DEFRA PROJECT FO0108

RESILIENCE OF THE FOOD SUPPLY TO PORT DISRUPTION

FINAL ANNEX REPORT 10:
UK PALM OIL IMPORTS
September 2012

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Contents

1. EXECUTIVE SUMMARY

The UK is heavily dependent on import of palm (kernel) oil, its fractions and derivatives, both for food manufacturing and processing; and a wide range of non-food industrial applications. Despite concerns about sustainability, world demand has grown exponentially since 1990 with the EU (incl. UK) receiving c.14% of all imports. UK refining capacity is located on the Humber, on the Thames, and at Liverpool but is small in comparison with Continental capacity.

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* which indicated that there were evidence gaps about UK port capabilities and food imports.

A further research report entitled *Mapping and Understanding the UK Palm Oil Supply Chain* was completed by Proforest for Defra in April 2011 and its findings taken into account in this research.

The project was undertaken by Peter Baker (PRB Associates) and Andrew Morgan (Global 78). This Annex Report contains the principal findings, recommendations and conclusions arising from their research on palm oil imports. Additional relevant information will be found in Annexes 3 to 6.

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:

Table 1.1 UK Palm Oil Imports 2010

Code	Description	Non-EU tonnes k	EU tonnes k	Total tonnes k
#1511	Palm oil + fractions	352.3	64.0	**416.3**
#1513	Other oils	42.1	22.0	**64.1**
	Total	**394.4**	**86.0**	**480.4**

- Crude palm oil and crude palm kernel oil for refining in the UK or continental Europe can come from a wide range of world suppliers: including Malaysia, Indonesia, Colombia, and Costa Rica. Principal UK ports of entry for these 'general' flows are Hull and London (AAK Ltd. and ADM Ltd. refineries respectively); principal Continental ports are Rotterdam, Brake and Hamburg

  Origin ports vary greatly in terms of capability, capacity and risk profile; arrival ports less so. The overall scale of the industry should provide flexibility to mitigate the effects of any port disruption in the UK or continental Europe but the leanness of supply chains could work against this

- Certified sustainable crude palm oil and crude palm kernel oil are shipped by New Britain Palm Oil Ltd from Papua New Guinea and the Solomon Islands to Liverpool (port and refinery). Origin ports are relatively small and undeveloped but the arrival port of Liverpool is far more resilient

- Crude oil will arrive in tankers of up to 50,000 tonnes capacity. In addition, (refined) product from Europe will arrive by coastal tanker (up to 4,000 tonnes); in ISO tank containers (25 tonnes) as unaccompanied RoRo traffic; or in road tank trailers (28 tonnes) as accompanied RoRo traffic.

- Because of its versatility, palm (kernel) oil, together with its fractions and derivatives, is used extensively in food (and non-food) manufacturing. There are reports that it appears in a third of products sold in a supermarket. Serious interruption of supply would have a rapid and widespread impact on product availability and choice for the consumer.

The research demonstrated that it is feasible to gather reliable information from industry stakeholders about UK palm oil import flows. Only by working at individual flow level is it possible to obtain the essential understanding to assess and mitigate supply risk. However, industry stakeholders will need to be persuaded about the merits of revealing information about their Business Continuity Planning.

2. INTRODUCTION

2.1 Overview

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) which indicated evidence gaps about UK port capabilities and food imports; and PRB Associates' follow-up report published in September 2009, *Background to Defra's Assessment of UK Food Security*.

The findings the research report entitled *Mapping and Understanding the UK Palm Oil Supply Chain* and completed for Defra by Proforest in April 2011 were also taken into account in the current work.

The research included a series of food commodity Case Studies on imports of frozen meat and fish; citrus fruits; sugar; and palm oil. This Annex Report contains the principal findings, recommendations and conclusions arising from the research on palm oil imports.

2.2 Background

The oil palm grows in the tropical regions of Asia, Africa and South America. Indonesia and Malaysia are the world's leading producers of palm oil, palm kernel oil and palm kernel meal. Palm fruits are harvested year round and are then crushed to extract the oil which can be further processed to produce a wide range of materials for food and non-food industrial applications. These uses take advantage of the (very different) chemical properties of palm oil and palm kernel oil.

In addition, palm oil and palm kernel meal are used by animal feed compounders in the production of commercial animal feeds, commercial fish food, and domestic pet foods. Palm oil is also used as a biofuel feedstock. For example, in order to reduce its energy costs, Brazilian mining giant Vale has recently announced plans to grow oil palm on 170,000 hectares of cleared land in the Amazon region state of Pará to feed the world's largest single palm oil processing plant.

There is significant competition for supply. A relatively low-cost vegetable oil to produce, palm oil is used widely as a food ingredient and as cooking oil, with c.25% of palm oil production used domestically. Europe (including the UK) receives c.14% of world exports each year.

Typical industrial applications for palm (or palm kernel) oil include the manufacture of oils and fats for:

- Food processing: frying fats, cooking oil, margarine and spreads, mayonnaise, sauces, ice cream, shortenings, bakery items, confectionery, etc.
- Cosmetics, detergents and soaps
- Chemicals, paint, lubricants, grease, etc.

Food labelling often describes palm oil as 'vegetable oil' so it becomes, in effect, an 'invisible ingredient'. However, a Unilever advertisement in April 2010 encouraging sustainability noted "more than one in three of the products you buy in your weekly shop contain palm oil".

To meet rapidly growing world demand, the land area under cultivation has increased dramatically over the last 20 years. This has led to rainforest clearance and has also encroached on natural habitats of headline species such as the orangutan. Sustainability issues have therefore come to the fore and many leading growers, refiners, food processors, consumer products manufacturers, and retailers have seen the value of involvement with the Roundtable for Sustainable Palm Oil (RSPO).

3. WORK PROGRAMME

The work programme for this Case Study had these 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 such 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 the 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 will not be published. However, this Annex Report does include information about key players in the industry from material already in the public domain.

The following **Table 3.1 Palm Oil Case Study Evidence Base** provides an overview:

	Number
Participating organisations – industry sector players	9
Participating organisations – logistics services providers	6
Total participating organisations	**15**
Web based evidence; hard and grey literature	26
Site visits / face-to-face interviews	7
Telephone interviews	4
Additional major inputs requested from participants	5
Total items in the evidence base	**42**

This activity summary excludes the considerable effort required to initiate communication, encourage participation, and also to arrange conference calls and meetings. It should be noted that while some organisations responded quickly and favourably to the initial invitation to participate, others responded more slowly and needed encouragement, often over several months, to participate.

4. RESULTS

Research findings are summarised under these headings: Defra import statistics (2010); palm (kernel) oil production and supply; UK industry players; UK import flows; and UK palm (kernel) oil demand by industry segment.

4.1 Defra import statistics (2010)

The following **Table 4.1 Palm Oil Imports** shows the 'starting point' data for the research:

Code	Description	Felix.	Soton.	T/port	London	Hull	L/pool	Belfast	Other ports	Non EU tonnes k	EU tonnes k	Total tonnes k
#1511	Palm oil + fractions	0.7			78.6	206.1	62.8	4.1		**352.3**	64.0	**416.3**
#1513	Other oils		0.1		20.9	17.5	2.0	1.6		**42.1**	22.0	**64.1**
	Total tonnes k	**0.7**	**0.1**	**0.0**	**99.5**	**223.6**	**64.8**	**5.7**	**0.0**	**394.4**	**86.0**	**480.4**
	Non EU tonnes % by port	0.2%	0.0%	0.0%	25.2%	56.7%	16.4%	1.4%	0.0%	**100.0%**		
									Non EU vs EU tonnes %	82.1%	17.9%	**100.0%**

	Ports
1	Felixstowe
2	Southampton
3	Thamesport
4	London
5	Hull
6	Liverpool
7	Belfast
8	Other ports

It will be noted that there are only two high-level commodity codes (with abbreviated official descriptions) relating to either palm oil or palm kernel oil. Code #1511 comprises palm oil and its fractions, whether or not refined. Code #1513 includes coconut oil, palm kernel oil, and babassu oil, and their fractions, whether or not refined. Both codes include oils for both food and non-food uses; and solid as well as liquid fractions.

