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DEFORESTATION AND SOCIAL RISKS IN THE UK'S COMMODITY SUPPLY CHAINS

3keel

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This report sets out research commissioned by WWF and the RSPB, carried out by consultancy 3Keel. It calculates the volume and source of UK imports (from 2011-15) of seven key forest-risk commodities: beef and leather, cocoa, palm oil, pulp and paper, rubber, soy, and timber. This data is then used to estimate the location and scale of the land footprint created by UK consumption of these commodities, and explores the risks associated with this footprint. The research uses publicly available data and sets out the assumptions made in estimating the footprint and risks.

The findings of this research are summarised and analysed in a separate report, which also includes recommendations on what UK government, companies and citizens can do to address the risks.

Risky Business: Understanding the UK's overseas footprint for deforestation-risk commodities

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1 Executive summary

Please note: The research presented in this report underpins policy and business recommendations developed by WWF and RSPB (available separately). As such, this is a technical report that focuses on reporting the data, methods and assumptions used to develop commodity/country risk analyses.

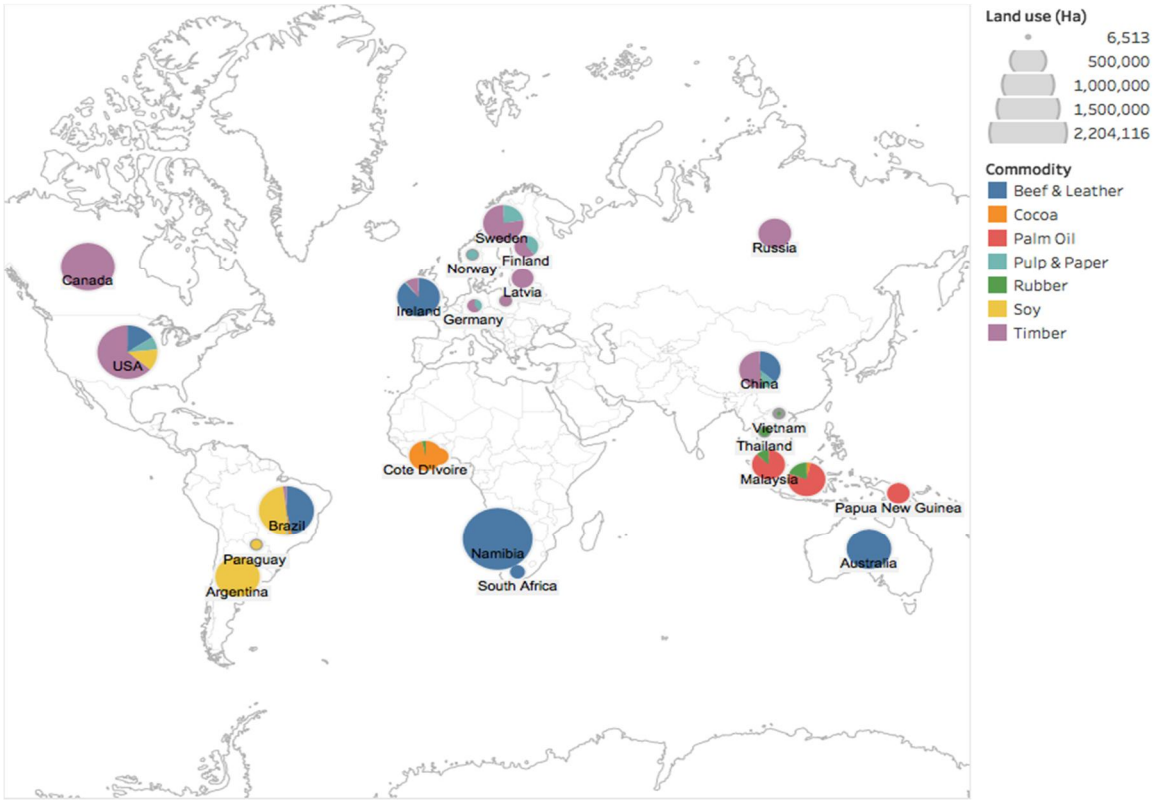
Between 1990 and 2015, the world lost 129 million hectares of forest. Deforestation, in the tropics at least, is largely driven by commercial agriculture and forestry, including such industries as soy, palm oil, timber, pulp & paper, beef & leather, rubber, and cocoa. The production of these commodities is an important source of income and employment in many communities, but can also be associated with serious social issues and abuses, including appropriation of land from communities and indigenous groups, and forced and child labour.

The UK imports significant quantities of all of the above commodities, and therefore puts people and forests at risk. This study estimates the quantities of these commodities that are imported, their provenance and the land footprint associated with their production.

The research presented here estimates that the total land area that was required to supply the UK's demand for soy, palm oil, pulp & paper, timber, beef & leather, rubber and cocoa was, on average, over 13.6 million hectares per year between 2011 and 2015. This is equivalent to a land area over half the size of the UK, and over six times the size of Wales.

Imports of beef and leather have the largest land footprints, followed by timber, soy and palm oil. The UK's footprint of these commodities is concentrated in a relatively small number of countries across North America, South America, east Asia, southern and western Africa, Australia and the EU (Figure 1).

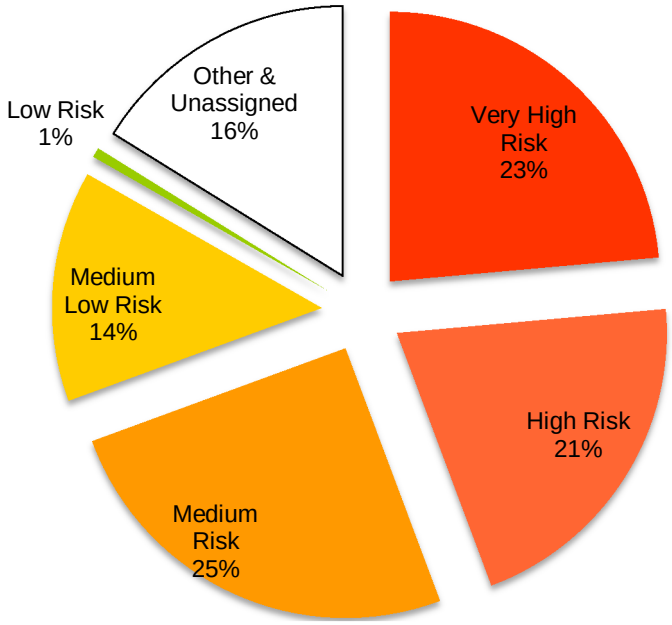
Figure 1: Area of land required to supply the UK with forest-risk commodities from producer countries



Commodity imports are rarely traceable back to individual farms or plantations, and so the exact contribution of the UK – via its imports – to deforestation and social problems is unknown. It remains, however, a very real risk.

We estimate this risk by rating major exporting countries according to the rate and extent of deforestation, the perceived rule of law and the labour rights conditions within those countries. The land footprint of the UK's imports of the analysed commodities was then allocated to these risk ratings. Over 44% of the total land area required to satisfy the UK's demand for these commodities was from countries rated high and very high risk (Figure 2). Looking at the profile of each specific commodity, at least half of the land footprint of the UK's imports of beef and leather, soy, palm oil, cocoa and rubber was from countries rated as high risk or very high risk.

Figure 2: The UK's land footprint for seven imported commodities according to risk category of producer countries



In brief, the risk rating captures the following characteristics of the commodities.

Soy: High volumes of soy imports come from Argentina, Brazil and Paraguay – countries that all have high deforestation and social risk. In the EU, 90% of all soy is used to feed livestock.[1] There is modest progress on credible, transparent certification with high social and deforestation safeguards (Round Table on Responsible Soy – RTRS), but this accounted for less than 1% of global production in 2015,[2] and little supply chain data transparency on certified imports. Greater uptake and reporting of RTRS-certified imports would undoubtedly reduce the risk further.

Palm oil: This is imported in high volumes from Indonesia, Malaysia, and to a lesser extent Papua New Guinea – countries that possess high deforestation and social risk. Strong progress on certification (Roundtable on Sustainable Palm Oil – RSPO) partially ameliorates the risk. The UK statement on sustainable production of palm oil in October 2012 and the reporting of certified imports or major imports of palm oil provided both a stimulus for

[1] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf
[2] http://www.responsiblesoy.org/mercado/volumenes-y-productores-certificados/?lang=en

importing certified products and a high degree of transparency about those imports. This commitment finished at the end of 2015.

Timber: This takes a large land footprint, but most imports come from countries with low deforestation and social risk, and efforts to eliminate imports of illegal timber have resulted in a high proportion of certified imports. Imports from China and Russia, although a modest proportion of the total, carry with them high risk. Rapidly increasing imports of fuel wood (mostly from the US) are quickly changing the profile of the UK's imports.

Pulp and paper: This has a low supply chain data transparency, but the majority of imports are from the EU and the US, with typically low deforestation and social risk, although the UK also imports significant quantities from Brazil and China, which have very high risk ratings.

Beef and leather: This has by far the largest land footprint due to the extensive nature of some grazing production systems. The land area required for the stocking of cattle shows huge variation between and within countries. Although the UK produces over 75% beef domestically and largely imports product from countries with modest deforestation and low social risk (Ireland, US and Australia), some countries do have higher risk (e.g. Brazil, China, Namibia, Argentina). Negligible progress on certification and poor supply chain transparency exacerbate the risks.

Rubber: Compared with other commodities, we import relatively small amounts of rubber material, and these are largely from high social and deforestation risk countries in south-east Asia (Indonesia, Malaysia, Thailand, China and Vietnam). Sourcing from West Africa is increasing with a rapid rise in imports from Côte d'Ivoire. The lack of a credible, transparent certification scheme means there is limited risk management.

Cocoa: Several sourcing countries have high social risk, especially the main trade partner, Côte d'Ivoire. However, the well-advanced certification schemes (e.g. Utz, Fairtrade) are likely to ameliorate the risks to some degree.

In all of these sectors there are companies that produce commodities responsibly, and companies that show a high degree of diligence in excluding deforestation and social exploitation from their supply chains. However, there is much still to be done by companies, the UK government and by the public to reduce the risks of UK imports of commodities being associated with deforestation and social exploitation.

The research presented in this report is intended to underpin a number of policy and business recommendations developed by WWF and RSPB.

2 Introduction

Please note: The research presented in this report underpins policy and business recommendations developed by WWF and RSPB (available separately). As such, this is a technical report that focuses on reporting the data, methods and assumptions used to develop commodity/country risk analyses.

In December 2015, Denmark, France, Germany, the Netherlands and the UK signed the Amsterdam Declaration Towards Eliminating Deforestation from Agricultural Commodity Chains with European Countries.[3] Taking note of related initiatives and global agreements such as the New York Declaration on Forests, the Sustainable Development Goals, and the global climate agreement reached at UNFCCC COP 21 (the Paris Agreement), the Amsterdam Declaration aims to support private sector and public initiatives to halt deforestation due to the production of agricultural commodities such as beef and leather, palm oil, paper and pulp, soy, cocoa and rubber by no later than 2020. In signing the Amsterdam Declaration, the UK government signalled its intent to address the UK's forest footprint overseas. In addition, the UK government's 25-year plan for the natural environment represents a significant opportunity to better understand our impacts on natural capital overseas and provide an operational framework to reduce any negative impacts we have due to international trade.

These commodities have been cited as drivers of deforestation[4] and habitat destruction in some of the most biodiverse and ecologically important places in the world.[5] Whilst they provide a livelihood for millions of people, they have also been associated with negative social outcomes, including land grabs, forced labour, and terms and conditions of employment that are below international norms. As one of the world's major economies, the UK is a significant user of commodities, and has a role to play in ensuring that the future production of these commodities no longer causes deforestation or social exploitation.

The overarching purpose of the research presented here is to inform ongoing policy development about eliminating commodity-driven deforestation through supply chain mapping in the UK. The specific research objectives for this report are:

- *To assess the extent to which the UK's supply chains for key forest-risk commodities are sustainable and deforestation-free;*
- *To identify relevant data gaps and supply chain 'blind spots';*
- *To generate a 'forest risk' score that illustrates the risk of deforestation and social problems that the UK's import of commodities creates.*

[3] https://www.euandgvc.nl/documents/publications/2015/december/7/declarations

[4] We use the FAO's definition of deforestation: 'The conversion of forest to other land use or the permanent reduction of the tree canopy cover below the minimum 10 percent threshold.' FAO (2015). *Global Forest Resource Assessment 2015: Terms and Definitions*. Rome: FAO.

[5] Boucher, D., Elias, P., Lininger, K., May-Tobin, C., Roquemore, S., and Saxon, E. (2010). *The Root of the Problem: What's Driving Tropical Deforestation Today?* The Union of Concerned Scientists.

The intent is to develop a robust and transparent approach that could be replicated in other countries to allow comparison, and be repeated to measure the UK's progress on reducing deforestation risk, as well as providing evidence to guide action.

2.1 About this document

The core of this document comprises seven sections profiling the consumption, imports and footprint of each of the commodities identified above. Each of the commodity sections has the following top-level structure.

- **Overview of commodity and trade** – basic introduction to the commodity, its production and end uses, and major trends.
- **UK supply chain** – summarises major steps from production to retail.
- **Certification** – an overview of the main certification schemes, what deforestation and social safeguards they have, and their market penetration.
- **UK imports** – an analysis of the UK's imports of the commodity in the form of raw materials, as an ingredient or embedded within production processes; and where they come from.
- **Risk analysis**: overview of the link between the commodity, deforestation and social problems, and an estimation of the UK's land footprint in each major trading partner.

Although this top-level structure is consistent across all commodities, the evidence and details that sit beneath vary, reflecting inherent differences in information availability and supply chain structure between the commodities.

After the last commodity, there is a section summarising the land footprint of the UK's imports of these commodities, and a further section summarising the risk index, allowing easy comparison across all of the commodities and across the major exporting countries. The final section summarises the main conclusions of the research.

3 Overview of method

The precise method used to calculate imports of commodities and the agricultural land required to produce them varies to some extent from commodity to commodity, depending on production process, use and data availability. Specific details are given in each commodity chapter, but the general approach to data analysis is outlined in this section.

3.1 Quantifying the UK's imports

Import data from the UN Comtrade database was used to estimate the quantity (net weight) of imports for the period 2011-15. Using this database allows a similar method to be replicated in other countries. We examined three routes by which commodities feature within UK supply chains:

- As raw materials (e.g. palm oil, soy meal, beef meat);
- As an ingredient of imported manufactured goods (e.g. natural rubber in imported car tyres, beef in corned beef products);
- 'Embedded' within imported products as part of the upstream production process (e.g. soy meal used in pig feed is 'embedded' in imported pork products).

Many commodities are used in thousands of different products, and so the data captured was confined to those product categories that are cited in the literature as being major uses of the commodity. The estimates provided are therefore conservative.

Where a commodity is imported as an ingredient or is embedded, it is only that part of the imported good which is a commodity that is of interest. For example, car tyres contain many elements including metal, compounds, synthetic rubber and around 14% natural rubber. The weight of imported goods containing commodities as 'ingredients' and 'embedded' was therefore adjusted to an estimated weight of the commodity. This was done using conversion factors derived from published literature where possible, with a mid-range conversion factor used when the proportion of commodity within a product is highly variable (e.g. the cocoa content of chocolate, or the pulp content of paper).

3.2 Estimating the provenance of the UK's imports

The Comtrade data includes both net weight of the commodity and exporting country. Three general situations are found:

- A country is a producer and exporter of the commodity. For example, Brazil is a major producer of soy. The UK imports can be assigned the provenance of the exporting country without further analysis.
- A country is a producer, importer and exporter of the commodity. Where the country is a major trading partner of the UK, the origin of its imports was analysed, and added to its national production. Exports to the UK were then assigned in the same proportion as the total production and imports. For example, China produces 23% of rubber raw materials itself and imports 43% from Thailand. These percentages were then applied to China's exports to the UK, i.e. 23% of the UK's imports of rubber from China were then assumed to originate in China, and 43% from Thailand.
- A country is an importer and exporter of the commodity. For example, the Netherlands imports and exports soy, but does not produce it. Where the country is a major trading partner of the UK, its imports were analysed, and the exports to the UK assigned according to the proportion of its imports. For example, the UK imports significant quantities of soy from the Netherlands. Fifty-one percent of soy imported

into the Netherlands is from Brazil, and therefore 51% of the Netherlands' soy exports to the UK were assigned Brazilian provenance.

3.2.1 Cut-off criteria

The combination of imports highlighted above means that some commodities are imported from hundreds of countries to the UK, even if the raw commodity is produced in a much smaller number. Given the inevitable need to focus limited research resources we aimed to examine the sourcing locations of more than 80% of UK supply by excluding countries responsible for less than 2% of the UK's imports. This scale of cut-off has been used by other researchers, for example de Ruiter et al.[6] used a cut-off of 1.5% in their analysis of the footprint of UK food. This research by de Ruiter et al. was published during the course of our project.

The exception to this rule was for beef and leather – where it was decided the method had to be adjusted to take account of the highly variable and much more extreme pasture land use efficiencies (i.e. the method had to account for cattle systems that require very little pasture, such as in India, up to those that can be very extensive, such as those in Australia and Namibia). If we had excluded some countries that produce less than 2% of UK beef and leather imports but are very land *extensive*, we would have excluded significant areas of cattle pasture. For the beef and leather analysis we therefore included countries that contributed less than 2% of imports, but have very extensive systems (i.e. Namibia). We then excluded from our analysis all producer countries that contributed less than 2% of the UK's *imported pasture land use* (as opposed to imports). Although this is an inconsistency in the method, if was decided to be the least worst option, given data availability and the time available.

3.3 Estimating the footprint of the UK's imports of commodities

Deforestation is measured by the area of land that has lost forest cover, and if we are to make meaningful assessments of the risk of deforestation caused by the UK's imports of the commodities assessed here, we need to understand the land area required to produce the UK's imports of each commodity.

This meant that, for each commodity, we had to develop estimates of land use per unit of commodity produced (e.g. hectares of grazing land per kilogram carcass weight beef produced). For some commodities this was relatively straightforward – for example there are country-level statistics on soy, palm, rubber and cocoa yields in primary production.[7] The yield for each country, each year, could be used to convert the imported volumes into an estimated land footprint. However, for commodities such as beef and leather here was no land productivity data and so we had to develop our own estimates. Full details of the methods used are given in the individual commodity chapters.

For crops that produce co-products (e.g. soy beans are processed into meal and oil) we allocated land use to co-product fractions. The basis for this allocation is explained in the commodity sections.

It is worth noting that this is a significant gap in global understanding of land productivity – particularly in the case of grazing animals, who use such a significant proportion of global agricultural land. The lack of data is likely due to the challenges of quantifying the productivity of such diverse and often extensive multi-year systems. However, it would be

[6] de Ruiter, H., et al. (2017). Total global agricultural land footprint associated with UK food supply 1986–2011. *Global Environmental Change*, 43, 72–81

[7] FAO STAT. The FAO calculate yield as the national production of the crop divided by area planted each year.

useful to develop more reliable data in this area, as one of the potential solutions that has been proposed for avoiding deforestation is the 'sustainable intensification' of production on existing agricultural land (e.g. beef production in Brazil).

3.4 Risk index

A risk-based approach is used to illustrate the potential association of the UK's imports of commodities with social issues and deforestation. To achieve this we have assigned a risk rating to each exporting country according to indicators of deforestation (area of forest cover loss and percentage of natural forest loss) and social risk (rule of law and labour rights). The land footprint of the UK's imports is then apportioned to risk categories based on the country of production.

This risk-based approach was preferred to other ways of assessing deforestation and social exploitation associated with the commodity trade, for the following reasons.

- Remote sensing has been used to estimate the amount of deforestation associated with the production of commodities[7] (although not the trade with specific countries). This presents a rigorous approach, but has the disadvantages of excluding the social dimensions of the commodities' impacts and is comparatively expensive if repeated for different importing countries. It also assumes a linear approach to deforestation (i.e. the plantation or farm in an area that was forested sometime in the past is the cause of deforestation), whereas deforestation is often a multi-stage process with several underlying drivers.
- Coupled economic-land use models have been used to estimate the EU's contribution to deforestation.[8] Again, this is a rigorous method but, similar to remote sensing, it is relatively computationally intensive, does not include social dimensions and has coarse (national level) assumptions about land use (e.g. that an increase in the planted area of a crop in a country is responsible for the same area of deforestation in that country).

Given the necessity to develop a robust approach that could be repeated in the UK in the future and in other countries, a risk-based approach allows a broader set of potential impacts to be considered across multiple commodities without making assumptions about the mechanisms of deforestation.

3.5 Data challenges

There are significant challenges and constraints inherent in assessing commodity data and the link between production and deforestation. Our analysis focuses on capturing the majority of the trade in each commodity, not the whole, and makes conservative assumptions where possible. If anything, the results are likely to be underestimates.

There are two overarching challenges when assessing the deforestation risk of the global commodity trade.

- **Deforestation process**: deforestation is not a linear process and so attributing specific conversion to single commodities simplifies a more complex situation. For example, actual deforestation may progress via logging, then farmers using logging

[7] For example, Vijay, V., Pimm, S.L., Jenkins, C.N., and Smith, S.J. (2016). The impacts of oil palm on recent deforestation and biodiversity loss. *PLoS ONE*, 11(7).
[8] EU (2013). Comprehensive analysis of the impact of EU consumption of imported food and non-food commodities and manufactured goods on deforestation. http://ec.europa.eu/environment/forests/pdf/1.%20Report%20analysis%20of%20impact.pdf

tracks to claim land and farm, consolidation of these settlements into larger landholdings (e.g. cattle ranching), and then further change into a 'final' commodity production (e.g. soybean production).

- **Traceability**: it is rarely possible to know which farm or plantation a particular end-product comes from, and hence whether its production has occurred directly on recently deforested land or not. Although advanced modelling and remote sensing are beginning to provide greater insight, these approaches are not available for all commodities in all producer countries.

In addition to these overarching challenges, specific challenges within the constraints of this study are as follows.

- **The diversity of products using a commodity**. For example, rubber has thousands of end uses, from automobile tyres, to rubber balls, medical equipment and engineering applications. The approach taken was to focus only on the major uses of each commodity; therefore, the estimated imports and land footprints are likely to be conservative.
- **Poor data on typical commodity use in products**. For example, one of the major import categories of cocoa is 'chocolate and other food preparations containing chocolate'. This includes a huge range of foods, containing vastly differing proportions of cocoa. The conversion factors used to estimate the commodity content are therefore only first-order approximations.
- **Complex/long supply chains**. For example, the UK imports leather bags from China, which also imports leather and leather bags. The estimation of provenance (see above) is for some products no more than a first-order estimate.
- **Need to cover multiple commodities and jurisdictions**. This means that key sub-national patterns in production, export and deforestation are not detected. This could lead to overestimations of risk if, for example, deforestation and production of a commodity are occurring in different parts of the same country. Equally, risk could be underestimated if a particular commodity was more tightly associated with deforestation than the national average land use change.
- **Variability in agricultural productivity and land efficiency**. For example, cattle system productivity is known to be highly variable between systems, countries and producers (e.g. feedlot production in US compared with extensive pasture-based systems in Brazil). We have used national yield and productivity assumptions; however, it is conceivable that the UK could source from a niche system with a different level of productivity from the country average.
- **The lack of consistent, high-quality and up-to-date data**. There is a lack of data on deforestation and social risk associated with each commodity in each major producing country.
- **The lack of readily available data on the UK's imports of certified commodities**. The exceptions are palm oil and timber, largely a result of UK commitments to report on certified palm oil imports and tackle illegal logging respectively.

This report provides a useful guide to the overall need for action, relative levels of risk between commodities and an indication of where the UK government, businesses and civil society might target their effort in order to have the most impact in reducing the country's forest footprint overseas. There are uncertainties in the specific figures calculated using this methodology but the index approach allows for an interpretation of the figures that is simple, useful and adequate to drive action.

4 Soy

4.1 Overview of production, trade and use

4.1.1 Introduction

Soy (or soybean, or soya), *Glycine max*, is a leguminous species native to East Asia, grown for its edible bean. It is grown widely in Asia, and North, Central and South America. The soybean contains 38% protein (double that of pork and treble that of eggs), a wide range of essential amino acids, a high proportion of unsaturated fat, and produces more protein per hectare than any other major crop. This high protein content has resulted in soy being a major animal feed ingredient. Cultivation is successful in climates with hot summers, with optimum growing conditions in mean temperatures of 20-30°C. It can grow in a wide range of soils, with optimum growth in moist alluvial soils with a good organic content. Soy, like most legumes, fixes nitrogen via a symbiotic relationship with bacteria.

The main uses of soy are:

- **Soy oil:** Soybeans contain approximately 18% oil, which is refined and used as vegetable oil for cooking and in a wide variety of processed foods.
- **Soy meal:** This is the material remaining from oil extraction, which contains 50% protein. The meal is 'toasted' (steam treated) and ground and then is almost entirely used in livestock feed.
- **Direct human consumption:** Soy is used directly in a range of food – especially in China, Japan and Indonesia – including soy sauce, tempeh, tofu, soy flour, soy milk, textured vegetable protein, and edamame.

4.1.1.1 Production

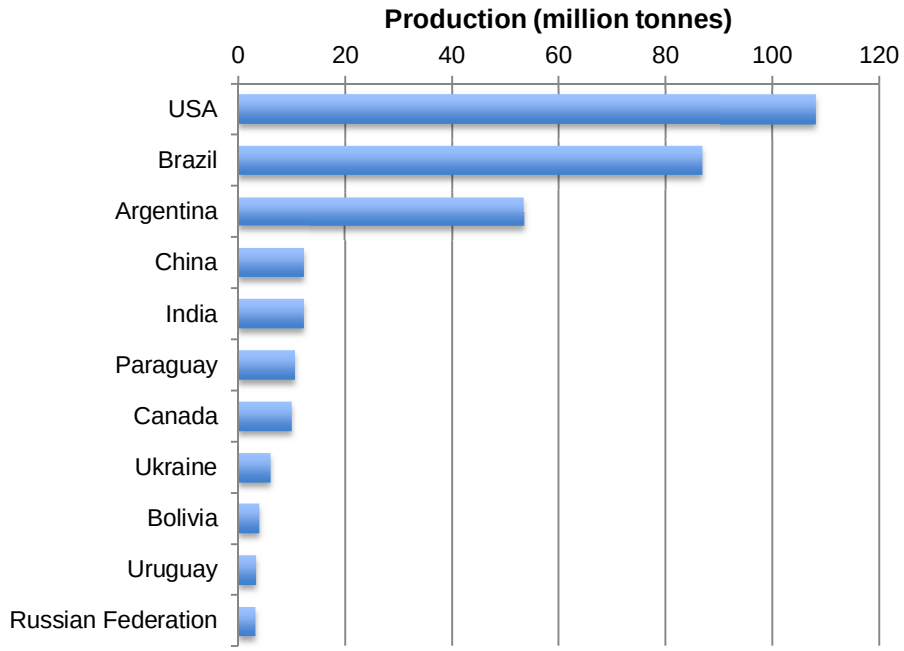
Soy production has increased eightfold since the 1960s and has doubled since 2000. This growth in production has been dominated by three countries: the US, Brazil and Argentina, which together account for over 80% of global production (Figure 3

Figure 3). The rate of growth has been particularly rapid in South America, with more than half of Argentina's agricultural area now used for the cultivation of soy.9

Global soybean production is projected to increase by around 2.5% per year over the next decade, compared with 5% during the past decade. Behind the slowdown is a marked decrease in the yearly expansion of area planted to soy in Argentina and Brazil, and a stagnation of planted area in the US.[10] Growth in production is likely to come primarily from expanding the cultivated area, as soy has relatively limited potential for yield increases.[11] South American producers are likely to cover most of the expansion of soy production and exports.[12] Developing countries are likely to account for the majority of additional soy meal consumption due to increased livestock production.

[9] García-Lopez, G.A. and Arizpe, N. (2010). Participatory processes in the soy conflicts in Paraguay and Argentina. *Ecological Economics*, 70(2), 196–206.
[10] http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1215457178567/Soybean_Profile.pdf
[11] https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-01-28-agricultural-commodities-brack-glover-wellesley.pdf
[12] http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1215457178567/Soybean_Profile.pdf

Figure 3: Soy oilseed production by country in 2015[13]



4.1.1.2 Global trade

Soy accounts for a projected 60% share of global oilseed production. About two-thirds of the global soybean harvest – an estimated 276 million metric tonnes in 2013 – is traded internationally.[14]

Brazil, the US and Argentina dominate international exports, with their exports an order of magnitude greater than other exporting countries such as Paraguay, India and Bolivia. The soy products exported differ between countries: the United States, Brazil and Paraguay export comparatively more beans, while Argentina and India perform most of the crushing of beans domestically, and thus export comparatively more meal and oil.

China dominates global imports of beans, oil and meal, with the EU also importing significant quantities. China's imports have increased sevenfold between 2000 and 2014, much of this demand being for animal feed in the pig and poultry industries. Demand has been primarily driven by a general deficit in protein crop production and by expanding livestock production, together with biofuel policy.

World prices of soy have almost halved since 2011, due to the end of the commodities price boom of the 2000s together with several years of strong harvests.[15]

Compared with trade in other agricultural commodities, trade in whole oilseeds, particularly soybeans, is relatively unrestricted by tariffs. Oilseed meals, and particularly vegetable oils, typically have higher tariffs.[16]

[13] Source: FAOSTAT
[14] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf
[15] http://www.reuters.com/article/research-and-markets-idUSnBw295291a+100+BSW20150529
[16] http://www.ers.usda.gov/topics/crops/soybeans-oil-crops/trade.aspx

4.1.1.3 End uses

Close to 85% of the global soybean crop is crushed for oil and meal, with approximately 70% of the total used to feed livestock. In the EU this figure rises to around 90%.[17] Soy meal accounts for over 60% of the world's production of vegetable and animal meal and occupies a prominent position among protein feedstuffs used for the production of feed concentrates.

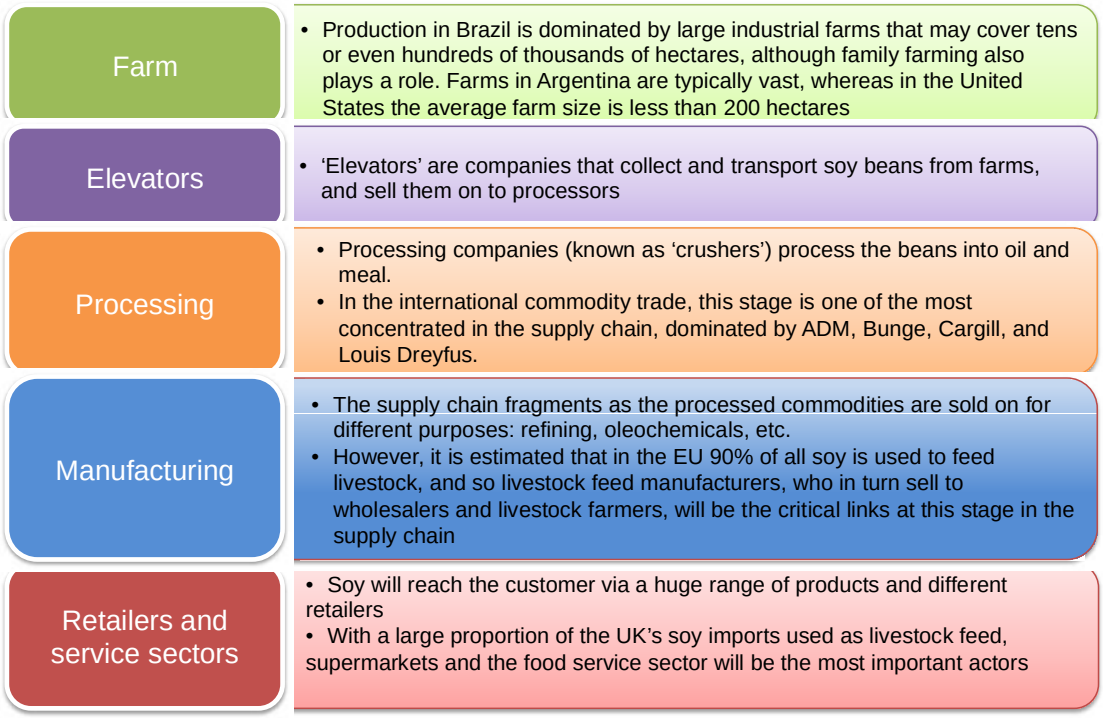
Soybean oil is the second most important vegetable oil (after palm oil), accounting for 25% of global vegetable/animal oils and fats consumption.[18] Soy oil is used in food products, cosmetics, detergents, industrial products and it is increasingly being used to produce biodiesel (especially in the US). A valuable by-product from the crushing process is soy lecithin. This is an effective emulsifying agent in food products such as chocolate, cookies, peanut butter and coffee creamer, but also in cosmetics, textiles, paints, coatings and waxes.[19]

Only about 6% of the global production is directly used in food products, and this predominantly in Asia, with another small share of beans used in animal feed prior to extracting the oil ('full-fat soybeans').[20]

4.1.2 UK supply chain

The UK's soy supply chain begins with production in the Americas, with a significant amount of refining in the country of origin (Figure 4). The four largest commodity traders in South America, from which most of the UK's soy originates, are ADM, Bunge, Cargill, and Louis Dreyfus, commonly referred to as 'ABCD'. Cargill and ADM each also have a crushing and refinery facility in the UK, producing meal, hulls, crude soy oil and crude lecithin.

