability of RDM will be product specific and therefore requires individual evaluation taking into account economic, social and environmental benefits and costs.
14 Conclusions

From the literature it is evident that local food is a well-researched topic however, there are fewer studies exploring local food in terms of food manufacturing and, in relation to the concept of RDM, little has been explored over the role of scale. This is an area which requires further research.

This report has focused on the opportunities and constraints of shortening the value chains for tomato paste and bread. We have found that when considering available resources it is currently not feasible to relocalise the production of tomato paste confirming findings from the LNN Food Feasibility Report. In terms of bread relocalising the entire bread supply chain may not be feasible, but there are opportunities to relocalise parts or all of the value chain depending on the product (e.g. artisan hand-made bread, local bakery with baking on-site), or having local farmers produce wheat, milled locally and then baked locally. RDM could provide opportunities for more advanced milling and baking procedures using technologies which are economically viable for small production runs and so on. Relocalising food production requires careful consideration as there will be economic, social and environmental trade-offs, these need to explore not only the impact on the local system but also impact on the wider global system. This is an area which requires further scrutiny particularly for food products such as tomato paste where relocalisation would take resources from the production of other food products.

Developing business models we identify new/alternative business models required to reconcile various environmental, social and economic objectives within a localised value chain, this could be a fully localised chain (closed loop model) or partially localised chain (open loop model).

Overall, in the case of Oxfordshire, our findings seem to suggest that firms are already very much relying on local and regional suppliers and customers and that they have reached the limit of what they can source locally in terms of variety, quality and cost, but also they there is glass barrier to blocking access directly to customers due to competition especially from large retailers.

To evaluate the business case for RDM the value proposition needs to be defined with consideration that value may not necessarily be economic but could be social, cultural and environmental.

Therefore, in order for RDM to be feasible we present the following business case:

There must be available resources in order for businesses to invest in RDM. These resources extend from environmental e.g. water, land; labour with the necessary skills to carry out a job within RDM, a market demand for the product whether this is the local market or national market and the availability of affordable technologies.

The suitability of RDM in the food sector is dependent on each specific product.

From this report we have been able to identify key future research questions in order to develop the field of RDM in the food manufacturing sector. These questions have been derived from what we believe is important from the literature and our findings and warrant further research.
1. How do we create dynamic Business models to take account of: incremental changes that could take place over 5 years; medium term changes 5-10 years; and, long term changes over ten years

2. What are the trade-offs of redistributing food manufacturing for the entire supply chain of specific products in terms of economics, social, environmental, and cultural factors?

3. Could redistributed food manufacturing alter the flow of power across food supply chains and provide opportunity for local and regional economic development?

4. Redistributed food manufacturing would need to address the triple bottom line in any business model (firm, industry, or value chain)

5. Relocalising food manufacturing may enable the relocalisation of other actors within the value chain, what are the knock-on resource effects of this process?

6. What are the effects of changes in the political dimensions of the UK which could affect business decisions in relation to re-distributed manufacturing?

7. How should RDM be implemented in a low margin sector (exclusion of artisan and specialist products) there would need to be a clear business case in terms of costs and returns on investment particularly for smaller enterprises
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Appendix

In the appendix we present further diagrams and data to support the report. Below we detail some of the models developed for tomato paste and bread where we show the inputs and the location of the activity across the value chain. This model is valid for tomato paste production in any country including the UK should it be viable. The model for bread has been developed specifically for the UK but could be applied to other countries.

<table>
<thead>
<tr>
<th>TOMATO PASTE</th>
<th>Inputs</th>
<th>location</th>
<th>Other functions</th>
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<tbody>
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<td>Agriculture</td>
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<td>Agriculutral inputs</td>
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<td>global through to local operations</td>
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<td>Agricultural inputs</td>
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<td>seed / plant provider</td>
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<td>water</td>
<td>global through to local operations</td>
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<td>energy</td>
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<td>global through to local operations</td>
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<td>other items</td>
<td>global through to local operations</td>
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<td>machinery</td>
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<td>Marketing</td>
<td>global through to local operations</td>
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<td>Research and development</td>
<td>global through to local operations</td>
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<td>Distribution</td>
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<td>Channels of distribution</td>
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<td>Business to Business</td>
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<td>Wholesalers</td>
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<td>Retailers</td>
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<td>Independent shops</td>
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<td>Farms shop</td>
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<td>Farmers market</td>
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<td>Internet E-commerce</td>
<td>local to national</td>
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<td></td>
<td>Organic boxes delivery</td>
<td>local to regional</td>
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<tr>
<td></td>
<td>Food manufacturer</td>
<td>local to national</td>
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* value is added here through branding and packaging