As shown above small amounts (both codes) arrived as non-EU containerised traffic at Felixstowe or Southampton. However, Hull is the principal port of arrival for non-EU imports of both codes, followed by London and Liverpool. The consultants' expectation from pre-project information received was that Hull imports would centre on AAK; London on ADM; and Liverpool on New Britain Oils.

Code #1512 was not included in the selection, as this code refers only to oils derived from sunflower seeds, safflower or cotton. Also excluded were finished food or non-food products manufactured or processed outside the UK that contain either palm oil, palm kernel oil, their fractions or derivatives.

An initial concern was that the above high-level information about UK palm (kernel) imports differed significantly from that previously presented as Key Findings of the Proforest Report, namely:

- UK imports of palm oil (2009): 595,000 tonnes
- UK imports of palm kernel oil (2009): 45,000 tonnes

However, FAOSTAT had reported:

- UK imports of palm oil (2009): 448,281 tonnes
- UK imports of palm kernel oil (2009): 61,988 tonnes

Although the FAO statistics related to 2009, they confirm the overall position and it was therefore assumed that the Defra data for 2010 in **Table 4.1** provided a reliable basis for the research.

Subsequent analysis of the detailed 2010 UK imports statistics for codes #1511 and #1513 supported this assumption. The analysis found the following totals: code #1511 = 419,937 tonnes and code #1513 = 63,846 tonnes. Both of which were close to those in **Table 4.1** and it was felt too that the variances could be attributed either to rounding errors or a slight difference in data selection criteria.

This analysis also led to the following conclusions:

- The palm oil (code #1511) volumes (tonnes) include imports for both food and non-food uses: food uses account for 93% and non-food for 7%. In view of the dominance of food imports, it was decided that this research would assess the overall import volume rather than try to distinguish food flows from non-food flows

- Code #1513 included both coconut oil and palm kernel oil imports. Breaking the total volume into its two components it was found that coconut oil (in various formats) accounted for 18,668 tonnes and that palm kernel oil (in various formats) accounted for 45,178 tonnes. These volumes represented 29% and 71% respectively of the combined volume of 63,846 tonnes

- Principal source countries for UK palm oil and palm kernel oil imports were Indonesia, Malaysia, and Papua New Guinea (non-EU); and the Netherlands and Germany (EU). Obviously imports from the EU would have originated in non-EU (tropical countries)

- Interview evidence suggests the need for more research into 1) import flows from EU countries and 2) arrivals on the Thames from non-EU origins. There are some anomalies in the currently available data sets that require resolution and for best effect this should not be restricted to palm (kernel) oil but also include the other edible oils.

4.2 Palm (kernel) oil production and supply

- The **oil palm** grows only in the tropical regions of Asia, Africa and South America. Commercial cultivation effectively began in the 19th Century, when palm kernel oil was an important industrial lubricant and a key component for making soap. Also, palm oil was widely used as cooking oil and as a food ingredient. Since then, the usage of both oils has grown exponentially to meet demand for many food and non-food applications, including production of biofuels.

  Indonesia and Malaysia are the leading producers (combined c.87% of world palm oil output), followed by Thailand, Colombia, Nigeria, Papua New Guinea, and Ecuador. The government of Malaysia had encouraged the development of that country's palm oil industry since the 1960s, and it is interesting to see that it is a Malaysian company that is the majority shareholder in New Britain Palm Oil Limited, the company now leading development of sustainable oil palm in Papua New Guinea and the Solomon Islands.

  The area under cultivation has increased dramatically in the last 20 years (approximately a 45% increase since 1990) to meet exponentially increasing global demand. According to FAOSTAT the global land area harvested for oil palm in 2010 was c.15 million hectares and the total amount of palm oil produced was c.45 million tonnes – this ratio taking into account the lower yields from smallholder production.

  Oil palms are highly efficient as oil producers, with over 50% of each fruit containing oil, so the palms require approximately ten times less land area than other oil producing crops. On average, 4 tonnes of palm oil per hectare per year are produced on a normal industrial plantation.

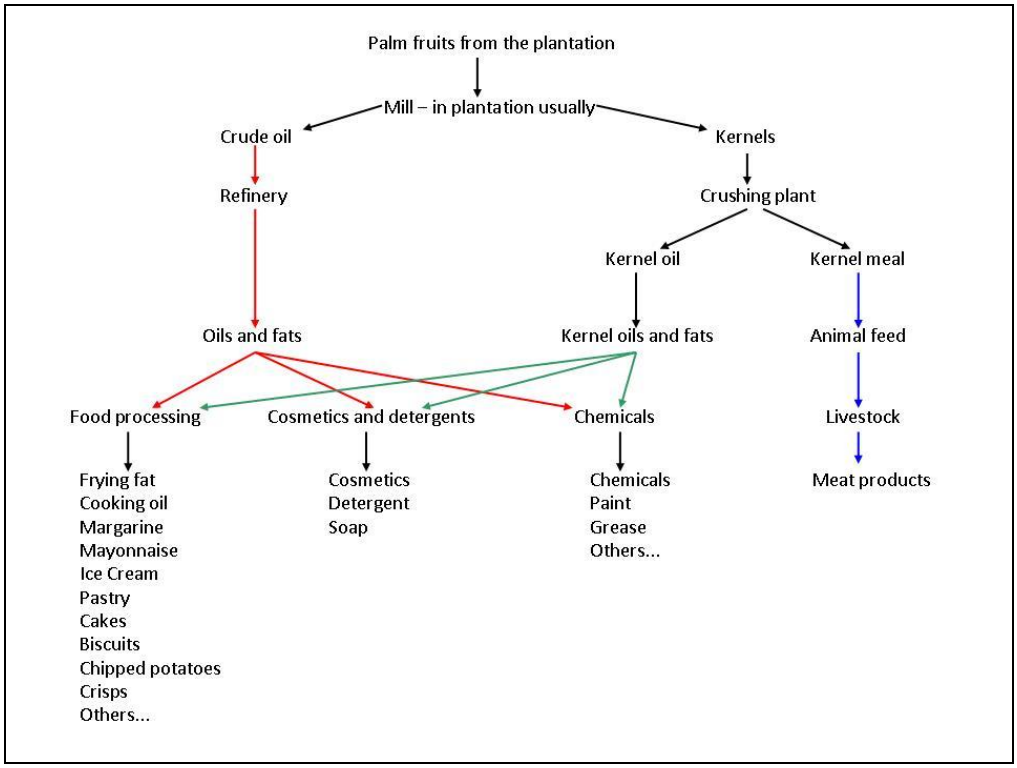
  After being grown in a nursery for up to 18 months, palms are planted into the field / plantation with fruiting occurring approximately 30 months later. Mature palms have an economic life of 20 to 30 years and produce 10 to15 fresh fruit bunches (FFB) each year, weighing on average 20kg and having up to two thousand 10g fruitlets (the fruitlet kernel is the source of palm kernel oil).

