



**DEFRA PROJECT FO0108**

**RESILIENCE OF THE FOOD SUPPLY TO  
PORT DISRUPTION**

**FINAL ANNEX REPORT 2:  
UK FOOD AND DRINK SUPPLY CHAINS  
September 2012**

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## 1. EXECUTIVE SUMMARY

This Defra project 'Resilience of the Food Supply to Port Disruption' involved an assessment of possible port disruptions, their potential impact on UK food supply and the options for remedial action in the short to medium term. It followed publication in 2009 of the *UK Food Security Assessment*.

The project was undertaken by Peter Baker (PRB Associates) and Andrew Morgan (Global 78). The Final Report and a series of supporting Annex Reports, of which this is one, contains the principal findings, recommendations and conclusions arising from their research.

The work programme included use and further analysis of requested HMRC / Defra import tonnage data (for 2010); work with industry stakeholders to compile an accurate description of 'as-is' import scenarios (i.e. product origins, modal formats, volumes, services used and frequencies, etc.); and an attempt to understand the stakeholders' approach to ensuring consistent supply and review strategies already in place (or planned) to mitigate likely possible effects of port disruption. Findings include:

- The two principal channels to meet UK consumer demand for food and drink are grocery retail and catering (foodservice). In grocery retail, the major multiples have led innovation in such areas as product ranges, store formats, and category management
- Changing patterns of consumer behaviour include demand for a far wider range of food and drink products and also to increased demand for fresh and chilled foods, including convenience lines. Other requirements include concerns about availability, affordability, food quality and safety, and reassurance about sustainable and ethical sourcing
- Catering (foodservice) has a different set of consumer requirements and a wider range of outlet types but players have adopted approaches that are similar in ethos to the grocery retail channel
- Developments in the grocery retail and foodservice channels have in turn shaped the activities of the food and drink manufacturing as a response to consumer demand
- The various segments of UK food and drink supply – grocery retail, foodservice, wholesale distribution, processing and manufacturing, import activity, and the provision of (temperature-controlled) logistics services – have collectively created inter-dependent supply chain networks that often rely on the same infrastructure and resources
- UK supply is dependent on both domestic and imported supply. It is a mistake to consider these in isolation because integrated supply from both sources and at all levels, through processing and manufacture to the point of consumption or sale, is now the norm
- Supply chain networks are highly effective, complex, and tightly-timed. They rely on sophisticated logistics processes and operations. While these are positive attributes, the results of port disruption could have unexpected and unforeseen knock-on effects
- Inventory management policies that keep stocks as low as possible constitute an approach that has financial logic, is encouraged by consumer demand for short shelf life products, and is enabled by sophisticated logistics. However, it brings a risk of supply failure
- External factors that could also impact adversely on the integrity of logistics operational capability either in the UK or overseas include rising fuel costs, increasing incidence of extreme weather events, or labour unrest. Because logistics is also dependent on information and communication technologies cyber crime is another potential source of food supply disruption.

**This preliminary research also demonstrated the value of looking at supply chains on an individual basis. The food and drink sector is not homogenous. Every category has its unique characteristics with the result that every supply chain will have its own specific configuration at global, regional or local level.**

## 2. INTRODUCTION

### 2.1 Project background

The Defra-funded research project FO0108 'Resilience of the Food Supply to Port Disruption' involved an assessment of possible port disruptions, their potential impact on UK food supply and the options for remedial action in the short to medium term.

The project was undertaken by Peter Baker (PRB Associates), a ports and shipping specialist, and Andrew Morgan (Global 78), an international food supply chain specialist.

The research was prompted in part by the outcomes of the *UK Food Security Assessment* (published in August 2009; updated in January 2010) and PRB Associates' follow-up report published in September 2009, *Background to Defra's Assessment of UK Food Security*.

The work included Case Studies on four import corridors: Dover and Channel Tunnel; Felixstowe and Southampton; Thames and Medway; and Humber. Complementary Case Studies also examined imports of four food commodity groups: frozen meat and fish; citrus fruits; sugar; and palm oil.

In support of the **Final Report** which contains the overall findings, conclusions and recommendations of the project; **Annex 1** reports on food and drink data; **Annex 2** sets the scene with essential background information about UK food and drink supply chains; and **Annexes 3 to 10** contain the findings, conclusions and recommendations arising from the individual Case Studies.

### 2.2 Work programme

The work programme for each Case Study had these three objectives:

- Determine the extent to which particular features of domestic and international transport infrastructure and food supply chains are likely to ameliorate / exacerbate the impact of UK port disruption on the supply of food imports into the UK
- Determine the extent to which UK food (import) security is contingent upon the resilience of overseas port infrastructure (both within and without EU waters, and now and in the future)
- Explore the behaviour, over the short to medium run (up to six months), of individual port operators, shipping companies and land-based logistics and food supply chain agents in the event of port disruption.

The programme therefore had the following principal steps:

- Desktop analysis and scoping discussions with industry specialists
- Review of HMRC / Defra imports tonnage data for 2010
- Identification of stakeholders willing to participate in the research
- Work with stakeholders to compile an accurate description of their 'as-is' import scenarios (in terms of product origins, modal formats, volumes, services used and frequencies, etc.)
- Understand stakeholders' approach to ensuring consistent supply and review strategies already in place (or planned) to mitigate likely possible effects of port disruption
- Report on findings to Defra and provide feedback to the stakeholders.

When the research started in September 2011, the most recent complete year for which statistics were available was 2010, so this was chosen as the preferred sample year. Also, in order to understand the physical dimensions of the flows, data about volumes (in tonnes) was chosen in preference to data about values. Maintenance of commercial confidentiality was a key concern and in line with this the identity of participating stakeholders has not been published.

### 3. UK FOOD AND DRINK DEMAND

The overall UK situation is illustrated in **Figure 3.1 UK Food Chain Schematic** overleaf, which is based on Chart 7.2 of Defra's *Agriculture in the UK 2010* Report. It shows how UK consumer demand for food and drink (including alcohol) was met through the two channels of retail and catering. These channels were supported in turn by food and drink manufacturers, either directly or through wholesalers, with original supply coming from either UK domestic production or imports.

Both the retail and the catering channels are complex, comprising a range of different entity types and business models. The term 'foodservice' can describe catering outlets (e.g. hotels, restaurants, clubs, pubs, bars, offices, schools, hospitals) or the wholesale distribution operations that support them.

With the above observations in mind, Section 3 groups its research findings under the generic headings of 1) 'grocery retail' when discussing those products bought for consumption in the home; and 2) 'foodservice' for those bought for consumption outside the home. Although these classifications are not exact and can overlap at times, they do provide a suitable structure for a review of key features and trends emerging from the research.