Figure 4: Simplified soy supply chain



[17] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf
[18] http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1215457178567/Soybean_Profile.pdf
[19] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf
[20] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf

After this point, the supply chain fragments as the processed commodities are sold on for different purposes: refining, oleochemicals, livestock feed manufacturers, etc. However, it is estimated that, in the EU, 90% of all soy is used to feed livestock (UK-specific estimates are not available at the time of writing).[21] The key elements of the UK supply chain are therefore likely to involve the major feed manufacturers, the large chicken, pork and beef producers, and the food retailers and food service sector from which the public purchase food.

4.1.3 Certification

The most prominent soy certification scheme is the Round Table on Responsible Soy (RTRS). RTRS members include producers, industry, trade & finance and civil society organisations. The scheme includes a standard with independent third-party verification, and chain of custody arrangements that include segregation, mass balance or a credit system.

The RTRS standard excludes deforestation of High Conservation Value Forest[22] after 2009, and has social requirements that are at and above the national legal minimum requirements for issues such as land rights and workers' terms and conditions.[23] A revised version of the standard effectively precludes the conversion of natural vegetation from June 2016 onwards.

The first RTRS-certified soy came on the market in June 2011. Over 10,000 producers in Argentina, Brazil, Canada, China, India and Paraguay produced around 2.3 million tonnes of RTRS-certified soy in 2015,[24] which is approximately 0.7% of global production. Despite this modest volume, the amount of RTRS-certified soy is increasing rapidly: in 2011, the amount of RTRS-certified soy was around 400,000 tonnes.[25] There is no readily accessible data concerning the amount of RTRS-certified soy entering the UK, although most of the companies buying credits are based in the EU.

A second certification scheme, the ProTerra Certification Program, was created in 2006 within Cert ID (part of Global ID Group), a global certification body that provides accredited certification programmes to the food and agricultural industry. It was transferred in full to the ProTerra Foundation in 2012. The standard includes sustainability criteria and excludes genetically modified (GMO) soy. Certification of producers, handling, transport and storage, and processing and manufacturing is possible, involving independent third-party verification. About 95% of the volume of certified ProTerra soy is from Brazil. The volume of ProTerra-certified soy has dropped from 4.5 million tonnes in 2007 to 2.8 million tonnes in 2014.[26]

In addition to these soy-specific multi-stakeholder standards, there are a number of proprietary standards (e.g. ADM's Responsible Soy Standard), the FEFAC guidelines (which benchmark standards), and the FEMAS standard (which is, in essence, a food quality benchmark with an add-on responsible soy module). These standards focus on legal compliance, good agricultural practice, and decent treatment of workers, but the provisions in these standards regarding deforestation and social issues are weaker than those of RTRS and ProTerra. For example, FEFAC compliant standards need only exclude illegal deforestation, thus allowing legal deforestation (Table 1). They are also significantly less

[21] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf
[22] High Conservation Value Forests are those that contain one or more outstanding biological, ecosystem, social or cultural value. First defined in the Forest Stewardship Council standard for sustainable forest management, the definition is now used in sustainability initiatives in many sectors.
[23] Potts, J., Lynch, M., Wilkings, A., Huppé, G., Cunningham, M., and Voora, V. (2014). *State of Sustainability Initiatives Review*. IISD & IIED.
[24] http://www.responsiblesoy.org/mercado/volumenes-y-productores-certificados/?lang=en
[25] WWF (2016). *Soy Scorecard: Assessing the Use of Responsible Soy for Animal Feed*. WWF. http://d2ouvy59p0dg6k.cloudfront.net/downloads/wwf_soy_scorecard_2016_r6.pdf
[26] http://www.proterrafoundation.org/index.php/certified-volumes (last accessed 6 June 2016).

transparent. Non-soy-specific standards, including organic standards, are also used in the sector.

Table 1: Deforestation requirements in selected soy standards

Standard	Deforestation requirement
RTRS	· No expansion of cultivation onto land cleared of native habitat after May 2009, with the exception of land in line with RTRS-approved maps or systems. If no RTRS-approved maps are available, expansion cannot occur into native forests or HCVAs. · Cultivation may expand into land cleared before May 2009 that has been used for agriculture within the past 12 years, unless the regenerated vegetation has reached the definition of native forest.
ProTerra	· No conversion of native vegetation or high conservation value areas (HCVAs), including primary forests, after 2004 ('core' or mandatory requirement). · Certified organisations must adhere to any additional limits (regarding land conversion) posed by governmental regulations and international conventions (non-mandatory requirement). · In certain limited circumstances in specific regions, measures to compensate for HCVAs that have already been cleared between 1994 and 2004 must be used to augment other indicators (core requirement).
ADM Responsible Soy Standard	· Prohibition on development in High Carbon Stock Forests and High Conservation Value areas · No burning.
FEMAS	· As for FEFAC – see below.
FEFAC	· No soy cultivation on land that is illegally deforested after the cut-off date mentioned in the relevant national legislation. · Areas secured by law must be protected. If alteration has taken place areas must be restored or compensated through legally approved actions.

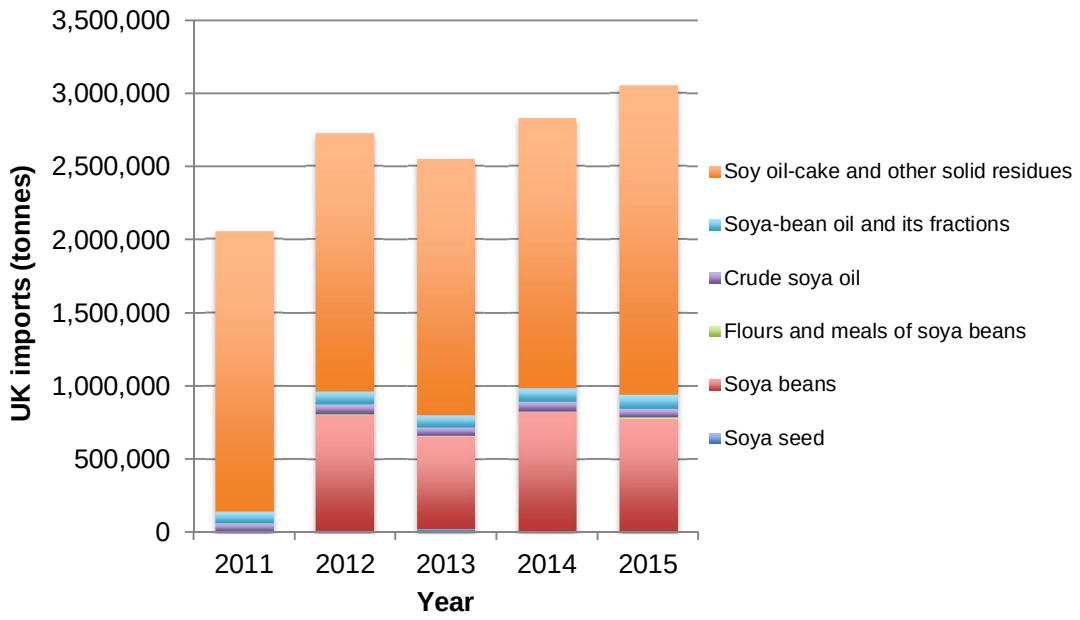
4.1.4 UK imports

Unless otherwise stated, all data is derived from the UN Comtrade database.

4.1.4.1 Direct and indirect imports

The UK imported 3,074,858 tonnes of soybeans, meal and oil in 2015. Raw materials for animal feed ('oil cake and other solid residues of soya') comprises by far the biggest import (Figure 5), consistently accounting for over two thirds of the volume of imports.

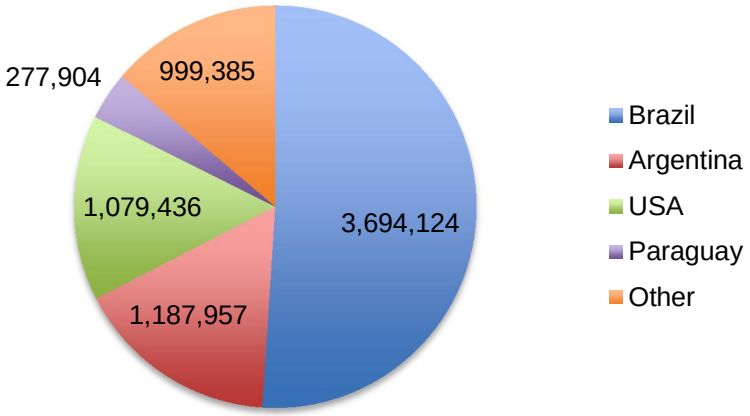
Figure 5: UK imports of soybeans, meal and oil[27]



Argentina was the largest exporter to the UK (37%), followed by the Netherlands (23%), Brazil (17%), the US (9%) and Paraguay (5%), and together these countries accounted for 90% of UK imports. Note that imports from Paraguay have grown from zero in 2013 to 139,466 tonnes in 2015, reflecting the rapid expansion of soy production in that country.

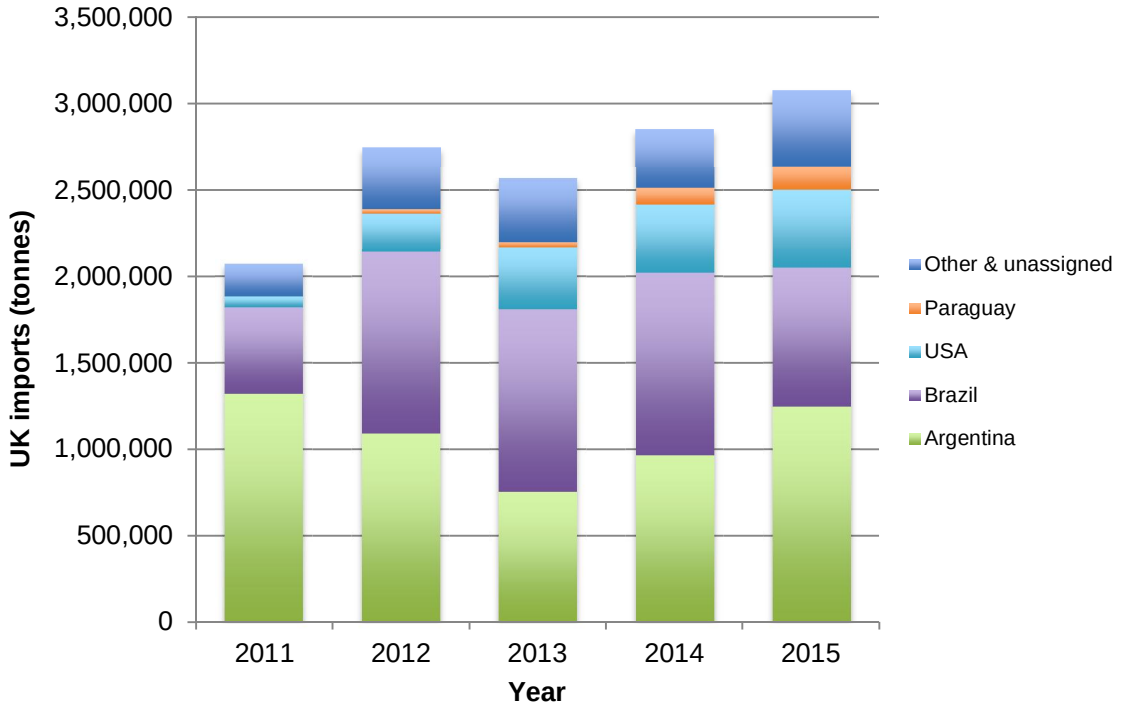
The major non-producer country supplying the UK is the Netherlands, which imports over half of its soy from Brazil (Figure 6). Assuming that the Netherlands exports to the UK in a similar proportion to that which it imports, the geographic origin of the UK's imported soy can be adjusted (Figure 7). This accounts for 87% of imports, and results in Brazil (37%) being the lead exporter to the UK, followed by Argentina (34%), US (14%) and Paraguay (3%).

Figure 6: Imports of soybeans, meal and oil to the Netherlands in 2014[28]



[27] Source: UN Comtrade.
[28] Source: UN Comtrade.

Figure 7: Estimated origin of UK imports of soybeans, meal and oil adjusted for Netherlands imports



4.1.4.2 Embedded imports

As well as being imported as raw materials (beans, oil and meal), soy is also imported in manufactured products, and embedded within animal products that have been fed soy and which are imported into the UK. Given the very wide-ranging uses of soy, and the fact that the soy embedded in some products is unknown, we have taken the approach of focusing on the embedded imports that are together likely to contain a significant proportion of the UK's imported embedded soy. These are poultry, eggs, pig meat, beef, dairy, soy sauce and biodiesel.

Poultry, pig products, beef and dairy[29]

Poultry imports into the UK averaged 370,000 tonnes between 2011 and 2015 (Figure 11). The largest exporter, accounting for 47% of all exports over the period, is the Netherlands. Applying the estimate for the Netherlands that 575 grams[30] of soy are used to produce one kilogram of chicken, this implies that poultry imports account for approximately 213,000 tonnes of embedded soy imports into the UK each year. Note that although soy is also used in animal feed for egg production, the UK's import of eggs is minor.

Pork, bacon and other fresh, chilled, frozen and preserved pig meats also constitute significant imports into the UK, averaging 759,000 tonnes per year between 2011 and 2015. The largest exporters over this period were Denmark (31%), the Netherlands (21%), Germany (16%) and Ireland (11%). Applying the estimate for the Netherlands that 263 grams of soya are used to produce one kilogram of pork, this implies that pork imports account for approximately 200,000 tonnes of embedded soy imports into the UK each year.

[29] Note that these conversion factors used may over- or under-estimate the actual embedded soy depending on the production systems used in the countries that export to the UK.
[30] Note that estimates of embedded soy in meat and dairy vary widely. This is calculated based on a mid-range estimate from various sources.

Beef (carcasses, cuts, chilled, frozen and preserved) constitutes significant imports into the UK, averaging 539,000 tonnes per year between 2011 and 2015. The largest exporters over this period were Ireland (67%), Brazil (7%) and the Netherlands (6%), with the EU27 together contributing 86% of exports to the UK over the period. Applying the estimate for the Netherlands that 0.175 grams of soy are used to produce one kilogram of beef, this implies that beef imports account for approximately 94,000 tonnes of embedded soy imports into the UK per year.

The UK imports considerable volumes of dairy products, especially cheese (an average of 0.9 million tonnes per year between 2011 and 2015), and buttermilk and yoghurt products (an average of 0.5 million tonnes per year). Almost all of these imports are from the EU27 countries, with France (28%), Ireland (26%) and Germany (15%) being the major exporters. The significant quantity of these imports, combined with the fact that some of them such as cheese and milk powder are in highly concentrated form,[31] means that the soy embedded within dairy imports constitutes a meaningful proportion of the total embedded soy imports. Assuming that 17 grams of soy is embedded within each litre of milk, imports of dairy products account for approximately 165,000 tonnes of embedded soy per year.

Soy sauce

Between 2011 and 2015, an average of 19,750 tonnes of soy sauce was imported each year into the UK. Assuming that soy constitutes 10% of the product, this gives an average annual import of approximately 1,975 tonnes of embedded soy within soy sauce per year. Note that there is little data on imports of other soy-based food, such as tofu or soy milk.

Biodiesel

Soy is a feedstock for the production of biodiesel, the use of which has been promoted by the UK's Renewable Transport Fuels Obligation (RTFO). Reporting in 2011, DEFRA estimated that 26% of the biofuel used in the UK was derived from soy feedstock, and that the majority of this originated in Argentina.[32] However, according to the UK government's statistics, the use of soy as a feedstock for biodiesel has declined to just 0.15% of the UK's biodiesel between April 2015 and April 2016. Assuming annual proportions of biofuel feedstock can be applied to imported biofuel (as opposed to all biofuel used in the UK) this implies an annual import of soy embedded in biodiesel of approximately 1,000 tonnes per year between 2012 and 2015.

Other uses

Soy is used as an ingredient or as a feedstock for numerous imported processed and manufactured goods, including paints, fungicides, detergents, bakery products, cosmetics, hypoallergenic milk, salad oils, lecithin (an emulsifier) and many others. However, the existence and quantity of soy within any one category are essentially unknowable, and so no attempt is made to estimate the soy embedded in manufactured and processed products. The total estimate provided below should thus be seen as a likely minimum UK soy footprint. The estimated soy imports in

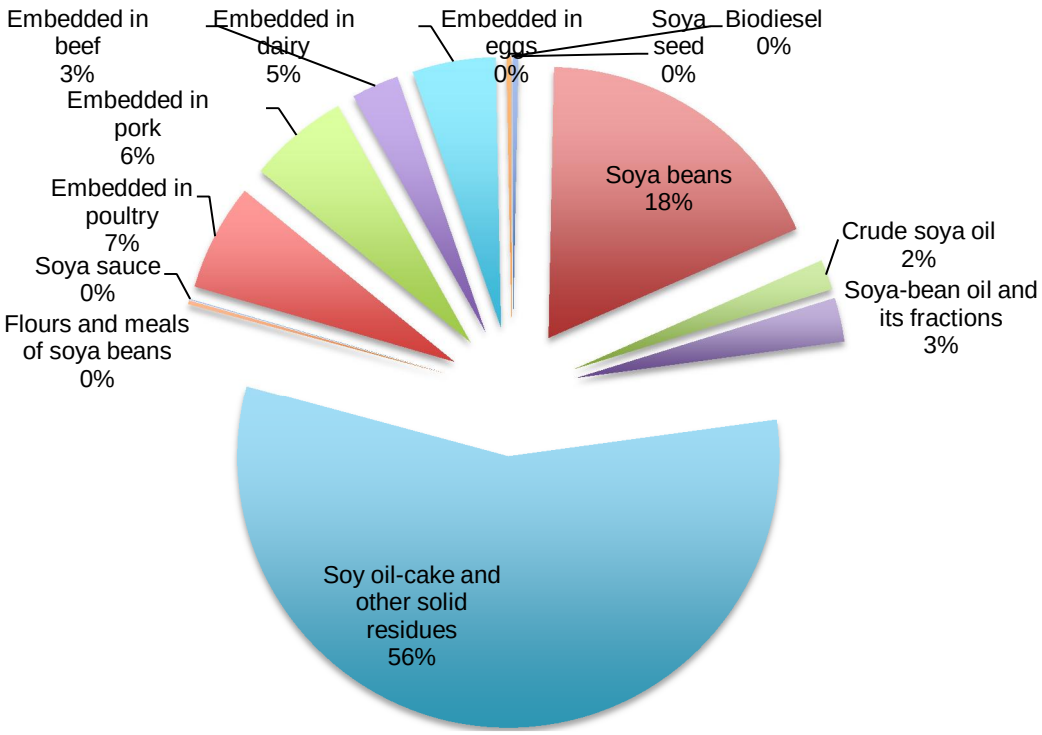
[31] According to the RTRS soy calculator, 1 litre of milk contains a modest 17 grams of embedded soy. However, it takes around 8.5–10 litres of milk to make 1 kg of hard cheese, 0.5 litres of milk to make 1 kg of 'fresh' cheese (such as cottage cheese and paneer) and around 8.5 litres of milk to produce 1 kg of milk powder. This concentration effectively increased the embedded soy in these products compared with milk.

[32] Defra: RTFO Year 3 Verified Report: 15 April 2010–14 April 2011.

Figure 8 summarise the imports of soy – directly imported, indirectly imported and imported embedded within other products – in all of the categories estimated. The overwhelming majority of imports are in the form of 'soy cake and residues' (meal) that are used as animal feed (56%) and soybeans (18%). Other significant imports are the soy embedded in imported poultry (6%), pork (6%) and dairy produce (5%).

The total imports of soybeans, oil, meal and embedded average 3.3 million tonnes per year between 2011 and 2015 (Table 2). This is equivalent to 11% of the EU28's imports of soybeans, soybean meal and soy oil in the harvest season 2013/2014.[33]

Figure 8: Estimated proportion of soy imported into the UK by product, 2011-15



[33] http://assets.wnf.nl/downloads/mapping_the_soy_supply_chain_in_europe_wnf_12_may_2015_final_1.pdf?_ga=1.15738609.614853425.1432130108

Table 2. Estimated imports of soy by product, 2011-15

Type of import	Product	(In tonnes) 2011	2012	2013	2014	2015	2011–2015 Average	%	Data transparency
Direct and Indirect Imports: Raw materials	Soy seed	0	16,216	26,401	6,816	3,967	10,680	0	Medium: direct import data but significant volumes via the Netherlands
	Soy beans	0	786,102	631,533	818,104	773,568	601,861	18	Medium: direct import data but significant volumes via the Netherlands
	Crude soy oil	55,649	65,809	56,617	65,804	57,466	60,269	2	Medium: direct import data but significant volumes via the Netherlands
	Soybean oil and its fractions	78,309	90,160	82,210	90,729	95,532	87,388	3	Medium: direct import data but significant volumes via the Netherlands
	Soy oil-cake & other solid residues	1,909,717	1,758,698	1,747,329	1,847,653	2,112,982	1,875,276	56	Medium: direct import data but significant volumes via the Netherlands
Direct and Indirect Imports: Food	Flours and meals of soybeans	10,229	8,505	5,771	4,887	10,292	7,937	0	Medium: direct import data but significant volumes via the Netherlands
	Soy sauce	1,909	1,982	2,012	1,869	2,105	1,975	0	Medium: direct import data but soy content estimated (at 10% by weight)
Embedded imports	Embedded in poultry	217,541	197,166	204,142	214,726	231,047	212,924	6	Medium: Assumes Netherlands estimate for embedded soy in chicken
	Embedded in pork	204,966	200,375	193,584	198,111	200,519	199,511	6	Medium: Assumes Netherlands estimate for embedded soy in pig
	Embedded in beef	92,292	90,487	91,823	96,037	100,646	94,257	3	Medium: Assumes Netherlands estimate for embedded soy in beef holds across producers
	Embedded in dairy	154,352	156,025	171,346	169,289	176,333	165,469	5	Low: Assumes RTRS estimate for embedded soy in milk, plus some products have conversion factors to 'milk equivalent', and some may contain other ingredients
	Embedded in eggs	2,477	10,509	11,548	11,279	10,465	9,256	0	Medium: Assumes Netherlands estimate for embedded soy in eggs
	Biodiesel	no data	2,502	2,018	22	284	1,206	0	Low: lack of clarity over composition of imports, so assumes DEFRA estimate of overall composition of UK biofuels.
	Totals	**2,727,441**	**3,384,535**	**3,226,335**	**3,525,326**	**3,775,207**	**3,327,769**		

4.1.4.3 Data transparency

Between 2011 and 2015 the UK imported an average of 1,837,651 tonnes of soybeans, oil, flour and meal from the main producer countries (Argentina, Brazil, US and Paraguay). This constitutes 68% of the total estimated import. The remaining 32% is either indirect (via the Netherlands and other non-producer countries) or embedded within products (especially meat). For these indirect and embedded imports, assumptions need to be made to estimate the provenance (indirect) and quantity and provenance (embedded).

4.2 Risk analysis

4.2.1 Links between production and deforestation

The expansion of soy production in South America has been strongly associated with deforestation and other natural habitat destruction.[34] One recent study estimated that soy production accounted for 0.6 million hectares of land use change per year between 2000 and 2011 in Brazil, Argentina, Paraguay and Bolivia. The same study estimated that 0.4 million hectares per year of this land use change was embedded in global trade.[35] Seventy percent of the Saladillo wetlands in Cordoba, Argentina, have been lost as a result of the construction of canals for soy cultivation.[36] Soy can also act as an indirect driver of deforestation, displacing cattle ranching towards the forest frontier.[37]

Soybeans and derived products were estimated to be responsible for 4.4 Mha of the 9 Mha of deforestation embodied in crop and livestock products imported into the EU between 1990 and 2008.[38] This estimate, however, does not include the role of soy as an indirect driver of deforestation via its impact on land prices.[39]

An average of 15 litres of chemicals is used per hectare for soy production in South America.[40] Excessive use of agrochemicals is one of the main environmental threats linked to soy production, causing contamination of water bodies as well as impacts on biodiversity.

4.2.2 Social issues associated with production

Soybean expansion has been associated with poor labour conditions and violations of human rights in Brazil[41] and Paraguay.[42] The fertilisers and pesticides used in soy cultivation could pose widespread health risks to people living near soy farms.[43]

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[34] Nepstad, D.C., et al. (2006). Globalisation of the Amazon soy and beef industries: Opportunities for conservation. *Conservation Biology*, 20, 6.

[35] Henders, S., Persson, U.M., and Kastner, T. (2015). Trading forests: Land-use change and carbon emissions embodied in production and exports of forest-risk commodities. *Environmental Research Letters*, 10.

[36] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf

[37] Barona, E., et al. (2010). The role of pasture and soybean in deforestation of the Brazilian Amazon. *Environmental Research Letters*, 5(2).

[38] EU (2013). Comprehensive analysis of the impact of EU consumption of imported food and non-food commodities and manufactured goods on deforestation. http://ec.europa.eu/environment/forests/pdf/1.%20Report%20analysis%20of%20impact.pdf

[39] Richards, P.D., Walker, R.T., and Arima, E.Y. (2014). Spatially complex land change: The Indirect effect of Brazil's agricultural sector on land use in Amazonia. *Global Environmental Change*, 29, 1–9.

[40] EU (2013). Comprehensive analysis of the impact of EU consumption of imported food and non-food commodities and manufactured goods on deforestation. http://ec.europa.eu/environment/forests/pdf/1.%20Report%20analysis%20of%20impact.pdf

[41] https://milieudefensie.nl/publicaties/factsheets/factsheet-2-dutch-soy-coalition-modern-slavery-in-brazil

[42] Hobbs, J. (2012). Paraguay's destructive soy boom. *The New York Times*, 2 July 2012. http://www.nytimes.com/2012/07/03/opinion/paraguays-destructive-soy-boom.html

[43] http://www.bothends.org/uploaded_files/document/Soy_Barometer2014_ENG.pdf

4.2.3 The UK's soy footprint

The evidence cited above suggests that the expansion of soy cultivation has played a significant role in driving deforestation in South America, and has been associated with social woes. Moreover, a large proportion of this has been shown to be driven by global trade.[44] While the Soy Moratorium[45] is seen to have significantly lessened its direct role in Amazonian deforestation, the problem of habitat destruction remains unmanaged in other soy sourcing areas such as in the Cerrado.

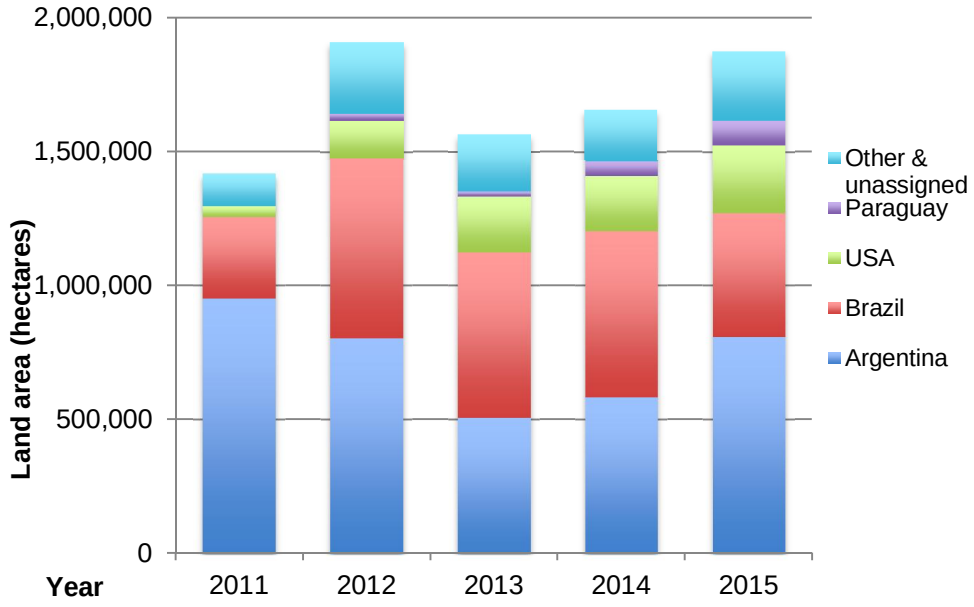
The UK's soy footprint was estimated as follows. The yield of soybeans in each country in each study year[46] was allocated according to the proportion by which they are produced from soybeans: whole soybeans 100%, meal 81% and oil 19%.[47] This method avoids double counting (i.e. counting oil and meal from the same bean) and is commonly used in research where a quantity has to be apportioned to co-products.

The hectares required to produce the imported products for each country in each year were then calculated as

(Share of imports × weight of beans imported) / yield
\+ (Share of imports × weight of meal imported) / yield allocated to meal
\+ (Share of imports × weight of oil imported) / yield allocated to oil

The land required to produce the soy imported to the UK is estimated to be on average 1.68 million hectares between 2011 and 2015 (Figure 9). This is equivalent to just under 1% of the average area of soy harvested annually between 2011 and 2014.[48]

Figure 9: Estimated land area required to produce the UK's annual imports of soy 2011-15



[44] Henders, S., Persson, U.M. and Kastner, T. (2015). Trading forests: Land-use change and carbon emissions embodied in production and exports of forest-risk commodities. *Environmental Research Letters*, 10.
[45] The Soy Moratorium is a voluntary agreement designed to ensure that traders do not buy soy grown in the Amazon on land deforested after 2013 (note that the original cut-off date was 2006). It started in 2006 and has been renewed thereafter.
[46] FAO STAT. Note that FAO STAT has soy yield data only until 2014, and so for 2015 an average of the preceding years was used. For countries other than the major exporters and for the fraction that was not assigned a provenance, the average yield of the major exporting countries was used.
[47] A unit of soybeans yields meal and oil in a ratio of 0.8:0.18. The remainder is waste. Distributing the waste between the two fractions gives ratios of meal to oil of 0.81:0.19. Thus, 81% of a given yield is allocated to meal and 19% to oil. From various industry sources, e.g. the US Soybean Export Council.
[48] FAO STAT.

5 Palm oil

5.1 Overview of production, trade and use

5.1.1 Introduction

The oil palm, *Elaeis guineensis*, is native to west and south-west Africa. It is now planted widely in tropical lowlands, with the most suitable areas for cultivation being between 10 degrees north and south of the equator, with temperature ranges between 24°C and 32°C and with rainfall that is evenly distributed.