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<thead>
<tr>
<th>Consumption</th>
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<tr>
<td>Independent Consumer</td>
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<tr>
<td>Commercial Consumer</td>
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<tr>
<td>Restaurants etc.</td>
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</tbody>
</table>

* at each stage there will be waste and by-products opportunity may arise for these to be recycled or used in other formats such as animal feed, or another food stuff

For example: soups, juices etc.

* for local production agricultural producer could also be the manufacturer and only supply to local market

This could be true for those selling organic boxes, farmers markets and local independent shops

grown and manufactured on same site then delivered directly to either other businesses or end-consumer

If organic inputs could well be local or regional at best
Simplified version of the value chain for tomato paste for UK consumers

Where parts of the value chain could be localised

*1 - this has implications in terms of energy and so on not only to transport tomatoes but also in the manufacturing process

This scenario would however work for tomato juice (premium product) or premium tomato sauces.

The next diagram presents the idealised re-localised chain.
This figure shows the local and global business activities for tomato paste from inputs to consumer:

**Agriculture**
- Inputs: Energy, water, infrastructure (glasshouse etc), machinery, fertilizers, seeds or plants
- Process: grow, harvest

**Manufacturing/Processing**
- Inputs: water, energy, tomatoes, infrastructure, machinery, packing.
- Process: peel, heat treat or cold treat, homogenizer, concentration, sterilizer, packaging.

**TOMATO PASTE**

**Local market**
- Business to Business
  - Restaurants
  - Other food manufacturer
  - Catering
  - E-commerce

**Regional, National and beyond**
- Business to Business
  - Restaurants
  - Other food manufacturer
  - Catering
  - E-commerce
  - Wholesalers
### BREAD

#### Inputs | location | Other functions
---|---|---
**Agricultural inputs** | global through to local operations | seed / plant provider: finance  
water: HR  
energy: Research and development
---|---|---
**Agriculture** | national through to local | fertilizer: finance  
plants: HR  
other items for supporting plant growth: Marketing  
machinery: Research and development
---|---|---
**Milling** | national through to local | machinery: HR  
packaging: Marketing  
research and development
---|---|---
**Baking and Packing** | flour and product | flour: operations
---|---|---
**Distribution** | Business to Business  
Supermarkets: finance  
Restaurants: Marketing  
Independent shops: local  
Farmers shop: local  
Farmers market: local  
internet commerce: local  
organic boxes delivery: local  
Food manufacturers: local  
channels of distribution
---|---|---
**Consumption** | Independent Consumer  
Commercial consumer  
Restaurants etc.
---

*value is added here through branding and packaging

---

* for local production agricultural producer could also be the manufacturer and only supply to local market
* this could be true for those selling organic boxes, farmers markets and local independent shops
* miller could also be the baker and sell to local market, some mills may also have a shop on site - these will be small artisan bakers
* certain product will have to come from the global market for example soyas this will be more the case for mass produced bread
* artisan bread ingredients will vary and therefore could be totally local or regional
**Agriculture**
Inputs – Energy, water, infrastructure, machinery, fertilizers, seeds or plants
Process – grow, harvest, cultivate

**Manufacturing/Processing**
MILLING for flour, DOUGH MAKING, BAKING, PACKAGING

BREAD
Other outputs – waste and by products

**LOCAL**
- Processed on site

**GLOBAL**
- Processed centrally

**Local market**
- Business to Business
  - Restaurants
  - Other food manufacturer
  - Catering
  - E-commerce
- Business to consumer
  - Local shop
  - Farm shop