#### 3.1 Grocery retail

Innovation in supply chain strategy and logistics operations has been a major contributor to the commercial success of the UK grocery retail sector during the past fifty years. This success saw a shift in power from food and drink manufacturers to the retailers as they provided and managed the interface with the UK consumer.

Against this background, the key features and trends in grocery retail that became evident during the research, particularly as they have affected food and drink supply, are summarised below:

- **UK grocery retail is dominated by the major multiples.** This has given them the scale and the buying power to dictate how their suppliers should work, including supply of own label as well as branded products. The retailers have also been able to create supply chain networks for efficient, cost-effective operations that give high levels of on-shelf availability for an increased range.

On the other hand, perhaps partly as a reaction to this dominance, the UK retail sector has also seen the emergence of independent food and drink specialists, relying on wholesale distributors.

- However, the leading supermarkets have progressively entered the domains of (independent) specialists. This has led to **retail innovations** such as in-store bakeries, meat and fish or cheese counters, sale of alcohol drinks, and convenience foods. It should be noted though that product ranges might be more restricted than hitherto – for example, while a traditional fishmonger might have retailed thirty different species, a retailer fish counter would feature no more than a dozen.
- **Store formats** have also changed. Having started with high street locations in the 1960s, and then encouraged out of town shopping with large store formats up to hypermarket level, more recently smaller urban store formats have been developed to capture other retail opportunities.
- **Store layouts** have seen a reduction in back-of-store receiving and storage space in order to maximise the sales area within a store's overall building footprint.
- **Consumer requirements and tastes** evolve continually, often with the assistance of retailers' sophisticated marketing campaigns. Important (sometimes conflicting) elements include variety, availability, affordability, food quality and safety, and reassurance about sustainable sourcing.
- Elements of the **mainline retailers' response** to these consumer demands have included:
  - Variety. Wider ranges of foods to include ethnic foods, local and regional foods, value ranges, premium ranges, indulgence lines, convenience foods, ready meals and prepared foods, fresh foods and juices, and more chilled products

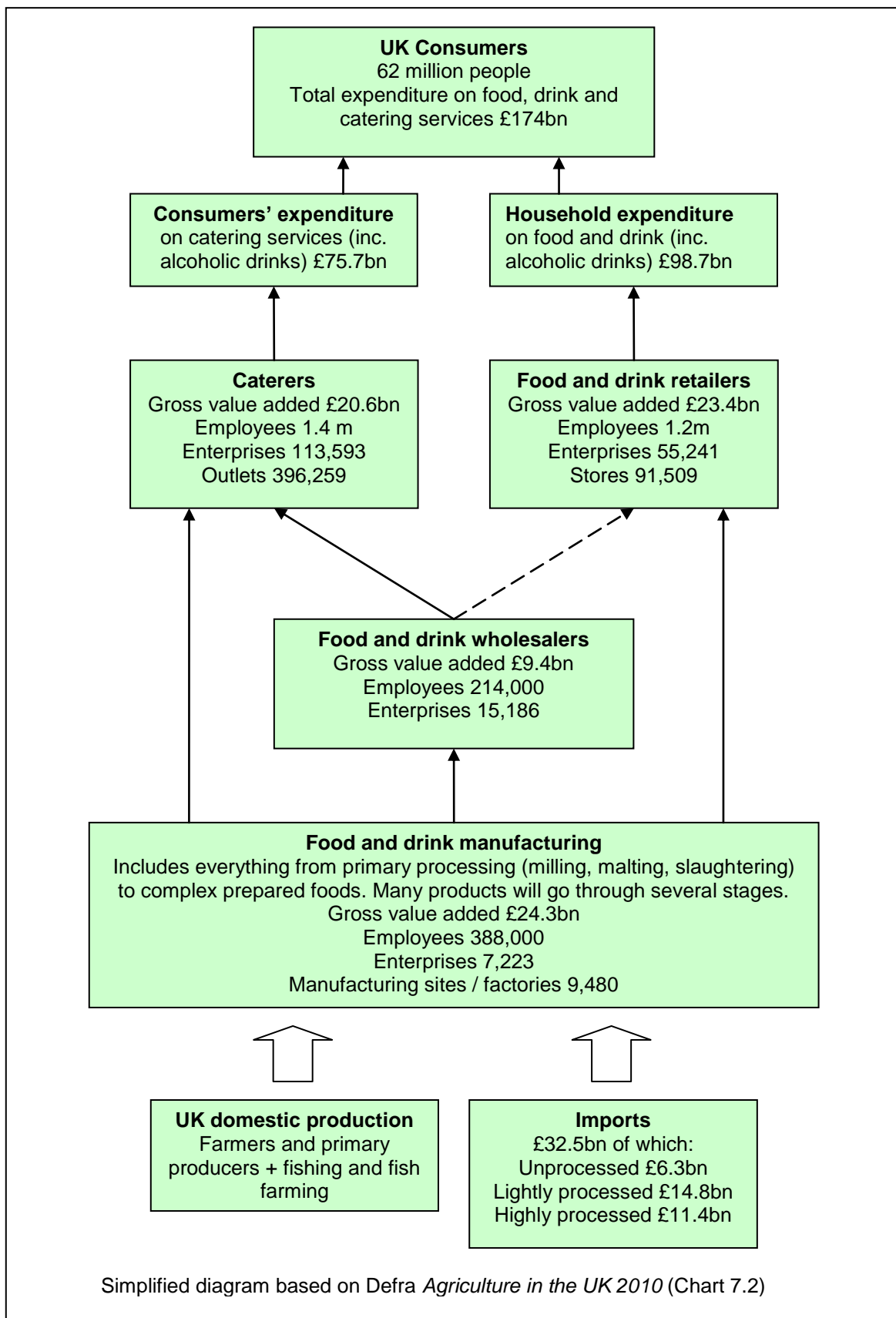
- Availability. High levels of on shelf availability (with no stock-outs) for all ranges and categories, and all year-round supply to include out-of-season fruits and vegetables
  - Affordability. Competition with discount retailers, price promotions, retailer own label lines as an alternative to branded products, value lines
  - Food quality and safety. Ingredients labelling, nutrition information, 'display until' dates, 'best before' dates, 'use by' dates, storage requirements, access to consumer carelines, traffic light labels and initiatives such as '5 a day' to encourage healthy eating. These developments have gone beyond regulatory compliance
  - Sustainable and ethical sourcing. Origin labelling, certification (e.g. Fairtrade, Marine Stewardship Council, Rainforest Alliance), Food Assurance schemes (traceability). The focus on sustainability also affects the amount and type of food and drink packaging and its suitability for recycling.
- **Category management**, in which attention is given to individual food categories for such aspects as range changes or maintenance, store zoning and shelf layouts, and procurement negotiations with suppliers, has also become the norm for grocery retailing. The following simplified list illustrates how different products can be grouped into a series of food or drink categories that share a number of common characteristics:
    - Bakery. In-store bakery, (bought-in) bread and cakes
    - Beer, wine and spirits
    - Fresh foods
      - Counters such as cheese and delicatessen, fish, or meat
      - Dairy and chilled convenience foods
      - Meat, fish and poultry
      - Produce and floral
    - Grocery
      - Beverages
      - Cereals
      - Cooking and canned foods
      - Frozen foods
    - Impulse foods
      - Biscuits
      - Confectionery
      - Crisps, snacks and nuts
      - Soft drinks