Harvesting begins when the palms are three to four years old, and plantations are harvested year-round. The fruit is processed into three main raw materials:

- **Palm oil**, which is extracted from the pulp of the fruit that has been sterilised by heating, and then pounded mechanically (known as digestion) followed by mechanical pressing. The oil is then refined, bleached and deodorised for most uses.
- **Palm kernel oil**, which is extracted from the seed of the fruit by mechanical crushing to remove the shells, steam cooking and pressing.
- **Palm kernel meal**, which is the residue from palm kernel oil extraction.

Palm oil is both the most-produced (46.6 million metric tonnes a year, a third of world production) and most consumed (ahead of soy oil) plant derived oil.[49] It is the most productive oil crop, yielding around five times more oil per hectare than rapeseed, the next most productive oil seed, and yields more than seven times more oil per hectare than soy.[50]

5.1.1.1 Production

Large-scale palm oil plantations usually also contain a processing mill, because fruit bunches must be processed within 24 hours of harvesting to maintain the quality of the oil. The mills typically take in fresh fruit bunches from the plantation as well as small- and medium-sized growers in the vicinity. The requirement to process harvested fruit rapidly, means that most smallholders are effectively tied to selling to a single mill, via agents.

An estimated three million smallholders grow oil palms, accounting for approximately 40% of total global oil palm production.[51] Oil palm is a popular crop among smallholders because of its 25-30 year economic lifespan, relatively low labour requirements and because it can give a substantially higher income than subsistence food crops.[52] However, smallholders' yields are generally lower than commercial plantation due to lack of access to higher-yielding stock and lower knowledge on agricultural practices.[53]

Global palm oil production has increased from 15.2 million tonnes in 1995 to over 57 million tonnes in 2014.[54] This volume is predominantly produced by Indonesia (51%) and Malaysia (34%). There has also been a marked increase in palm oil production in other parts of the

[49] Note: these are 2011 figures. http://www.befair.be/sites/default/files/Huile%20de%20Palme%20EN.pdf
[50] *Oil World* (2016).
[51] http://www.rspo.org/certification/smallholders
[52] http://www.rainforest-alliance.org/sites/default/files/2016-08/smalholder_palm_oil_financing.pdf
[53] Smallholder yields have been reported as being between 90% of plantation yields in Malaysia and Indonesia where smallholders are directly supported by the government or private sector. In Indonesia, unsupported smallholders may have yields 81–48% of that of plantations. See: Vermeulen, S. and Goad, N. (2006). *Towards Better Practice in Smallholder Palm Oil Production*. IIED.
[54] FAO STAT.

world in recent years, with most of the additional volume generated in South and Central America, Thailand and western Africa.[55]

The palm oil industry in Indonesia has developed rapidly, and its land footprint nearly doubled in size between 2000 and 2010, from 4.2 million hectares to 8.0 million hectares. The Indonesian industry is dominated by private enterprises, which accounted for 54% of production in 2010, followed by small-scale farmers and state-owned enterprises.[56]

5.1.1.2 Global trade

Global demand for palm oil has seen strong and sustained growth. Major consuming countries include India, China, the EU, Indonesia and Malaysia. In 2013, India, China and the EU combined, accounted for almost 60% of global imports.

5.1.1.3 End uses

Palm oil is extremely versatile and can be easily separated into solid (stearin) and liquid (olein) components for use in hard products such as soaps and margarines or in liquid products such as oils and lubricants. Palm oil, palm kernel oil and their derivatives[57] are estimated to be present in over 50% of packaged supermarket products.[58] Some of the key uses are:

- **Palm oil:** cooking oil, and an ingredient in manufactured foods including biscuits, baking, ice cream, margarines, snacks, confectionery, dairy products and dairy replacers.
- **Palm kernel oil:** used in the oleochemical industry for making soap, detergent, toiletries and cosmetics and for industrial use.
- **Palm kernel meal:** widely used as animal feed, and also in electricity production.

China and India use palm oil predominantly for cooking oil and other culinary purposes. However, growth in demand in both India and China has been correlated with increasing incomes, urbanisation and an associated dietary shift towards processed foods.[59] In contrast, palm oil is used in the EU more in manufactured products than directly for cooking, and demand growth is partly driven as an indirect consequence of policy support for biofuels: palm oil has replaced other vegetable oils, mainly rapeseed oil, that have been diverted into biofuel production.

Palm oil consumption is vulnerable to competition from other vegetable oils, particularly soybean oil; the two can substitute for one another as cooking oil, biodiesel feedstock and in certain food production.

5.1.2 UK supply chain

Although some refining takes place in producer countries, around 80% of the volume imported into the UK is of crude palm oil (CPO), palm kernel oil (PKO) and palm kernel meal (PKM) (Figure 10). Part of the reason for this import of raw material is that higher tariffs on

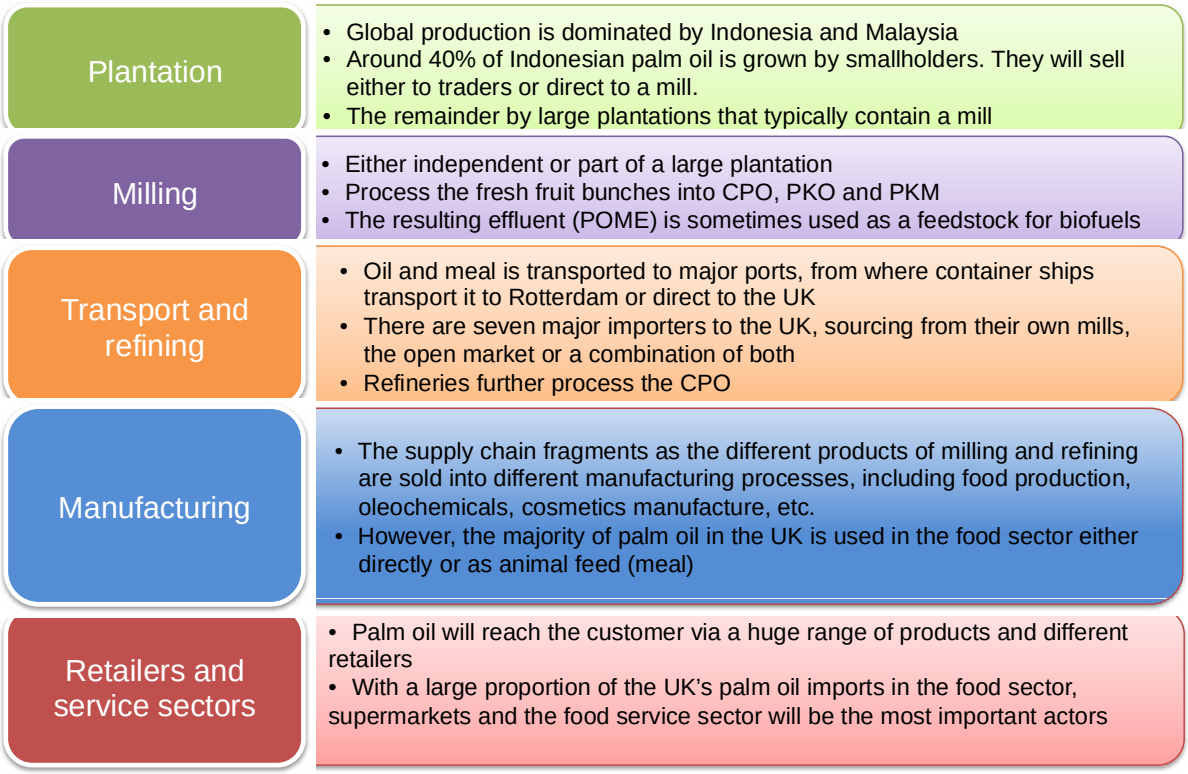
[55] http://www.palmoilandfood.eu/en/palm-oil-production
[56] https://www.pwc.com/id/en/publications/assets/palm-oil-plantation-2012.pdf
[57] Derivatives of palm oil and palm kernel oil are variously labelled as palmitate, palmolein, glyceryl, stearate, stearic acid, palmitic acid, palm stearine, palmitoyl oxostearamide, palmitoyl tetrapeptide-3, sodium laureth sulfate, sodium lauryl sulfate, sodium kernelate, sodium palm kernelate, sodium lauryl lactylate/sulphate, hydrated palm glycerides, etyl palmitate, octyl palmitate, palmityl alcohol.
[58] https://www.pwc.com/id/en/publications/assets/palm-oil-plantation-2012.pdf
[59] https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-01-28-agricultural-commodities-brack-glover-wellesley.pdf

refined oils in consumer markets mean that considerable refining capacity also exists at major import destinations such as Rotterdam. The UK has four refineries processing palm oil:[60] ADM (Purfleet), AAK UK (Hull), New Britain Oils (Liverpool) and Britannia Food Ingredients (Goole).[61]

However, palm oil is also imported in significant quantities in finished goods (e.g. personal care products), and indirectly (e.g. in meat that has been fed on palm kernel meal, and electricity). Defra's palm oil mapping project estimated that these finished products add 30-50% on to the total use of palm oil in the UK. This continues to be acknowledged as an uncertain area by researchers.[62]

The food sector is estimated to use 68% of the total import of palm oil and palm kernel oil in the UK, not including imported manufactured goods and compound ingredients.[63] Biscuits make up the largest share of this, likely using over 20% of the total import of palm oil. In addition, over 80% of the imported palm kernel meal is used for animal feed, with the remaining 20% going into electricity generation. In total, the food sector is estimated to account for approximately 75% of the combined tonnage of palm oil, palm kernel oil and palm kernel meal imports into the UK.[64]

Figure 10: Simplified palm oil supply chain



[60] ProForest (2011). *Mapping and Understanding the UK Palm Oil Use*. Final Report to the Department for Environment, Food and Rural Affairs, April 2011. DEFRA http://randd.defra.gov.uk/default.aspx?Module=More&Location=None&ProjectID=17170
[61] ProForest (2011). *Ibid.*
[62] For example CPET (2015) *Annual Review of UK Palm Oil Consumption*. Report for Defra.
[63] ProForest (2011). *Ibid.*
[64] ProForest (2011). *Ibid.*

Biofuels derived from palm oil are almost all imported as methyl esters, and thus use little (if any) of the bulk palm oil imported into the UK. The supply chains for biofuels are complex because biofuel goes through several storage and blending refineries before becoming an end product. The UK government reports on the source of biofuels under the Renewable Transport Fuels Obligation (RTFO). Personal care products have a similar complexity with several manufacturing stages for the palm oil to go through.

A portion of the UK's imported PKM is used for electricity generation, as well as some Palm Fatty Acid Distillate (a product of the refining process), although there are only three operators involved (RWE nPower, Scottish and Southern Energy, Trostrey Generating Station).[65]

5.1.3 Certification

The major certification scheme for palm oil is the Roundtable on Sustainable Palm Oil (RSPO). RSPO is a multi-stakeholder initiative with members from all stages of the supply chain and from environmental and social NGOs. RSPO was formed in 2004 and has a certification standard that includes environmental, social and economic aspects. New plantings on High Conservation Value (HCV) Forest and High Carbon Stock (HCS) Forest are forbidden, and a process of Free Prior and Informed Consent (FPIC) is required if communities have use rights to the land.

Certification is via independent, third party verification. RSPO allows four chain of custody options:

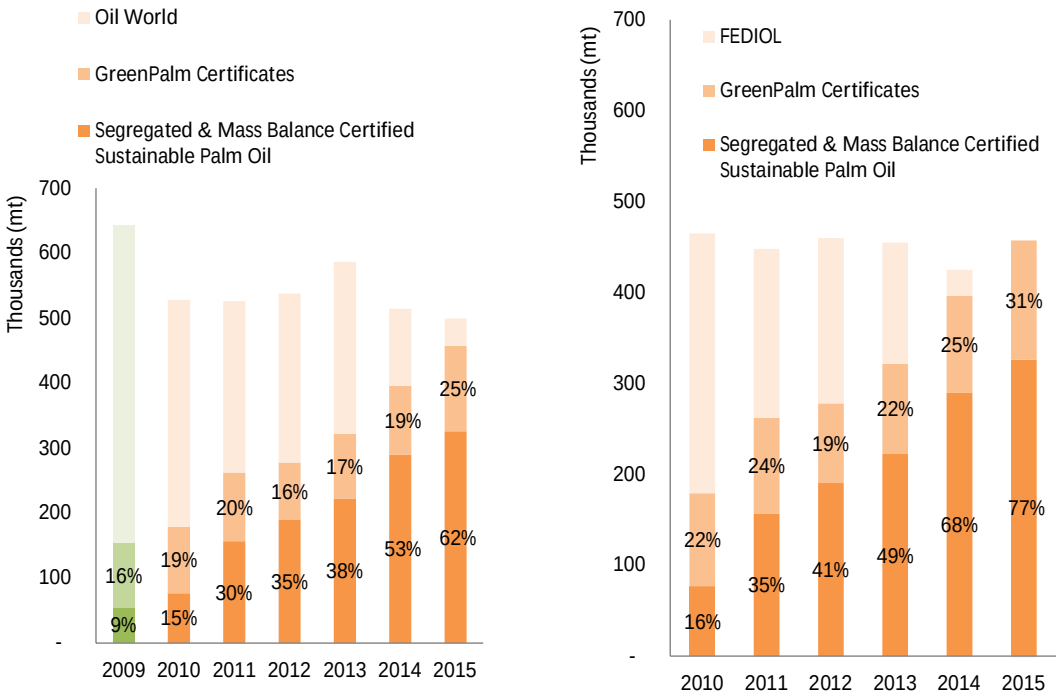
- **Identity preserved**: palm oil from a single identifiable certified source is kept separate from ordinary palm oil throughout the supply chain. Controlled through independent third-party verification.
- **Segregated**: palm oil from different certified sources is kept separate from ordinary palm oil throughout the supply chain. Controlled through independent third-party verification.
- **Mass balance**: palm oil from certified sources is mixed with ordinary palm oil throughout the supply chain, with equivalent percentages of certified and non-certified palm oil sold in the marketplace. Controlled through independent third-party verification.
- **GreenPalm** ('Book and Claim'): RSPO-certified palm oil growers convert their certified tonnage into GreenPalm certificates. Manufacturers and retailers can then purchase GreenPalm certificates from an RSPO-certified palm oil grower to offset each tonne of palm oil, palm kernel oil they use. There is no chain of custody and hence no chain of custody control.

RSPO has been conspicuously successful in achieving scale when compared with sustainability certification schemes in most other commodities. The RSPO currently has 2,879 members and RSPO certified palm oil accounts for 17% of global production in 2016.[66] In 2012, against a 2009 baseline, the UK government and a number of key organisations representing businesses within the palm oil supply chain in the UK committed to source 100% credibly certified (RSPO) sustainable CPO and PKO by 2015.[67] An annual update of progress against this target was conducted by Central Point of Expertise on Timber (CPET) but this service ended in March 2016. CPET estimated that between 87%

[65] ProForest (2011). *ibid*
[66] http://www.rspo.org/about Last accessed 7 December 2016.
[67] DEFRA (2012). *Sustainable Production of Palm Oil, UK statement*. DEFRA. October 2012.

and 108% of the CPO and PKO imported by UK refiners (excluding derivatives and finished goods) was under RSPO mass balance, segregation or GreenPalm in 2015 (Figure 11).[68] However, because the animal feed sector, derivatives and finished products were outside the scope of the UK Statement on Sustainable Production of Palm Oil, reliable data on the uptake of certification for these uses is not available.

Figure 11: Proportion of the UK's imports of palm oil and palm kernel oil that is sustainably sourced, estimated from Oil World (left) and FEDIOL data (right).



In spite of, or because of, its success, RSPO is facing a number of critiques:

- whether the Principles and Criteria are sufficiently robust;
- the quality and transparency of the auditing system;
- the extent to which RSPO should take a role in improving the practices of members or influencing government.
- the recent legal challenge (later withdrawn) of the producer IOI who had its certification withdrawn by RSPO after allegations of illegal deforestation in Indonesia.

These critiques, including some high-profile investigations of certified plantation companies that have revealed actions that are in direct contradiction of the RSPO standard,[69] have resulted in reduced confidence among many actors that RSPO certificates always guarantee that palm oil is produced without deforestation and exploitation.

[68] CPET (2017) *Annual Review of UK Palm Oil Consumption*. Report for DEFRA.
[69] See: EIA (2015). *Who Watches the Watchmen? Auditors and the Breakdown of Oversight in the RSPO*, EIA; and Amnesty International (2016). *The Great Palm Oil Scandal: Labour Abuses behind Big Brand Names*. Amnesty International.

Indonesia and Malaysia have both developed palm oil certification systems in recent years. The Indonesian Sustainable Palm Oil Foundation (ISPO) was established in 2009 to implement a certification policy system designed by the Indonesian Ministry of Agriculture. The ISPO system is mandatory and applies to all oil palm growers operating in Indonesia, from large plantation companies to smallholders, although requirements for each vary. ISPO audits have been conducted by independent certification bodies since May 2012, with a deadline involving all Indonesian growers by the end of 2014. The Malaysian Sustainable Palm Oil (MSPO) standard is a national certification standard created by the Malaysian government and developed with input from various stakeholders in the palm oil industry. It was first launched in November 2013, and officially came into implementation in January 2015. There are plans to merge ISPO and MSPO to create a coordinated 'Council of Palm Oil Producing Countries' (CPOPC). It is important to note that neither standard has criteria preventing deforestation, other than instances where deforestation would be illegal.

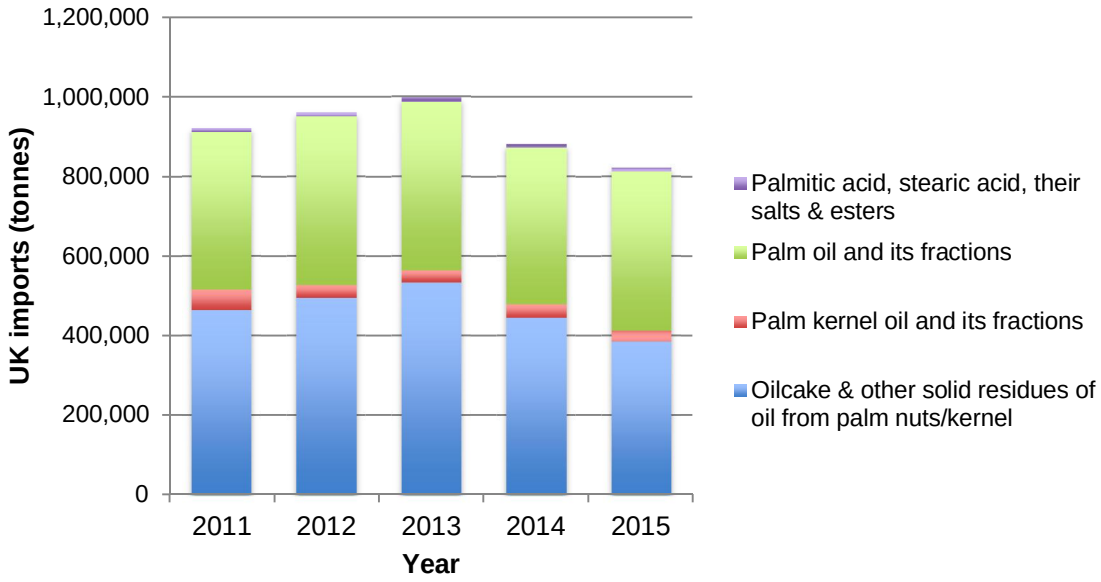
5.1.4 UK imports

5.1.4.1 Direct imports

Data on UK imports of palm oil, palm kernel oil, oilcake and palmitic acid were extracted from the UN Comtrade database.[70] Figure 12 shows a recent decline in the import volumes of these commodities. This is attributable to record soy harvests in the US and South America in 2014, which drove the price of soybeans down faster than that of palm oil, causing imports of palm oil to fall by 14% globally (by net weight).[71] In the UK, this decline was sharpest for oilcake.

The top four trading partners – Indonesia, Malaysia, Papua New Guinea and the Netherlands – account for 87% of imports. Increasing volumes of palm oil products have come from Malaysia in recent years. Some 8% of UK imports come from the Netherlands, which imports predominantly from Indonesia and Malaysia (Figure 13).

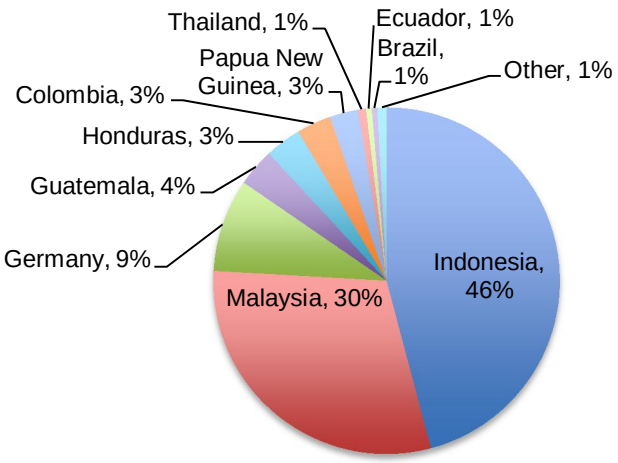
Figure 12: UK imports of palm oil and its fractions



[70] http://comtrade.un.org/data/

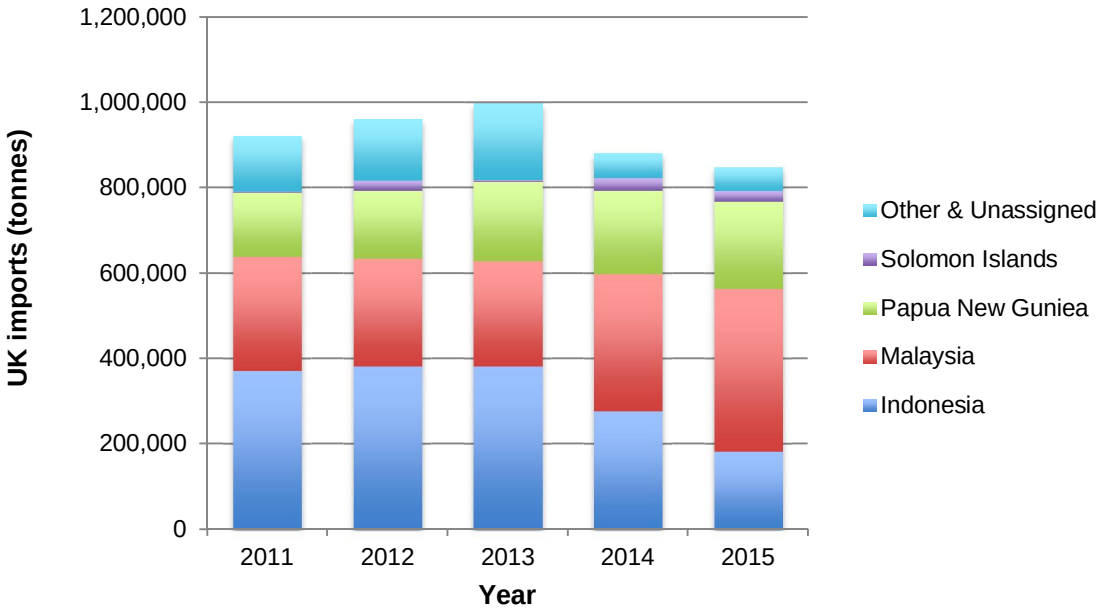
[71] https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-01-28-agricultural-commodities-brack-glover-wellesley.pdf

Figure 13: Palm product import sources for the Netherlands (2014) (rounded to the nearest percent)



Assuming that the Netherlands exports to the UK in the same proportions that it imports from producer countries, UK imports between 2011 and 2015 were predominantly from Indonesia (35%), Malaysia (32%) and Papua New Guinea (19%). Since 2014, Malaysia has replaced Indonesia as the top source of UK imports (Figure 14), with imports from Papua New Guinea steadily growing over the period.

Figure 14: Provenance of UK imports of palm oil, palm kernel oil, meal and stearic acid adjusted for the Netherlands imports



5.1.4.2 Embedded imports

Palm oil and its fractions are ingredients that can be found in many hundreds of imported product types. Much of this import is essentially untraceable without intensive research into the manufacture of thousands of individual products, which was beyond the scope of this research. The approach taken here was to focus on the products that were estimated by DEFRA[72] to account for the biggest share of palm oil. These are soap, bakery products,

[72] ProForest (2011). *Mapping and Understanding the UK Palm Oil Use*. Final Report to the Department for Environment, Food and Rural Affairs, April. DEFRA

margarine, ice cream and chocolate. Biodiesel is also included, as biofuel is a key area of sustainability policy.

Soap

The UK imported an average of over 194,000 tonnes of soap and soap preparations per year between 2011 and 2015, with 69% of this coming from the EU. Assuming a palm oil content of 60% and a PKO content of 15%[73] implies an estimated 145,000 tonnes of palm oil and KPO were imported per year between 2011 and 2015. This is similar to the 2009 estimate of 120,000 tonnes palm oil and 30,000 tonnes KPO.[74]

Bakery

The UK imported an average of 740,000 tonnes of bakery products per year between 2011 and 2015, with 93% of this coming from the EU. There are no reliable estimates of the palm oil content of baked products – which in any case vary hugely between product types – and so imports were further broken down into sub-categories[75] for which estimates could be made.[76] This approach yielded an average annual import of 18,000 tonnes of palm oil in bakery products between 2011 and 2015.

Margarine

The UK imported an average of over 43,000 tonnes of margarine per year between 2011 and 2015, with over 99% of this coming from the EU. Assuming a palm oil content of 24%[77] implies an estimated 18,000 tonnes of palm oil imported per year between 2011 and 2015. Note that, in 2009, net imports of margarine were 18,700 tonnes with an estimated palm oil content of 4,488 tonnes.[78]

Ice cream

The UK imported an average of over 111,000 tonnes of ice cream per year between 2011 and 2015, with over 99% of this coming from the EU. Assuming a palm oil content of 10%[79] implies an estimated 11,000 tonnes of palm oil were imported per year between 2011 and 2015. Note that, in 2009, net imports of ice cream were 86,000 tonnes with an estimated palm oil content of 8,600 tonnes.[80]

Chocolate

The UK imported an average of nearly 46,000 tonnes of chocolate[81] per year between 2011 and 2015. Assuming a palm oil content of 5.15% implies that an estimated 2,000 tonnes per year of palm oil were imported as an ingredient of chocolate.

Biodiesel

Palm oil is a feedstock for the production of biodiesel, the use of which has been promoted by the UK's Renewable Transport Fuels Obligation (RTFO). According to the UK government's statistics, the use of palm oil as a feedstock for biodiesel has declined, and

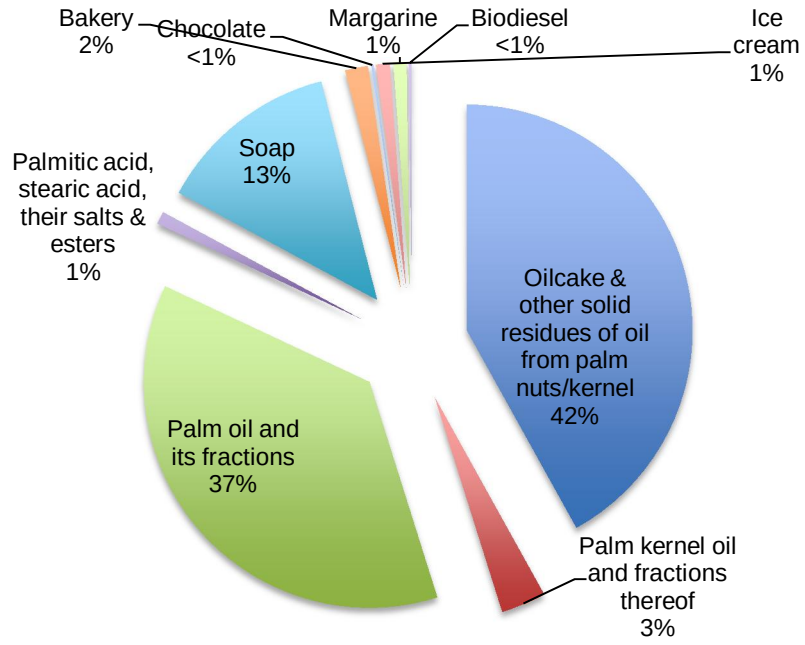
[73] ProForest (2011). *Ibid.*
[74] ProForest (2011). *Ibid.*
[75] Source: HMRC.
[76] www.bakingbusiness.com/
[77] ProForest (2011). *Ibid.*
[78] ProForest (2011). *Ibid.*
[79] ProForest (2011). *Ibid.*
[80] ProForest (2011). *Ibid.*
[81] Chocolate is imported in numerous forms, many of which will have essentially unknowable quantities of palm oil. For the purpose of this calculation only the HS category 'Blocks, slabs, bars, liquid, paste, powder, granular or other bulk form, over 2 kg' is included. This therefore provides a conservative estimate of the total amount of palm oil imported in chocolate.

most of the palm oil feedstock now used is derived from Palm Oil Mill Effluent (POME), which is otherwise essentially a waste product from primary palm oil fruit processing. Disregarding the POME content implies an annual import of approximately 2,000 tonnes of palm oil embedded in biodiesel per year between 2011 and 2015.[82]

5.1.4.3 Estimating the UK's import of palm oil

Figure 15 summarises the imports of palm oil, palm kernel oil and palm kernel meal – directly imported, indirectly imported and imported as an ingredient within other products – in all of the categories estimated. The largest fractions are palm oil and meal, with soap also contributing a significant proportion.

Figure 15: Estimated proportion of palm oil, palm kernel oil and meal imported into the UK by product, 2001-15 (rounded to the nearest percent)



The data is further summarised in Table 3, which shows that the UK imported an average of 1.1 million tonnes of palm oil, palm kernel oil and oilcake each year between 2011 and 2015. This is equivalent to 1.1% of global palm oil production[83] and 1% of palm kernel oil production for 2013, the latest year for which data is available.

The 2011 DEFRA report, written by ProForest, used different methods to estimate the UK's imports of palm oil, palm kernel oil and oilcake.[84] Their estimate was that approximately 1.95 million tonnes were imported in 2009.[85] Recalculating 2009 figures using the methods described above leads to an estimate of 1.7 million tonnes, a figure 13% lower than ProForest's.

[82] https://www.gov.uk/government/collections/biofuels-statistics
[83] FAO STAT.
[84] ProForest used a combination of trade data (HMRC) and industry interviews.
[85] ProForest (2011). *Mapping and Understanding the UK Palm Oil Use*. Final Report to the Department for Environment, Food and Rural Affairs, April. DEFRA

Table 3. Estimated imports of palm oil by product, 2011-15 (percentages are rounded to the nearest 0.1%)

Type of import	Product	(In tonnes)					2011-15		Data transparency
		2011	2012	2013	2014	2015	Average	%	
Direct & Indirect Raw materials	Oilcake & other solid residues of oil from palm nuts/kernel	463,151	494,347	533,657	444,578	385,064	464,160	41.9	Medium – direct import data but some assumptions about indirect imports necessary
	Palm kernel oil and fractions thereof	53,024	33,037	30,927	33,789	27,330	35,621	3.2	Medium – direct import data but some assumptions about indirect imports necessary
	Palm oil and its fractions	396,622	425,079	423,719	393,655	399,352	407,685	36.8	Medium – direct import data but some assumptions about indirect imports necessary
	Palmitic acid and stearic acid, their salts & esters	10,762	9,560	10,157	9,255	10,402	10,027	0.9	Medium – direct import data but some assumptions about indirect imports necessary
Embedded	Soap	138,586	143,518	136,807	140,431	167,815	145,431	13.1	Low – based on DEFRA estimate of palm oil content but assumptions about indirect imports necessary
	Bakery	15,597	16,375	19,395	19,142	21,442	18,390	1.7	Low – based on limited information on palm oil content
	Chocolate	1,687	1,725	1,925	2,009	2,164	1,902	0.2	Low – based on limited information on palm oil content
	Ice cream	11,479	10,434	11,300	11,070	11,071	11,071	1.0	Low – based on DEFRA estimate of palm oil content but assumptions about indirect imports necessary
	Margarine	10,712	12,129	9,133	9,736	10,428	10,428	0.9	Low – based on DEFRA estimate of palm oil content but assumptions about indirect imports necessary
	Biodiesel	4,541	1,197	0	6,172	0	2,382	0.2	Low – DEFRA data, with biodiesel derived from POME excluded
	Total	**1,106,161**	**1,147,401**	**1,177,021**	**1,069,837**	**1,035,067**	**1,107,097**	100%	

5.1.4.4 Data transparency

Between 2011 and 2015, the UK imported an average of over 748,000 tonnes of palm oil, palm kernel oil and palm kernel meal per year from the main producer countries (Indonesia, Malaysia, Papua New Guinea and the Solomon Islands). This constitutes 65% of the total estimated import. The remaining 35% is either indirect (via the Netherlands and other non-producer countries) or as an ingredient within products (especially soap). For these indirect and embedded imports, assumptions need to be made to estimate the provenance (indirect imports) and quantity and provenance (embedded imports).