**Regional, National and beyond**
- Business to Business
  - Restaurants
  - Other food manufacturer
  - Catering
  - E-commerce
  - Wholesalers
- Business to consumer
  - Retailers
Bread manufacturing process

**Dough Manufacturing process**

- **Mix**
- **Flour**
- **Water**
- **Yeast**

**Divide**

**Round**

**By pass**

**First proof** → **Final mould** → **Final proof**

**De pan** ← **Bake**

**Cool**

**Slice and bag**

**Dough manufacturing location**

- **Local**
  - Auto weighing
  - Mixing tank
- **Regional**
  - Fermenter
  - Dough topper
- **National**
  - Pack and ship

**Dough manufacturing**

- This can take place local, regional, national, European, globally
- This either goes straight into the baking process or it is split off frozen and then sold or is sold straight as dough
- This process is often undertaken at large factories

**Simplified bread supply chain for UK consumer**

<table>
<thead>
<tr>
<th>Bread Supply chain for UK based consumer</th>
<th>(Milling for flour)</th>
<th>(Baking and packaging)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural inputs</td>
<td>Agriculture</td>
<td>Pre-manufacturing</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td><strong>Local</strong></td>
<td><strong>Regional</strong></td>
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</tbody>
</table>

- **Milling for flour**
- **Baking and packaging**
- **Agricultural inputs**
- **Agriculture**
- **Pre-manufacturing**
- **Manufacturing**
- **Distribution**
- **Retail**
- **Consumer**
Mass produced bread

Local Bread

Local production of bread

(a) Milling for flour

(b) Dough manufacturing

(c) Baking

Location | Agricultural inputs | Agriculture | Pre-manufacturing | Manufacturing | Distribution | Retail | Consumer
---|---|---|---|---|---|---|---
Local | | | | | | |
Regional | | | | | | |
National | | | | | | |
European | | | | | | |
Global | | | | | | |

flour can be sold direct to customers

these are dependent on the quality of the flour required for

dough can be sold onto retail for bake off in store, baked off in small shops, restaurants, cafes etc. Or to be baked off in the home dough could also be sold european and globally

Flour can be sold direct to restaurants, consumers and also retail to bake on site these will be local, regional, national could also be european and global
Artisan model

The diagram below presents different aspects of the supply chains for tomato paste and bread.

<table>
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<tr>
<th>LOCAL PRODUCTION OF ARTISAN BREAD</th>
<th>Local</th>
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This may not be entirely possible for all agricultural inputs particularly if non-organic.

The value proposition model

Suppliers → knowledge base → Infrastructure → Process → Customer relationship → Distribution Channel → Output

The diagrams below present different aspects of the supply chains for tomato paste and bread.
### TOMATO PASTE Supply chain for UK based consumer

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Not relevant for us as these are non-UK based consumers.
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<td>Family business 250 years old, 85 cows, no employees</td>
<td>Dairy products and manufacturing of products – butter, cream and ghee</td>
<td>Organic Raw milk products – milk, butter, cream and ghee</td>
<td>Began with Farmers markets then door step deliveries, Food festivals, vending machine in Selfridges (removed as per request from FSA)</td>
<td>Food Standards Agency (FSA) licensing Raw milk can only be sold direct from farmer to consumer</td>
<td>Add value to milk by telling a story of organic grass based milk production. Direct selling gives the farmer control and integrity of the product</td>
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<td>RSPCA freedom food approved 200 sow indoor unit, 2 employees rest family labour</td>
<td>Pig farm, produces own cereals</td>
<td>pigs</td>
<td>Direct sales for meat and breeding stock</td>
<td>Consumer wants top quality food raised by highest welfare standards at lowest possible price</td>
<td>Allowing more space per animals has reaped rewards with better weight gains</td>
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<td>Family enterprise 155 years 1000 milking cows. Achieved carbon trust triple standard.</td>
<td>Cheese manufacturer (also produce ingredients for Biogas (green gas))</td>
<td>Cheese</td>
<td>Supermarkets</td>
<td>UK supply chain can’t see the damage being done with Quality of British produce and nostalgia that’s helps sell the product</td>
<td>Strengthen global demand for the product (Currently sold in 160</td>
</tr>
</tbody>
</table>