  Although there are peaks and troughs, harvesting occurs all the year round, producing a continuous supply of oil. Oil extraction has to occur immediately after harvesting because fruit bunches and fruitlets cannot be stored. Therefore plantations often have their own milling plant for immediate extraction. The oil is subsequently refined and fractionated, either in the country of origin or overseas, to give palm olein and palm stearin.

  Sustainability has become a major issue, particularly regarding the island of Borneo (shared by Malaysia and Indonesia), as a result of land clearance and new plantations to meet rapidly

growing world demand. Focus is on aspects such as rainforest destruction, hardwood extraction, ecological damage, the loss of natural habitats for species such as the orangutan, and the associated impact on indigenous peoples. As described in Section 5 the Roundtable for Sustainable Palm Oil (RSPO) was established in 2003.

Figure 4.1: Palm (Kernel) Oil Production and Supply below provides a simplified overview of the way in which palm fruits are transformed by primary processing into crude palm oil (CPO), crude palm kernel oil (PKO), and palm kernel meal (PKM); and then by secondary (and tertiary) processing into a wide range of fractions and derivatives for food and non-food industrial applications.



- **Palm oil** is a versatile, low production cost, widely-available vegetable oil that can be used both as cooking oil and as a food ingredient. It is becoming a significant feature of the increasing consumption of oils and fats in developing countries, a factor that boosts global demand. About 25% of palm oil production worldwide is used domestically, while the rest is exported. The biggest single importer is India (c.19%), followed by China (c.16%), and the EU (c.14%).

  It is used in such foods as margarine, shortening, cooking oil, soups, sauces, crackers and other baked goods, and confectionery products. The most widely-used oil after soybean oil it can be substituted for hard animal fats (butter and lard); for soy, olive, or canola liquid vegetable oils; and for partially hydrogenated vegetable oil, which is a staple of the baking, fast-food, and other industries.

  Its versatility for food manufacture is enhanced through fractionating. For example, when extracted (by pressing or boiling the fruit of the oil palm), palm oil is either yellow or red in colour, the latter reflecting its high carotene content. This characteristic is then maintained in the red palm olein used in frying oils to control the colour of fried foods.

  Although complying with EU regulations, palm oil often appears as ‘vegetable oil’ on food labels.

  Palm oil is also in demand for non-food industrial applications, including its use for the production of biodiesel. The full potential of palm oil as a biofuel has not yet been fully realized. However, its importance is emphasised through the presence of multinational petrochemical oil companies as members of the Roundtable on Sustainable Palm Oil (RSPO).

- **Palm kernel oil (PKO)**

  Although the properties of palm kernel oil are different from those of palm oil, it too is an important vegetable oil, particularly for non-food uses where its use is encouraged by its economic cost. It is high in myristic and lauric fatty acids, which are important for the manufacture of personal care products, detergents and soaps.

  Palm kernel oil is also used to make biodiesel. In this regard, the Malaysian government has actively supported production of biofuels through approvals for biodiesel refinery projects, as well as government regulations that require fuels to have a percentage biofuel content.

  World palm kernel oil imports are around 2.5 million tonnes with the EU as the biggest single importer (c.26%), followed by China (c.18%), and India (c.8%). It is important to note that palm oil and palm kernel oil are inter-dependent from a supply chain perspective.

- **Palm kernel meal**

  Palm kernel meal, a by-product of palm kernel oil extraction, is used mainly for animal feed both in the oil palm growing countries and in their export markets. It is a high-fibre, medium-grade protein feed component best suited to ruminants such as dairy cattle. As an indicator of volumes, Proforest reported that the UK imported some 660,000 tonnes of palm kernel meal in 2009, mainly from Indonesia.

- **Other edible oils**

  The world edible oils industry centres on the production of vegetable oils from palm, rape, sunflower seed and soya. To some degree the oils and fats derived from the different crops can be interchangeable, although it is evident from the foregoing description that each one has its own particular chemical properties and food manufacturing recipes have been developed accordingly. So it might not be as easy to substitute oils as sometimes stated in the event of supply disruption.

  Other edible oils include those from groundnut, coconut, linseed, cotton, sesamum, mustard, poppy, olive and maize (corn). While production and import quantities are nowhere near as high, these oils also have a range of food (and other) industry applications.

  Oils that are extracted from soya bean, sunflower seed, rapeseed (canola), or maize (corn) are also classified as soft oils.

  Although an individual oil seed crushing plant may be dedicated to a particular commodity such as rape or soya, its associated refinery may be processing a variety of other oils as well. Also feedstocks may come from domestic production (e.g. UK rape seed is crushed at ADM's plant at Erith) or overseas production (e.g. South American soya is crushed at Cargill's plant at Liverpool).

4.3 UK industry players

Even including companies in the wider UK edible oils arena, as opposed to those involved solely in palm oil extraction, processing and / or trading operations, it is apparent that the industry players are relatively few in number. The key players (in alphabetical order) are as follows:

- **AarhusKarlshamn UK (AAK), Hull** is a subsidiary of Sweden's AarhusKarlshamn AB, which is the world's leading manufacturer of high value-added speciality vegetable fats, including bulk cooking oil for foodservice suppliers. Its fats are used by the food, chocolate confectionery, and cosmetics industries. It also serves the industrial lubricants and animal feeds sectors.

  AAK services a number of food industry sectors including bakery, food manufacture, and foodservice with a wide range of speciality oils and fats. The bakery sector is supplied with cooking oils, margarines, fats, shortenings and emulsifiers; food manufacturers with a range of liquid, block, flaked and powdered fats, often formulated to meet specific requirements; and foodservice with a comprehensive range of frying oils.

Many of the above products are prepared from palm (kernel) oil or its fractions and derivatives. AAK's Hull refinery receives bulk shipments of crude oils at the adjacent King George Dock, from where they are pumped into holding tanks, as illustrated in **Annex 10, Appendix I**.

- **Archer Daniels Midland (ADM), Erith and Purfleet.** The US parent company is a publicly-quoted global food processing corporation with its headquarters in Decatur, Illinois and its agri-business competitors include Cargill. ADM's extensive interests in the UK and continental Europe include oilseed processing and its related activities.

  The **ADM Erith** site has the largest combinable crop processing plant in the UK, crushing c.40% of the domestic rape crop. Although the plant is located on the Thames and has river berths, most rape seed arrives by road. Annual oil output totals c.385,000 tonnes: supplying domestic and export markets, including biofuels; the adjacent ADM / Princes Foods joint venture **Edible Oils** bottling plant (supplying 70% of UK retailers' bottled oils requirements); and **Pura Foods** at Purfleet.

  The **ADM Pura Foods** site at Purfleet receives more than 300,000 tonnes of edible oils each year at its Jurgens Jetty on the north bank of the Thames. These include sunflower, rapeseed (including by barge from ADM Erith), palm and coconut oils. The plant comprises a mixed oils refinery and blending plant, together with an oils and fats packing facility (opened in 2005).

  Through **ADM Trading Ltd**, the site supplies c.45% of the UK's bulk oil requirements. It also supplies material to the adjacent **Unilever** margarine and spreads plant – reputed to be the largest in Europe (with a capacity of c.180,000 tonnes of margarine and spreads each year).

  These ADM facilities, combined with the nearby Edible Oils and Unilever factories, form an integrated and interdependent refining, blending and manufacturing complex. Port disruption on the Thames could in certain circumstances have very serious consequences for UK food supply.