Unlike most commodities, the data on the amount of RSPO-certified palm oil imported into the UK is readily available as a consequence of DEFRA's UK Statement on Sustainable Production of Palm Oil, which tasked Central Point of Expertise on Timber (CPET) to report on CSPO imports annually. Unfortunately, there has been no commitment yet made to continue this beyond 2016 or extend to derivatives, imported products and ingredients.

5.2 Risk analysis

5.2.1 Links between production and deforestation

The expansion of palm oil cultivation has long been linked with deforestation in Indonesia, Malaysia and beyond.[86] A recent study concluded that 45% of oil palm plantations studied in Southeast Asia came from areas that were forests in 1989. For South America, the figure was 31%.[87] An estimated 16% of all deforestation in Indonesia between 1990 and 2005 was caused by the expansion of oil palm cultivation,[88] and a significant part of this deforestation is embedded in global trade.[89] According to the European Commission study on the impact of EU consumption on deforestation, palm oil was the fourth highest product in terms of impact, accounting for 10% of deforestation embodied in EU imports between 1990 and 2008.[90]

Almost a fifth of palm oil expansion in parts of Indonesia and Malaysia has taken place on peat soils. Clearing and draining peat land – especially when burning is used for land clearance – results in significant greenhouse gas emissions, as well as contributing to transboundary haze.

5.2.2 Social issues associated with production

Forest clearance associated with palm oil expansion has also forced some indigenous peoples off their land and deprived them of their livelihoods, for example in countries such as Indonesia, Malaysia, Cameroon, and Liberia.[91] Forced labour and other abusive labour

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[86] For example, Koh, L.P. and Ghazoul, J. (2010). Spatially explicit scenario analysis for reconciling agricultural expansion, forest protection, and carbon conservation in Indonesia. *PNAS*, 107(24), 11140–11144; Boucher, D., Elias, P., Lininger, K., May-Tobin, C., Roquemore, S. and Saxon E. (2010). *The Root of the Problem: What's Driving Tropical Deforestation Today?* The Union of Concerned Scientists.

[87] Vijay, V., Pimm, S.L., Jenkins, C.N., and Smith, S.J. (2016) The impacts of oil palm on recent deforestation and biodiversity loss. *PLoS ONE*, 11(7).

[88] Fitzherbert, E.B., Struebig, M.J., Morel, A., Danielsen, F., Brühl, C.A., Donald, P.F. and Phelan, B. (2008). How will oil palm expansion affect biodiversity? *Trends in Ecology and Evolution*, 23(10), 538–545.

[89] Henders, S., Persson, U.M. and Kastner, T. (2015). Trading forests: land-use change and carbon emissions embodied in production and exports of forest-risk commodities. *Environmental Research Letters*, 10.

[90] https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-01-28-agricultural-commodities-brack-glover-wellesley.pdf

[91] For example, FPP & Pusaka and Pokker SHK (2014). *Securing Forests, Securing Rights*. Report of the International Workshop on Deforestation and the Rights of Forest Peoples.

practices are periodically reported.[92] In December 2016, Amnesty International published the results of an investigation into Wilmar, the world's largest processor of palm oil, finding serious human rights abuses on the plantations of Wilmar and its suppliers. These included forced labour and child labour, gender discrimination, and exploitative and dangerous working practices that put the health of workers at risk.[93]

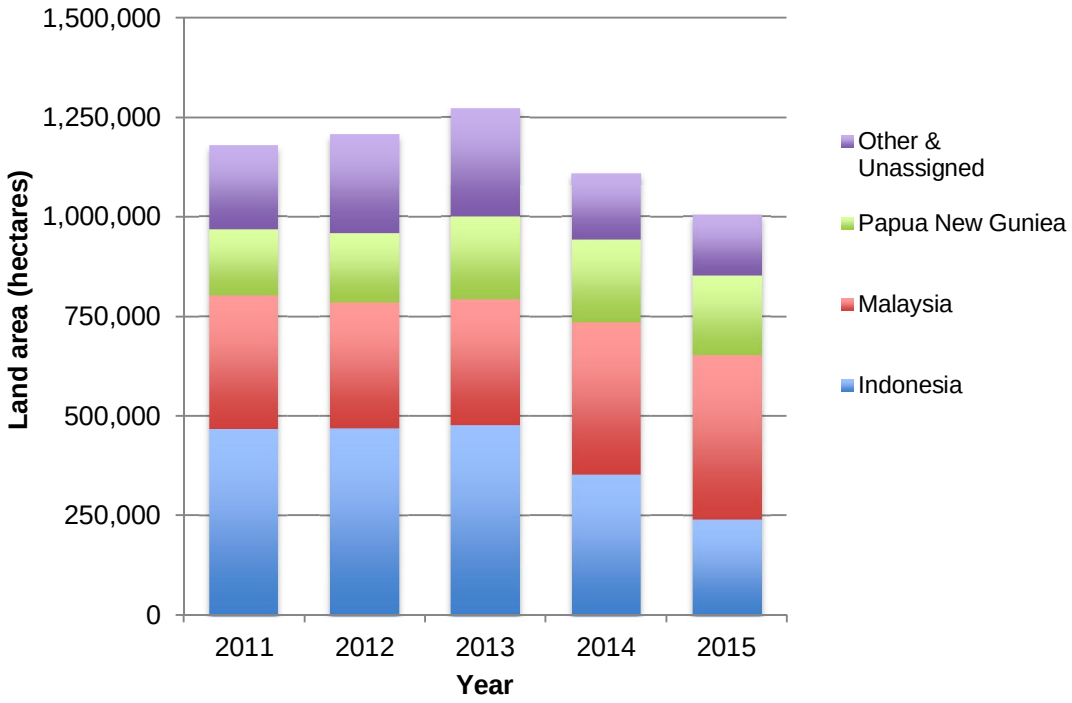
5.2.3 The UK's palm oil footprint

The evidence cited above suggests that the expansion of palm oil has played a significant role in driving deforestation in the main producer countries, and has been associated with negative human rights outcomes.

The UK's land footprint was estimated in a similar way to that described for soy (Section 4.2.3), with a yield of 3.9 tonnes per hectare allocated to CPO, 0.5 tonnes per hectare to PKO and 0.54 tonnes per hectare to PKM.[94]

Over the period, this amounted to an average of 1.16 million hectares per year, including 0.4 million hectares in Indonesia, 0.35 million hectares in Malaysia and 0.19 million hectares in Papua New Guinea (Figure 16). Unfortunately the FAO has no up-to-date data on the global harvested area of oil palm with which to compare this result.

Figure 16: Estimated land area from each major exporting country required to satisfy the UK's imports of palm oil



[92] For example,
https://campaign.worldvision.com.au/wp-content/uploads/2013/04/Forced-child-and-trafficked-labour-in-the-palm-oil-industry-fact-sheet.pdf
http://www.schusterinstituteinvestigations.org/palm-oil-controversies-forced-labor-child-labor

[93] Amnesty International (2016). *The Great Palm Oil Scandal: Labour Abuses behind Big Brand Names*. Amnesty International.

[94] From various industry sources, including RSPO.

6 Timber

6.1 Overview of production, trade and use

6.1.1 Introduction

There are six key product types within the timber sector: sawn-wood, plywood, particleboard, furniture, fuelwood, and pulp and paper (the latter considered separately in Section 7). Forests are home to more than 50% of all terrestrial species, provide ecosystem services such as flood protection, reduce atmospheric carbon dioxide levels, and provide a livelihood for forest-dependent communities (including the 60 million indigenous people who live in forests). Responsible forest management is key to retaining as many of these benefits as possible, whereas unsustainable logging contributes to deforestation and degradation. Negative impacts include corruption, with knock-on effects for social infrastructure and human well-being in the countries concerned, loss of long-term income and security for forest-based communities, loss of habitat for plant and animal species, and increased vulnerability to natural disasters such as erosion, siltation, landslides, flooding and forest fires.

Illegal logging and trafficking of timber is estimated to be a US$100 billion industry globally,[95] and there has been a strong focus on eliminating illegal timber from UK supply chains by UK businesses in recent years. The UK government played an active role in developing the EU's Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan in 2003 which contains measures to increase the capacity of developing and emerging market countries to control illegal logging, while reducing trade in illegal timber products between these countries and the EU. The EU Timber Regulation (EUTR) was adopted in 2010, came into force in March 2013 and prohibits companies placing illegally harvested timber and certain categories of timber products on the market. It requires due diligence in the companies' supply chains, and maintenance of records of their suppliers and customers.

6.1.1.1 Production

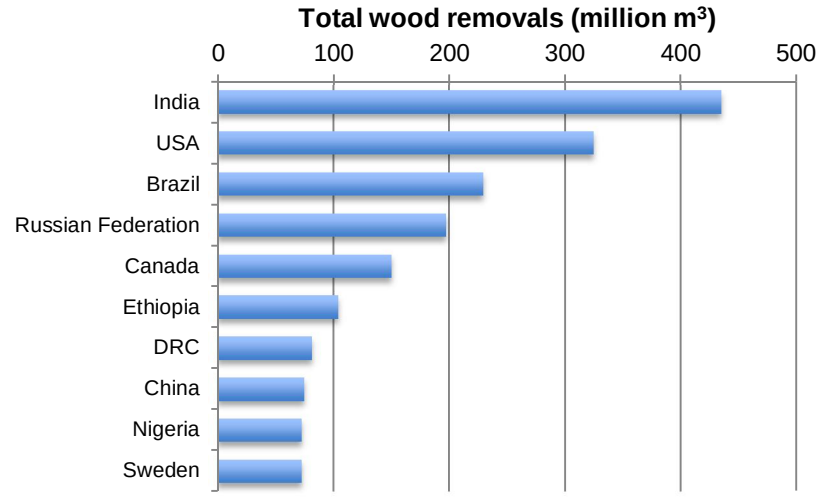
There are two major production systems for timber: plantations and natural forest. The bulk of the world's forest is natural forest, with an estimated 3.7 billion hectares in 2015. The area of planted forest has increased by over 105 million hectares since 1990, and now there is an estimated 291 million hectares of plantations. Around 31% of the world's forests (almost 1.2 billion hectares) are designated as production forest, with a further 28% (over 1 billion hectares) designated as multiple use, i.e. serving multiple functions including timber production.[96]

The two main categories of timber in the trade are 'hardwoods', which are usually broad-leaved trees from the tropics, temperate or boreal regions, and 'softwoods' which are coniferous species from temperate and boreal areas. Softwood species dominate global trade.

In 2015, timber removals (i.e. the volume of wood produced) from the world's forests totalled 2.997 billion cubic metres.[97] FAO statistics from 2011 rank India as the largest producer, with 89% of its production used as fuel, and they record the US, Brazil, Russia, Canada and Ethiopia as responsible for in excess of 100 million m^3 each (Figure 17).

[95] https://blogs.thomsonreuters.com/answerson/cut-risk-illegal-logging-supply-chain/
[96] FAO (2016) *Global Forest Resource Assessment 2015: How are the World's Forests Changing?* Rome: Food and Agriculture Organization of the United Nations.
[97] FAO (2016). *Ibid*.

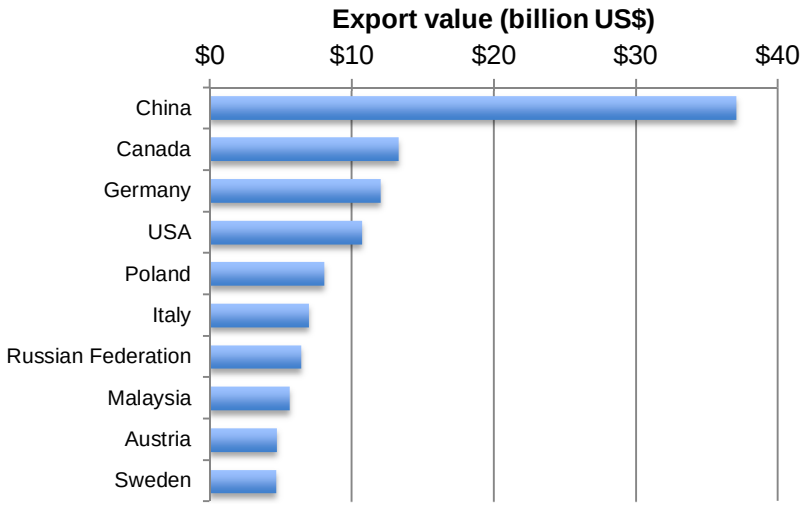
Figure 17: Top 10 countries for timber removals in 2011[98]



6.1.1.2 Global trade

The total value of the trade in timber and timber products in 2015 was US$155 billion. China alone accounts for US$37 billion (22%) of the value this market (Figure 18). In terms of the net weight of timber and timber product exports, Russia and the US are the largest exporters, accounting for 11% and 9% of the weight of exports respectively. The disparity between China's leading position in value and its lower proportion of weight of timber exports reflects the degree of value addition that China gains on timber products.

Figure 18: Top 10 exporters of timber and timber products by value in 2015[99]

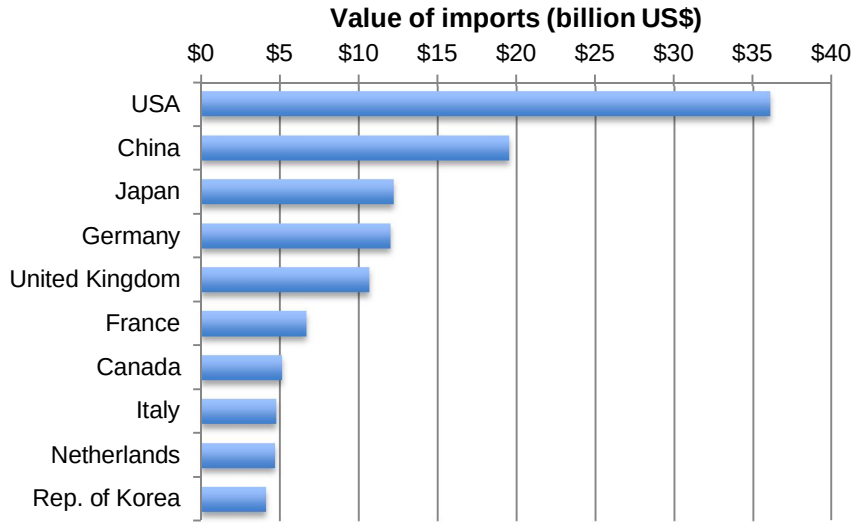


Global imports of timber and timber products were worth US$181 billion in 2015, with the US and China together accounting for 31% of this value. The UK is the fifth largest importer, at 14.7 million tonnes and US$10.7 billion (

Figure 19).

[98] Data from FAO (2016). *Ibid.*
[99] Source: UN Comtrade.

Figure 19: Top 10 importers of timber and timber products by value in 2015[100]



6.1.1.3 End uses

Wood is extremely versatile and has a wide variety of end uses, including:

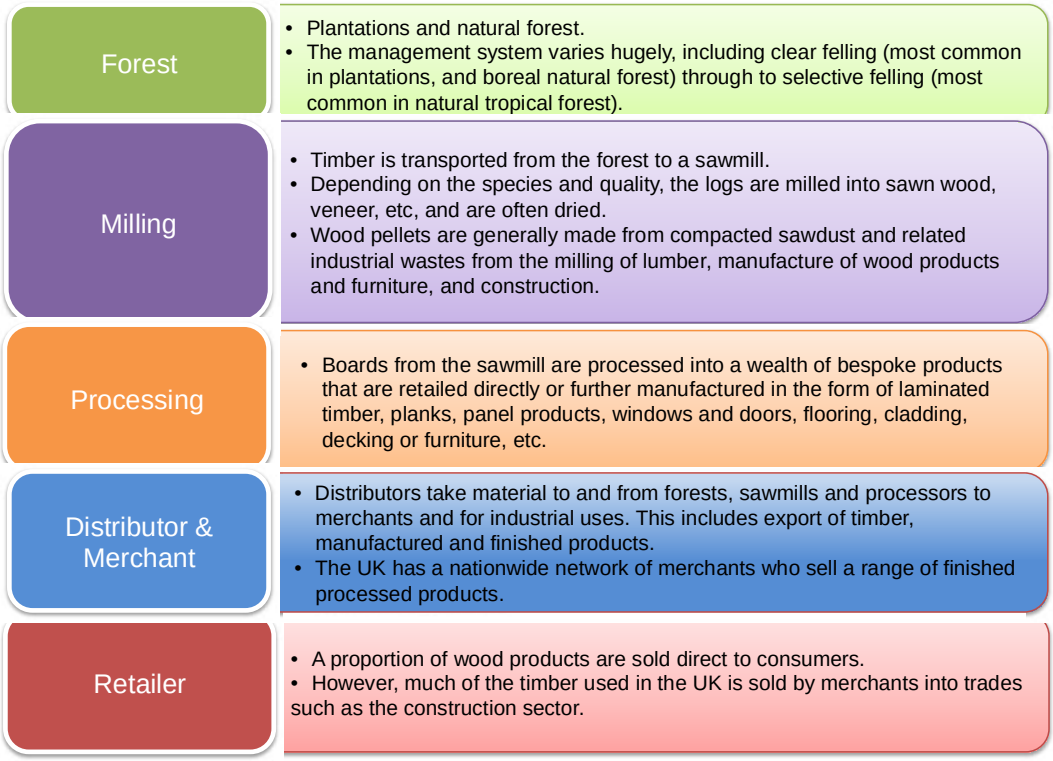
- **Fuel:** Globally, 49% of harvested wood is used for fuel,[101] particularly in developing countries.
- **Construction:** Roughly 20% of new houses in the United Kingdom and up to 70% in Scotland are timber frame.[102] Timber is also widely used as a construction material in flooring (solid wood; laminate or parquet blocks), window frames, doors and doorframes, skirting, decking, garden buildings, telegraph poles, fencing, boat building, railway sleepers, etc.
- **Furniture:** Varying from softwood furniture (e.g. pine) and plywood/laminate flat pack furniture to luxury hardwood (e.g. mahogany).
- **Various:** Musical instruments, tool handles, decorative items, packaging (e.g. pallets), etc.
- **Industrial processes**: Wood is used in electricity generation (increasing rapidly in the UK, imported principally in the form of wood pellets (see Section 6.1.4), in food processing (smoking), etc.

6.1.2 UK supply chain

The UK's forests and woodlands delivered 10.8 million tonnes of roundwood (softwood and hardwood) to wood processors in 2015. However, imports predominate – as the UK imports 82% of its wood-based products[103] – with significant quantities of timber, manufactured products (e.g. laminates, MDF) and finished timber products (Section 6.1.4). This means that there are large variations in how wood products, or products using wood in their manufacture, get to market. However, the supply chain is represented in very simple terms in Figure 20.

Figure 20: Simplified timber supply chain

[100] Source: UN Comtrade.
[101] FAO (2016) *Global Forest Resource Assessment 2015: How are the World's Forests Changing?* Rome: Food and Agriculture Organization of the United Nations.
[102] NHBC (2012). *Housing Market Report*. UK: NHBC.
[103] Forestry Commission (2016*) Forestry Statistics 2016*. UK: Forestry Commission.



6.1.3 Certification

Within the forestry sector, there are two main forest certification schemes covering timber: the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). By mid-2013, these initiatives had together certified 23% of the world's managed forests, and the area certified grew at 6% per year between 2008 and 2013.[104] Canada, the United States, Russia, Finland and Sweden were the top five countries in terms of certified forest area.

PEFC reported that globally, by the end of 2015, more than 272 million hectares of forests were covered through PEFC certification.[105] Globally, the FSC has 195 million hectares certified.[106]

The FSC and PEFC standards have broadly similar requirements,[107] although the FSC is regarded as having more rigorous requirements on some key outcome requirements (e.g. maintenance of High Conservation Values, workers' rights) and process aspects (e.g. multi-stakeholder engagement and formulation of audit teams).[108] The FSC also has a greater certified area in the tropics than PEFC, and is supported by leading environmental NGOs.

[104] Potts, J., Lynch, M., Wilkings, A., Huppé, G., Cunningham, M., and Voora, V. (2014). *State of Sustainability Initiatives Review*. IISD & IIED.
[105] PEFC Annual Report (2016). https://www.scribd.com/doc/313163361/PEFC-UK-Annual-Report-2016
[106] https://ic.fsc.org/preview.facts-figures-november-2016.a-6449.pdf
[107] Potts, J., Lynch, M., Wilkings, A., Huppé, G., Cunningham, M., and Voora, V. (2014). *State of Sustainability Initiatives Review*. IISD & IIED.
[108] WWF International (2015). WWF Certification Assessment Tool v03: Forest Stewardship Council (FSC), and WWF Certification Assessment Tool v03: Programme for the Endorsement of Forest Certification (PEFC). Both available at http://wwf.panda.org/?246871/WWF-Forest-Certification-Assessment-Tool-CAT

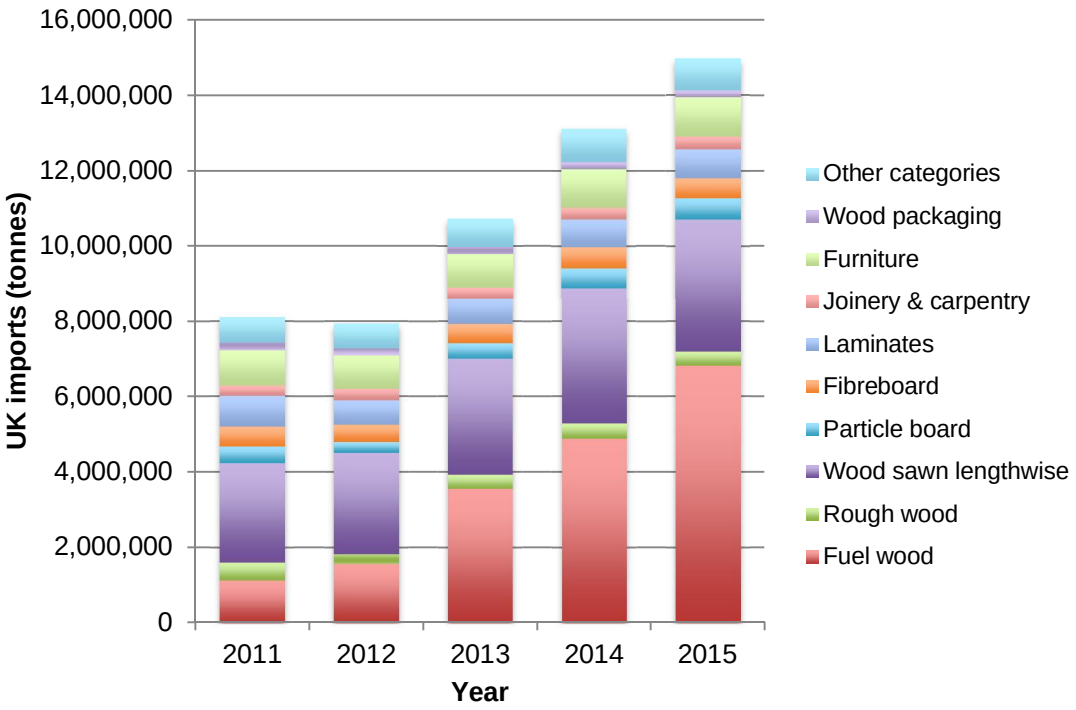
6.1.4 UK imports

6.1.4.1 Direct imports

Data on UK imports of timber and timber products were extracted from the UN Comtrade database.[109]

Figure 21 shows the UK's imports of timber and timber products between 2011 and 2015. The import of most product categories is relatively stable over this period. However, there has been a five-fold increase in imported fuel wood from 1.1 million tonnes in 2011 to 6.8 million tonnes in 2015. Fuel wood accounts for an average of 33% of the weight of imports over this period, and 46% in 2015 alone. Sawn wood imports account for an average of 28% of the weight of imports and have also increased from 2.6 million tonnes to 3.5 million tonnes (a 17% increase). Around 18% of the imports are in manufactured products for further use (e.g. plywood, fibre board, particle board, timber for joinery) and 8% of the total weight is imported as furniture. Very little timber (4%) is imported into the UK in the form of logs.

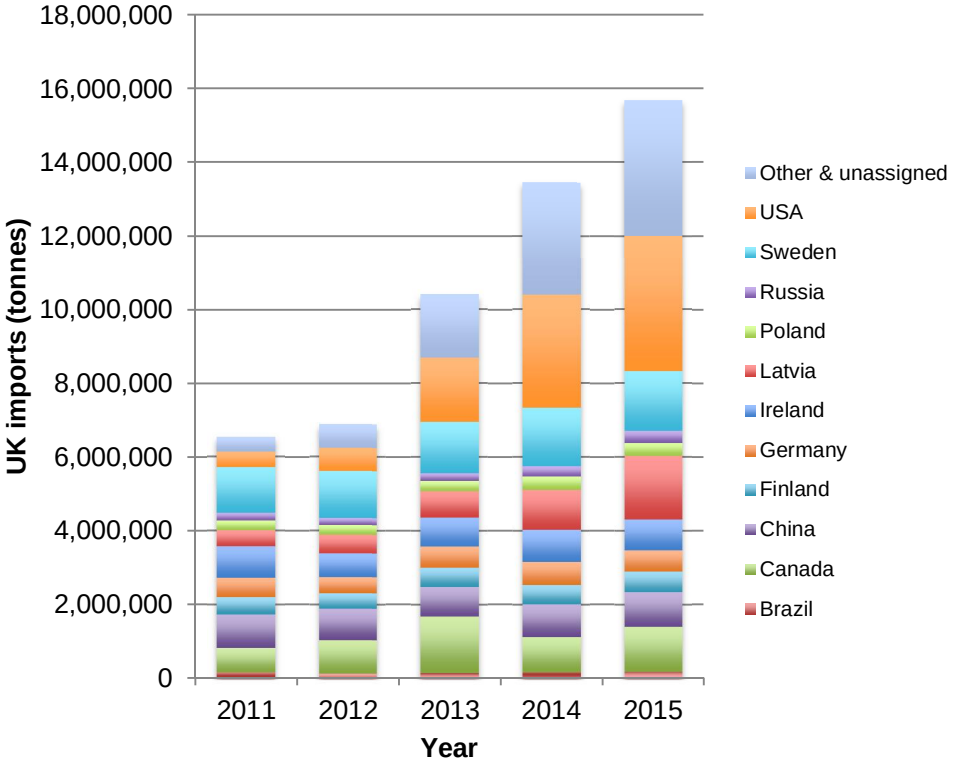
Figure 21: Imports of timber and timber goods into the UK by product



The UK imported timber and timber products from a total of 172 countries between 2011 and 2015. The top three trading partners, the US (18%), Sweden (13%) and Canada (10%) together accounted for 41% of the weight of imports over the period, with the top 12 countries accounting for 87% (Figure 22). Imports from the US grew from around 425,000 tonnes in 2011 to over 3.6 million tonnes in 2015. Over the same period, imports from Latvia and Portugal increased approximately four-fold, and imports from Canada doubled. Imports from countries linked with deforestation and/or the illegal timber trade do not comprise a large proportion of imports: only China (average 880,000 tonnes per year, 8% of total imports), Russia (245,000, 2%) and Brazil (166,000, 2%) contribute more than 2% of the total imports.

[109] http://comtrade.un.org/data/

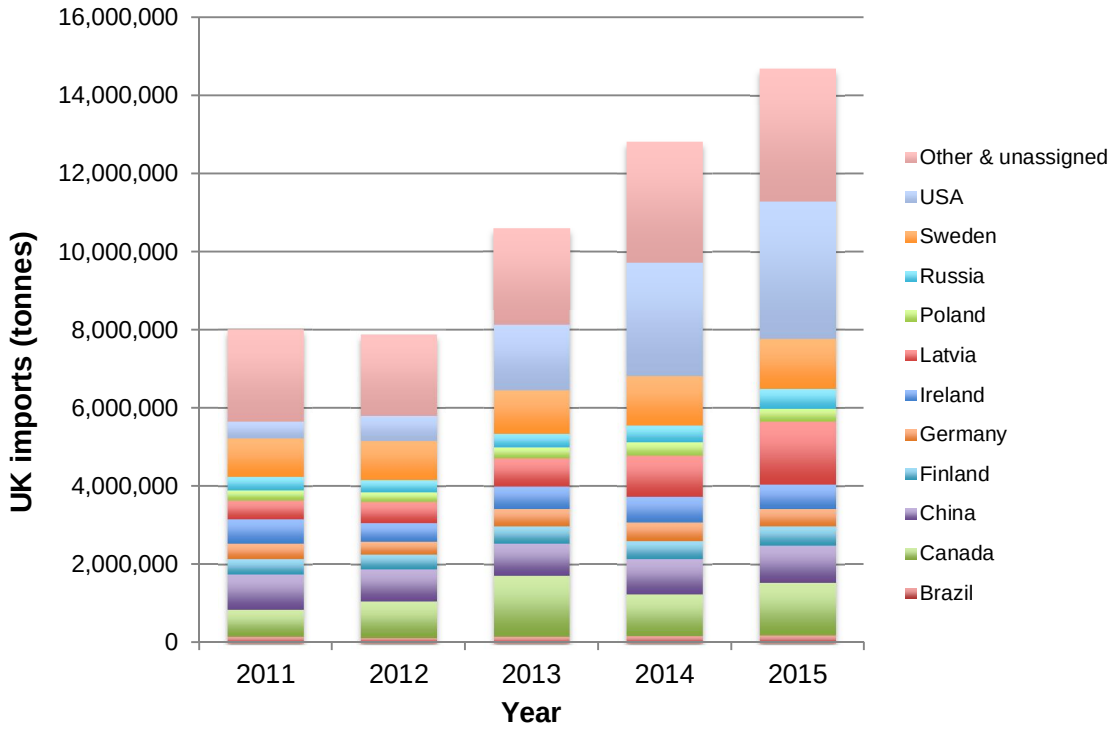
Figure 22: UK imports of timber and timber products from the main trading partners



However, all of the major trading partners produce timber as well as importing and exporting it. There is therefore no guarantee – without chain of custody assurance – that timber and timber products imported by the UK are made from wood grown in the exporting country. In order to provide a clearer estimate of the origins of the wood imported in the form of timber and timber products, the production[110] and imports[111] of the UK's major trading partners were analysed. Assuming that their exports to the UK were in the same proportion as their overall supply of timber (i.e. the combination of their production plus imports from their trading partners) allows a first-order estimate of the provenance of the wood used to supply the UK with timber and timber products (Figure 23).This does not significantly change the estimated provenance of imports, with domestic production contributing over 70-99% of the total wood supply in all major export countries.

Figure 23: UK imports of timber and timber products by provenance, adjusted for imports of trading partners

[110] Source: FAO STAT.
[111] Source: UN Comtrade.



6.1.4.2 Embedded imports

'Embedded' wood is imported in wooden packaging, and also in processed goods where wood is used in their manufacture (e.g. smoked fish). This latter category is beyond the scope of this study and is not considered further. Although wooden packaging of imported goods is not reported on trade databases, the UK government's Environmental Agency requires companies to report the packaging on imported goods they sell and this data is publicly available on the National Packaging Waste Database.[112] Wood packaging on imported goods averaged 0.5 million tonnes per year, 1.8% of the total weight of imports.