Table 2: UK wide secondary data
<table>
<thead>
<tr>
<th>Location</th>
<th>Farm Type</th>
<th>Notes</th>
<th>Strategy</th>
<th>Challenges</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Yorkshire</td>
<td>Beef Farm</td>
<td>Previously a dairy farm now run as a husband and wife team. Focus on genetics and showing animals and sell all animals as breeding stock around the world. Pedigree Breeding stock from show animals internationally renowned herd (Commercial stock). Direct sales to other farmers. Show sales. Natives don’t perform well in the commercial arena. Keep rare breed alive native Aberdeen Angus less than 250 registered breeding females on rare breed endangered list. Find a way to blend native Aberdeen Angus with the commercial north American breed lines.</td>
<td>Low farm gate prices. Abroad, home market no interest except for price.</td>
<td></td>
<td>Find a way to blend native Aberdeen Angus with the commercial north American breed lines.</td>
</tr>
<tr>
<td>Staffordshire</td>
<td>Traditional butcher</td>
<td>Family business run by 3rd and 4th generation. Butchers, abattoir, butchery school, outdoor events, independent shop selling meat, vegetables, dairy products, eggs and bread. Online, shops and produce for outdoor events. Retaining customers and competitive pricing. Local produce supporting local countryside. Expand local produce.</td>
<td></td>
<td>Retaining customers and competitive pricing.</td>
<td>Local produce supporting local countryside.</td>
</tr>
<tr>
<td>Exeter</td>
<td>Dairy farm</td>
<td>Husband and wife team with staff employed for processing products. 220 On farm production and processing of Hand made organic yoghurt Delivered direct to either retailer. Inputs costs. Able to employ local people. Continue as they are.</td>
<td></td>
<td>Retaining customers and competitive pricing.</td>
<td>Local produce supporting local countryside.</td>
</tr>
<tr>
<td>County</td>
<td>Farm Type</td>
<td>Description</td>
<td>Produce</td>
<td>Distribution Method</td>
<td>Benefits</td>
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<tr>
<td>Lincolnshire</td>
<td>Beef Farm</td>
<td>Originally mixed dairy and arable farm now beef farm run by two brothers and their parents. Produces own cereals for stock. Production of prize winning breeding stock.</td>
<td>Pedigree breeding stock. Direct sales or show sales</td>
<td>High herd health status, prize winning cattle able to charge a premium for stock</td>
<td>Online service for selling semen and embryos</td>
</tr>
<tr>
<td>Leicestershire</td>
<td>Arable Farm</td>
<td>Two brothers, their sons farm 2000 hectares in Leicestershire, Nottinghamshire and Warwickshire mix of owned and rented. 3 full time staff and 6 seasonal casuals. Business started 100 years ago.</td>
<td>Winter wheat, barley, rape seed, linseed, beans and grass. Marketing is through openfield.</td>
<td>Different soil conditions for growing, different agreements for land</td>
<td>Specialisation and technology to assist planting and cropping e.g. gps for seed applications</td>
</tr>
<tr>
<td>Cornwall</td>
<td>Dairy Farm</td>
<td>Family business - Father, brother and sister enterprise, 3 units totaling 1000 cows each on cheese contract with Dairy Crest Davidstow plant. Produces milk for cheese production</td>
<td>Milk. Direct sales to Dairy Crest on cheese contract</td>
<td>Input costs</td>
<td>Extended grazing season with the temperate Cornish climate</td>
</tr>
<tr>
<td>Peebleshire</td>
<td>Dairy Farm</td>
<td>Family business husband and wife with their three children. 550 cows Produces Milk.</td>
<td>Milk and breeding stock from prize winning herd. Direct sales to milk buyer on a contract. Sales of pedigree stock either through show sales or direct to other</td>
<td>Input costs</td>
<td>Benefits of pedigree cattle. Increase the genetic capacity of the herd</td>
</tr>
<tr>
<td></td>
<td>Dairy Farm</td>
<td>Organic Milk</td>
<td>Direct sales to organic milk suppliers cooperative</td>
<td>Large financial repayments</td>
<td>Evolve milk production to suit milk buyers global requirements</td>
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<tr>
<td>Herefordshire</td>
<td>Family business Husband and wife with son and daughter. 120 organic cows</td>
<td>Produces Organic Milk, also produces most of their own electricity through solar panels</td>