- **Britannia Food Ingredients Ltd., Goole**, founded in 1996, is now owned by Singapore-based Olam International, a leading supplier in agricultural commodities, including cocoa. The UK company is a supplier of speciality fats to the chocolate, confectionery, ice cream, bakery, and snack food manufacturing sectors, where customised fat formulations are particularly important.

  Refined palm oil and its fractions are an important raw material for its customised blends. Blended products include filling fats based on palm fractions that are compatible with cocoa butter; frying oils that are based on palm olein; and general purpose fats that are suitable for toffee or dough preparation.

  Britannia Foods is a good example of a relatively small specialist company that supplies a wide customer base in UK food manufacturing. Customer recipes and specifications are precise; and orders will often be for small consignments on short lead times.

  Inbound raw material supply requirements can therefore both be complex and demand rapid response from palm oil refiners. Shipments are received overland from locations such as Harwich and Hull (tank containers on unaccompanied RoRo services) or Liverpool (road tank trailers).

- **Cargill, Witham St Hughs**. Cargill is the world's largest privately-owned commodities trader with extensive agri-business interests. The headquarters of the UK commercial divisions of Cargill's European refined oils, and grain and oilseed supply chain businesses, are located at Witham St Hughs in Lincolnshire. Operations managed include those at Hull and Liverpool.

  Cargill's plant in Hull crushes rapeseed and speciality crops to extract crude oil and mid protein meal for use in food applications (e.g. margarine), biodiesel, and animal feed. In Liverpool, the soya bean crush plant at the Royal Seaforth Dock produces crude soya oil and crude lecithin, together with high-protein soya meal and soya hulls. The rapeseed crush plant at Brocklebank Dock produces crude rape oil and mid-protein meal. The crush plant outputs are then developed (or refined) for use in the food or non-food industries, as well as for animal feed.

Although in terms of edible oils production Cargill's UK focus is on soya and rapeseed, rather than on palm, it is a key player in the overall oils market. It should also be noted that Cargill has extensive edible oils refining capacity in Rotterdam.

- **New Britain Oils, Liverpool** is owned by New Britain Palm Oil Ltd (NBPOL), a fully integrated industrial producer of sustainable palm oil operating five plantations in Papua New Guinea and one in the Solomon Islands. In 2010 the parent company produced some 479,000 tonnes of crude palm (kernel) oil, with c.90% shipped on US$ contracts to EU refineries in Germany, the Netherlands, and the UK.

  In February 2012, NBPOL announced the commissioning of a dedicated fractioning plant at its Kumbango refinery to supply Ferrero Group in Italy and the UK; the doubling of Liverpool refinery capacity; and expansion of its segregated supply chain model to Wilmar's refinery in Brake, Germany. The company also cites Jordans and United Biscuits as typical customers.

  With its fully segregated and traceable inbound supply chain, the Liverpool refinery is the UK's leading producer of certified sustainable palm oil and its derivatives. It supplies branded frying oils and bakery ingredients; as well as bulk material to food and personal care product manufacturers.

- Among other (non-UK) players to watch are **Sime Darby Unimills** and **Wilmar Edible Oils**, both of which have extensive storage and refining capacities in Rotterdam.

  Sime Darby has its roots in three British enterprises in Malaysia: Sime Darby (founded 1910), Kumpulan Guthrie Berhad (founded 1821), and Golden Hope (founded 1905). It is now Malaysia's leading multinational conglomerate involved in five core sectors: plantations, property, industrial, automotive, and energy and utilities. Sime Darby is one of the world's leading listed oil palm plantation groups, also having a significant presence in downstream palm oil activities.

  Wilmar International, Asia's leading agribusiness group, began in 1991 as a palm oil trading company. It is now a Singapore-based holding company with more than 400 subsidiaries. Activities include oil palm cultivation; oilseeds crushing; edible oils refining, processing and merchandising; speciality fats; oleochemicals; biodiesel production; as well as grains processing and merchandising. Its growth has included acquisition of certain interests held by Archer Daniels Midland Asia Pacific (ADM); and it also has a joint venture in Africa with Olam International.

4.4 UK import flows

A key to transporting palm oil is maintaining oil quality. As noted earlier, the fruits cannot be stored and so are milled on site or at least within the country of cultivation. Once milled/ crushed into an oil, the marker for quality is oil acidity. If the pH is to low then there is an excessive free fatty acid content, which will turn palm oil sour and cause discolouration.

Additionally, oils and fats can become rancid, which is promoted by light, oxygen and moisture. Oil tanks and barrels have to be filled as full as possible (with allowance for expansion with temperature). The maximum storage time is generally accepted as six months at a temperature of 30°C.

Palm oil is usually transported in tanks. It is exported from the major countries of supply by deep sea shipping (in tankers of up to 50,000 tonnes capacity or even larger). Within the countries of export / import transportation can be by coastal tanker (up to 4,000 tonnes); by rail: or by road (road tankers and ISO containers).

A major consideration in transportation of palm oil is the temperature at which it becomes solid. Oil needs to be liquid for loading / discharge. However, palm oil has a relatively high solidification range of 41 - 31°C. In the tropical countries where it is cultivated it is naturally liquid but in the temperate latitudes of the UK the oil can become "fatty" (solid) and so needs to be heated to maintain the liquid state. Transport and storage equipment therefore not only has to be food grade but also to be able to heat the cargo / maintain its temperature as appropriate. So, because it is solid at European ambient temperatures, liquid bulk crude palm (kernel) oil is shipped to Europe in tanker vessels and stored in tanks capable of heating it to 40°C before being pumped.

UK palm oil imports can be split into distinct flow types, each with its individual characteristics. The way they align with the Defra import classification that was described earlier is shown below:

Table 4.2: UK Palm Oil Import Flows		
Code	**Description**	**Import flow types (and source)**
#1511	Palm oil and its fractions	• Crude palm oil in liquid bulk for UK refining (non-EU) • Refined palm oil in bulk, containers, or road trailers (EU)
#1513	Other oils including palm kernel oil and its fractions	• Crude palm kernel oil in liquid bulk for UK refining (non-EU) • Refined palm kernel oil in bulk, containers, or road trailers (EU)

When undertaking a classification of these import flows it is necessary to distinguish between crude oils and refined oils. The former generally involves large consignments from tropical (i.e. non-EU sources), while the latter will usually comprise far smaller consignments, coming either from EU refineries or from EU bulk storage (if already refined in the non-EU country of origin).

Crude palm (kernel) oil arrival from non-EU sources will be in liquid bulk tanker vessels as illustrated in **Annex 10: Appendix I**. Deep sea vessel capacities can range from 20,000 to 50,000 tonnes (or more) and these can make a series of port calls in the UK and / or northern European ports; the actual port rotation varying according to circumstances. In order to limit shipping and handling costs, transhipment is kept to a minimum. However, smaller vessels of up to 5,000 tonnes can be used within European waters for movement to a refinery from a bulk storage terminal.

Refined products from EU refineries, such as those in the Netherlands of Germany, can arrive in a number of different formats. Larger bulk movements can be in coastal tankers with a capacity from 1,500 tonnes upwards; smaller bulk movements can be in either tank containers (c25 tonnes) or road tank trailers (c28 tonnes). Container movements in Europe will generally be in International Standards Organisation (ISO) 20’ or 30’ food-grade, heated and insulated tank containers. Container traffic will usually arrive on unaccompanied, and road tanker traffic on accompanied, RoRo ferry services.

- **Crude palm (kernel) oil:** in liquid bulk for UK refining (non-EU)

  Crude palm (kernel) oil for refining in the UK or continental Europe can come from a wide range of world suppliers, whether or not the plantations are certified as sustainable.