As noted above, this is a simplified list but it does provide an insight into current retail thinking about how logical groupings of products assist both sale to consumers and management of suppliers. Within each of these categories industry leaders are seeking responsible sourcing, security of supply, true cost-efficiency, and enhanced product quality.

- **Time compression** is a final aspect to be noted. At store level there is pressure to have stock on the shelves where it can be sold, rather than in back room storage. Sales trigger replenishment orders so that stock is pulled from suppliers as required. However, because there is very little reserve stock held at store level, future sales rely on rapid replenishment from these suppliers.

Retailer response to consumer demand therefore has a critical **impact on food and drink suppliers** and on their supply chains, both in terms of responsiveness and technical characteristics (e.g. temperature and atmosphere control). This is particularly the case for short shelf-life products. Also at a strategic level, product life cycles may be shorter with a need for product innovation, re-branding and / or re-packaging. There is also a continual pressure to keep supply costs to a minimum.

**Figure 3.1 UK Food Chain Schematic 2010**



## 3.2 Foodservice

The catering sector has witnessed significant change over the past fifty years. Features include an increased number of outlets; emergence of chains and global brands in catering, hotels and fast foods; the closure of many UK pubs and the shift of the remainder from 'wet trade' to meal provision; and foodservice supply from regional or national contract suppliers instead of from local providers (such as bakers, butchers, and fishmongers).

On the other hand, the catering sector has evidently seen the appearance of smaller, independent businesses. This is suggested by **Figure 3.1 UK Food Chain Schematic 2010**, which reported over 113,000 sector enterprises with nearly 400,000 outlets in the UK.

The net result is that consumer demand is being met through a wide range of different catering service providers. Consequent innovation in foodservice supply chain strategy and logistics operations has often imitated that of the UK grocery retail sector. Network design has emphasised such things as wide product range, competitive pricing, ease of ordering, and prompt delivery.

Key features and trends evident from the research are summarised below:

- **Outlet types** vary considerably and their supply arrangements will depend in part on their ownership. For example, a national fast food chain may be supported by a national distribution network that delivers all their supplies for the next day or few days. Arrangements include:
  - Hotels and restaurants. Local, regional or national suppliers delivering daily
  - Fast food outlets. Supply network with consolidated delivery by store
  - Pubs and bars. Local, regional or national suppliers delivering periodically
  - Institutional locations: e.g. offices, schools, and hospitals. If catering services are provided by a chain, daily support is generally via national contracts
  - Airports and other terminal locations. Supply will include non-catering products
- **Frequent delivery** is often necessary because (temperature-controlled) storage at catering outlets is generally limited. This results in a requirement for daily delivery or at least several replenishment calls each week
- **Multi-drop delivery routes** are the norm for foodservice logistics. This is unlike retail store scenarios, where it is common to deliver a full vehicle load to a single location. The number of drops per route will be high when individual delivery (drop) sizes are small
- **A high degree of manual handling** is another feature. Each drop will typically comprise a number of drums, sacks, boxes, trays, and tubs or similar, often to call points with only pedestrian access. Return of empties may also be required, also needing manual handling
- **Site access** to the foodservice call point is often limited by such factors as narrow streets, vehicle height and / or weight restrictions, and unloading time restrictions. Access can also be affected by security restrictions. Permissions affect permitted vehicle type and size, as well as utilisation
- **Food safety and freshness** are key concerns. This means that food deliveries often require (multi-temperature) refrigerated vehicles. However, local noise regulations applying to operation of vehicle refrigeration units can restrict out-of-hours deliveries.



## 4. UK FOOD AND DRINK SUPPLY

Research findings on UK food and drink supply are summarised under these headings: Defra statistics (2010); UK agriculture; UK processing and manufacturing; UK food and drink imports.

### 4.1 Defra statistics (2010)

The following **Table 4.1** shows the 'starting point' data for the research. It is based on Defra's 'Agriculture in the UK 2010' and provides an overview of UK food supply volumes by commodity, measured in millions of tonnes. It shows UK production (value and volume) for the 2010 calendar year, plus imports, less exports, to give a final (new) figure to represent the food supply volume.

Category	Table ref	Commodity	Prod. Value £m	Volume million tonnes			
				Gross	+ Imp	- Exp	New
Arable	5.2	Wheat	1,683	14.8	1.1	3.3	12.7
	5.3	Barley	510	5.3	0.1	1.0	4.3
	5.4	Oats	63	0.7	<0.1	<0.1	0.6
	5.1	Rye, corn, triticale, maize	4	0.1	0.9	<0.1	1.0
	5.5	Oilseed rape	702	2.2	0.2	0.3	2.1
	5.6	Linseed	23	0.1	<0.1	<0.1	<0.1
	5.11	Potatoes	780	6.0	1.6	0.5	7.1
	5.7	Sugar beet (not for feed)	198	6.5	0.0	0.0	6.5
	5.8	Peas for stockfeed	12	0.1	0.0	0.0	0.1
	5.8	Beans for stockfeed	91	0.6	0.0	0.0	0.6
		<b>Total arable</b>	<b>4,066</b>	<b>36.4</b>	<b>4.1</b>	<b>5.4</b>	<b>35.1</b>
Other	5.7	Sugar (refined basis)	---	1.0	1.3	0.5	1.8
		<b>Total other</b>	<b>---</b>	<b>1.0</b>	<b>1.3</b>	<b>0.5</b>	<b>1.8</b>
Horti- culture	5.9	Fresh vegetables (inc. Channel Islands)	1,257	2.7	1.9	0.1	4.5
	5.12	Fresh fruit	574	0.4	3.2	0.1	3.5
	5.10	Plants and flowers		Not included			
		<b>Total horticultural</b>	<b>1,831</b>	<b>3.1</b>	<b>5.1</b>	<b>0.2</b>	<b>8.0</b>
Livestock	5.13	Beef and veal	2,191	0.9	0.3	0.1	1.1
	5.14	Pigmeat	984	0.7	0.8	0.2	1.4
	5.15	Mutton and lamb	970	0.3	0.1	0.1	0.3
	5.16	Poultrymeat	1,799	1.6	0.5	0.3	1.8
		<b>Total meat</b>	<b>5,944</b>	<b>3.5</b>	<b>1.7</b>	<b>0.7</b>	<b>4.6</b>
Dairy	5.17	Milk ( <i>litres</i> )	3,325	13.5	0.1	0.4	13.2
	5.18	Eggs for human consumption ( <i>dozens</i> )	561	0.8	0.2	<0.1	1.0
		<b>Total dairy</b>	<b>3,886</b>				