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<tr>
<td>Cheshire</td>
<td>Part of Grosvenor Estate. Cows housed all year round 800 cows run by farm manager who family have been on the estate for 100 years. Solar power system</td>
<td>Largest supplier of milk to Tesco on the sustainable supply chain contract. Generate their own electricity and feed for the cows</td>
<td>Milk</td>
<td>Direct sales to milk buyer on sustainable supply chain contract for tesco</td>
<td>disease</td>
</tr>
<tr>
<td>Cumbria</td>
<td>900 acre Family run beef and sheep farm. Family also own truck stop, caravan park and Rheged Centre in Lake District. Beef and lamb from the farm supplies truck stop and are also sold on</td>
<td>Retail and hospitality combined with farming. Farmer joined forces with a local baker and hotelier to open truck stop. 70 local farmers supply the business and provides 550 local jobs</td>
<td>Beef, Lamb, food services</td>
<td>Truck stop is supplied with local, homemade produce</td>
<td>Decline in margins from farming especially for upland farmers</td>
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<tr>
<td>Gloucestershire</td>
<td>Motorway services</td>
<td>Service station working with 130 local producers and 70 more British producers. Employs 400 people</td>
<td>Food services Restaurant, coffee shop and farm shop all selling local produce</td>
<td>Food services Service station supplied from local farmers within 30 miles of the service station</td>
<td>Decline in farming incomes and seen as a way to buck the trend</td>
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<tr>
<td>Berkshire</td>
<td>Horticulture - Soft fruit</td>
<td>300 acres fruit, reservoir for the farms irrigation system, solar panels floating on reservoir</td>
<td>Soft fruit and electricity production</td>
<td>Soft fruit and electricity contracts</td>
<td>weather</td>
</tr>
<tr>
<td>Hampshire</td>
<td>Horticulture Watercress and wasabi</td>
<td>Second generation farm, 15 years growing watercress and is now the UK’s leading farm. Production of green salads, Red and green watercress, babyleaf salad, wasabi and wasabi plants. Online sales, direct sales to chefs, specialist Japanese distributors, mailorder, farmers markets</td>
<td>Getting the conditions right for plant growth requires exact workflow, lighting and precision timing</td>
<td>Only farm to produce wasabi in the UK</td>
<td>New crop development</td>
</tr>
<tr>
<td>Herefordshire</td>
<td>Horticulture Potatoes</td>
<td>Second generation farm supplying McCain Production of potatoes</td>
<td>Direct sales to McCain on a contract</td>
<td>Disease and weather – failed crop</td>
<td>Direct sales</td>
</tr>
<tr>
<td>Hertfordshire</td>
<td>Horticulture Fruit Farm</td>
<td>Business started in 1958 a small holding 18 acres of apples and blackcurrants now 350 acres and at peak times employs 300 seasonal casual workers Fruit production</td>
<td>Supply supermarkets</td>
<td>Disease, fruit imports</td>
<td>Grow new crops – one of the first to grow kiwi berry and buy local British produce</td>
</tr>
<tr>
<td>County</td>
<td>Sector</td>
<td>Description</td>
<td>Crop Production</td>
<td>Markets and Challenges</td>
<td>Production Challenges</td>
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<tr>
<td>Lincolnshire</td>
<td>Horticulture</td>
<td>10 hectares growing salad leaves</td>
<td>Salad leaves</td>
<td>Focus is on exotic seasonal salad leaves</td>
<td>Small scale means they only need a small amount of new seed which means they can trial crops quicker than larger producers</td>
</tr>
<tr>
<td>Shropshire</td>
<td>Dairy Farm</td>
<td>300 cows on 400 hectares, organic dairy farm.</td>
<td>Organic milk</td>
<td>Organic milk Focus is on exotic seasonal salad leaves</td>
<td>Organic is growing market</td>
</tr>
<tr>
<td>Devon</td>
<td>Poultry Farm</td>
<td>Small scale poultry farm</td>
<td>Chicken</td>
<td>Sell to wholesaler Reliant on imported feed</td>
<td>Change to crop production</td>
</tr>
<tr>
<td>Herefordshire</td>
<td>Soft fruit farm</td>
<td>Family business 180 hectares of blackcurrents, raspberries and strawberries.</td>
<td>Soft fruit production 4% of blackcurrent production is organic</td>
<td>Organic blackcurrent sold to Yeo Valley yoghurt. Rest</td>
<td>Disease</td>
</tr>
<tr>
<td>Region</td>
<td>Business Type</td>
<td>Description</td>
<td>Policy</td>