6.1.4.3 Estimating the UK's imports of timber

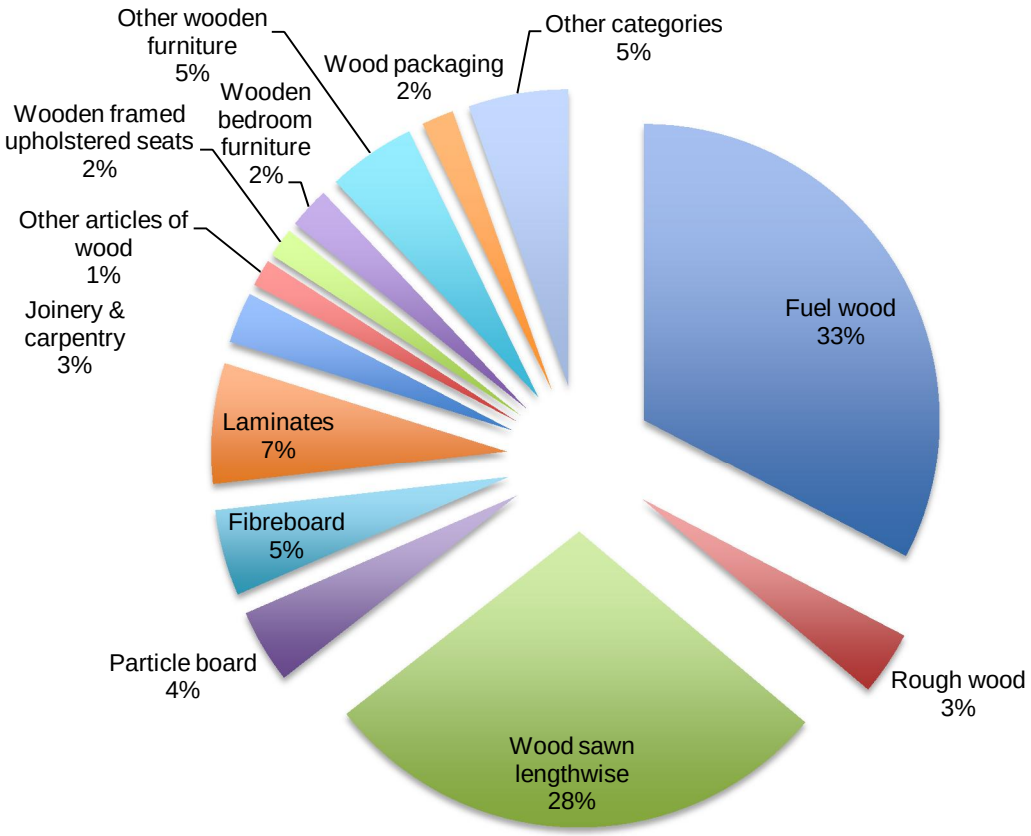
Figure 24 summarises the imports of timber – directly imported and embedded in packaging – in all of the categories estimated. The largest fractions are fuel wood and sawn wood, with laminates, fibreboard and wooden furniture also contributing significant proportions.

The data is further summarised in Table 4, which shows that when adjusted for the wood content of manufactured products, the UK imported an average of 10.9 million tonnes of timber and timber products each year between 2011 and 2015.

The UK's Forestry Commission provides annual estimates of imports of timber,[113] using different data sources to this study (HMRC plus industry surveys), estimating a subset of imports, and aggregating or disaggregating product types differently. This means that the estimates are not directly comparable, but as an illustration, the Forestry Commission's estimate for sawn-wood imports in 2015 was 6.3 million m^3, compared with ours of 5.3 million m^3 (16% lower), and they estimated that 6.5 million tonnes of wood pellets were imported, compared with our estimate of 6.8 million tonnes of wood fuel (5% higher, but including other products alongside wood pellets).

[112] https://npwd.environment-agency.gov.uk/Public/PublicSummaryData.aspx
[113] http://www.forestry.gov.uk/forestry/infd-7aqdgc

Figure 24: UK imports of timber products, average of 2011-15



6.1.4.4 Data transparency

All of the countries that export to the UK produce and also import timber and timber products, meaning that, in the context of this study, the forest origin of the UK's imports can only be estimated by assuming that exports are in the same proportion as the total timber stock for each country (i.e. production plus imports).

In addition, the UK imports significant quantities of manufactured timber products (furniture, laminates, particle board, fibreboard) in which timber is the major but not sole component. Additional assumptions need to be made regarding the proportion of timber within these manufactured products. For categories of product such as particle board and fibreboard, figures are available for some typical products that are used to estimate the wood content of imports.[114] The variability of other manufactured products, such as furniture, means that limited technical data is available to support estimates.

[114] For example, for OSB: http://osbguide.tecotested.com/faq7 and http://www.greenspec.co.uk/building-design/wood-panel-types-1/; for MDF: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.600.911&rep=rep1&type=pdf and http://www.greenspec.co.uk/building-design/wood-panel-types-1/

Table 4: Imports of timber and timber products, adjusted for timber content

Type of import	Product	(In tonnes)					2011-15		Data transparency
		2011	2012	2013	2014	2015	Average	%	
Direct	Fuel wood	1,118,875	1,559,449	3,545,244	4,874,307	6,810,565	3,581,688	34	Medium – 100% wood content but countries both produce and import
	Rough wood	475,529	260,049	386,133	419,051	382,023	384,557	4	Medium – 100% wood content but countries both produce and import
	Wood sawn lengthwise	2,643,500	2,692,138	3,066,565	3,590,708	3,519,948	3,102,572	29	Medium – 100% wood content but countries both produce and import
	Particle board	380,014	254,862	368,612	468,424	484,726	391,328	4	Low – assumptions required to estimate wood content, and countries produce and import.
	Fibreboard	441,213	368,265	407,359	466,749	434,410	423,599	4	Low – assumes average 82% wood fibre (from technical references) and countries both produce and import
	Laminates	786,485	637,870	683,821	705,905	753,069	713,430	7	Low – assumes 2% glue (limited information) content and countries both produce and import
	Joinery & carpentry	272,228	305,826	288,807	317,295	346,103	306,052	3	Medium – 100% wood content but countries both produce and import
	Other articles of wood	141,458	140,313	140,586	162,366	151,617	147,268	1	Low – assumes 90% timber content (limited information) and countries produce and import
	Wooden framed upholstered seats	158,922	148,314	149,066	171,267	165,361	158,586	2	Low – assumes 90% timber content (limited information) and countries produce and import
	Wooden bedroom furniture	232,283	219,364	209,726	234,061	220,912	223,269	2	Low – assumes 90% timber content (limited information) and countries produce and import
	Other wooden furniture	462,041	425,994	449,360	503,071	536,655	475,424	5	Low – assumes 90% timber content (limited information) and countries produce and import
	Other categories	429,424	401,103	463,406	561,634	533,981	477,910	5	Low – assumes 90% timber content (limited information) and countries produce and import
Embedded	Wood packaging	170,733	169,005	166,869	177,425	185,851	173,976	2	Low – assumes 90% timber content (limited information) and countries produce and import
Total		**7,712,706**	**7,582,552**	**10,325,554**	**12,652,262**	**14,525,221**	**10,559,659**		

6.2 Risk analysis

6.2.1 Links between production and deforestation

The trade in timber and timber products has long been linked with deforestation and forest degradation.[115] The most obvious direct impact of the timber industry is when natural and semi-natural forest is replaced by tree plantation monocultures. The FSC Principles and Criteria exclude certification of plantations established on areas converted from natural forest after November 1994, unless the plantation is a small part of the certified area, or if the management organisation was not responsible for the conversion.[116] The PEFC standard is broadly similar, with a cut-off date of 2010.[117]

However, timber harvesting also plays an indirect role in deforestation. One well-documented example is the illegal harvesting of mahogany (*Swietenia macrophylla*) in the Brazilian Amazon. Illegal loggers create earth roads to access high value mahogany trees in inaccessible areas, which are then used by smallholder colonisers who deforest small patches for agriculture. These holdings are then consolidated with further deforestation by cattle ranchers.[118]

Beyond conversion, forest management for timber production can play a significant role in environmental degradation. In tropical rainforests – where a typically small proportion of trees are harvested – the impacts of harvesting are debated. One meta-analysis of other studies showed that, on average, 54% (albeit with variation around this average) of the timber volume extracted during the first harvest from primary forest will be available for the second and third cuts, with 76% of the above-ground carbon retained soon after harvesting.[119] The impact of harvesting primary tropical forest on biodiversity is mixed, with selectively logged forests supporting, on average, 84% of the bird species richness of unlogged forest, but with little impact on plants, mammals and invertebrates,[120] even after more intensive selective logging.[121] Logging in temperate and boreal forests has been found to have no[122] or a negative[123] impact on bat diversity and behaviour compared with unlogged forest and reduce the number of forest specialist beetle species,[124] fungi[125] and other

[115] Dudley, N., Jeanrenaud, J.P., and Sullivan, F. (2014). *Bad Harvest: The Timber Trade and the Degradation of Global Forests*. Taylor & Francis.
[116] Forest Stewardship Council (2015). *FSC International Standard: Principles and Criteria for Forest Stewardship FSC-Std-01-001 V5-2 En*.
[117] PEFC International Standard (2010). *Requirements for Certification Schemes*. PEFC ST 1003:2010.
[118] Fearnside, P. (1997) Protection of mahogany: a catalytic species in the destruction of rain forests in the American tropics. *Environmental Conservation*, 24, 303–306; Verissimo, A., Barreto, P., Tarifa, R., and Uhl, C. (1995) Extraction of a high-value natural resource in Amazonia: the case of mahogany. *Forest Ecology & Management*, 72, 39–60.
[119] Putz, F.E., Zuidema, P.A., Synnott, T., Peña-Claros, M., Pinard, M.A., Sheil, D., Vanclay, J.K., Sist, P., Gourlet-Fleury, S., Griscom, B., Palmer, J. and R. Zagt (2012). Sustaining conservation values in selectively logged tropical forests: the attained and the attainable. *Conservation Letters*, 5, 296–303.
[120] Putz et al. (2012). *Ibid*.
[121] Edwards, D.P., Larsen, T.H., Docherty, T.D.S., Ansell, F.A., Hsu, W.W., Derhé, M.A., Hamer, K.C., and Wilcove, D.S. (2011). Degraded lands worth protecting: the biological importance of Southeast Asia's repeatedly logged forests. *Proceedings of Biological Science*, 278, 82–90.
[122] Menzel M.A., Carter T.C., Menzel J.M., Mark F.W., and Chapman B.R. (2002) Effects of group selection silviculture in bottomland hardwoods on the spatial activity patterns of bats. *Forest Ecology and Management*, 162, 209–218
[123] Russo D., Cistrone L., Garonna A., and Jones G. (2010) Reconsidering the importance of harvested forests for the conservation of tree-dwelling bats. *Biodiversity and Conservation*, 19, 2501–2515.
[124] Niemela, J., Langor, D., and Spence, J.R. (1993). Impacts of clear-cut harvesting on ground-beetle assemblages (Coleoptera: Carabidae) in Western Canada. *Conservation Biology*, 7, 551–561.

species groups.[126] Other environmental impacts that have been associated with some plantations and clear felling operations include pollution of watercourses, and soil compaction and degradation.

As described in Section 6.1.3, the large proportion of certified timber imported by the UK will substantially reduce many of the environmental risks with which poor practice in the timber sector is associated.

6.2.2 Social issues associated with production

The US Department of Labor lists timber from Brazil, North Korea and Peru as being associated with forced labour, and timber from Cambodia and Vietnam as being associated with child labour.[127] Of these countries, only Brazil exports to the UK in significant quantities (

Figure 23) although timber and timber products from Vietnam (0.9% of imports) reach the UK market and, in addition, timber originating from Cambodia and Vietnam may be illegally entering China before being exported.[128]

As described in Section 6.1.3, the large proportion of certified timber imported by the UK will substantially reduce many of the social risks with which poor practice in the timber sector is associated.

6.2.3 The UK's timber footprint

As trees are a perennial crop, with hugely variable management systems, there is no straightforward 'yield' that can be used to estimate the land required to produce a given amount of timber in the way that there is for agricultural crops. The approach taken was therefore to use the annual increment, which is the increase in the volume of timber in a forest per hectare per year,[129] and which in effect accounts for the area of forest needed to produce a given amount of timber in a specific year. For example, if the increment were one cubic metre per hectare per year, it would take 10 hectares to produce 10 cubic metres of timber in a year (equally, one hectare would produce the same amount in 10 years).[130]

The UK's imports of timber were converted into cubic metres,[131] which is the common unit of production from forestry. The imports of manufactured wood products (e.g. laminates, particle board, fibreboard) were adjusted for their wood content (Table 4) before conversion

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[125] Abrego, N. and Salcedo, L. (2013). Variety of woody debris as the factor influencing wood inhabiting fungal richness and assemblages: Is it a question of quantity or quality? *Forest Ecology and Management*, 291, 377–385

[126] Woodcock, P., Halme, P., and Edwards, D.P. (2015). Ecological effects of logging and approaches to mitigating impacts. In K.S.-H. Peh; R.T. Corlett and Y. Bergeron (Eds.), *Routledge Handbook of Forest Ecology* (pp. 422–435). UK: Taylor & Francis.

[127] https://www.dol.gov/ilab/reports/child-labor/list-of-goods/

[128] Greenpeace (2008). *Alternatives to Unsustainable Plywood in the UK Construction Industry*. London, UK: Greenpeace; and https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/402325/Chinese_Plywood_Research_Report.pdf

[129] Technically, the increment measure used was Net Annual Increment (NAI) which is defined as the average annual volume of gross increment over the given reference period less that of natural losses on all trees, measured to minimum diameters as defined for 'growing stock'. Source: FAO (2012). *FRA 2015 Terms and Definitions*. Rome: FAO.

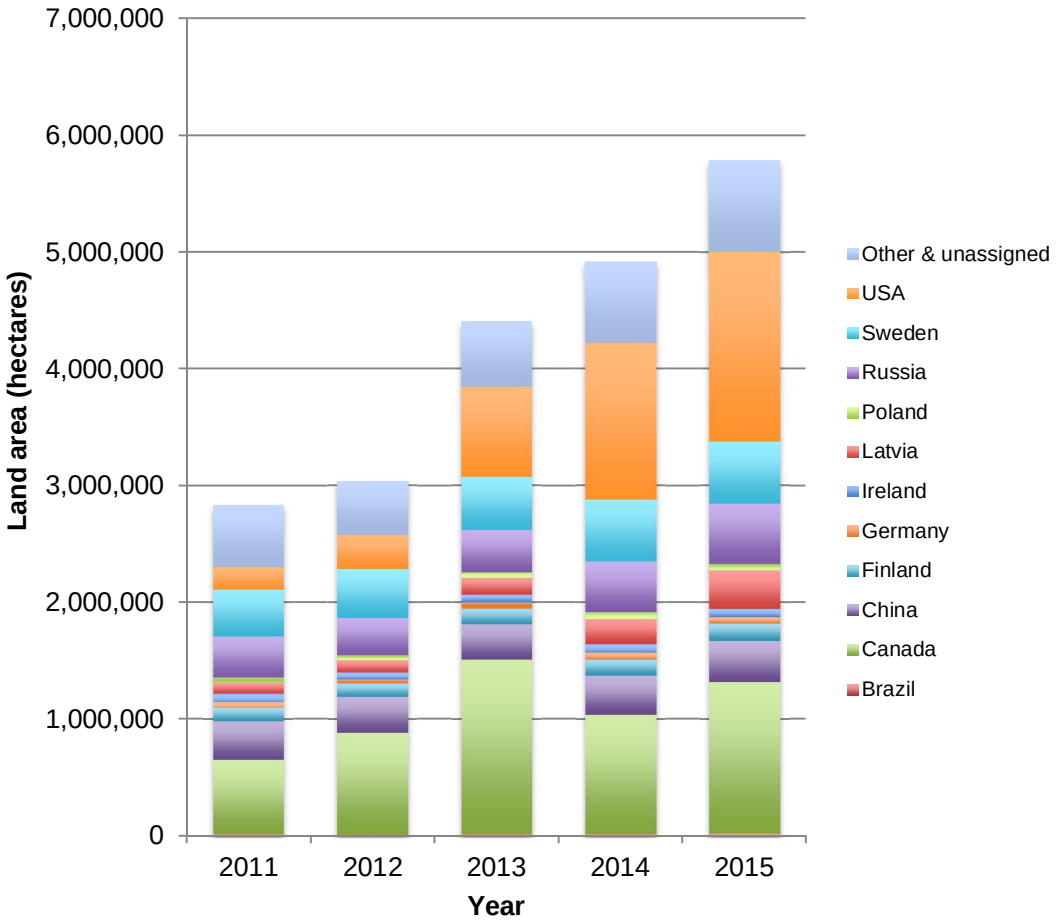
[130] Note that due to the large variation in NAI according to forest type and management system, the use of country-level NAI could lead to significant over- or under-estimation of land footprint if the UK's imports from a particular country are highly specific (e.g. a particular species, or from a particular plantation). However, it does provide a reasonable first-order estimate.

[131] Different types of wood have different densities, and so in the absence of knowing species and moisture content of all imports, the FAO's general conversion weight to volume factor of 1.39 was used throughout.

into cubic metres. The total volume of imports was then assigned to the major exporting countries in the proportion that the UK imports from them. The area of forest required to produce this timber was then divided by the Net Annual Increment (NAI)[132] to produce an estimate of the area of forest required in each country to supply the UK's imports.

This method provides an estimate that the land required to satisfy the UK's demand for timber and timber products averaged 4.2 million hectares per year over the period 2011-15. The land footprint has effectively doubled over this period, from around 2.8 million hectares in 2011 to 5.8 million hectares in 2015 (Figure 25), as a result of the huge increase in fuel wood imports from the US in particular.

Figure 25: Estimated land area from each major exporting country required to satisfy the UK's imports of timber and timber products



[132] Net Annual Increment (NAI) data was obtained from FAO (2016) *Global Forest Resource Assessment 2015: Desk Reference*. Rome: Food and Agriculture Organization of the United Nations. The FAO does not provide NAI for three of the major exporters. NAI for Brazil was calculated as the average of estimates given in Alder, D., Silva, J.N.M., de Ca Carvalho, J.O.P., Lopes, J. do C., and Ruschel, A.R. (2012). The cohort-empirical modelling strategy and its application to forest management for Tapajós Forest, Pará, Brazilian Amazon. *Bois et Forets Des Tropiques*, 314; Valle, D., Schilze, M., Vidal, E., Grogan, J. and Sales, M. (2006). Identifying bias in stand-level growth and yield estimations: A case study in eastern Brazilian Amazonia. *Forest Ecology and Management*, 236(2–3), 127–135 (both Amazon); and http://www.fao.org/3/a-ac121e.pdf (Brazilian pine plantations). NAI for Canada was the midpoint from Canadian Council of Forest Ministers data (http://www.ccfm.org/ci/prog_cr23_e.pdf). NAI for Portugal was from the European Forest Institute, Long-term European forest resources assessment (http://dataservices.efi.int/ltfra/).

7 Pulp and paper

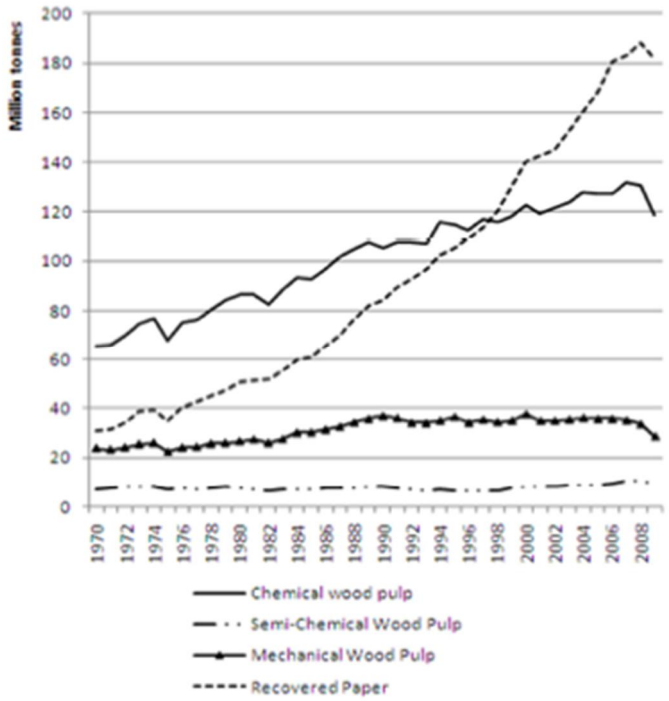
7.1 Overview of production, trade and use

7.1.1 Introduction

7.1.1.1 Production

Pulp and paper are made predominantly from cellulose fibres present in trees in developed countries, with agricultural residues more widely used in some developing nations. Globally, there has been a shift in recent decades away from hardwood from natural forests towards 'fastwood' plantations, especially eucalyptus and acacia. The cellulose fibres are derived directly from pulp grade logs, from wood chips and wood reclaimed from other manufacturing processes (e.g. furniture making) and from recycled paper. There has been a steep rise in the use of recovered and recycled paper in recent decades (Figure 26). However, it is important to note that paper is not infinitely recyclable, and fibre from tree species with specific technical characteristics is required for particular types of product.

Figure 26: Wood pulp and recovered paper production, 1970-2009[133]



7.1.1.2 Global trade

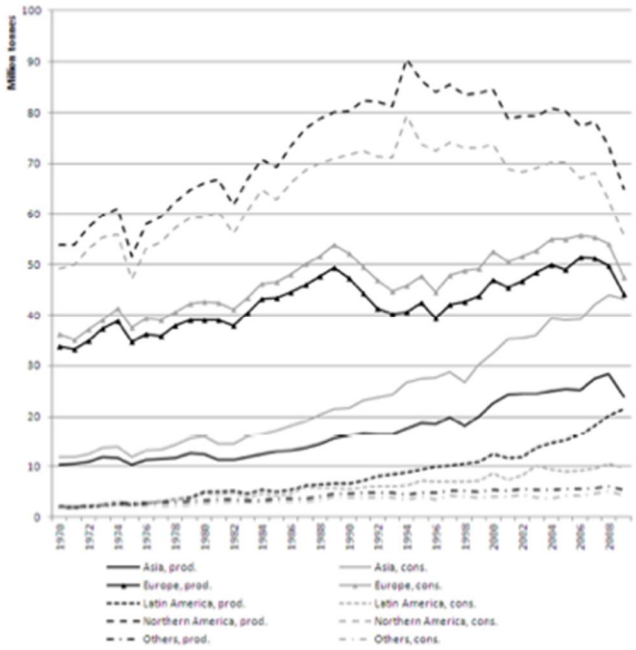
In 2013, global production of pulp reached 180 million tonnes – 37% from North America and 22% from Asia.[134] Paper consumption in Europe and North America has decreased from a peak in the early 1990s (Figure 27), due largely to the replacement of paper by digital communication, but per capita consumption remains several times higher in the US and

[133] Hujalaa, M., Arminena, H., Hillb, R.C., and Puumalainen, K. (2013). Explaining the shifts of international trade in pulp and paper industry. *Forest Science*, 59(2), 211–222.

[134] http://www.paper.org.uk/members/statistics/papermaking/eukey/CEPI_KeyStatistics_2014.pdf

western Europe than elsewhere.[135] Asian markets continue to grow, however, and demand from China is now a key driver of market conditions.

Figure 27: Global paper and board production and consumption, 1970-2009[136]



7.1.1.3 End uses

Paper is used in magazines, books, stationery, office paper, boxes, packaging, tissues, and labels. It can be coated with a wide variety of materials for specific uses such as printing photographs, pressure sensitive papers, or heat sensitive papers.

7.1.2 UK supply chain

The UK consumed 9.3 million tonnes of paper and board in 2014, down from a high of nearly 13 million tonnes in 2000.[137] This paper and board is produced partly in the UK and partly imported.

Paper from UK mills or imports is further transported direct to retail, to printers and manufacturers before reaching organisational consumers (businesses and public sector institutions) and individual consumers, either as paper-based products or packaging, labelling or documents for other consumer products.

7.1.2.1 UK pulp and paper production

The most important source of fibre for the UK's pulp manufacturing industry is reclaimed (recycled) paper, accounting for around 70% of the fibre used in UK paper and board manufacture.[138] A further 5% derives from home grown timber, pulped in just two mills (Iggesund Paperboard in north-west England and UPM-Kymmene's Caledonian mill in

[135] RISI (2005). *2005 Pulp & Paper Global Fact & Price Book*. San Francisco: Paperloop.
[136] Hujalaa, M., Arminena, H., Hillb, R.C., and Puumalainen, K. (2013). Explaining the shifts of international trade in pulp and paper industry. *Forest Science*, 59(2), 211–222
[137] CPI (2015). *Annual Review 2014-15 – Working Together for a Competitive Future.* Confederation of Paper Industries. Available at http://www.paper.org.uk/information/pages/annual_reviews.html
[138] Confederation of Paper Industries (2013). *Recovery and Recycling of Paper and Board*. Fact Sheet. Confederation of Paper Industries.

south-west Scotland) and 2% from other fibres. Of the fibre used in UK paper manufacture, 20% is imported pulp.

There are 50 paper mills operating in the UK, producing just under 4.4 million tonnes of paper and board in 2014. The biggest 10 mills account for 70% of the total production.[139] The mills produce the following five main categories of paper, with the percentage of total UK paper production for 2012 listed in parentheses:[140]

- **Packaging paper using recycled fibre** (37% of total UK paper production): large mills**,** supplying a range of products, mostly traditional corrugated boxes and cores.
- **Printing and writing paper including newsprint** (34%): paper for general printing, newspapers and magazines, high-grade packaging and graphics.
- **Tissue and hygiene paper** (18%): making tissue grades, cellulose wadding and wet wipes.
- **Specialist packaging paper** (7%): supplying a wide variety of products, including luxury product packaging.
- **Specialist paper** (4%): products with different and closely specified properties in relatively small tonnages.

7.1.2.2 Imported paper

To make up the shortfall between domestic production and consumption (a difference of approximately 4.9 million tonnes in 2014), the UK is the largest net importer of paper in the world,[141] with imported paper accounting for approximately half of paper and board used in the UK in 2014.[142]

7.1.3 Certification

As pulp and paper is derived from trees, the same certification systems that are used in the timber sector (FSC and PEFC) may also apply. These are described in Section 6.1.3. These schemes certify the timber output, where pulp and paper are downstream products produced under chain of custody using certified (or not) wood as a material input. Data on the degree of market penetration of FSC and PEFC is not readily available for the sector, and UK companies manufacturing and/or retailing paper products show a wide variation in the degree to which they use certified material.[143]

For paper and board manufactured in the UK derived from reclaimed fibre, products often carry a recycling mark. The FSC has an on-product recycled label for paper products, which can contain any balance of reclaimed materials as long they are independently verified as such,[144] but which does not guarantee that the wood in the recycling portion originally came from a forest managed in compliance with the FSC Principles and Criteria. The National

[139] CPI, Interviews and evidence gathering from CPI members, Confederation of UK Paper Industries, 2014

[140] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416673/Pulp_and_Paper_Report.pdf

[141] RISI (2014), cited in Department of Energy and Climate Change and the Department for Business, Innovation and Skills (2015). *Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050: Pulp and Paper*.

[142] The Confederation of Paper industries estimate that the UK consumed around 9.3 million tonnes of paper and board in 2014, of which domestic production (which is based on domestic raw material, reclaimed material and imported pulp) of 4.4 million tonnes. CPI (2015). *Annual Review 2014-15 – Working Together for a Competitive Future.* Confederation of Paper Industries. Available at http://www.paper.org.uk/information/pages/annual_reviews.html

[143] WWF UK (2015). *WWF-UK Timber Scorecard: Measuring the Progress of Timber and Timber-product Buyers on Sustainability in 2013–2014*. Woking, UK: WWF.

[144] FSC recycled Factsheet. http://www.fsc-uk.org/en-uk

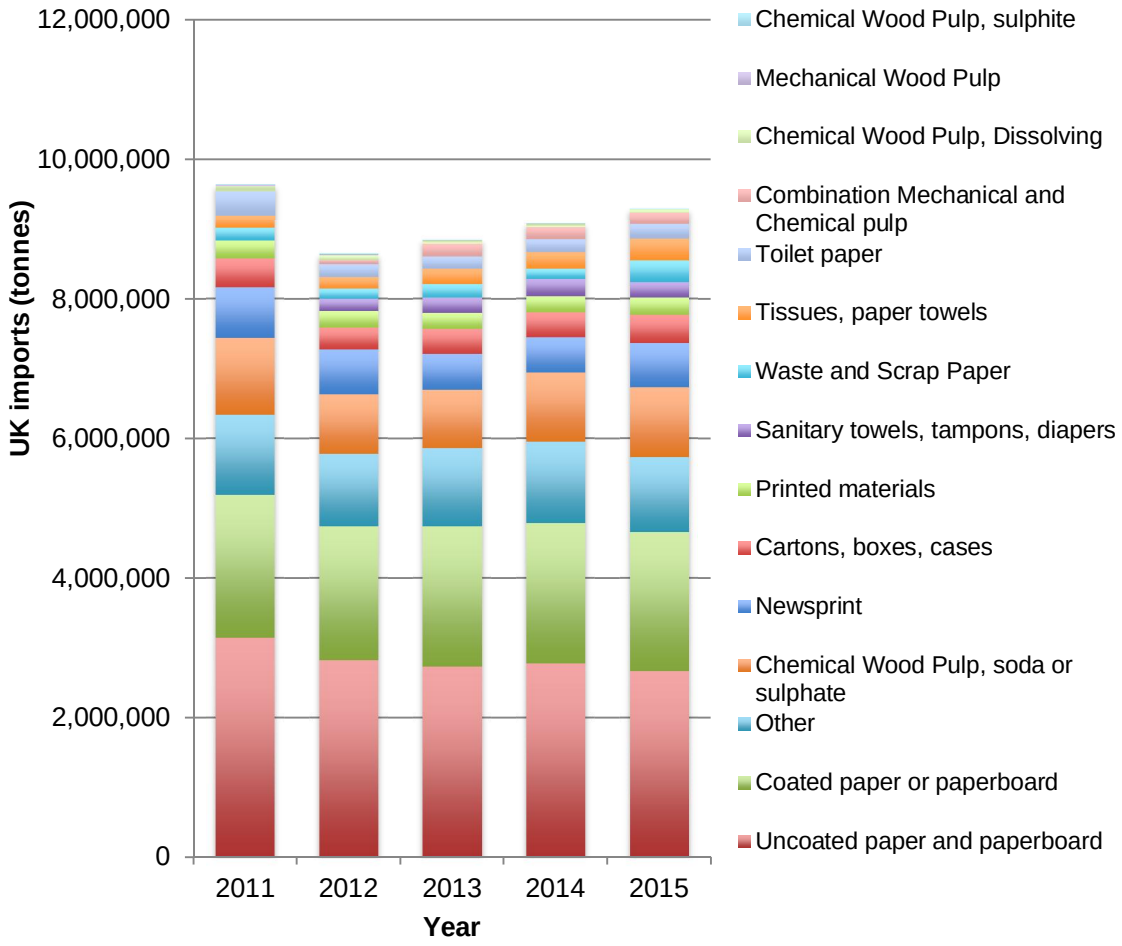
Association of Paper Merchants and the Mobius Loop labels are also used for products containing recycled material.

7.1.4 UK imports

7.1.4.1 Direct imports

Data on UK imports of pulp and paper were extracted from the UN Comtrade database.[145] Figure 28 shows imports relatively stable at between 8.6 and 9.6 million tonnes from 2011-15. An average of 1.3 million tonnes of pulp were imported each year. Imports of paper averaged 8.9 million tonnes per year, of which the main imported products were coated and uncoated paper or paperboard, together accounting for 46% all pulp and paper imports.