  Suppliers include the integrated industry leaders in Malaysia and Indonesia as well as suppliers in countries such as Colombia, Costa Rica, or Honduras. The principal UK port of entry for these ‘general’ flows is **Hull**, where AAK has its UK refinery; followed by **London** (Purfleet), where ADM has its Pura Foods mixed oils refinery. The principal Continental ports of entry are close to refineries at Rotterdam (NL), Brake (DE), and Hamburg (DE).

  Certified sustainable crude palm (kernel) oil from Papua New Guinea and (in the future) the Solomon Islands arrives in the UK at the New Britain Oils refinery in **Liverpool**, and on the Continent at Rotterdam and Brake. Segregated flows from a variety of different origins also arrive at AAK in **Hull**. Unlike conventional flows, these supply chains are fully segregated and traceable.

Table 4.3: Crude Palm (Kernel) Oil Flows		
	Import flow and source	**Most likely route(s)**
1	Large tanker from Indonesia or Malaysia	Deep sea from port at / near Singapore to northern European port (e.g. Rotterdam, Brake, Hamburg) and / or UK port (possibly transhipped to smaller vessel before onward shipment to the UK)
2	Medium size tanker from countries such as Colombia, Costa Rica, Honduras, Guatemala, Ivory Coast, Panama, etc.	Deep sea from port in country of origin to northern European port (e.g. Rotterdam, Brake, Hamburg) and / or UK port (UK more likely to be included directly in port call rotation)
3	Tanker from Papua New Guinea, Solomon Islands, or elsewhere (segregated flow)	Deep sea from port(s) in country of origin to northern European port (i.e. Rotterdam, Brake) and Liverpool (included in port call rotation) or Hull

Port selection in the UK or continental Europe will depend on refinery location and the capacity of associated bulk storage facilities.

- **Refined palm (kernel) oil:** in coastal tanker, ISO tank containers or road tank trailers (EU)

  As noted above, refined oils for further refining, blending, or packing in the UK can arrive from (or via) Europe in different ways. These include coastal tanker (up to 4,000 tonnes); in ISO tank containers as unaccompanied RoRo traffic; or in road tank trailers as accompanied RoRo traffic. A factor to bear in mind is that, if multiple compartment tank equipment is being used, a single shipment could be composed of more than one type or grade of oil.

  The 'detailed analysis' total for crude and refined oils imported from the EU was 90,064 tonnes (or 86.0k tonnes in the Defra 'starting point' figures) with the refined oils component as follows:

Code #1511 refined palm oil	55,806 tonnes
Code #1513 refined palm kernel oil	2,146 tonnes
Total	**57,952 tonnes** (i.e. 64% of the EU total)

  From interview evidence, the flow types for these EU refined products are as follows:

Table 4.4: Refined Palm (Kernel) Oil Flows

	Import flow and source	Most likely route(s)
1	Coastal tanker from refinery or storage terminal in the Netherlands (or Germany) to UK refinery	Direct shipment to refinery on the Thames or Humber
2	ISO tank container from the Netherlands (or Germany) to UK blender or packer	Unaccompanied traffic on RoRo ferry service into ports such as Purfleet, Harwich, or Hull (from NL) or Immingham (from DE)
3	Road tank trailer from the Netherlands to UK blender or packer	Accompanied traffic on RoRo ferry service into ports such as Harwich or Hull (from NL)

  Except for coastal tanker shipments, connection between UK port and destination will generally be made by road (using skeletal trailers for containers).

Further research and analysis would be required to verify or amend the above conclusions about UK import flows. Another point to note is that **seasonality within the week, month, or year** has not been examined but past experience indicates that this will also be an important aspect for investigation.

4.5 Resilience of import flows

The resilience of import flows to port disruption can be summarised as follows:

- The capability, capacity, and risk profile of **origin ports** vary considerably, with ports in Asia particularly at risk from earthquakes or tsunamis.

  Indonesia (the world's largest exporter) ships crude palm oil from a variety of ports including Teluk Bayur and Dumai in Sumatra and Pontianak in Kalimantan (Borneo). However, the country's general infrastructure is poor; the ports sector has been targeted in Indonesia's 2011-2025 economic development masterplan; and detailed information on palm oil export flows is limited

  Ports in **Malaysia** are better developed. For example, Johor Port, close to Singapore, is a major export terminal for palm oil and it has the world's largest palm oil storage facility in its Free Trade Zone. Deep sea ports and terminals in Malaysia (and Indonesia) are supplied by truck and by coastal vessels operating from a variety of local ports.

  Kimbe in West New Britain is the principal port for crude palm (kernel) oil export from **Papua New Guinea**. Although the port is small, the palm oil terminal has recently upgraded storage facilities and is able to load vessels of >40,000 tonnes capacity for direct shipment to the UK and Europe.

Ports in the **Caribbean** and **West Africa** have similar variation in capabilities, capacities, and risk profiles as the Asian ports described above.

- Resilience of the supply chain can also be affected both by rising costs (e.g. for vessel charter, fuel, insurance, etc.) and by the inherent risks of **long distance sea freight**. For comparison, distances from selected key origin ports to Rotterdam (in nautical miles) / transit times at 11 knots (in days) are as follows: Port Moresby (PNG) 10,941 / 41; Singapore (SG) 8,265 / 31; Cartagena (CO) 4,584 / 17; and Accra (GH) 3,918 / 14. Actual total distances and times will be higher to account for time in port and port rotation(s) at either end of the voyage.

- Also there is strong competition for **deep sea tankers** from the hydrocarbon industries; other vegetable oils sectors; and the molasses industry (which also has to be heated before discharge).

- The capability, capacity, and risk profile of the **destination ports** also vary but without the range seen at the origin ports. However, each port will have its own characteristics and constraints. **Hull** is constrained by lock size at the King George Dock, so that it cannot accept the largest vessels used on palm oil traffic, and by the fact that there is only one lock. The most recent lock gate failure was in December 2011 when the gates were out of action for several days. Vessels had to discharge at a river berth into road tankers which took the product to the refinery storage tanks.

  On the **Thames**, the Jurgens Jetty at Pura Foods can handle vessels of up to c180 metres length which permits tankers of c45,000 tonnes deadweight. But current capacity at nearby third-party bulk terminals is mainly dedicated to fuel imports on medium term contracts (5 to 10 years) because of the continued decline in UK domestic oil refining. So the Thames no longer has spare food grade bulk storage tank capacity – the last edible oils loads were stored 10 years ago.

  At **Liverpool**, the oil seeds crushing plants / refineries, palm oil refinery, and most of the (heated) food grade bulk storage tanks for crude palm oil (and molasses) are clustered around the interconnected Royal Seaforth, Gladstone, and Canada docks. Dock access is through two locks, each of which can accept large vessels, which spreads the risk in the event of lock gate failure.

  But suitable storage tank capacity at Liverpool (as provided by ED&F Man, UMG Liquids, and Westway) is limited and fully utilised on existing contracts. So buffer stocks are necessarily limited and it would also be difficult to provide any extra tank capacity at Liverpool if needed – for example if there were disruption at Hull or London (and vice versa).

- It should be noted that UK edible oils refining capacity is located in only **three single-refinery strategic locations**, Hull, London and Liverpool; and that these locations also process edible oils in addition to palm (kernel) oil. So even if alternative ports such as Avonmouth or Grangemouth could conceivably discharge vessels and provide suitable storage, they would be unable to offer the essential refining and blending capacity. **This leads to the conclusion that major port disruption could be catastrophic for the UK food chain**.