**Agricultural sectors**, as summarised in the above table, comprise arable farming (grains, oilseeds, potatoes, other root crops such as sugar beet, and pulses); horticulture (vegetables, fruit, and plants and flowers); livestock production (red meat and poultrymeat); and dairy farming, including eggs. This classification is useful for subsequent mapping and understanding the supply chains that have been created to move agricultural outputs to primary processing and then to secondary (or even tertiary) food processing and manufacturing.

**The geographic distribution** of these sectors across the UK has been shaped over many centuries by the land configuration and climatic conditions. In general terms the wetter, hillier, western half of the country is home to livestock rearing and dairy industries; while the drier, flatter landscapes of the eastern half have suited arable farming. Within this broad demarcation, certain areas have also become known for specific activities, such as fruit growing in Kent or the Vale of Evesham. Despite significant changes in agriculture in recent decades, this underlying structure still exists, with a consequent impact on the location of the associated food processing and manufacturing industries.

## 4.2 UK agriculture

Some of the key features of UK agriculture affecting food and drink supply are as follows:

- **Industrialised agriculture** is now the UK norm for cereals and root crops, with large-scale mechanised farms, intensive bulk transportation of farm outputs, and centralised primary processing, particularly across eastern England.
- **Other sectors** vary in type and scale. For example, dairy and beef herds such as those in the West Country are generally small, although often supplying large scale dairies or abattoirs. Welsh lamb production is similar. Pig-rearing can also be on a small scale, increasingly supplying specialist processing. However, poultry-rearing is often on an industrial scale, with some operations producing c.1.6 million chicks per week for rearing on some 90 grow out farms.
- **Relationships with retailers** have become important. Retailers have worked with UK farmers and growers to ensure quality and consistency of supply. One example is the supply of milling wheat for in-store bakeries, involving centralised storage and dedicated supply to and from mill. Another example has the UK grower also arranging out-of-season supply of vegetables from overseas growers, with attendant technical and logistical issues, in order to provide the retailer with year-round supply of suitable products.
- **Traceability** across the whole food supply chain is a key element that is tied in with consumer concerns about food safety and good agricultural practice. The Red Tractor Farm Assurance scheme logo is intended as a guarantee that the food has been produced and supplied to minimum welfare from farm to supermarket shelf. All the major supermarkets and an increasing number of catering outlets support a range of assured produce bearing this symbol.
- **Environmental and sustainability issues** in agriculture have also come to the fore, as exemplified by the voluntary measures outlined by the Campaign for the Farmed Environment's to protect the countryside, its wildlife, soils and water quality. Such initiatives, which include proper management of uncropped areas and field margins, are supported by the Royal Society for the Protection of Birds (RSPB) and similar organisations with a major influence on public perceptions and opinion.

### 4.3 UK processing and manufacturing

Moving downstream from agriculture, some of the key features of UK processing and manufacturing that impact on food and drink supply to retail, wholesale, and foodservice channels are as follows:

- **The food and drink manufacturing sector** includes everything from primary processing (e.g. refining, crushing, milling, malting, and slaughtering) to manufacture of complex prepared foods. The numbers are large, with >7,000 enterprises and c.9,500 manufacturing sites or factories across the UK. Also, individual categories have specific configurations that have evolved in response to different economic drivers.
- Although food and drink production is **geographically diverse**, from ice cream makers in Cornwall to whisky distilleries in Scotland, there are manufacturing clusters, such as in the Midlands or along the M62 corridor. Others are located near traditional sources of supply, for example fish and seafood production at Grimsby, and poultry processing in Norfolk.
- **Manufacturing footprints** vary considerably. In soft drinks, national manufacturers have multiple sites, all producing the same or similar products at plants that are in proximity to the consumer market areas. Brewing is increasingly dominated by global players with production concentrated on single national sites. UK bread baking has networks of large regional plant bakeries belonging to large national brands.
- Some companies focus on the **supply of ingredients**, in effect taking outputs from primary processing and putting them through a series of secondary processes before supplying them to tertiary stage food manufacturers. An example would be the production of yeast and bakery ingredients such as bread improvers, dough conditioners, and bakery mixes that are then supplied to plant or artisanal bakers or distributed via wholesale and foodservice channels.
- In line with this, although requirement for a particular ingredient might be relatively small, it could be a critical item for a particular recipe. This point is developed further in **Annex Reports 9 and 10**, on sugar and palm oil imports respectively.
- Many organisations work as part of a **global or at least pan-European operation**. For example, one large privately-owned agribusiness has a UK starches and sweeteners operation. The factory uses the UK wheat crop to produce glucose syrups, glucose-fructose syrups, and potable and industrial alcohol. However, it is one of ten similar sites across Europe and management decisions about production and supply will be made within this broader context.
- A single organisation may include **companies across multiple sub-sectors**. For example, one leading food manufacturer has an extensive brand portfolio with beverages, cereals, crisps, bread, sauces and Oriental foods. This spread might provide opportunities for supply chain collaboration when company interests coincide.
- Although it is often the large organisations that capture attention, **small companies** are also important, as illustrated by the situation in the UK's ice cream industry. One of the world's largest ice cream makers has c.40% of the UK market. However, especially within the past five to ten years, the UK has seen the emergence of a number of specialist makers that are competing with more established players through the offer of traditionally-made ice creams, using raw materials from regional creameries but using novel flavours.
- Many source their raw materials from both **domestic and overseas sources**, either because some critical items (e.g. cocoa) are not produced in the UK, or because supply (e.g. glucose syrups) which used to come mainly from the UK now comes from the Continent as well.

In addition, because climate change and the increasing incidence of extreme weather events have the potential to affect UK agricultural outputs, imported supplies, and primary transportation networks, the processing and manufacturing sector should include this in its future Business Continuity Planning and forward-facing policy development.