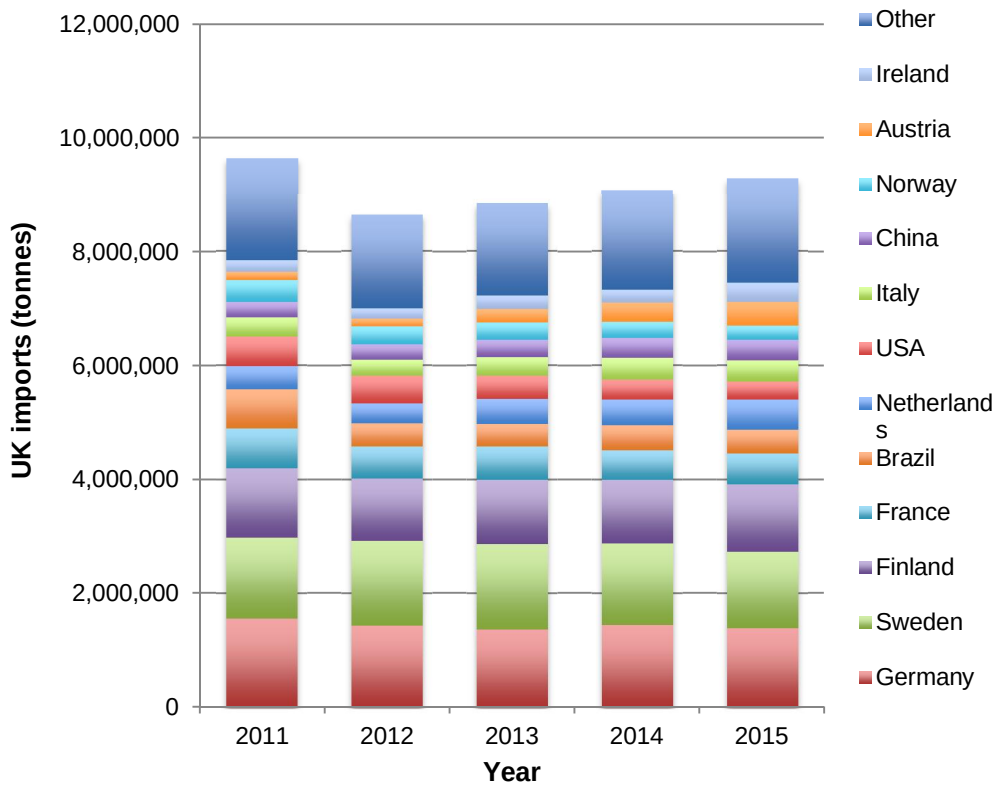
Figure 28: Imports of pulp and paper to the UK by product



The UK imported pulp and paper from a total of 191 countries between 2011 and 2015. The top two trading partners, Germany and Sweden, each accounted for 16% of the net weight of imports, with the top 11 countries accounting for 81% (Figure 29).

[145] http://comtrade.un.org/data/

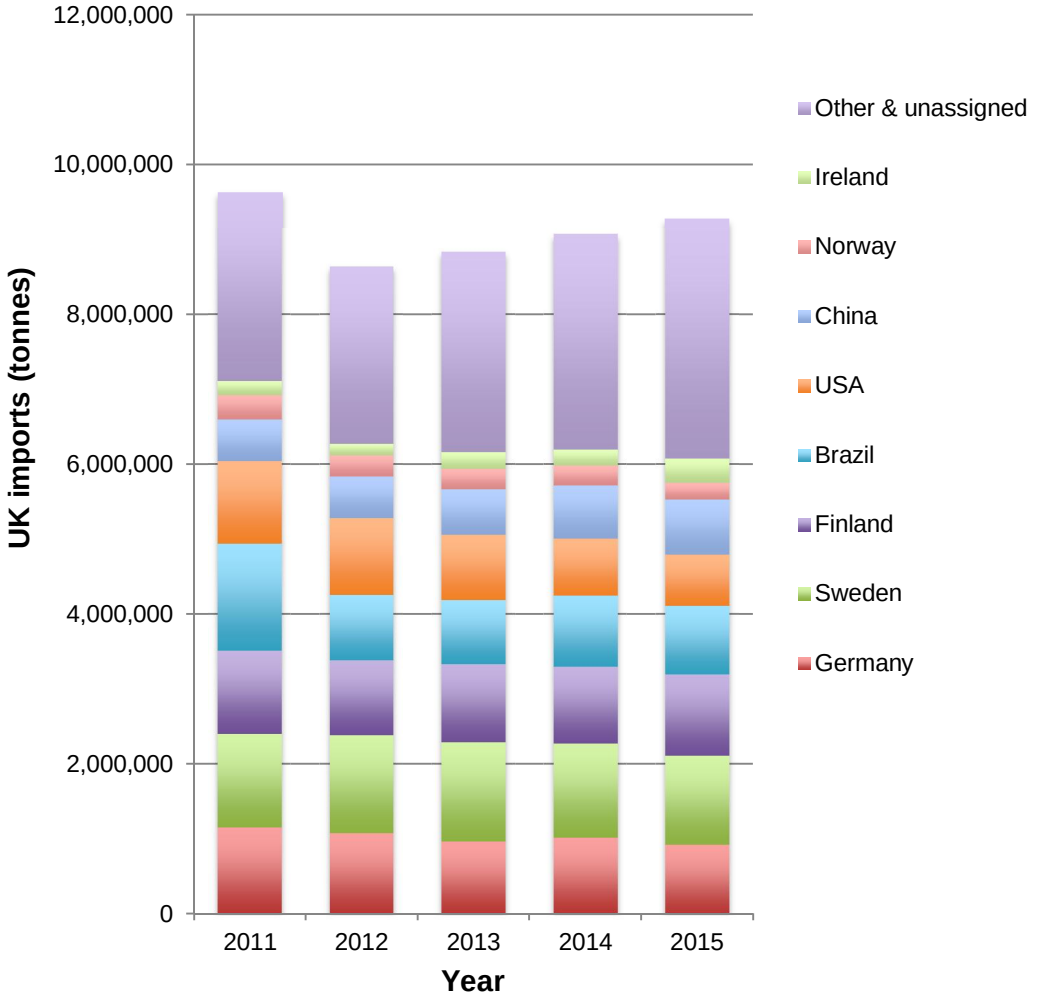
Figure 29: Imports of pulp and paper from the main trading partners



However, the provenance of these imports is complex to assess. All of the major trading partners produce pulpwood, pulp and paper, import pulp and paper, and export it. There is therefore little certainty without chain of custody certification that pulp and paper imported by the UK from another country is made from wood grown in that country. In order to provide a clearer estimate of the origins of the wood imported in the form of pulp and paper, the production[146] and imports[147] of the UK's major trading partners were analysed. Assuming that their exports to the UK were in the same proportion as their overall supply of pulp paper and pulpwood (i.e. the combination of their production plus imports from their trading partners) allows a first-order estimate of the provenance of the wood used to supply the UK with pulp and paper (Figure 30). Germany, Sweden, Finland, Brazil and the US together account for an estimated 58% of the imports. However, a large proportion (30%) is attributed to other countries that each account for less than 2% of the UK's imports.

[146] Source: FAO STAT.
[147] Source: UN Comtrade.

Figure 30: UK imports of pulp and paper by provenance, adjusted for imports into trading partners



7.1.4.2 Embedded imports

The main category of embedded imports is packaging: the cardboard boxes, manuals, and paper that many consumer goods manufactured abroad are packaged in. This is not recorded in international trade data, but fortunately the UK's Environmental Agency obliges companies to report on the packaging present on all items they sell and this data is publicly available on the National Packaging Waste Database.[148] This has remained relatively constant at around 1.2 million tonnes per year from 2011 to 2015. However, the provenance of the wood that goes into this packaging is not readily traceable.

7.1.4.3 Estimating the UK's pulp and paper imports

Figure 31 summarises the imports of pulp and paper in all of the categories estimated. The largest fractions are uncoated paper or paperboard (27%), coated paper or paperboard (19%), packaging of imported goods (11%), and chemical wood pulp, soda or sulphate (9%). The data is further summarised in Table 5.

[148] https://npwd.environment-agency.gov.uk/Public/PublicSummaryData.aspx

Figure 31: The UK's import of pulp and paper, 2011-15, by product category (rounded to nearest 1 per cent)

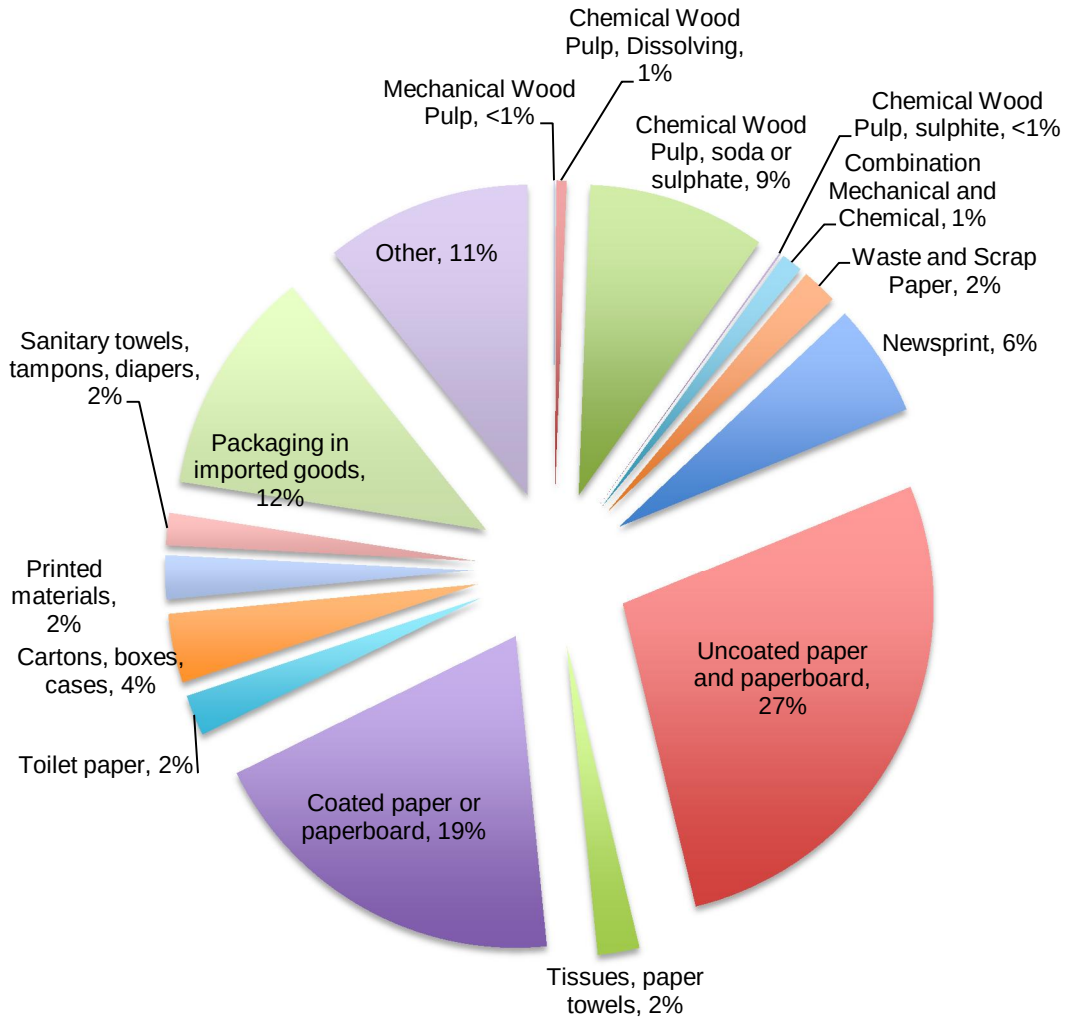


Table 5. Imports of pulp and paper by product type

Type of import		(in tonnes)					2011-15		
	Product	2011	2012	2013	2014	2015	Average	%	Data transparency
Pulp	Mechanical Wood Pulp	12,944	11,353	1,626	1,323	1,131	5,675	0	Medium – direct import data but assumptions required due to cross-trade
	Chemical Wood Pulp, Dissolving	74,760	71,379	43,881	42,790	46,400	55,842	1	Medium – direct import data but some assumptions about indirect imports necessary
	Chemical Wood Pulp, soda or sulphate	1,097,673	853,034	839,932	991,978	997,558	956,035	9	Medium – direct import data but some assumptions about indirect imports necessary
	Chemical Wood Pulp, sulphite	11,111	15,348	11,939	8,585	3,264	10,049	0	Medium – direct import data but some assumptions about indirect imports necessary
	Combination Mechanical and Chemical	3,359	56,718	181,974	176,141	159,710	115,580	1	Medium – direct import data but some assumptions about indirect imports necessary
	Waste and Scrap Paper	180,429	143,211	191,439	143,150	307,422	193,130	2	Medium – direct import data but some assumptions about indirect imports necessary
Paper	Newsprint	728,619	648,422	509,614	508,427	630,762	605,169	6	Medium – direct import data but some assumptions about indirect imports necessary
	Uncoated paper and paperboard	3,140,535	2,819,235	2,724,514	2,778,600	2,666,505	2,825,878	27	Medium – direct import data but some assumptions about indirect imports necessary
	Tissues, paper towels	182,223	165,773	221,461	236,135	318,296	224,778	2	Medium – direct import data but some assumptions about indirect imports necessary
	Coated paper or paperboard	2,047,371	1,922,729	2,015,214	2,001,159	1,993,133	1,995,921	19	Medium – direct import data but some assumptions about indirect imports necessary
	Toilet paper	337,555	188,222	177,099	187,945	209,311	220,026	2	Medium – direct import data but some assumptions about indirect imports necessary
	Cartons, boxes, cases	412,706	312,268	363,497	357,173	404,908	370,110	4	Medium – direct import data but some assumptions about indirect imports necessary
	Printed materials	261,485	230,203	226,458	232,102	250,391	240,128	2	Medium – direct import data but some assumptions about indirect imports necessary
	Sanitary towels, tampons, diapers	0	178,041	218,186	248,817	222,151	173,439	2	Medium – direct import data but some assumptions about indirect imports necessary
	Imported packaging	1,197,875	1,206,858	1,192,120	1,221,479	1,256,892	1,215,045	12	Low – effectively untraceable without significant assumptions
Other	Other	1,147,626	1,032,127	1,115,751	1,166,131	1,072,135	1,106,754	11	Low – provenance requires significant calculation and assumptions
	Totals	**10,836,269**	**9,854,919**	**10,034,703**	**10,301,933**	**10,539,970**	**10,313,559**		

7.1.4.4 Data transparency

Pulp and paper has complex trade patterns: unlike most of the commodities considered in this report all countries produce pulp and paper, as well as importing and exporting it. In addition, the UK imports from many more countries than is the case for many commodities, and a large proportion of imports (packaging) have a provenance that cannot be estimated without unwarranted assumptions. The fibre content of paper and board varies, meaning that further assumptions need to be made regarding the wood content.

7.2 Risk analysis

7.2.1 Links between production, deforestation and social issues

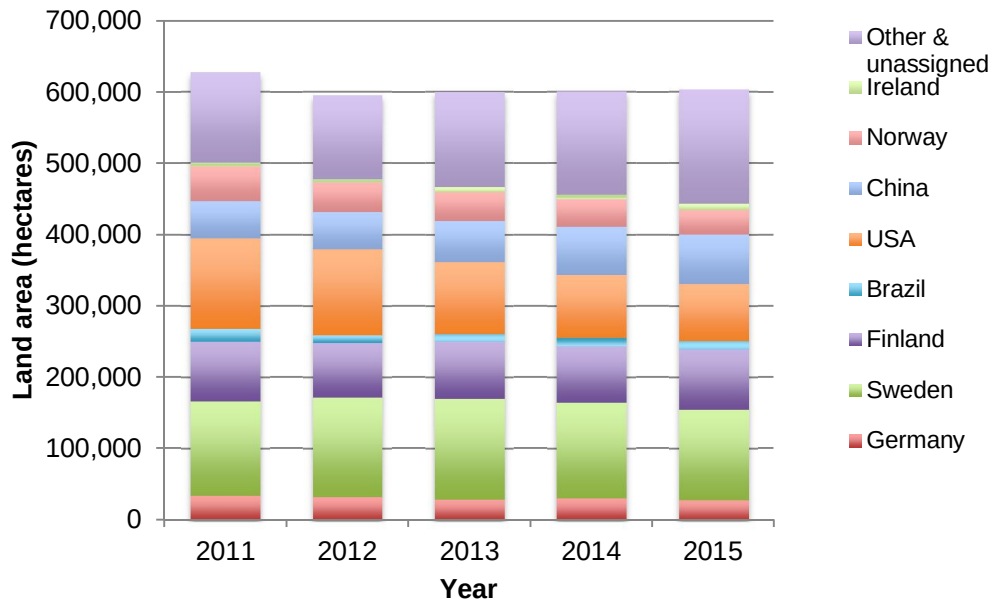
Social and environmental concerns are broadly the same as for timber production, as covered in Section 6.2.

7.2.2 The UK's pulp and paper footprint

The calculation of the UK's footprint for pulp and paper imports uses a similar methodology to that described for timber (Section 6.2.3), with the additional initial steps of converting import weights into cellulose content,[149] and then from cellulose to timber equivalent.[150] Pulp and paper derived from reclaimed paper was included within the calculation as ultimately this derives from forests.

The land area required to supply the UK's imports of pulp and paper averaged just over 600,000 hectares each year from 2011 to 2015 (Figure 32). The largest footprints were Sweden and the US (each averaging over 100,000 hectares and together accounting for 39% of the footprint), with Finland and China also significant.

Figure 32: Land area required to supply the UK with pulp and paper from major trading partners



[149] The general composition of pulp is 90% cellulose, 10% water. Source: http://www.ruraltech.org/projects/conversions/briggs_conversions/briggs_ch08/chapter08_combined.pdf. The pulp content of paper varies from about 50-90%. A midrange figure of 70% is used for calculation purposes, as the breakdown of paper quality types imported is not available.

[150] The cellulose content of wood is around 45%. Source: http://www.cepi.org/system/files/public/documents/publications/othertopics/2014/RESOURCES_EFF_CEPI.pdf.

8 Beef and leather

Beef and leather share the same supply chain at primary production and primary processing (i.e. slaughter). Beyond this, their routes to the UK and end uses are very different.[151]

8.1 Overview of production, trade and use

8.1.1 Beef introduction

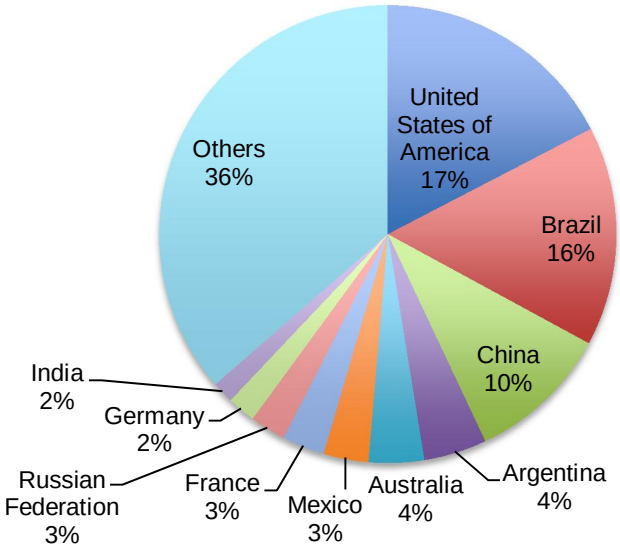
Beef is the third most popular meat in the UK, with 18kg eaten per person annually.[152] Overall, beef consumption in the UK has not increased since the 1990s.[153]

The majority of beef is purchased and consumed as fresh or frozen cuts, e.g. steaks, mince and roasting joints. However – like most meats – it is also found in a range of food products, e.g. burgers, ready meals, and pastry products. Production in the UK and the Republic of Ireland dominates UK supply, with 11% of total supply coming from other countries. Most non-EU beef is used in processed foods and by food service sector players, e.g. catering contractors.[154]

8.1.1.1 Production

The top 10 producer countries of cattle meat account for about two-thirds of global production – with the United States, Brazil and China being the three largest producers (Figure 33). The UK is the 13th largest producer.

Figure 33: Global production of cattle meat, 2013[155]



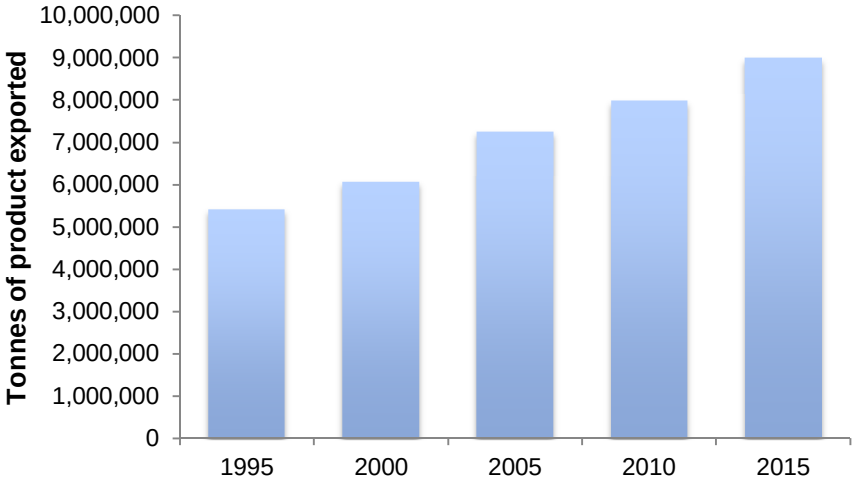
8.1.1.2 Global trade

Global exports of beef have risen consistently over the past 20 years. Some 9 million tonnes of beef were exported in 2015, compared with just over 5 million tonnes in 1995 (Figure 34). While many of the biggest beef producers are also exporters (e.g. Brazil and the United States) some of the smaller producers have a greater focus on export markets, including

[151] Other cattle products were not within the original scope of the research – most notably tallow. Nearly all Brazilian produced tallow is used for making biodiesel in Brazil: see UNFAO and Global Agriculture Network (GAIN) quoted on http://www.zerodeforestationcattle.org webpage dealing with tallow.
[152] AHDB Beef & Lamb. *UK Yearbook 2015 – Cattle*.
[153] AHDB Beef & Lamb. *UK Yearbook 2015 – Cattle*.
[154] Personal communications: Tim Bastable, project beef sector specialist. Also an imports briefing paper written by the International Meat Trades Association (IMTA).
[155] FAOSTAT, 'Meat indigenous, cattle' production for all countries in 2013.

Australia, the Netherlands, New Zealand and Ireland. The UK has relatively low levels of exports compared with production levels (13% of production). China exports only 2% of its production.

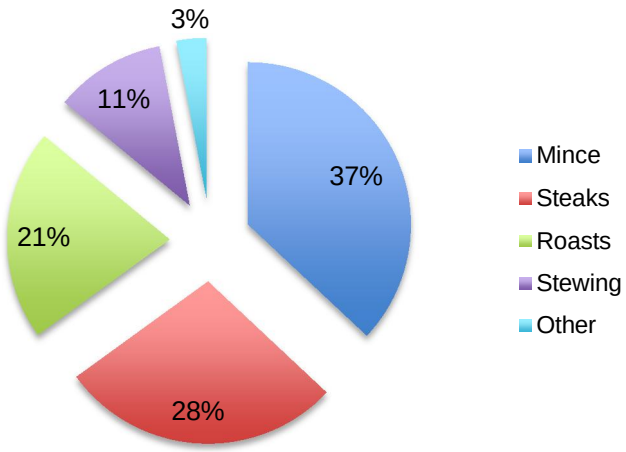
Figure 34: Growth in global exports volume of beef since 1995[156]



8.1.1.3 End uses

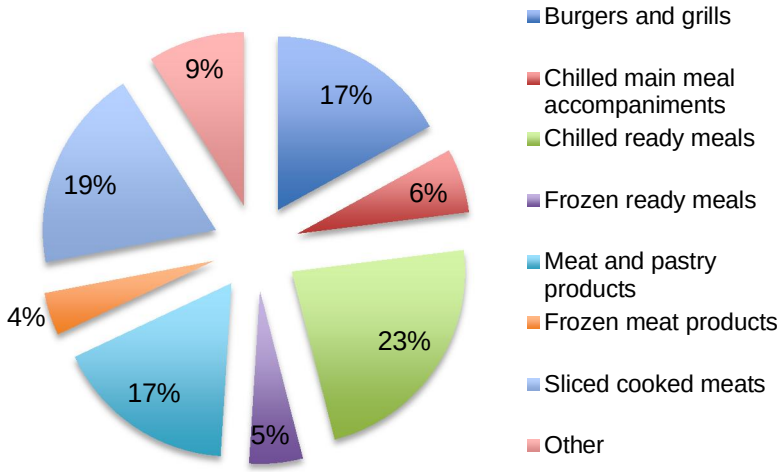
In the UK, the majority of beef is eaten in the home and purchased at major food retailers. The fresh/frozen beef market was worth £2 billion in 2014, with the most popular products being mince and steaks (Figure 35). The processed beef market was worth £1.8 billion in the same year, with popular products being ready meals, sliced meats and pasties (Figure 36).

Figure 35: Retail expenditure profile for fresh/frozen beef in UK, 2014[157]



[156] UN Comtrade data on fresh, frozen and prepared beef, 2015.
[157] AHDB Beef & Lamb. *UK Yearbook 2015 Cattle*.

Figure 36: Retail expenditure profile for processed beef in UK, 2014



8.1.2 Leather introduction

The accepted definition of leather is hide or skin with its original fibrous structure more or less intact, tanned to be imputrescible (i.e. not liable to decomposition). The hair or wool may or may not have been removed. It is also made from a hide or skin that has been split into layers or segmented either before or after tanning.[158] Leather quality varies and depends on the quality of the hide and the degree to which it has been processed (see Table 6).

Table 6: Common leather terms[159]

Term	Description
Full grain	Strongest and thickest type. Has the original grain surface of the skin. Used in high quality footwear and furniture.
Top grain	The first cut taken from the grain side of a split hide. Most common leather used in luxury goods.
Corrected grain	Lower quality hides that have the surface grain corrected by sanding, dyeing, etc.
Split	What's left from the hide once the 'Top grain' has been removed. If thick enough it can be split more than once.

Bovine leather is the major source of leather globally and is the main type of leather used by UK manufacturers (Figure 37).[160] This document focuses on bovine leather as cattle are an important driver of global land use change compared with other livestock species.[161]

[158] British Standard BS 2780:1983 Glossary of Leather Terms.
[159] For fuller description, see https://en.wikipedia.org/wiki/Leather#Types
[160] UK Leather. http://www.ukleather.org/trade-issues/industry-statistics.htm
[161] FAO (n.d.). *Cattle Ranching and Deforestation*. Livestock Policy Brief 03.

Figure 38: Global share of leather by animal type (rounded to nearest 0.1%)

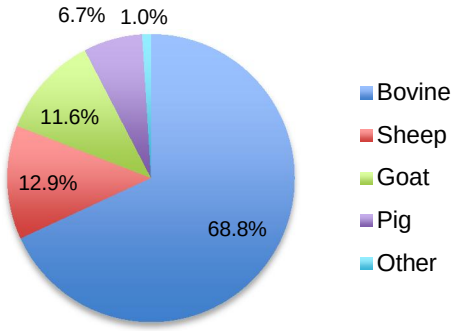
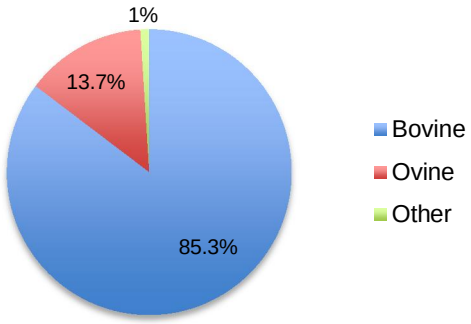


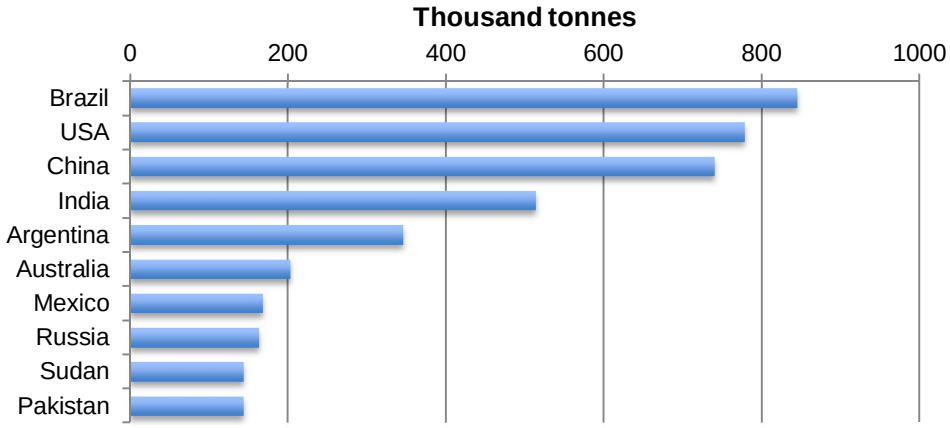
Figure 37: UK share of leather by animal type (rounded to nearest 0.1%)



8.1.2.1 Production

Global production of bovine skins and hides in 2014 was 6.6 million tonnes. As most leather is a by-product of beef production, global output is largely determined by the output of the beef sector.[162] The major producers are therefore Brazil, US, and China (Figure 39). The EU produces 669,000 tonnes in total, with the UK a relatively small producer of hides (60,000, 1% of total) – much of which is now exported for processing as local leather production has decreased significantly over recent decades.

Figure 39: Major producers of bovine hides and skins (wet salted weight, thousand tonnes)[163]



8.1.2.2 Global trade

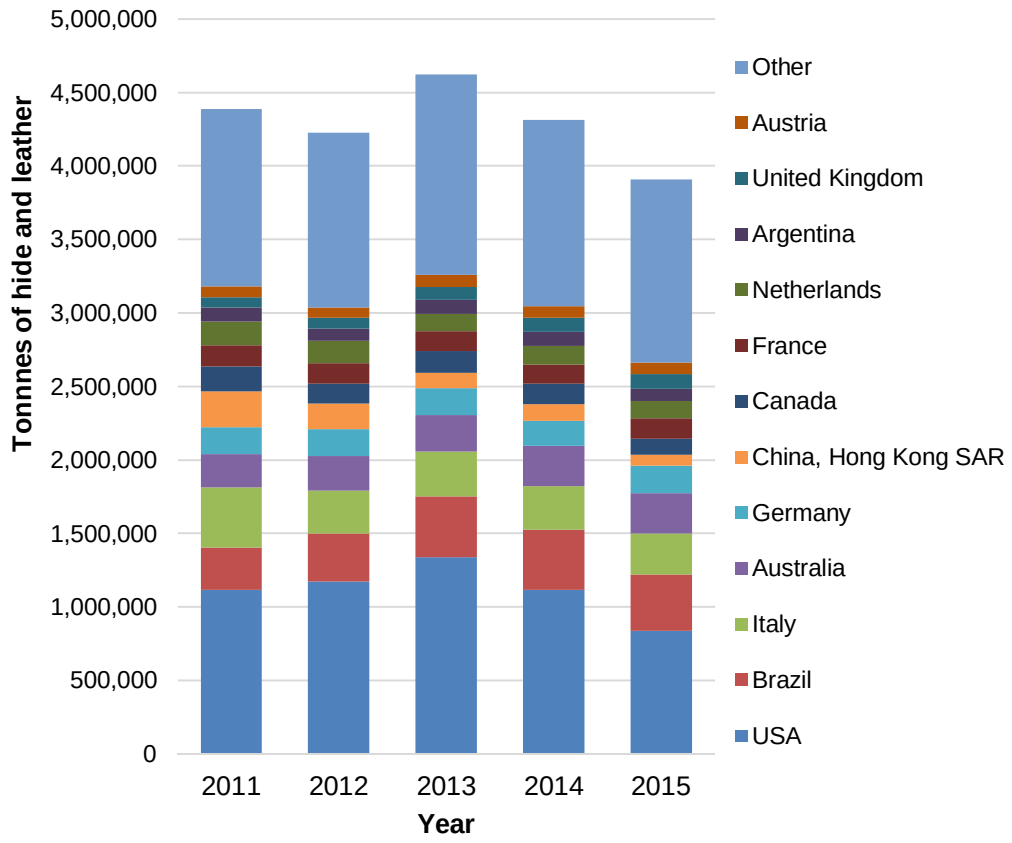
The leather industry is globalised, with significant trade in raw hides, tanned leather and finished leather products. Leather is one of the most widely traded goods in the world – the value of exports of hides, leather and leather products was approximately US$82 billion in 2015.[164] This compares with US$44 billion for coffee, for example.[165] The most important producing, processing, importing and exporting leather countries are located outside Europe.