- **Flows of refined palm (kernel) oil from EU countries** are using both coastal vessels and road vehicles via different RoRo ferry services from the Netherlands and Germany to supply UK blenders and manufacturers. These flows from the Continent are manageable while UK refineries are working normally. However, if a refinery were out of action for more than a short time, bearing in mind that it might also be refining more than palm (kernel) oil, replacement flows from the Continent could be significant and not easily accommodated on existing RoRo services.

  The total **EU refined palm (kernel) oil import volume** reported for 2010 was 58k tonnes. This could equate to either c.25 coastal vessels; 2,300 tank containers; or 2,000 tank trailers over the year. The reality would be a mix of modal appearances. However, current arrival numbers even allowing for seasonality are evidently manageable. However, a sudden and prolonged shift from a UK to a continental EU refinery for supply of refined products could create radically different scenarios. Decisions would also have to be made about which parts of the refining, fractioning, and blending process could be still undertaken in the UK. This situation therefore demands careful evaluation, scenario modelling, and risk assessment.

- Inbound raw material and work-in-progress **stock levels** are kept at low levels for a number of reasons. The financial imperative is to employ working capital to best effect including 'making to order' whenever possible. A related parameter is the need to meet food manufacturer requirements precisely and on time. In view of the wide range of different blends consequently required, often in small quantities, refiners and blenders will delay their use of raw or part-processed material for final transformation as long as possible.

  This ensures that their manufacturing processes are able to make the best use of material, time, and cash. However, this approach requires efficient and reliable process flows of information (e.g. customer orders) and of material (e.g. part-refined product). These process flows rely in turn on dependable logistics infrastructure and services throughout the end-to-end supply chain. The risk of these 'no waste' lean supply chains is that buffer stocks are too low for unforeseen events. A common problem too is that not enough strategic thought has been given to alternative scenarios.

4.6 UK palm oil demand by industrial sector

In order to meet the project's objectives, the consultants wished to assess the potential downstream impact of port disruption on palm oil supply. This required gaining an understanding of demand by industrial sector, which was not easy in view of the constraints of commercial confidentiality. Also, in view of Data Protection Act considerations, trade associations involved with the downstream supply chain felt unable to assist.

However, the Seed Crushers' and Oil Processors' Association (SCOPA) provided valuable insights about import flows. Following on from this, high-level information about demand was compiled mainly from interviews along with cross-checks to literature in the public domain. As such, the results are provisional and should be considered as a starting point for more detailed research.

Interview estimates of the total UK market demand in 2010 for edible oils ranged from 1.3 to 1.6 million tonnes, met by a mix of domestic refining and imports. A point to note is that an industry convention is to describe volumes in terms of equivalent refined tonnes rather than absolute 'raw' numbers which may cause misleading comparisons.

Against this background an estimated profile of annual edible oils demand (in terms of volume) by segment is shown below. This was compiled from interview evidence and requires further validation.

	Segment	**% split**
1	Foodservice	44%
2	Margarines and spreads	13%
3	Snack foods	10%
4	Sauces	7%
5	Bakery – breads and cakes	6%
6	Bakery – biscuits	6%
7	Confectionery	5%
	Sub-total	**91%**
8	Other	9%
	Total	**100%**

Interestingly, one of the leading manufacturers and processors reported on its website that it bought 23,121 tonnes of pure and refined palm oil; palm oil derivatives such as fractions of olein and stearin; and palm kernel oil or derivatives in 2010. The company also bought 24,000 GreenPalm certificates to cover its branded and own-label products. Other manufacturers have similar large-scale requirements.

However, in view of the versatility of palm oil and its fractions, it should be noted that blends even in small quantities, are a critical ingredient for many food products. In addition, many small food companies are dependent on palm oil supply of some sort. A detailed assessment of the downstream market, while out of the scope of this research, would provide valuable additional evidence.

As described earlier, because palm (kernel) oil is also widely used in personal care products, soaps and detergents, the impact of serious supply disruption would be far-reaching.

4.7 Food stocks and the attitude of the supply chain to replenishing stock

- The overall approach to stockholding on the part of stakeholders was described in Section 4.5 above. As noted, most food manufacturers choose to have very limited raw material storage capacity on-site and depend on continuous stock replenishment from edible oils refiners and blenders.

- Little detailed evidence about raw material stock levels could be uncovered within the time constraints of the research. Also the annual Defra *Food Stocks Survey* (the findings of which were not shared with the consultants because of Data Protection Act concerns) is understood to collect data about stock levels of finished goods rather than of raw materials.

- However, based on the levels of stakeholder co-operation already enjoyed by the consultants, it would probably be feasible to undertake a detailed fact-finding exercise that could produce reliable evidence about inbound stock levels of palm oil fractions and derivatives in UK food manufacturing. A challenge would be the fact that there are relatively few suppliers to the market and that they would almost certainly see this exercise as commercially highly sensitive.

- In the meantime interview evidence (and past experience) suggests that most food manufacturers and processors keep raw material stock levels to a minimum in order to contain stockholding costs; because their inbound storage facilities are restricted; and because they have grown accustomed to frequent deliveries from the UK suppliers, or their European counterparts.

4.8 Behavioural aspects of the various players in the event of supply chain disruption

- Little evidence about behavioural aspects could be uncovered. This was due in part to the time constraints of the research but also could be because stakeholders probably regard their Business Continuity Planning as commercially sensitive and are therefore reluctant to share this information. However, there are a number of logical assumptions that can be made about likely behaviours.

- At the outset it should be noted that because most UK supply comes from domestic refining and manufacture, the first issue concerns disruption to imports of raw material. Even if these imports were interrupted, flows of refined or fractionated outputs from continental European production might still be possible, depending on the nature and extent of the disruption.

- Unfortunately, the second issue is that many secondary manufacturing recipes that use palm oil derivatives or fractions are unique and bespoke, and so would not easily be replicated from alternative sources. A parallel situation almost certainly exists with non-food uses. Also, as noted before, factory stocks are kept to as low a level as possible.

- With these points in mind, likely behaviours could be as follows:

    - Large-scale food manufacturers might be able to source from continental Europe provided there was adequate capacity – their requirements would be expected to be large enough for economic quantities to be produced

    - Small-scale food manufacturers would be expected to source from the Continent also but would no doubt find difficulty in obtaining sufficient quantities of the right formulations quickly enough

    - Most of the UK suppliers are part of larger organisations with pan-European or global networks and could be expected to work with their respective customer bases to secure adequate supply.

It must be noted that these assumptions are based on interview evidence restricted by the limits of commercial confidentiality and would need further validation.

A summary schematic of Section 4 of this Annex Report appears as **Annex 10: Appendix II**.

5. DISCUSSION

5.1 Overall assessment of the results

The pattern of UK import flows is complex and driven by a range of macro-economic factors and issues surrounding the UK import flows themselves. The following highlights emerged:

Relevant factors

- **World supply and demand profiles** show that while supply continues to increase with new plantations coming on stream in countries like Liberia, Cameroon, and Gabon in Africa and Papua New Guinea in the Pacific, it has been outpaced by rising demand. This has come not only from Europe but also from markets such as India and China. This situation has contributed to a world stocks to usage ratio for edible oils that had fallen to 8.5% by 2011/2012 (USDA figures).

  It is also evident that players such as IOI Loders Crooklaan, Olam International, Sime Darby, and Wilmar International work globally to exploit available business opportunities to the full. Although their supply base is Indonesia, Malaysia and Papua New Guinea, they see Europe as a key market and therefore have located refinery and processing capacity in this region.