#### 4.4 UK wholesale

According to **Figure 3.1** food and drink wholesalers in the UK in 2010 numbered >15,000 enterprises, supplying both caterers, and to a lesser extent food and drink retailers.

Looking first at catering, foodservice suppliers have created full range national distribution networks to offer a next day delivery service across a wide range of categories in grocery, fresh, chilled and frozen foods, as well as non-food lines. In addition smaller, independent regional competitors are also widening their geographic reach to begin to offer a national service.

Other wholesalers have seized niche value added opportunities, such as the supply of prepared vegetables or meats to hotels, restaurants and institutions. Still others have concentrated on specialist areas such as fish, seafood, or poultry. Interestingly, while some tenants at the UK's wholesale markets have left, others have stayed to develop new opportunities, such as in Halal foods, or operate nationally but concentrate on drinks supply..

Wholesalers also supply independent food and drink retailers, including those with forecourt locations, including motorway service areas. Categories include not only grocery, dairy, chilled and frozen products, but also snack foods, crisps, nuts and confectionery.










All these wholesale operations depend on both domestic production and imported supply.

#### 4.5 UK food and drink imports

In **Figure 3.1** food and drink import values in 2010 are split between unprocessed (£6.3bn), lightly processed (£14.8bn), and highly processed (£11.4bn). With a total value of £32.5bn these import flows are obviously significant inputs both for UK processing and manufacturing as well as for UK consumers. Although the research Case Studies examined only selected port clusters and food commodities, relevant findings about the overall picture are as follows:

- **End-to-end management** of international food and drink supply chains can be complex as products are moved by different stakeholders through many processing and manufacturing steps from 'field to fork'. However, a number of players including some retailers, importers, and processors have taken the lead to create integrated management across the whole supply chain.
- Defra import statistics distinguish between **EU and non-EU supply**. As shown in the other Annex Reports, traffic that is shown as EU often originates in a non-EU country but is cleared (and stored / processed in some way) in an EU country before being brought into the UK.
- **EU sources** include Germany, the Netherlands, and Spain. Imports arrive mainly as accompanied or unaccompanied road trailer traffic on either short-sea ferry services or on Eurotunnel Shuttle services through the Channel Tunnel, although there are some (limited) alternatives by through train or short-sea container services, particularly from Spain.
- **Non-EU sources** include countries such as Australia and New Zealand, Argentina and Brazil, and South Africa depending on the food commodity and the season. Product might be shipped directly in bulk to UK processing facilities or as unit load container traffic to terminals at ports such as Southampton, Tilbury, or Felixstowe. Alternatively transhipped containers can arrive at UK ports including Immingham on feeder services from Continental ports such as Rotterdam.
- **Different temperature regimes** can apply across the supply chain, ranging from frozen regimes for meats and fish, to heated regimes for bananas. These scenarios will apply not only to transport but also to storage facilities at either end of the chain. Atmosphere control can also be required for transport and storage. For example, fruit importers offer ripening facilities in the UK as part of an integrated supply chain. In addition, other imports (e.g. sugar in containers or palletised beer, wines and spirits traffic) will travel as ambient temperature traffic.

Import modes of appearance vary as illustrated below in **Figure 4.1 Import Modes of Appearance**. It illustrates the basic scenarios and also shows how the researched Case Study commodities can be mapped against modal appearance.

	Roll on Roll off	Lift on Lift off	Liquid bulk
	<i>Meat, fish, citrus</i>	<i>Meat, fish, citrus</i>	<i>Palm oil</i>
Vessel			
Terminal			
Delivery			

Photographs © 2012: AAK, London Container Terminal; P&O Ferries; Maritime Transport; Solstor

The research identified the following main points about each mode of appearance:

- **Unit load Roll on / Roll off (RoRo) short sea ferry services** carrying road trailers, either as driver-accompanied or unaccompanied traffic.

Accompanied trailers can also enter the UK on the Eurotunnel Shuttle services via the Channel Tunnel. Ferry services that are designed to carry mainly unaccompanied traffic, in addition to road trailers, may also carry containers stacked on MAFI trailers.

Trailer types used for food traffic include curtain-sided vehicles, dry freight or refrigerated boxes, and food grade tanks. Dry product loads are usually palletised, and can comprise bulk pallet boxes or bags (typically 1 tonne capacity). Tank trailers are generally insulated and used to carry heated loads such as chocolate.

Also, because unaccompanied services have only limited accommodation for drivers they could not readily absorb any diverted accompanied traffic.

- **Unit load Lift on / Lift off (LoLo) container services.** Container types used for food traffic include dry freight or refrigerated boxes, and food grade tanks.

Dry and refrigerated container loads may be palletised or loaded loose. Variations include 'bag-in-a-box' lined containers able to receive a bulk load which is discharged by tipping at the final delivery point.

Deep sea services will carry containers of International Standards Organisation (ISO) dimensions (i.e. lengths of 20', 30', or 40', selected according to load density). Short sea services in Europe will carry 45' (= c.13.6 metre) length dry freight or refrigerated containers as well as the ISO types and sizes.

Intermodal swap bodies (also 13.6 metres long) are similar but have different lifting arrangements.

Once landed at a UK port, containers of either regime can be forwarded by road or rail (subject to rail loading gauges). Other, mainly ambient container traffic such as beer, wines and spirits will enter the UK as through rail traffic via the Channel Tunnel and unloaded at an inland terminal.

- **Bulk services** in dry bulk or liquid bulk vessels requiring discharge by crane or pump. Examples include raw cane sugar unloaded by shore-based grab crane or crude palm oil discharged by pumping equipment on the ship
- **Terminal facilities** are configured to suit the traffic, whether LoLo, RoRo or bulk.

LoLo handling facilities range from large gantry cranes and associated movement equipment at deep sea ports like Tilbury or Felixstowe, to more limited container gantries at inland rail terminals. Container terminals also need suitable hard-standing for loaded and empty container stacks, and electric plug-in points for reefer containers awaiting movement. Adequate Port Health and Border Inspection Post facilities are also essential.

A RoRo port which receives large volumes of unaccompanied traffic will need terminal tugs and tractors to move trailers on and off the ships, as well as extensive parking and marshalling areas. Reefer plug-in points are also required. Unaccompanied traffic profiles vary: for example Harwich receives refrigerated meat and fresh produce imports, while Purfleet receives high volumes of ambient food imports, along with significant numbers of tank containers of orange juice.