[162] Brack, D. Glover, A. and Wellesley L. (2016) *Energy, Environment and Resources Agricultural Commodity Supply Chains Trade, Consumption and Deforestation*. Chatham House Research Paper.
[163] UNFAO World Statistical Compendium for Raw Hides and Skins, Leather and Leather Footwear 1998–2014.
[164] This is conservative as it only includes products with significant leather content. Estimate based on UN Comtrade data on: Raw hides and skins (other than fur skins) and leather (HS Code 41); Articles of leather – saddlery and harness (HS Code 42); Footwear with leather uppers (HS Code 6403).
[165] Estimate based on export values in UN Comtrade database. HS Code 901: Coffee, whether or not roasted or decaffeinated; coffee husks and skins; coffee substitutes containing coffee in any proportion.

One significant exception is Italy which is – after China – the world's second largest producer, processor, importer and exporter of leather and leather goods.

China is the main leather destination but is now in decline. This is for a number of reasons, including losing market share in footwear to plastic, and footwear manufacturing in general leaving China for other countries.[166]

Figure 40: Exports of bovine & equine skins and leather (UN Comtrade)



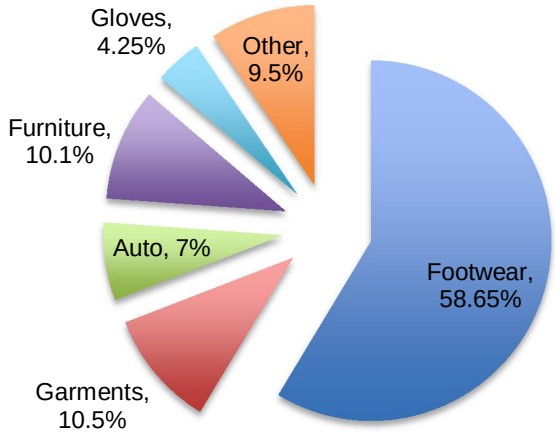
8.1.2.3 End uses

Globally, the major user of leather is the footwear industry (Figure 41). It is expected that the percentage of leather used in footwear will decline due to a number of reasons, e.g. changing fashion trends, more alternative materials, ease of automation of other materials, and so on.[167] A good example of a market increasingly using leather is car vehicles (automotive): according to industry estimates quoted in a report by the Leather Panel in 2010, in Europe:

> 14% of all new automobiles in Europe have leather upholstery, and an additional 4% are done in combinations of leather, textiles, composites, and faux leathers. Over the next five years, these shares are expected to grow to 17% and 6% respectively.

[166] Personal communications, Mike Redwood.
[167] Leather Panel (2010). *Future Trends in the Leather and Leather Products Industry and Trade.* Leather Panel.

Figure 41: Global share of leather by end use[168]



8.1.3 UK supply chain

8.1.3.1 Beef

The typical supply chain for beef starts on a farm and goes through a number of processing and packing stages before reaching the consumer (Figure 42). Depending on the supply chain, there can be agents and traders between all the main processing, manufacturing and retailing stages. This is particularly the case with imported beef that can be moved through intermediaries in mainland Europe.

Home production dominates UK net supply, with the latest data from AHDB Beef & Lamb showing that the UK was 76% self-sufficient in beef in 2015. This has fallen from 82% in 2011, due a reduction in home production. The future level of imports will be influenced by the UK's future trading relationship with the EU and the potential impact of changes to agricultural subsidies on UK production.

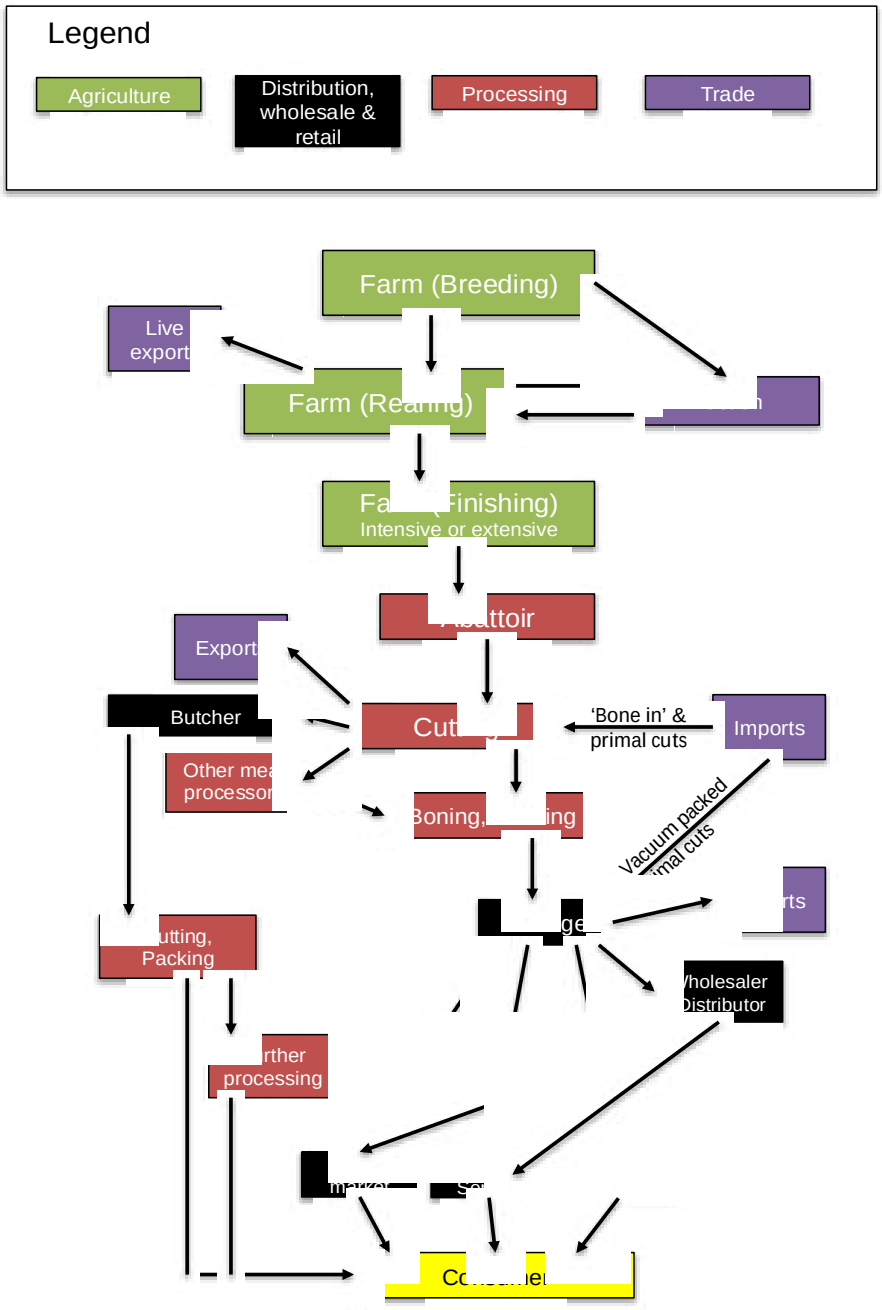
According to meat sector research by IBIS*World*:

> The horsemeat scandal in 2013 prompted some consumers to seek out British rather than imported meat in the hope that a shorter supply chain would ensure the quality of the product. This helped to push up meat prices after the scandal occurred. Currently, livestock prices are declining as a result of oversupply in the [UK] market.[169]

Oversupply is due to recent global increases in production.

Figure 42: Example beef supply chain[170]

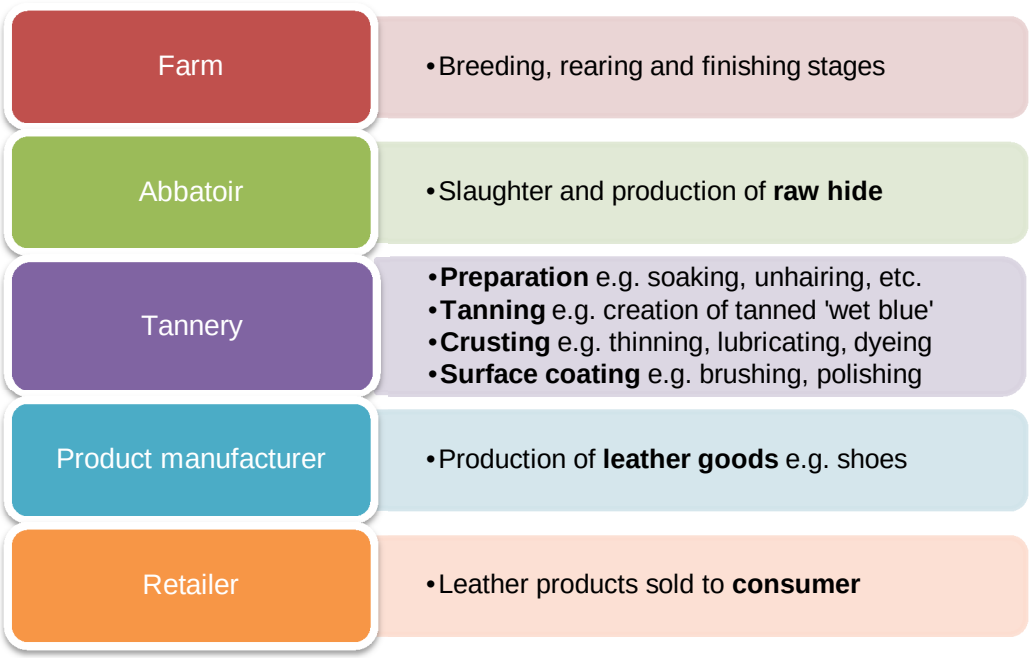
[168] Chart from UK Leather (http://www.ukleather.org/trade-issues/industry-statistics.htm). 'Other' includes other leather goods, e.g. bags.
[169] IBIS*World* Meat Processing in the UK, February 2016.
[170] Adapted from SafeFood (2008) A review of the beef food chain.



8.1.3.2 Leather

The typical supply chain for leather starts on a farm and goes through three main stages before reaching the point of sale (see Figure 43 for a simplified version). No cattle are raised specifically for their leather, i.e. it is a by-product of beef production – and so their management is no different from cattle raised for beef. Depending on the supply chain, there can be merchants and traders between all the main processing, manufacturing and retailing stages. Supply chains can be integrated (i.e. highly traceable and potentially owned downstream businesses) – especially in premium products where quality and provenance of raw material are highly valued to ensure sufficient supply and quality of leather.

Figure 43: Typical leather supply chain



Leather can be traded having been just tanned (e.g. so-called 'wet blue' leather, which has been tanned using chromium) or as 'crust'[171] or finished leather. Countries such as Brazil are increasingly adding value to raw leather before exporting it, e.g. it is exported part-processed as 'wet blue', as finished leather or as leather products such as clothing and bags.[172]

It is worth noting that the hide accounts for about 10% of the slaughter value of cattle,[173] so it makes a relatively small but worthwhile contribution to the overall profitability of the beef livestock sector. Despite this value, cattle are not raised and slaughtered primarily for their hides but for their meat. As a result, leather availability tracks trends in beef production.

8.1.4 Certification

The issue of deforestation has been tackled in the Amazon using several sector and supply chain approaches (see summary in Table 7). As can be seen, many of the existing popular solutions do not fully mitigate the risk of deforestation.

Table 7: Private sector options for managing deforestation risk in beef value chains[174,175]

Type of intervention	Available?	Notes
Credible certification	Yes – but low adoption	The Sustainable Agriculture Network (SAN) Standard for Sustainable Cattle Production Systems (Rainforest Alliance).[176] It appears there has been relatively limited uptake[177] – with examples being a European beef burger producer[178] and Gucci (for leather handbags).[179]

[171] Crust leather is leather that has been tanned, dyed and dried, but not finished.
[172] Leather Panel (2010) *Future Trends in the Leather and Leather Products Industry and Trade*. Leather Panel.
[173] Brack, D. Glover, A., and Wellesley L. (2016) *Energy, Environment and Resources Agricultural Commodity Supply Chains Trade, Consumption and Deforestation*. Chatham House Research Paper.
[174] Zero Deforestation Cattle website http://www.zerodeforestationcattle.org/
[175] DATU research (2014) *Deforestation and the Brazilian Beef Value Chain.*
[176] According to the cattle standard guidance document it is critical that the farm can demonstrate: 'It purchases cattle born and raised on non-certified farms that do not violate the following SAN criteria: … Destruction of a high value ecosystem after November 1, 2005 (critical criterion 2.2)'.
http://www.san.ag/biblioteca/docs/SAN_GIG_Cattle_Standard___February_2013.pdf

Other credible deforestation mechanisms	Yes – but costs high and doesn't cover whole chain	Animal tracking and traceability systems have been developed and deployed in South America – however costs can be prohibitive.[180] These include programmes implemented by some of the biggest suppliers, such as Marfrig and JBS. The G4 Agreement between Greenpeace and major beef producers has been seen as a good step forward but currently doesn't cover full supply chain.
Other relevant initiatives and standards	Yes	The Global Roundtable for Sustainable Beef (GRSB) and local chapter Brazilian Roundtable on Sustainable Livestock[181] (GTPS) are important initiatives that are developing standards, criteria, and common practices that address the protection of native forests from deforestation. The Leather Working Group is a multi-stakeholder group based out of the UK.[182] They have a leather manufacturer audit which has no deforestation requirements for direct suppliers.[183] Novo Campo is a programme to increase the productivity of existing pasture.

8.1.5 UK imports

8.1.5.1 Beef

According to *AHDB Beef & Lamb*, the UK was approximately 76–82% self-sufficient in beef between 2011 and 2014 (see Figure 44, extracted from *AHDB Cattle Yearbook 2015*). Based on information in the 2015 *AHDB Beef Outlook* we calculated imports in 2015 to be 20% of overall supply. These data points include all fresh meat and processed products.

Figure 44: Meat balance sheet for UK, 2011-14

Beef and veal (000 tonnes)	2011	2012	2013	2014
Production	935.5	885.2	846.7	877.4
Imports	382.9	406.3	393.1	413.6
Fresh/frozen	291.7	291.8	298.8	314.9
Processed	91.3	114.6	94.3	98.7
Exports	176.0	147.9	131.8	142.0
Total consumption	1,142.5	1,143.6	1,108.0	1,149.1

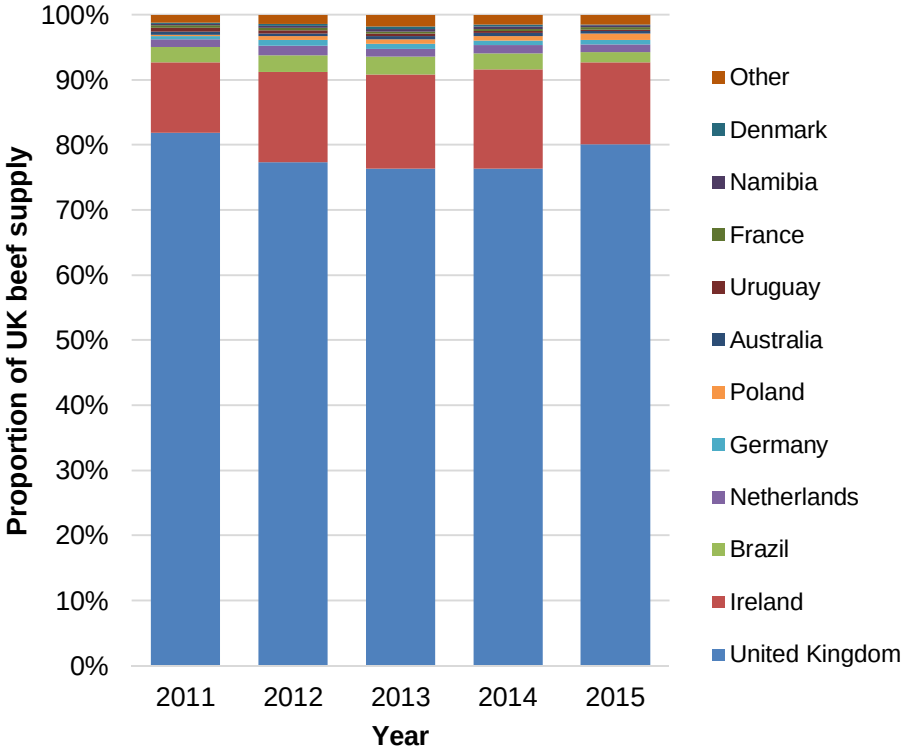
Note: Total supplies of meat available for consumption, including imported processed meat. Net production figures are for standard 52-week years.
Note: All fresh meat and processed products have been converted to carcase weight equivalent (cwe).
Source: AHDB Beef and Lamb, Defra, GTIS/HMRC

[177] The Rainforest Alliance 2015 Impacts report shows cattle land coverage is relatively small compared with others, e.g. coffee http://www.rainforest-alliance.org/sites/default/files/publication/pdf/SAN_RA_Impacts_Report.pdf
[178] http://www.frozenfoodeurope.com/europes-first-rainforest-alliance-certified-frozen-beef-product-launches-at-anuga/
[179] Rainforest Alliance press release: http://www.rainforest-alliance.org/newsroom/press-releases/gucci-goes-sustainable
[180] http://www.zerodeforestationcattle.org/#reading/ch5t2
[181] http://www.pecuariasustentavel.org.br/
[182] http://www.leatherworkinggroup.com/
[183] The standard says: 'The direct farms (within the Amazon Biome) should be GPS mapped in at least one location by July 05, 2010 and have their complete boundary shape registered by November 13, 2010. The farms should not have been involved in any form of deforestation in the Amazon biome since October 05, 2009.'

The self-sufficiency data was combined with UN Comtrade data on beef and beef product imports to identify the sourcing location of all beef consumed in the United Kingdom. The majority of beef imports are from the Republic of Ireland – with Brazil supplying less than 2% of beef consumed in the United Kingdom.

Data from *AHDB Beef & Lamb* on total consumption volumes was combined with sourcing proportion calculations to estimate the total volumes of beef products coming from each country (Figure 45). Overall, this accounts for more than 1 million tonnes of beef (in carcass weight equivalent[184]).

Figure 45: Sourcing locations of UK beef supply



8.1.5.2 Leather

As with most other commodities, there is no UK data on total quantities of leather material used, imported or produced, in the UK each year. In addition, the quantity of leather material used in products is highly variable, diverse and unreported by relevant sectors (e.g. the quantity of leather used in car interiors sold in the UK). Because of this, it was necessary to develop a different approach to estimating overall leather material usage in the UK.

Our starting point was industry data on global leather use by product type (see

Figure 41). An examination of UK and global leather shoe production data suggested that this split was applicable to the UK situation, and so was assumed to be the case for this study. The total quantity of leather embedded in all products sold in the UK was estimated

[184] Carcass Weight Equivalent: The weight of meat products expressed in terms of the weight of a dressed carcass. Using this format enables easier analysis of meat and livestock data. The carcass weight equivalent, or CWE, includes inedible parts such as bones (source: Agrimoney.com).

by using this assumption and information on UK leather footwear sales volumes and composition.

According to the *UNFAO World Statistical Compendium for Raw Hides and Skins, Leather and Leather Footwear (1993-2012)*, the United Kingdom had an apparent availability of 145 million pairs of leather shoes in 2011 (the latest year for which there is data). Assuming 0.23 m^2 leather is used per pair of shoes,[185] this equates to 33.4 million square metres of leather. Given our base assumption that 59% of leather used in UK products is in shoes, we can derive estimates for the area of leather used in other products (Table 8).

Table 8: Estimates of areas of leather used in UK sold products

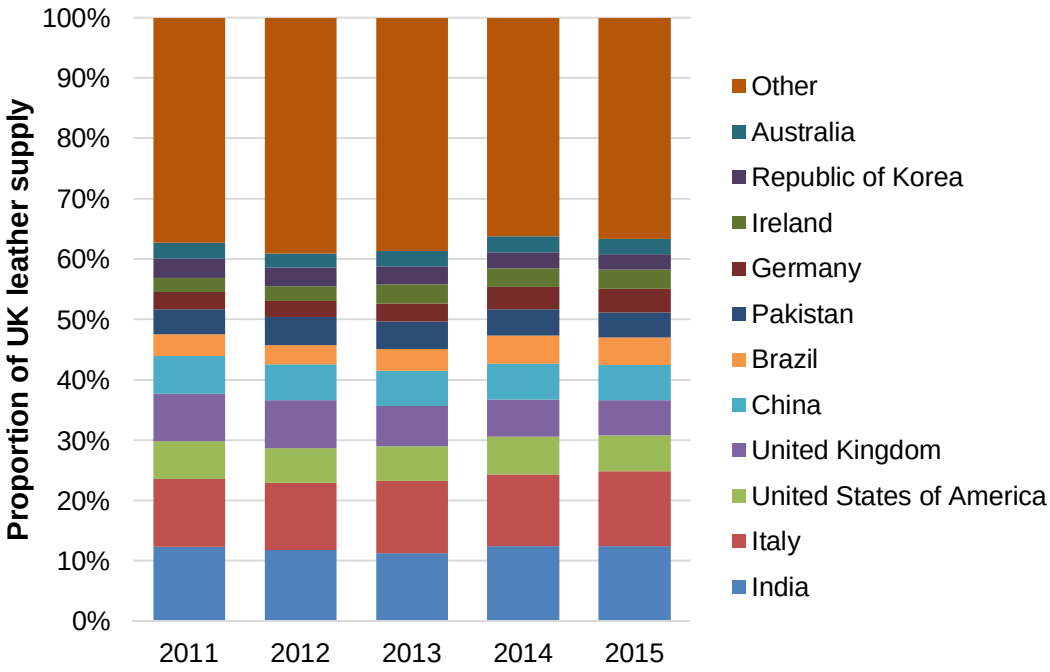
Product type	Area of leather (m^2)
Footwear	33,500,000
Garments	6,000,000
Furniture	6,000,000
Auto	4,000,000
Gloves	2,500,000
Other	5,500,000

The provenance of each of these product types was identified by using UN Comtrade import data. Given that each of the countries from which we import these products is often a producer, importer, and exporter of leather, we had to undertake an additional analysis of the trade dataset to identify likely sourcing locations of leather raw materials and hides supplying each country. To do this, we examined leather production, import and export data of major UK import partners. This data was used to establish the proportion of each country's leather supply that was imported (and from where) compared with home production. We assumed the provenance of the leather in goods exported to the UK was in these same proportions.

The end result of the analysis is an estimate of the top locations of production of hides in supply chains of products sold in the UK (Figure 46). India comes out top as it is a relatively important source of many products – and imports a relatively small proportion of its leather raw material. Brazil accounts for approximately 5% of leather supply, which is of a similar order of magnitude to the beef that is imported.

[185] Average of quantities reported in the United Nations Industrial Development Organization (UNIDO) report on the *Structure of Production Costs in Footwear Manufacture* (http://www.unido.org/fileadmin/import/userfiles/timminsk/leatherpanel14schmelcosts.pdf).

Figure 46: Top sourcing locations of hides for UK products containing leather



8.1.5.3 Data transparency

While data on beef production and import is relatively good, global leather statistics on production and trade are relatively poor compared with some commodities.[186] This is for a few reasons: hides are sold by weight, while leather is sold in square feet, making conversion between the two difficult; hides are segmented into different layers and into different shapes during processing; there is a lot of semi-processed trading; the illegal avoidance of export duties distorts trade data; and some 'leather' products aren't really leather (i.e. they are imitations made from plastic, etc.).[187] This is a necessary consideration when interpreting these results.

8.2 Risk analysis

8.2.1 Links between production and deforestation

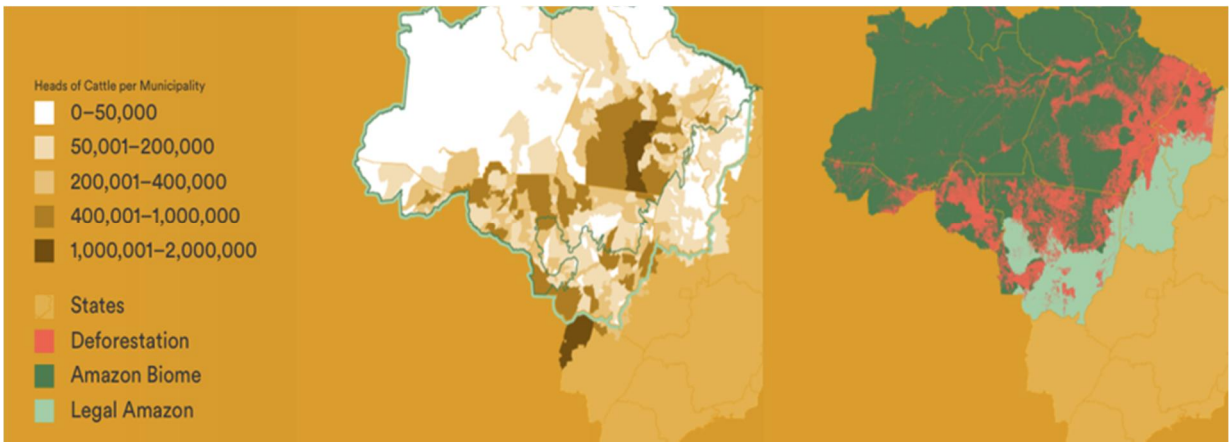
Cattle production is the dominant land use following deforestation in WWF Priority Places such as the Amazon, Cerrado and Pantanal. According to the research by Gibbs et al[188]:

> Cattle ranching occurs on over two-thirds of deforested land in the Brazilian Amazon … The large-scale expansion of the cattle herd into the Brazilian Amazon has come at great environmental cost, as large expanses of tropical forests have been cut, burned, and converted to pastures.

Figure 47 shows the patterns of cattle herd expansion and forest cover loss in Brazil. It is important to note that the production of soy, which is sometimes fed to cattle, is also driving deforestation in South America. This is analysed within the soy section of this report.

[186] Personal communications, Mike Redwood, and Leather Panel (2010) *Future Trends in the Leather and Leather Products Industry and Trade*. Leather Panel.
[187] Personal communications, Mike Redwood.
[188] Gibbs, H.K., et al. (2016). Did ranchers and slaughterhouses respond to zero-deforestation agreements in the Brazilian Amazon? *Conservation Letters*, 9(1), 32–42

Figure 47: Patterns of cattle herd expansion and forest cover loss in Brazil[189]



8.2.2 Social issues associated with cattle production

Research for the US State Department identifies cattle ranching in Brazil as a source of forced labour in the country.[190] According to the International Labour Organisation, some 62% of slave labour in Brazil is employed in livestock farming-related businesses.[191]

8.2.3 The UK's beef and leather footprint

Calculating the area of grazing land associated with the production of the leather and beef quantities identified above proved challenging. Unlike crop products, such as soy and palm, we found no publicly available data on cattle pasture productivity for a cross-section of countries (i.e. kg carcass weight per hectare of pasture). While individual studies were found for some countries, a variety of methods were used in these reports and so using a mixture of different sources was not feasible. This seems like a significant gap in global agricultural data given the significant land use associated with cattle farming. To fill this data gap we adopted the method used by de Ruiter et al (2017)[192] that allocates total country pasture to different grazing animals based on the relative feed conversion efficiencies and overall sector production. An example of the UK calculation is provided in Table 9, assuming the total pasture area of 12.3 million hectares is shared between dairy cattle, beef cattle and sheep.

Given that beef cattle have two products (meat and leather), we decided to allocate a share of the land footprint to beef and leather co-products on the basis of their mass (the hide being 10% of the mass of a sold carcass, it was allocated 10% of the land footprint). This was to avoid the potential double-counting of land where beef and leather where sourced from the same country. See Table 10 for an example calculation.

[189] zerodeforestationcattle.org citing Gibbs et al.
[190] US State Department (2016) *Trafficking In Persons Report.* Washington, DC: US State Department.
[191] ILO (2009) *Fighting Forced Labour: The Example of Brazil*. International Labour Organization.
[192] de Ruiter, H., et al. (2017) Total global agricultural land footprint associated with UK food supply 1986–2011. *Global Environmental Change*, 43, 72–81.

Table 9: Pasture allocation and productivity in UK – example assumptions

Livestock type	Output (tonnes of product) – lamb and beef in carcass weight	% of feed from pasture	Feed conversion rate	Pasture allocation to livestock (million hectares)
Lamb	289,000	90%	31.7	3.2
Dairy (milk)	13,900,000	75%	1.1	4.5
Beef	847,000	75%	18.5	4.6

Table 10: Example allocation of land footprint to cattle hide co-product for United Kingdom

Variable	Value and unit
Total land for beef cattle (see Table 9)	4.6 million hectares
Percentage of cattle weight that is hide	10%
Land allocated to leather production	460,000 hectares
Cattle skins output	59,000 tonnes
Land use per kg hide	78 m^2/kg hide

There are limitations to this method (explored in detail in de Ruiter et al., 2017*)* – for example we assume similar feed conversion rates and pasture use in all countries. Despite these limitations, given the lack of evidence in this area it was felt to be a reasonable approach to estimating sector-level grazing use for beef cattle.

This calculation showed significant variation between countries – including some countries that appear to be very extensive e.g. Namibia (>5000 m^2/kgCW) and Australia (800 m^2/kgCW). It is also worth noting that India appears to have a very high pasture stocking rate; however, we suspect this is because cattle often graze on wasteland, common land, urban areas and on waste by-products (e.g. rice husks). Hence, a large cattle population appears to be supported by a relatively small amount of grazing pasture.

8.2.3.1 Cattle land footprint

The tables and charts in this section summarise our estimates of beef and leather land use for UK supply of these two commodities – first of all individually and then combined. The combined leather and beef footprint is used in our risk analysis.

As is noted in Section 3.2, the method to determine which countries should be included in this footprint is different for beef and leather compared with all other commodities. The producer countries reflected in this analysis are those for which supplying UK imports requires an area of more than 2% of the total pasture land in the producer country.