  It should also be noted that industry players are active across edible oils markets, including rapeseed and soya bean. In Germany ADM has Europe's largest rapeseed and soya bean crushing plant at Hamburg, while in the UK Cargill crushes and refines rapeseed and soya bean at Liverpool. So it is important to understand the dynamics of the edible oils market as a whole rather than look at palm oil in isolation.

  Within the UK, the food manufacturers and processors that depend on palm (kernel) oil, its fractions and derivatives, have supply arrangements with the main line refiners and blenders, or with intermediate blenders and processors. However, they have to compete for secure supply with their competitors in continental Europe; with world markets such as India and China; and with demand for biodiesel feedstocks.

- **Extreme weather conditions and other environmental factors** will affect plantations; the long-distance supply chains required to transport crude palm (kernel) oil to refineries in the UK and continental Europe; and destination ports. The origin countries are also in major earthquake, volcanic, and tsunami zones and this could have a negative impact on availability of ports and shipping.

- **Possible alternative sourcing arrangements** are limited in the event of serious port disruption. It was noted in Section 4.5 that UK refining is concentrated at only three locations: Hull, London and Liverpool. Interview estimates indicated that at a high-level these refineries are working at between 60% and 65% of capacity, which suggests that there is enough inherent flexibility in the system to absorb any supply shocks if one location were out of action.

  However, closer examination of the facts reveals a far more complex picture. As noted previously, customer requirements can include demand for a wide range of different oils, fractions and derivatives and refineries have been configured accordingly. Also, some facilities are set up to handle refining or blending of mixed oils, including but not restricted to palm (kernel) oil.

  Another aspect of complexity is illustrated by the ADM operations on the Thames at Erith and Purfleet which, although they are on opposite banks of the river, are effectively one site. They also supply significant adjacent factories: Edible Oils at Erith and Unilever at Purfleet.

  Looking at Liverpool, if port disruption was of the type and scale to prevent New Britain Oils from refining palm oil, the likelihood would be that it would also close the adjacent Cargill rapeseed and soya bean operations at the same time because they share dock facilities if not the same berth.

  So in the case of major port disruption adversely affecting one refinery, it would not be straightforward to increase output at another refinery to compensate. Any solution would also be likely to have a continental European dimension and this would affect flow profiles.

- **Roundtable on Sustainable Palm Oil** (ROSPA)

  Sustainability is a major factor that will influence future supply chain development. Concern has focused particularly rainforest destruction, hardwoods extraction, ecological damage, the loss of natural habitats for species such as the orangutan, and the impacts on indigenous peoples.

  The Roundtable for Sustainable Palm Oil (RSPO) was therefore established in 2003 with the objective of promoting the growth and use of sustainable oil palm products through credible global standards and engagement of stakeholders.

  It is a not-for-profit association that unites stakeholders from seven sectors of the palm oil industry – oil palm producers, palm oil processors or traders, consumer goods manufacturers, retailers, banks and investors, environmental or nature conservation NGOs and social or developmental NGOs – to develop and implement global standards for sustainable palm oil.

  GreenPalm is a web-based certificate trading programme operating independently of the physical supply chain endorsed by the RSPO that is designed to enable manufacturers and retailers of products containing palm oil and its derivatives to support the production of sustainable palm oil.

5.2 Difficulties and risks associated with current systems

- Macro-economic conditions and events of the sort described above, as well as those that are weather-related and / or unexpected, can impact on oil palm plantations, refineries and on transport links (land and ocean) across the supply chain

- Because all palm oil originates in tropical countries there is a 100% dependency on long-distance supply chains, even if some imported product comes immediately from an EU refiner or blender. Therefore risks include such factors as increased fuel prices and freight rates

- There is severely limited availability of bulk storage facilities with food-grade heated tanks. Also, terminals such as Avonmouth or Grangemouth have no suitable refinery nearby

- Because palm (kernel) oil, its fractions and derivatives, is used in so many food products and even small quantities is an essential ingredient for many recipes, a broad spectrum of UK food supply could be compromised by a shortage

- The most likely pinch points, which vary by import flow, can be summarised as follows:

Table 5.1: Import Flow Pinch Points

	Import flow (and source)	Appearance	Port group(s)	Pinch points
1	Crude palm (kernel) oil (non-EU: e.g. ID; MY; CO; CI; HN; SB)	Liquid bulk vessel	Thames Humber	River Thames channel and jetty; River Humber channel and Hull King George Dock
2	Crude palm (kernel) oil (non-EU: PNG)	Liquid bulk vessel	Mersey	River Mersey channel and Canada Dock
3	Refined palm oil (EU)	Coastal tanker	Thames Humber	As #1 above
		ISO tank container	Purfleet Harwich Hull	Port entry channel Terminal Landside connection
		Tank trailer	Harwich Hull	

6. CONCLUSIONS

The research emphasised the dependence of UK food manufacturing on supply of palm (kernel) oil, its fractions and derivatives, for a wide range of products. Because all imports originate in tropical countries and arrive via long-distance transport links there is a critical dependency on the resilience of these supply chains.

Palm oil refining in the UK is concentrated on just three locations, namely Hull, London (Purfleet), and Liverpool. In view of current factory utilisation levels it might appear that UK production could be maintained in the event of serious port disruption. However, it would not be straightforward to increase output at another refinery to compensate. Any solution would also be likely to have a continental European dimension and this would affect flow profiles.

A fair appraisal of the Palm Oil Imports Case Study would therefore be:

	Objective	Result
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	A substantial base of meaningful evidence has been compiled. Importantly this is by individual flow type, which has in turn enabled a preliminary assessment of risk. More work needs now to be done on specific upstream and downstream aspects
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)	Evidence indicates a significant dependency on non-EU port infrastructure for palm oil flows, particularly in Indonesia, Malaysia, Papua New Guinea / Solomon Islands, and western Africa
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	This was limited by stakeholder reluctance to provide information about their Business Continuity Planning. However, a number of reasonable assumptions have been made

The work programme also segmented the high-level import categories, first of all into individual import flow types, and then into more detailed information about routes. At this level it was possible to show how the flows depended on infrastructure, transport equipment and services of different types.

It showed that it is feasible to gather reliable information from industry stakeholders about UK palm oil imports. Although compilation of evidence was time-consuming and encountered setbacks, such as when stakeholders were cautious about whether to participate, the overall result was positive. Data quality (i.e. definition, completeness, accuracy, etc.) 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. However, further work is required to look at the detail of imports on the Thames and on flows from the Netherlands and Germany in particular.

The research confirmed the importance of consistent and reliable supply to manufacturers and processors across multiple food segments. Based both on anecdotal evidence and past experience, it is known that many companies have honed their inbound supply chains from refineries and blenders so that they have only enough raw material stock for a short period – sometimes for as little as a day or a week – and time-based supplier performance is therefore critical.

7. MESSAGES AND FINDINGS

The recommendations arising from the research are as follows:

1. 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.

2. 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.

3. There are also serious evidence gaps about the ordering / stock holding patterns of UK food manufacturers and their supply relationship with UK palm oil refiners and blenders. These gaps need to be filled through continuing investigation using the approach and methodology employed for this research.

   It should be noted that these evidence gaps are similar to those concerning sugar research that were identified in **Annex 9**. Parallels between the commodities exist as regards bulk modal appearance (although palm oil is liquid bulk, while sugar is dry bulk); the fact that there are only a few players responsible for UK and European refining and manufacture; and also the fact that supplies of manufactured product are going to a very wide industrial customer base. However, the authors of this report recommend that Defra should commission further investigation to fill these gaps.