It can be seen from Section 4 that UK food and drink supply to both the grocery retail and catering channels is complex and that it depends first of all on relationships between domestic agricultural production, processing and manufacturing, and wholesale distribution. Although those required for agricultural production (such as animal feeds, fertiliser and fuels) have not been included in the discussion, the significance of imports for UK food and drink supply is clearly evident. Also, while modes of appearance fall into three main categories, each one has its own variations and associated characteristics.

## 5. UK SUPPLY CHAINS

Research findings on UK supply chains are summarised under these headings: overview; cool chain flows; cold chain flows; and difficulties and risks associated with current systems. It should be borne in mind that while Section 5 is focused on the UK, these domestic supply chains are in many cases either connected to, or part of global or, European supply chains, as described in **Annexes 7 to 10**. Hence the wider remit for this study to examine the potential effects of port disruption on food supply

### 5.1 Overview

The following overview highlights a number of key issues and trends that have influenced supply chain strategy and logistical operations in recent decades. The findings relate particularly to UK grocery retail because this sector has led much of the supply chain innovation which has also been the driver for consequential change in processing and manufacturing and other sectors.

- The **food and drink sector** is not homogenous. Every category is different based on unique characteristics such as technology, materials, temperature regime, shelf life, rate of sale, promotional practices, and market channel mix. The result of this situation is that every supply chain will have its specific configuration at global, regional or local level in response to the economic drivers.
- **Technical requirements** which have implications for packaging, storage and handling also come into play. For example, maintenance of on-shelf availability in the retail store requires being able to match high volumes of consumer demand for stone fruit, such as peaches, against the need to ensure optimum ripeness at the time that the consumer is ready to eat it. How the fruit ripens as it moves through the supply chain therefore has crucial importance.
- **Distribution networks**. Major multiple grocery retailers with support from third-party logistics service providers have led supply chain development over the past 40 years. They have taken advantage of technology revolutions in transport, materials handling, storage, information and communications, as well as deregulation in transportation. Centralisation and outsourcing have been key themes. Slower moving stock is held in national centres; faster moving items are held regionally, near the consumer. Networks have been designed around rapid flows of products and information.

Retailer networks vary as regards distribution centre numbers, types, and sizes. Typically, a retailer could have anywhere from 8 to 12 regional locations across the UK, usually with both ambient and chilled facilities. Building footprints can range from less than 50,000 sq. ft. to more than 500,000 square feet. They all operate 24 hours per day, 364 days of the year and might be operated in-house or by third-party contractors. In addition to these frontline support locations, there will be a number of additional dedicated or shared-user facilities operated by contractors who provide specialist (temperature-controlled) support for manufacturers, importers and retailers.

- **Inventory** has been moved progressively upstream. Sales areas in stores have increased so that back rooms have only limited ambient, fresh, chilled, and frozen capacity. Regional Distribution Centres (RDCs) have become essentially sortation centres for store-specific deliveries. RDCs typically now hold only limited ambient stock while chilled and fresh items are cross-docked daily. Frozen items are held centrally at strategic locations across the UK and then delivered either to RDC or direct to store as required. Regional consolidation centres have also come into play to receive stock from multiple suppliers and sort orders into RDC-specific deliveries.
- **Information flows** are critical. Centralised supply chain management permits a system-wide view of demand and supply that can be translated into operational logistics instructions. Demand data from the retail outlet are transmitted on a daily basis. Orders are placed on suppliers against short cycle times. Inbound primary flows from suppliers (e.g. manufacturers or importers) are monitored carefully. Stock levels, order picking, cross-dock and transportation activities at the consolidation and distribution centres are managed to ensure high levels of 'on-time in full' performance.
- **Time compression** is evident throughout the supply chain. Reduced cash-to-cash cycle time is a key underlying element for overall business success and this has been translated into a range of

time-related performance indicators for logistical management. Unnecessary time is regarded as wasted time that has an associated cost. This fact is a key factor in understanding why supply chains, often with an international dimension, are configured as they are, with strategically placed inventory aligned to rapid order flow and responsive distribution networks.

- In line with this focus on time, **handling regimes** now minimise the amount of manual handling and human intervention needed in the supply chain. Potatoes are now moved from the packing shed in re-usable moulded plastic bins that can be wheeled into the retail store and used as part of the display; soft drinks come from the factory on wheeled dollies ready for store display; and roll cages loaded at distribution centres have products in aisle sequence for unloading onto shelf.
- Finally, different product characteristics drive **different supply chain processes**. Short shelf life products which require next day delivery direct to store need agile supply chains to cope with consumer demand volatility. In contrast, the production processes of longer shelf life products can take advantage of lean manufacturing techniques as demand volatility can be buffered by inventory at strategic locations points across the supply chain. However, whatever the shelf life characteristics, the whole ethos of these processes is to 'pull' inventory as required, rather than 'push' what has already been made.

Importantly, these modern food and drink supply chains do not differentiate between domestic and imported supply. Wherever the source, product and information flows are expected to conform to the above ways of thinking and working.

In addition to providing the above overview, the research programme was also able to have a closer look at selected cool chain and cold chain flows, as described in the following sections.

## 5.2 Cool chain flows

UK cool chain flows include fresh and chilled products such as dairy and chilled convenience foods; meat and fish, including poultry; fruit and vegetables; and flowers. Although there may be individual variations, these products are all short shelf life and all require refrigeration. In principle, what is described below about cool chains in grocery also applies to foodservice. As a footnote, fresh milk supply to store is usually handled by separate dedicated cool distribution networks.

- **Primary cool chain networks** are generally operated by national third-party companies working under contract for customers in manufacturing and / or grocery retail. These operators often had small beginnings in a specific sector and location, such as fresh produce in the East of England or dairy products in Shropshire, and later expanded in terms of geography and spread of business to create their current network.
- Their **key role** is in the upstream supply chain, to link importers and manufacturers with retailers. Tasks for those involved, for example, with dairy and chilled convenience foods, include collection of finished products from suppliers, short-term storage if necessary, order picking, consolidation into vehicle loads, and then delivery as full loads to individual RDCs. Ongoing maintenance of on-line visibility of stock levels and order status for both supplier and retailer is also required.
- **Transport equipment** will be refrigerated, but because load densities are relatively light for chilled products such as sandwiches, vehicles may be of maximum legal size rather than maximum weight. On the other hand, vehicles carrying butter and fats or fresh produce will be maximum weight. There is also increasing use of double-deck trailers for some applications.
- **On arrival at the distribution centre** loads are cross-docked, unloaded on one side of the building as full loads of a specific product category (e.g. yoghurt), and then 'picked to zero' across a bank of store order locations, before being marshalled for outloading on the other side into full load (multiple category) store deliveries.
- **Onward movement** from RDC to retail store is then handled by multi-temperature store delivery vehicles that can transport ambient and chilled together; or chilled and frozen together. Vehicle types go up to maximum weight, rigid or articulated configurations, and there is also some use of double-deck equipment. RDC and transport operations might be in-house or contracted out.