<td>Possibility</td>
<td>Source</td>
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<tr>
<td>North Yorkshire</td>
<td>Pig Farm and Butcher</td>
<td>High end pig meat and butchers shops in affluent areas of London. Farm 3000 acres in North Yorkshire and works with local farmers. Entire business employs 106 people.</td>
<td>One business entire supply chain from farm to consumer each shop is individually catered depending on the clientele. Pig meat. Direct sales, direct to shops and also wholesale arrangement with high end restaurant chain. Getting the quality right every time. Know your customer and know that it isn’t quantity it is quality.</td>
<td>Possibility of more shops. The Times.</td>
<td></td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>Poultry Farm</td>
<td>3rd generation poultry farm outdoor reared and fed on algae. Farm works to Waitrose bespoke welfare standards and is part of the 10 year project exploring benefits of feeding algae to chickens to boost omega 3 oil content. Omega 3 oils enhanced chicken. Waitrose contract. Trying something not proven as yet. Providing health benefits for people.</td>
<td></td>
<td></td>
<td>Waitrose Magazine</td>
</tr>
<tr>
<td>Usk Valley</td>
<td>Mixed Farm</td>
<td>Husband and wife business 650 acres with 50 acres cereals, 75 suckler cows and 1050 ewes. Mixed farm operation, solar panels to provide electricity and provide education. Lamb, beef. Supply waitrose with lamb and beef goes to the local market. Production of high quality food alongside good environmental practices. To continue to be a profitable farm business maximizing our resources and increasing biodiversity.</td>
<td></td>
<td></td>
<td>Waitrose Magazine</td>
</tr>
<tr>
<td>Castle Douglas, Scotland</td>
<td>Dairy Farm</td>
<td>Husband, wife son and daughter family business. 360 acres, grow most of their own feed and have 230 cows.</td>
<td>Obtain as much milk from home grown forage as possible. Obtained a grant for a new youngstock shed and covered forage pit.</td>
<td>Milk and dairy heifers and cows</td>
<td>Supply Arla on a contract</td>
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</tr>
<tr>
<td>Yorkshire</td>
<td>Horticulture</td>
<td>Family business growing rhubarb in the rhubarb triangle since 1930. 500 acres of owned land and 200 acres of rented land. 220 acres of outdoor rhubarb as well as indoor employ 100 seasonal workers</td>
<td>Growing rhubarb and strawberries and also offer tours of the forced rhubarb production. Forced Rhubarb has protected designated origin status</td>
<td>Rhubarb and strawberries</td>
<td>Sell to Marks and Spencer, Asda and wholesalers</td>
</tr>
<tr>
<td>Lancashire</td>
<td>Dairy Farm</td>
<td>Husband and wife 3rd generation tenants of Duchy of Lancaster. 125 cows. 300 breeding ewes</td>
<td>Maximize margins through grazing and reduce costs. Utilize social media to promote raw milk, direct selling increases</td>
<td>Milk, lamb, eggs</td>
<td>Milk sold to Clifton dairies raw milk sold direct at farm gate alongside lamb boxes, free range eggs and turkey’s at Christmas 30%</td>
</tr>
<tr>
<td>Area</td>
<td>Type</td>
<td>Description</td>
<td>Lamb sold directly at farm gate and farmers markets</td>
<td>Continue with high quality animals</td>
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</tr>
<tr>
<td>Derbyshire</td>
<td>Beef and Sheep</td>
<td>Estate farm with farm manager, 4500 acres with a further 1700 acres arable land used to grow crops to feed livestock</td>
<td>Beef and lamb sold direct via farm shop, local butchers or through local market</td>
<td>Continue with high quality animals</td>
<td></td>
</tr>
<tr>
<td>Derbyshire</td>
<td>Beef and Sheep</td>
<td>Estate farm 3800 acres estate runs one farm 336 acres organically</td>
<td>Organic beef and lamb sold direct to local butchers</td>
<td>Continue with high quality animals</td>
<td></td>
</tr>
<tr>
<td>Herefordshire</td>
<td>Cheese and Yoghurt manufacturer</td>
<td>Husband and Wife team producing niche artisan products. Son also helps and they have seven local employees. Milk is collected from small local dairy farm</td>
<td>Assisted by a rural enterprise grant 2003, extension to the facility. Installation of solar panel waste water is kept in ponds and run through reed</td>
<td>Continue with high quality animals</td>
<td></td>
</tr>
</tbody>
</table>