Appendix I: Crude Palm (Kernel) Oil Arrival at Hull Refinery

Import flow classification		
A	Food commodity	*Crude palm (kernel) oil (CPO / CPKO)*
B	Source region / country	*Tropical countries*
C	Temperature / atmosphere regime	*Solid at European ambient temperatures*
D	Transport mode(s)	*Sea*
E	Flow type	*Liquid bulk*
Logistics information		
1	Commodity format	*Liquid*
2	Shipping unit	*Bulk*
3	Vessel / vehicle type	*Tanker*
4	Terminal handling	*Pipeline*
5	Storage on arrival	*Bulk tanks*

Battery Park (15,037 DWT) at King George Dock, Hull

Discharging at King George Dock, Hull

Quayside pipelines at King George Dock, Hull

Bulk oil tanks at King George Dock, Hull

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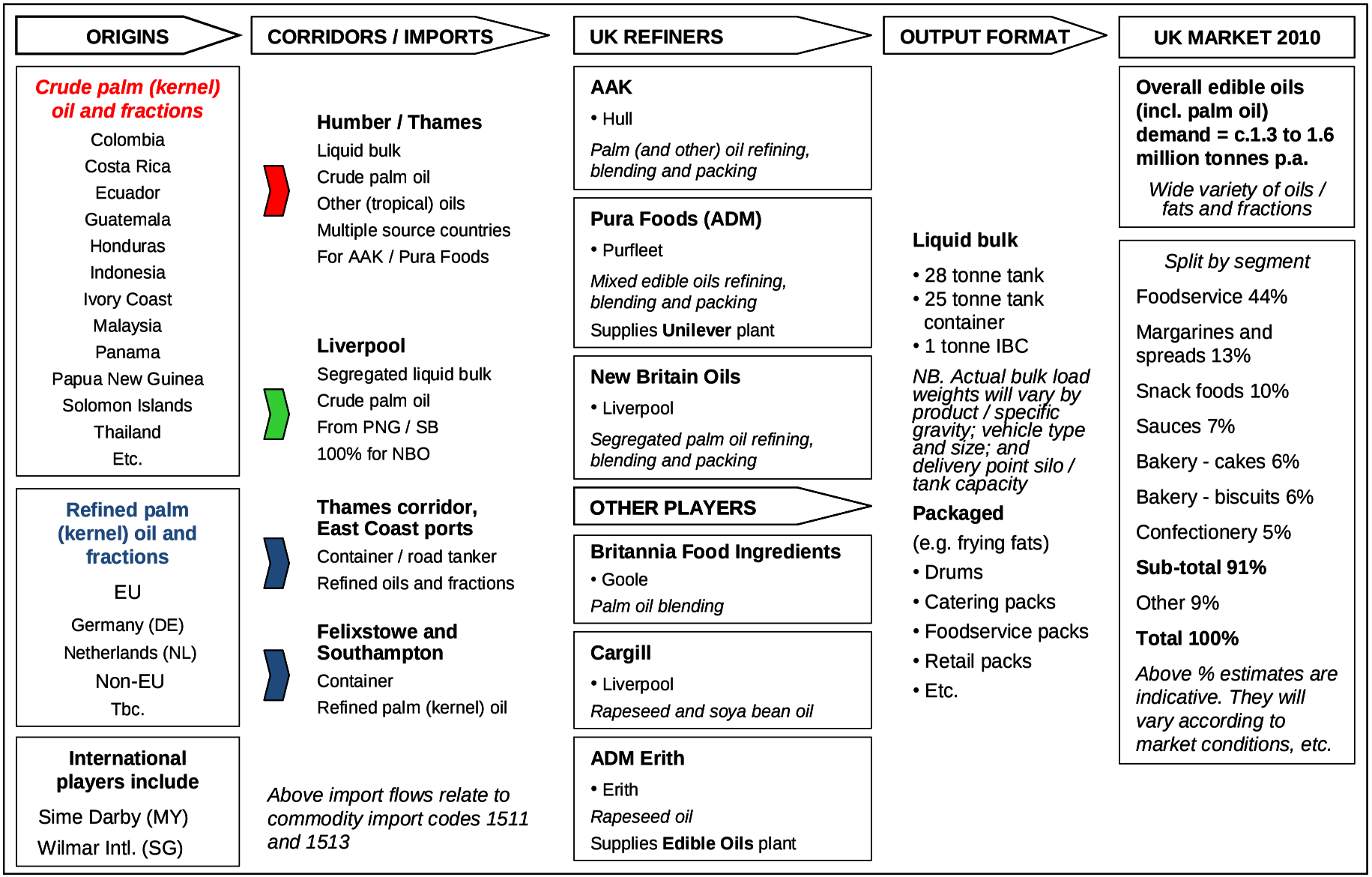
ORIGINS
CORRIDORS / IMPORTS
UK REFINERS
OUTPUT FORMAT
UK MARKET 2010
Crude palm (kernel) oil and fractions
Colombia
Costa Rica
Ecuador
Guatemala
Honduras
Indonesia
Ivory Coast
Malaysia
Panama
Papua New Guinea
Solomon Islands
Thailand
Etc.
Refined palm (kernel) oil and fractions
EU
Germany (DE)
Netherlands (NL)
Non-EU
Tbc.
International players include
Sime Darby (MY)
Wilmar Intl. (SG)
Humber / Thames
Liquid bulk
Crude palm oil
Other (tropical) oils
Multiple source countries
For AAK / Pura Foods
Liverpool
Segregated liquid bulk
Crude palm oil
From PNG / SB
100% for NBO
Thames corridor, East Coast ports
Container / road tanker
Refined oils and fractions
Felixstowe and Southampton
Container
Refined palm (kernel) oil
Above import flows relate to commodity import codes 1511 and 1513
AAK
• Hull
Palm (and other) oil refining, blending and packing
Pura Foods (ADM)
• Purfleet
Mixed edible oils refining, blending and packing
Supplies Unilever plant
New Britain Oils
• Liverpool
Segregated palm oil refining, blending and packing
OTHER PLAYERS
Britannia Food Ingredients
• Goole
Palm oil blending
Cargill
• Liverpool
Rapeseed and soya bean oil
ADM Erith
• Erith
Rapeseed oil
Supplies Edible Oils plant
Liquid bulk
• 28 tonne tank
• 25 tonne tank container
• 1 tonne IBC
NB. Actual bulk load weights will vary by product / specific gravity; vehicle type and size; and delivery point silo / tank capacity
Packaged
(e.g. frying fats)
• Drums
• Catering packs
• Foodservice packs
• Retail packs
• Etc.
Overall edible oils (incl. palm oil) demand = c.1.3 to 1.6 million tonnes p.a.
Wide variety of oils / fats and fractions
Split by segment
Foodservice 44%
Margarines and spreads 13%
Snack foods 10%
Sauces 7%
Bakery - cakes 6%
Bakery - biscuits 6%
Confectionery 5%
Sub-total 91%
Other 9%
Total 100%
Above % estimates are indicative. They will vary according to market conditions, etc.

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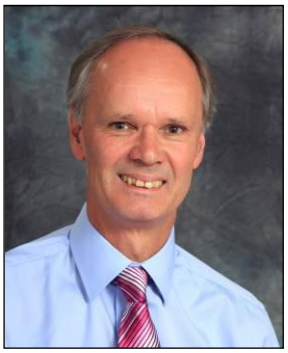

Peter Baker, the founder and owner of PRB Associates, specialises in operational, financial and market analysis in the ports and shipping sectors; with working experience in the ports sector and in RoRo ferry operations.

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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