- **Cycle times** are very short. For example, the total time between departure from the factory gate and arrival on the retail shelf can often be achieved within 12 to 24 hours in order to maximise shelf freshness at the retail outlet.

### 5.3 Cold chain flows

Frozen products have longer shelf life than (deep) chilled products and require storage and transport that operates at lower temperatures, down to -22°C depending on circumstances. In addition to raw materials for industrial processing and manufacturing (including non-food sectors), the cold chain handles finished products for retail and foodservice. These include meat and fish; fruits; vegetables; baked products; ice cream and desserts; pies and pizzas; ethnic foods; and prepared meals.

- **Cold chain networks** are operated by some of the broad range third-party service providers. These companies offer cold storage, transport, and / or other value added services such as blast freezing. Their contract base includes not only grocery retailers, but also manufacturers and others with a requirement to receive, store, and despatch both raw materials and finished products.
- As with cool chain operations, their **key role** is in the upstream supply chain, especially to support importers and manufacturers and then connect them with retailers. Cold chain tasks include receipt of containers from ports such as Tilbury, Felixstowe, and Southampton, de-stuffing, collection of raw materials and finished products by road trailer from UK and continental suppliers, storage, inventory management, order picking, consolidation, and full load delivery to RDCs.

Seasonal stock building is an important part of cold store operations, with the result that stock cover levels can often be measured in months, as opposed to days. As with cool operations, ongoing maintenance of on-line visibility of stock levels for both supplier and retailer is required, although now because of the length of the storage cycle instead of its shortness.

- **Transport equipment** will be refrigerated and even though loads and densities of manufactured products (particularly when configured for RDC delivery) can be less than for inbound raw materials, vehicles are nearly always maximum weight trailers. However, double-deck trailers are also used for some applications.
- In view of the consumer shift away from frozen towards chilled products, some retailer distribution networks will have only a few locations for **frozen storage**. Of these most will be single temperature facilities although those in less dense delivery regions, such as North East England or Scotland, may be multi-temperature composites. Other retailer networks have frozen capacity on all sites but then operate their temperature-controlled (chilled and frozen) traffic independently of their ambient traffic.

Whatever the network configuration, inbound frozen stock will be delivered directly from a manufacturer or from a consolidator in full loads for storage and subsequent picking and despatch to store. At this point in the supply chain, frozen stock holding can be anywhere from 7 to 20 days of stock cover depending on circumstances.

- **Onward movement** from the retailer (frozen or composite) DC to retail store is then handled by refrigerated delivery vehicles that will undertake either multi-drop all-frozen delivery to a number of stores, or multi-temperature delivery to one, or at most two, stores. Vehicle types will usually be maximum weight articulated configurations. RDC and transport operations might be in-house or contracted out.
- While storage cycles may be long, **delivery cycle times** to retailer Distribution Centres are short. For example, an order received by 12 noon on Day 1 will be delivered to the frozen DC on or before the evening of Day 2.

## 5.4 Difficulties and risks associated with current systems

The difficulties and risks that became apparent during the research are as follows:

- UK food and drink supply is **dependent on both domestic production and imports**, whether those imports are unprocessed, lightly processed, or highly processed. The supply chains involved are intertwined – for example, a manufacturing recipe will often require a wide range of ingredients and some will almost certainly come from overseas. So it is a mistake to think of domestic versus overseas production; the reality is that they are both important.
- **Supply chains are complex and tightly timed.** So it is not always apparent how disruption in one part of the system could affect another part. An instance would be if, as a result of port disruption either in continental Europe or in the UK, an unaccompanied RoRo ferry service were to be severely interrupted. This would mean that the connecting road tractors would be unable to keep to schedule. This could easily have a knock-on effect for other, related networks.
- While stocks of some products (such as frozen raw materials for food manufacture or items for seasonal holiday demand) can be substantial, the overall message is that a **policy of low stock levels brings a risk of failure to supply**. The policy is understandable: it is driven by focus on optimal cash-to-cash cycle times and best use of working capital; it is encouraged by consumer demand for short shelf life products; and it is enabled by sophisticated logistics.
- The **dependency on sophisticated logistics** involves movements by air (although out-of-scope for this study), sea, and land (road, rail, and inland waterway in Europe). These modes are all subject to factors such as rising fuel costs, increasing incidence of extreme weather events, or labour unrest. Logistics is also dependent on effective, reliable information and communication technologies and it must be assumed that cyber crime is another potential source of disruption.

This is not an exhaustive list as it does not consider any of the wider political, economic, or climatic issues that could compromise either the domestic market or an overseas supply market. It does however draw attention to key difficulties and risks that could affect UK food and drink supply chains.

## 6. CONCLUSIONS

**This preliminary research showed the inter-dependence of the various segments of UK food and drink supply. It also found that supply is dependent on both domestic and imported supply. Supply chains are highly effective but also complex and tightly-timed. They are dependent on sophisticated logistics networks and processes. Risks come from inventory management policies that keep stocks as low as possible and from external factors that could impact adversely on the integrity of logistics operational capability in the UK or overseas.**

The research also demonstrated the value of looking at supply chains on an individual basis. As was noted in Section 5, the food and drink sector is not homogenous. Every category has its unique characteristics with the result that every supply chain will have its own specific configuration at global, regional or local level.

Therefore, following on from this high-level description of UK food and drink supply chains, **Annexes 3 to 10** report on the Case Study evidence compiled about four UK port clusters: the Dover Corridor; Felixstowe and Southampton; the Thames and the Medway; and the Humber. **Annexes 7 to 10** then report the Case Study evidence about four food commodity import groups: (frozen) meat and fish; citrus fruit; sugar; and palm oil. These are significant supplies for some or all of the following: food processing and manufacture; manufacture of soft drinks; foodservice; and grocery retailing.

The three objectives of these Case Studies were as follows:

1. Determine the extent to which particular features of domestic and international transport infrastructure and food supply chains are likely to ameliorate / exacerbate the impact of UK port disruption on the supply of food imports into the UK
2. Determine the extent to which UK food (import) security is contingent upon the resilience of overseas port infrastructure (both within and without EU waters, and now and in the future)
3. Explore the behaviour, over the short to medium run (up to six months), of individual port operators, shipping companies and land-based logistics and food supply chain agents in the event of port disruption

The work programme demonstrated that it is feasible to gather reliable information from industry stakeholders (despite some initial reservations) about UK import flows. Data quality (i.e. definition, completeness, accuracy, etc.) also caused some concerns at times during the research but overall the evidence gathered is believed to be reliable.