**Derbyshire Beef and Sheep Estate farm**

- Manager, 4500 acres with a further 1700 acres arable land used to grow crops to feed livestock.
- High herd health status, with use of home grown feed and grass where possible.
- Beef and lamb sold direct via farm shop, local butchers or through local market.
- Continue with high quality animals.
- Farmers Guardian

**Derbyshire Beef and Sheep Estate farm**

- 3800 acres estate runs one farm 336 acres organically
- Run as environmental and conservation production with rare breed long horn cattle and native sheep own forage and cereals are grown.
- Organic beef and lamb sold direct to local butchers.
- Continue with high quality animals.
- Farmers Guardian

**Herefordshire Cheese and Yoghurt manufacturer**

- Husband and Wife team producing niche artisan products. Son also helps and they have seven local employees. Milk is collected from small local dairy farm.
- Assisted by a rural enterprise grant 2003, extension to the facility. Installation of solar panel waste water is kept in ponds and run through reed.
- Greek-style yoghurt, soft cheese and crème fraiche.
- Top food outlets in London and mail order.
- Labour intensive process which increases cost.
- Niche product sells at London's high end food outlets.
- No intention to expand as the business is already successful.
- The Farmer
<table>
<thead>
<tr>
<th>Henley Oxfordshire</th>
<th>Dairy Farm</th>
<th>519 hectares and part of the Nettlebed Estate. Farm manager</th>
<th>Organic Produces milk for milk buyer on a contract and also produces milk for cheese production (another part of the business)</th>
<th>Organic milk and unpasturised cheese</th>
<th>Direct sales to milk buyer. Cheese sales</th>
<th>Making sure maintain high quality milk.</th>
<th>Must maximise return on investment</th>
<th>British Farmer and Grower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridgeshire</td>
<td>Vegetables and cereals</td>
<td>1100 hectare farm</td>
<td>10% of the farm is organic the rest is conventional</td>
<td>Vegetables and cereals</td>
<td>Sell to produce world who then sell to supermarkets</td>
<td>Running a mixed operation of organic and conventional total organic production would be too costly</td>
<td>Organic sector is becoming increasingly important</td>
<td>British Farmer and Grower</td>
</tr>
<tr>
<td>Cambridgeshire</td>
<td>Arable farm</td>
<td>Husband and wife tenants of 320 acres. Husband drives lorries in winter months to have an income</td>
<td>Wheat, barley sugar beet and oil seed rape on rotation</td>
<td>Wheat, barley sugar beet and oil seed rape.</td>
<td>Grains sold in consignments to large conglomerates – Dalmark, Fengrain and Frontier</td>
<td>Finance and know how to farm your land</td>
<td>Promote agriculture to the next generation talks to school children about food production</td>
<td>No plans to change</td>
</tr>
</tbody>
</table>