This leads to the conclusion that research of this type – as opposed to data analysis in isolation – has significant value. In fact it is probably the only way to acquire adequate understanding of what is happening and why in the supply chain. It is also recognised that the macro-economic environment is continually changing and that it will be important to stay up to date and regularly refresh knowledge and understanding. This can be expected to enable effective scenario planning for risk mitigation.

## **7. MESSAGES AND FINDINGS**

The recommendations arising from the research are as follows:

1. A suitable framework and forum must be devised in which industry stakeholders can be persuaded to share information about their Business Continuity Planning processes and conclusions.
2. More should be done to help all the stakeholders involved in UK food and drink supply to have a broader view of the industrial landscape in order to discover new perspectives. At present, most individual managers are too busy with daily transactional tasks to be able to stand back and see the bigger picture and understand how they might then cope with unforeseen situations.
3. A scenario planning exercise combined with detailed modelling is required to evaluate business risk. The complexity of supply chain networks argues for scenario planning based on adequate information and understanding. Only by working at individual flow level is it possible to obtain this.

## Appendix I: UK Agricultural Outputs 2010

### Land use

Overall	Land area m ha	Land area %	Agricultural land area in UK = 75.9% of total 24.1m ha
Agricultural holdings	17.1	93.4	
Common rough grazing	1.2	6.6	
<b>Total agricultural land area</b>	<b>18.3</b>	<b>100.0</b>	
Allocation			
Croppable	6.0	35.1	
Permanent grass	10.0	58.5	
Other (e.g. woodland)	1.1	6.4	
<b>Total holdings</b>	<b>17.1</b>	<b>100.0</b>	

Source: Defra 'Agriculture in the United Kingdom 2010'

### Crops in 2010 calendar year

Commodity		Land area m ha	Land area %	Production volume Tonnes**	Value £m	Value %
Cereals	Wheat	1.9	73.33	14,878,000	1,683	69.0
	Barley	0.9		5,252,000	510	
	Oats	0.1		685,000	63	
	Rye, mixed corn, triticale, maize	0.2		132,000	4	
Oilseeds	Oilseed rape	0.6		2,230,000	702	
	Linseed	<0.1		72,000	23	
Potatoes		0.1		6,045,000	780	
Other arable	Sugar beet (not for feed)	0.1		6,484,000	198	
	Peas and beans (stockfeed)	0.2		660,000	103	
<b>Total arable</b>		<b>4.4</b>		<b>73.33</b>	<b>36,438,000</b>	
Fresh vegetables (inc. open + protected)*		0.1	3.33	2,712,000	1,257	31.0
Fresh fruit (inc. orchard and soft)		< 0.1		421,000	574	
Plants and flowers		< 0.1		Na	Na	
<b>Total horticultural</b>		<b>0.2</b>	<b>3.33</b>	<b>3,133,000</b>	<b>1,831</b>	<b>31.0</b>
Temporary grassland		1.2	23.33			Na
Uncropped		0.2		Na	Na	
<b>Total other</b>		<b>1.4</b>	<b>23.33</b>	<b>Na</b>	<b>Na</b>	<b>Na</b>
<b>Total</b>		<b>6.0</b>	<b>100.0</b>	<b>39,571,000</b>	<b>5,897</b>	<b>100.0</b>

Source: Defra 'Agriculture in the United Kingdom 2010'; figures as at June 2010.

\*\*listing provisional 2010 figures. Values £m are on a "value of production at market prices basis, excluding all subsidies and levies where applicable".

\* Fresh vegetables: cabbages, carrots, cauliflowers, lettuces, mushrooms, peas, tomatoes, etc.

### Livestock in 2010 calendar year

Category	Population	Products	Volume (tonnes)	Value £m	Value %
Cattle and calves	10,112,000	Beef and veal	898,000	2,191	22.3
		Milk	13,540,000 litres	3,325	33.8
Pigs	4,460,000	Pigmeat	712,000	984	10.0
Sheep and lambs	31,084,000	Mutton and lamb	287,000	970	9.9
Poultry	163,867,000	Poultrymeat	1,573,000	1,799	18.3
		Eggs***	826 million dozen	561	5.7
<b>Total</b>				<b>9,830</b>	<b>100.0</b>

Source: Defra 'Agriculture in the United Kingdom 2010'. Values £m are on a "value of production at market prices basis, excluding all subsidies and levies where applicable".

\*\* Milk products: butter, cheese, cream, eggs, condensed milk, milk powders

\*\*\* Eggs for human consumption only (total production volume 949 million dozen)

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**Peter Baker**, the founder and owner of PRB Associates, specialises in operational, financial and market analysis in the ports and shipping sectors; with working experience in the ports sector and in RoRo ferry operations.

In addition to a range of project commissions in the UK and internationally, Peter has researched and produced the '*UK Short Sea Freight RoRo and LoLo Capacity Analysis and Report*' every year since 2000 and for the first time in 2009 produced an Irish equivalent. The report and database information provide a detailed analysis and assessment of the capacity provision and spread in the market, with comprehensive route, service, vessel and port information contained in detailed appendices.

**PRB Associates Limited** specialises in providing shipping and transport consultancy and analysis services for private and public sector organisations. Founded in 1998, PRB Associates has successfully completed commissions for freight generators, freight transport service providers (shipping lines and road transport operators), port operators and various public sector organisations. Assignments have ranged from service analyses, feasibility studies, financial modelling and economic impact studies, to market research and appraisal and national transport strategy formulation.



**Andrew Morgan**, the founder of Global 78, has extensive international business and logistics experience gained in projects across many industrial sectors, including food supply projects in Europe, Brazil and India. These advisory and implementation projects have ranged in scope from agri-business, through manufacturing and processing, to wholesale and retail distribution in final consumer markets.

A Chartered Member of the Chartered Institute of Logistics and Transport (UK), Andrew is the author of '*Making the Brazil Connection – managing risk in the international food supply chain*' and also co-author of the UKIBC Report '*India Agri-Food Supply Chains: Overview and Opportunities*'.

**Global 78 Limited** is focused on helping commercial clients discover new perspectives for success in local and international markets and for delivery of real bottom-line improvements. It also undertakes research for public sector policy-making. Food supply chains are complex. Innovation, resilience and sustainability are all vital elements for successful policy, strategy, and operations. The Global 78 team therefore provides clients with quality research, specialist advice, and support for implementation.

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