Table 11: Grazing land footprints of UK beef supply (hectares)

Country	2011	2012	2013	2014	2015
United Kingdom	4,573,461	4,327,555	4,139,337	4,289,423	4,439,020
Namibia	1,442,139	1,568,729	2,537,266	2,038,876	1,378,969
Ireland	472,996	601,451	611,053	669,014	545,069
Brazil	401,516	438,269	441,260	424,091	269,114
Australia	391,918	339,034	441,060	445,054	318,325
Other	256,407	262,350	280,405	227,992	212,224

Figure 48: Grazing land footprint of UK beef supply (hectares)

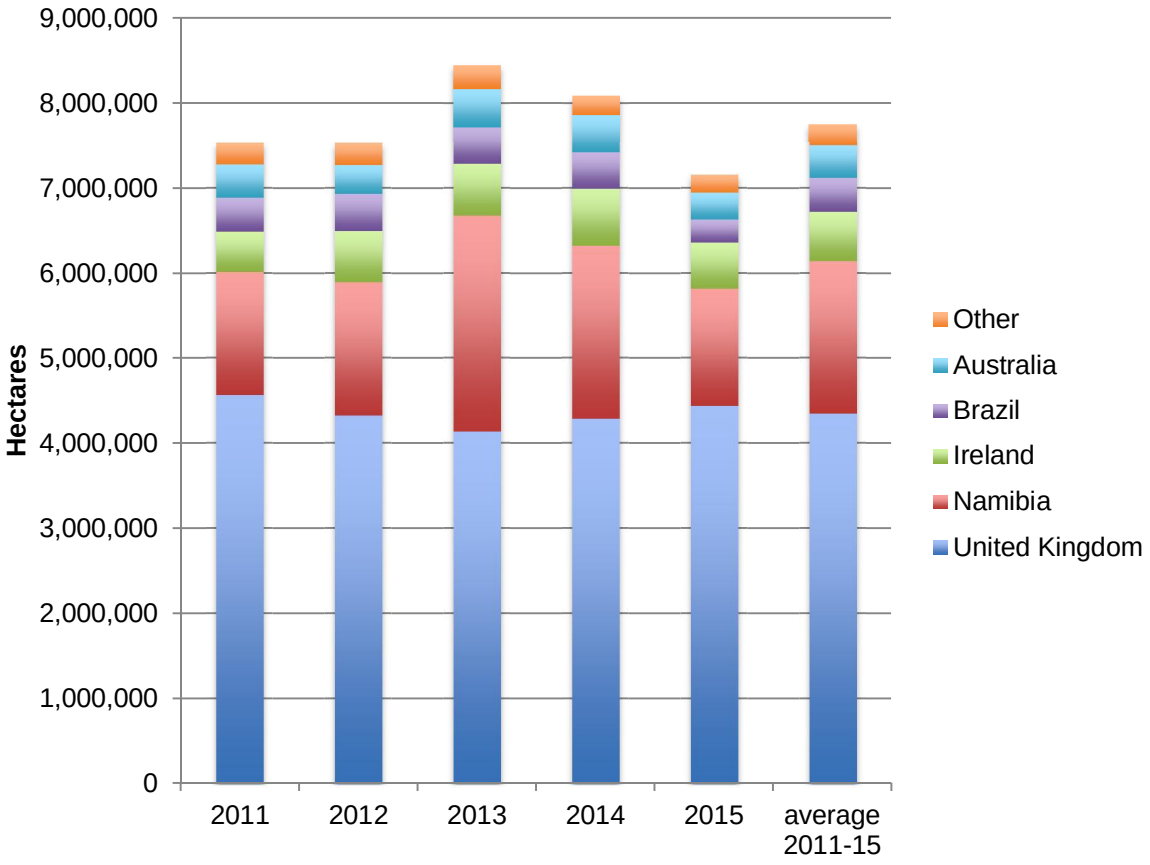


Table 12: Grazing land footprints of UK leather supply (hectares)

Country	2011	2012	2013	2014	2015
Other	539,662	578,800	604,585	547,267	565,554
Australia	348,700	301,469	338,567	363,211	350,224
China	236,433	226,322	225,107	232,431	231,808
US	209,118	190,641	197,156	212,722	206,105
Brazil	96,525	85,433	101,272	130,946	129,420
UK	90,581	91,747	79,193	74,213	71,405
South Africa	66,330	75,581	92,710	85,449	82,660
Italy	57,325	56,815	63,119	62,955	66,358
Argentina	44,799	41,376	41,181	53,676	54,812
Indonesia	42,821	43,988	36,412	33,099	33,692

Figure 49: Grazing land footprints of UK leather supply (hectares)

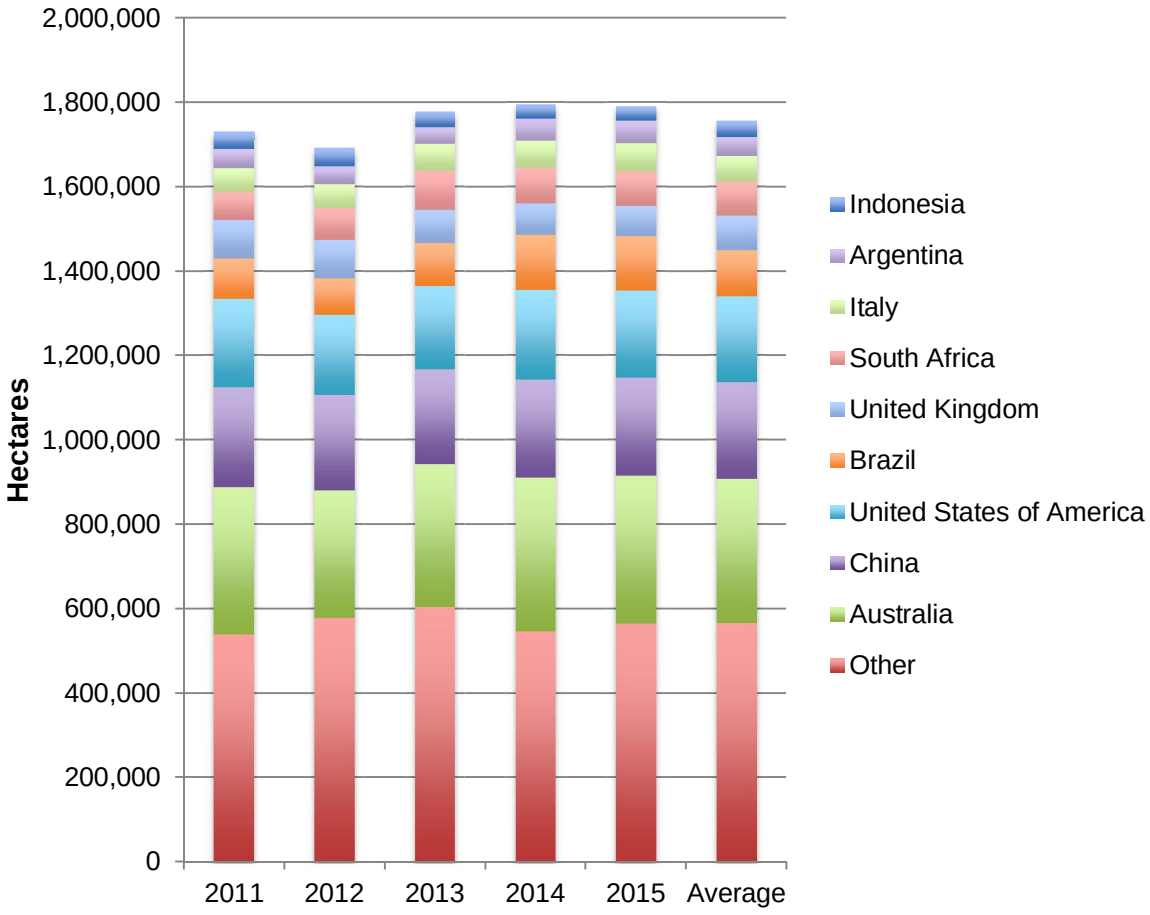


Table 13: Combined beef and leather footprints for UK imports – 2011-15 average (hectares)

Country	Beef	Leather	Beef & leather
Namibia	1,793,196	0	1,793,196
Australia	387,078	340,434	727,513
Ireland	579,917	18,215	598,132
Brazil	394,850	108,719	503,569
China	0	230,420	230,420
US	0	203,148	203,148
Uruguay	73,738	14,406	88,144
South Africa	0	80,546	80,546
Other	174,138	678,107	852,244

9 Natural rubber

9.1 Overview of production, trade and use

9.1.1 Introduction

The primary source of natural rubber is the rubber tree, *Hevea brasiliensis*. The species is native to Brazil and the Guianas,[193] and grows in humid, tropical lowland conditions, limiting its cultivation to areas within 15 degrees of the equator. Production is now mainly in south-east Asia, with plantations in South America hampered by a fungal disease (known as South American leaf blight). Natural rubber is used in thousands of ways, from engineering and industrial applications, to tyres, bouncing balls, boots, balloons and latex gloves.

A second type of rubber, synthetic rubber, is produced from petrochemical feedstocks (crude oil), with a range of varieties produced that possess different properties. The majority of rubber produced is synthetic, and this results in the price of natural rubber being determined in part by the prevailing global price of crude oil. The rest of this section will, however, focus on natural rubber.

9.1.1.1 Production

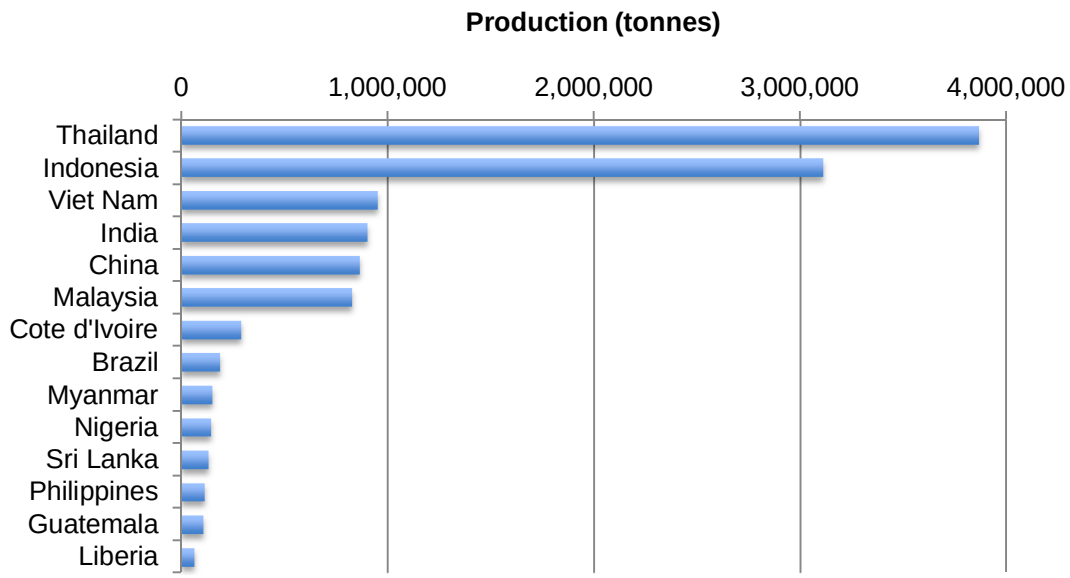
The rubber tree is grown in plantations, both large-scale and smallholder. Individual trees are tapped on alternate days, with the latex collected in suspended vessels, and most plantations have a 'rest period' where tapping is suspended in the dry season. The latex is then coagulated with acid to make rubber, which is further processed to a finished product. The most important of these processes is vulcanisation, which is most commonly done by adding a curing agent (e.g. sulphur compounds) and treating the rubber at high temperature and pressure.

Smallholder production has traditionally dominated production in many of the main producing countries, including Indonesia, Malaysia, and India.[194] For example, about 7 million Indonesian farmers gain some or all of their income from growing and selling rubber, managing just over 85% of the planted area and producing 81% of the latex between 2000 and 2005.[195] Large plantations are increasingly emerging on expansion frontiers (e.g. Laos).

Global production of natural rubber was 11.9 million tonnes in 2013,[196] a 58% increase since 2000. The overwhelming majority of the world's natural rubber is produced in Asia. Thailand accounts for 30% of world production, Indonesia 26%. Along with Vietnam, India (8% each), China and Malaysia (7% each), these 'top six' producer countries account for 88% of global production (Figure 50).

[193] Mabberly, D.J. (1987). *The Plant Book*. Cambridge, UK: Cambridge University Press.
[194] Manivong, V (2007). The economic potential for smallholder rubber production in northern Laos. http://lad.nafri.org.la/fulltext/LAD010320080112.pdf
[195] Pye-Smith, C. 2011. Rich rewards for rubber? Research in Indonesia is exploring how smallholders can increase rubber production, retain biodiversity and provide additional environmental benefits. *ICRAF Trees for Change* no. 8. Nairobi: World Agroforestry Centre. http://www.worldagroforestry.org/downloads/Publications/PDFS/B17073.pdf
[196] Source: FAO STAT http://faostat3.fao.org/home/E (last accessed 25 April 2015).

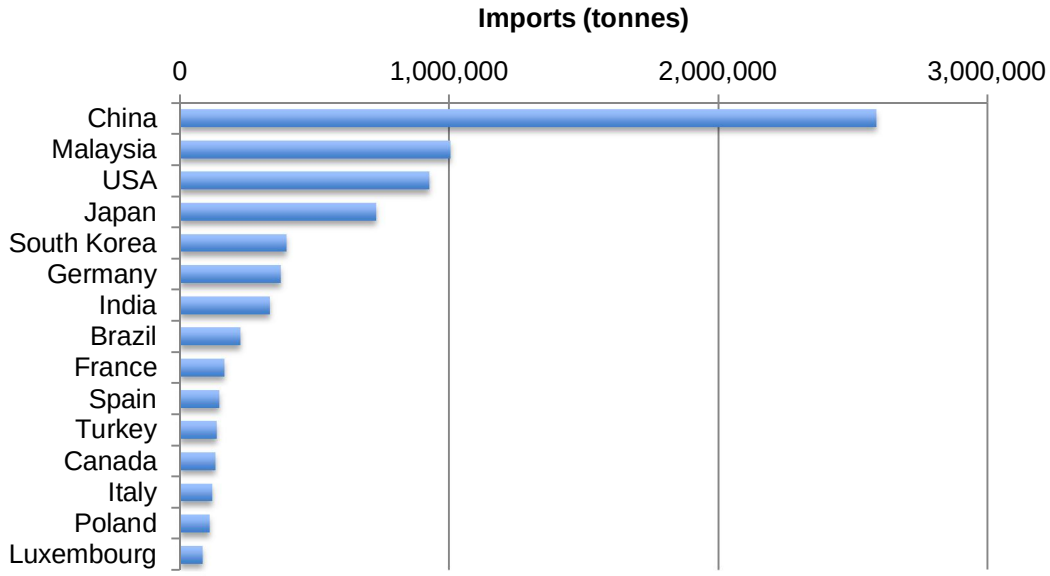
Figure 50: Natural rubber production by country in 2013[197]



9.1.1.2 Global trade

China dominates global imports, accounting for 30% of natural rubber traded as raw materials. The top five importing countries in 2013 (in order of size of imports) were China, Malaysia, US, Japan and South Korea, together accounting for 66% of global imports. Some of the largest producer countries are also importers of natural rubber, especially China, Malaysia and India. The UK accounted for just 1% of global imports of natural rubber raw materials in 2013 (Figure 51), and the EU for 17%.

Figure 51: Major importing countries in 2013[198]



[197] Source: FAO STAT http://faostat3.fao.org/home/E (last accessed 25 April 2016).
[198] Source: FAO STAT http://faostat3.fao.org/home/E (last accessed 25 April 2016).

Three of the largest companies on the global stage are: Thai Rubber Latex Corporation PLC, which claims to be the largest natural concentrated latex producer and supplier;[199] Sinochem International and HalcyonAgri, currently in the process of merging to create the world's largest natural rubber supply chain manager;[200] and Olam, which is partnering with the government of Gabon to develop 28,000 hectares of rubber plantations by 2019,[201] and which has recently agreed to stop forest conversion from its expanding rubber estates in that country.[202]

9.1.1.3 Major end uses

More than half of all the rubber used is synthetic rubber, produced from petroleum by-products (66% of rubber imported into the UK was synthetic in 2015).[203] The two forms of rubber are not fully substitutable for all end uses, with the competitive advantage between them determined partly by oil prices where substitution is possible. Some natural rubber is more or less necessary in tyre production as it provides the highest level of (unvulcanised) strength and high tack (the ability of tyres to 'stick' to the road surface). The proportion of natural rubber is least in car tyres, rises in truck tyres, and is highest in aviation and 'outsized' vehicle tyres.

9.1.2 UK supply chain

In terms of raw material, only 33-39% of the rubber imported into the UK each year was natural rubber, the rest being synthetic (Table 14). Synthetic rubber is largely imported from the EU and US.

Table 14: Imports of natural and synthetic rubber raw material into the UK (tonnes)[204]

	2011	2012	2013	2014	2015
Natural rubber	97,532	73,516	77,601	81,938	71,674
Synthetic rubber	152,808	130,491	134,798	144,576	144,895
% natural	39%	36%	37%	36%	33%

The rubber that is imported into the UK for further manufacture is largely in the form of Technically Specified Natural Rubber (TSNR)[205] and natural rubber latex (whether or not pre-vulcanised). Assuming that the general proportion of use broadly holds for the UK, around 60% of imported natural rubber is then used in the manufacture of tyres.[206] The UK produces approximately 15 million motorbike, car, van, truck and aircraft tyres per year,[207]

[199] http://www.thaitexgroup.com/main_page/index_our_company.php
[200] http://uk.reuters.com/article/us-hac-m-a-sinochem-intl-idUKKCN0WU04D
[201] http://olamgroup.com/products-services/industrial-raw-materials/rubber/
[202] http://www.eco-business.com/news/olam-pledges-to-stop-clearing-forest-in-gabon-for-a-year-after-ngo-pressure/
[203] Source: Comtrade http://comtrade.un.org/data/ (last accessed 25 April 2015).
[204] For this analysis, all rubber raw material was taken as HS Code 4001 (which includes small amounts of other rubbers, such as guta percha), and synthetic rubber is HS Code 4002.
[205] TSNR is rubber produced in blocks (rather than the more traditional sheets) and which is graded according to technical parameters (such as the dirt content, ash content and nitrogen content) and properties (such as its Plasticity Retention Index).
[206] Agricultural Commodities: Profiles and Relevant WTO Negotiating Issues. FAO, Rome, 2002. http://www.fao.org/docrep/006/y4343e/y4343e03.htm#bm03.2
[207] http://xukht3z7r3u3afw993ylh21d.wpengine.netdna-cdn.com/wp-content/uploads/2014/12/tif-factbook-0712.pdf

with total revenue of £2.3 billion.[208] There are four major tyre manufacturers with eight manufacturing sites in the UK: Pirelli, Goodyear Dunlop, Michelin and Cooper Tires.[209]

Manufactured tyres are traded to wholesalers/distributers both within the UK and the EU, who then sell them to retailers.[210] Globalisation is high in the tyre industry, with leading tyre manufacturers tending to operate a number of factories across the world, and with most of the factories having moved to countries where production costs are cheaper (e.g. China and Thailand).

The UK also imports significant quantities of other manufactured products containing rubber. These products will often include both natural and synthetic rubber, as well as other materials. There is no data on the natural rubber content of these goods, which will vary from product to product.

9.1.3 Certification

There is currently no independent, third-party verification certification system specifically for rubber.

The Sustainable Natural Rubber Initiative (SNR-i) has developed a set of voluntary guidelines and criteria for members that include indicators on productivity, quality, forest sustainability, water management, and human/labour rights. Twenty-three of SNR-i's registered companies have completed the self-declaration stage. There is no independent third-party auditing or certification, and the scheme is expected to work as a credit/mass-balance scheme.[211]

There are no UK members of SNR-i currently; however, members include the European Tyre & Rubber Manufacturers Association, with which some companies with UK operations will be connected. Industry members include many of the major tyre manufacturing companies with UK operations (namely Bridgestone, Goodyear, Pirelli, and Michelin). However, it is presumably the international companies rather than their UK subsidiaries that are members.

Other certification schemes that apply to rubber include FSC (for rubber wood, hence included within the relevant chapter on timber) and organic standards. Organic certified rubber is, however, imported in diminutive quantities (e.g. for mattresses).

The lack of credible sustainability mechanisms suggests the need to raise awareness of sustainability issues within the sector, and catalyse a credible sectoral approach to sustainability. Michelin has recently announced a 'zero net deforestation policy' that excludes deforestation of primary forest, High Carbon Stock Forest and High Conservation Value Forest from their supply chains[212] and is in partnership with WWF-France, which indicates that the sector is perhaps open to addressing its environmental footprint.

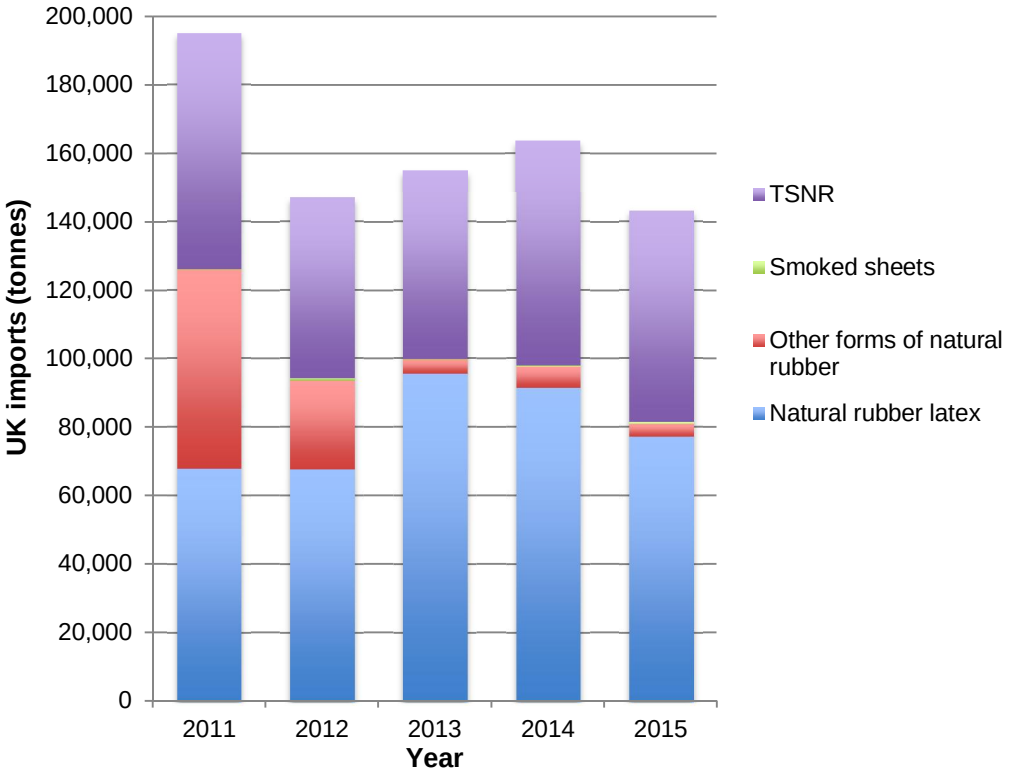
[208] IBISWorld (2015). IBISWorld Industry Report C22.110 Tyre Manufacturing in the UK.
[209] http://xukht3z7r3u3afw993ylh21d.wpengine.netdna-cdn.com/wp-content/uploads/2014/12/tif-factbook-0712.pdf
[210] http://xukht3z7r3u3afw993ylh21d.wpengine.netdna-cdn.com/wp-content/uploads/2014/12/tif-factbook-0712.pdf
[211] http://www.snr-i.org/index.php
[212] Sustainable Natural Rubber Policy. Reference Document. 2016 edition. Michelin.

9.1.4 UK imports

9.1.4.1 Direct imports

Most of the import of natural rubber raw materials into the UK (by volume) is in the form of latex (whether or not pre-vulcanised) and Technically Specified Natural Rubber (TSNR). Together these two categories accounted for 97% of the imported volume of raw materials in 2015.[213] The import of these two materials has remained relatively stable over the last five years (Figure 52).

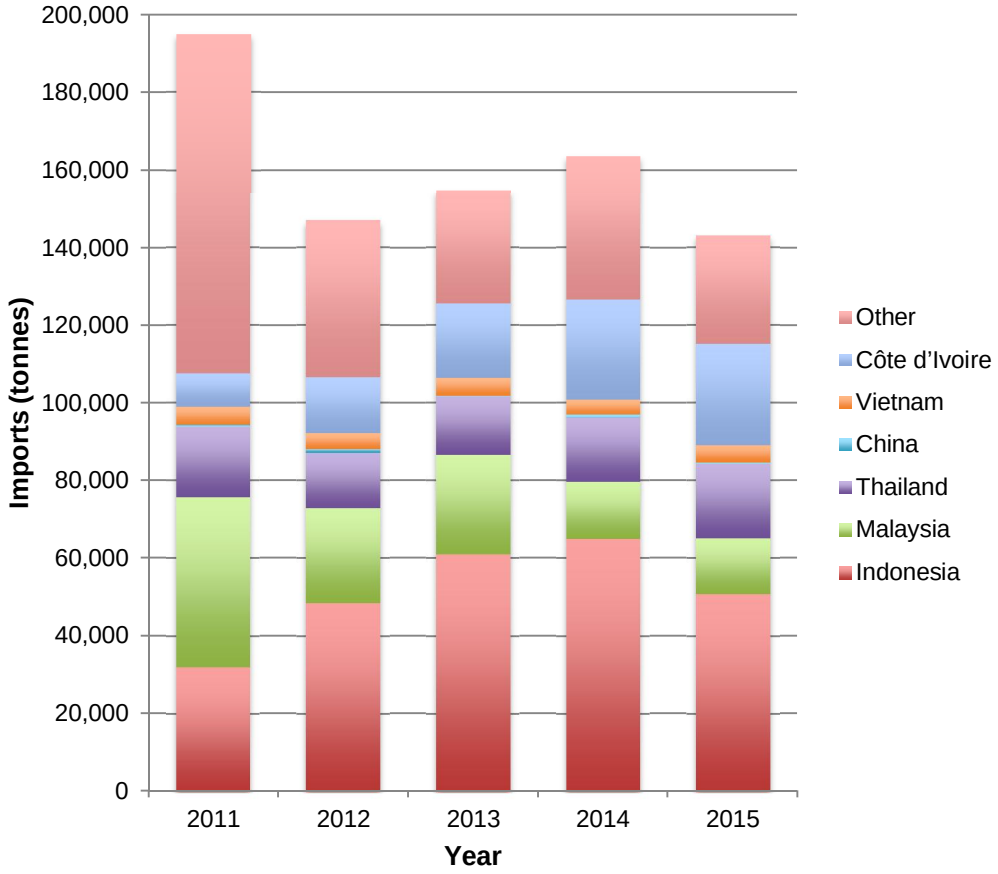
Figure 52: UK imports of natural rubber raw material



The bulk of the natural rubber raw materials imported into the UK comes from Indonesia (Figure 53), which accounts for 33-40% of annual imports into the UK. Imports from Côte d'Ivoire are increasing rapidly, from 4% in 2011 to 18% in 2015, with those from Malaysia declining over the same period.

[213] Source: Comtrade http://comtrade.un.org/data/ (last accessed 25 April 2015).

Figure 53: Annual UK imports of natural rubber raw material by exporting country



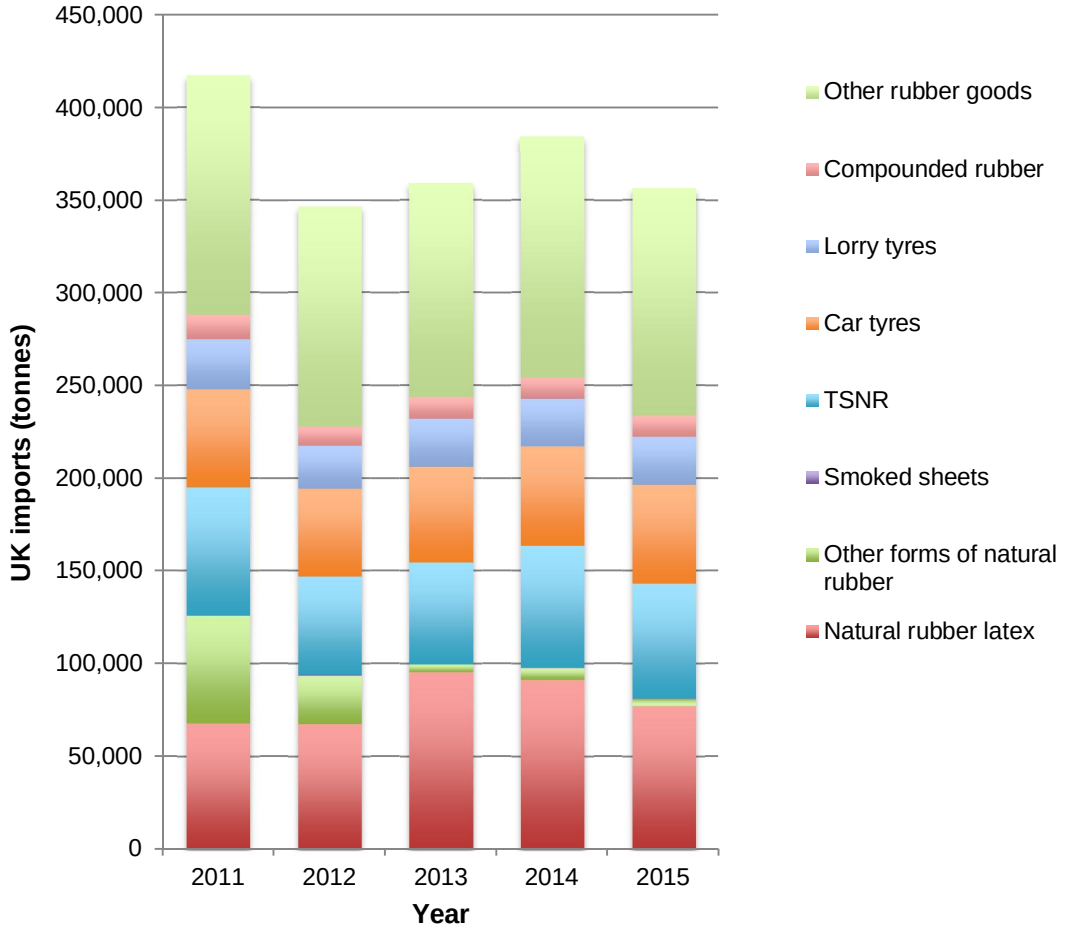
9.1.4.2 Embedded imports

The UK imports significant volumes in manufactured goods containing natural rubber, especially tyres. The globalisation of the tyre industry is reflected in trade statistics, where tyres produced in the UK are sold on the domestic market, exported (to a value of £711.9 million in 2015-16), and imported (£2.1 billion in 2015-16). The EU and China (22% of value) are the main exporters of tyres to the UK. Within the EU, Germany alone accounts for 16% of the value of tyres imported to the UK.[214]

The natural rubber content of car tyres is approximately 14%[215] (and 28% in truck tyres). Adjusting the weights of imported tyres to reflect the natural rubber content provides an estimate of the quantity of natural rubber imported into the UK (Table 15 and Figure 54). This suggests that, on average, 43% of natural rubber is imported as raw materials, 21% within imported tyres, and 36% in other manufactured products. Global rubber production in 2013 was 11,965,846 tonnes,[216] making the UK's imports equivalent to 2.6% of global production.

[214] IBISWorld (2015). IBISWorld Industry Report C22.110 Tyre Manufacturing in the UK.
[215] The tread of car tyres contains about 28% natural rubber, but the whole tyre, which includes metal, compounds, synthetic rubber among many other elements, contains about 14% natural rubber. Truck tyres contain almost twice this amount of natural rubber (27%) http://infohouse.p2ric.org/ref/11/10504/html/intro/tire.htm
[216] FAO STAT (last accessed 18 November 2016).

Figure 54: Estimated imports of natural rubber, adjusting manufactured goods for rubber content



The UK imports tyres mainly from the EU (43%) and China (39%). The EU's imports of natural rubber are dominated by Indonesia (average 35%, 2011-15), Malaysia (19%), Thailand (16%) and Côte d'Ivoire (13%). China is both a producer of rubber and an importer, with imports from Thailand, Indonesia, Malaysia and Vietnam totalling 2.8 times China's own production.[217] Using the assumption that China's exports to the UK were in the same proportion as its overall supply of rubber (i.e. the combination of production plus imports from its trading partners) allows a first-order estimate of the provenance of the rubber used to supply the UK. This results in the provenance of natural rubber imported into the UK becoming dominated by Indonesia, Malaysia, Thailand, China, Vietnam and Cote d'Ivoire (Figure 55).

[217] This figure is derived from UN Comtrade (import) and FAO STAT (production).

Figure 55: Estimated provenance of UK imports of natural rubber, adjusted for imports of tyres from the EU and China

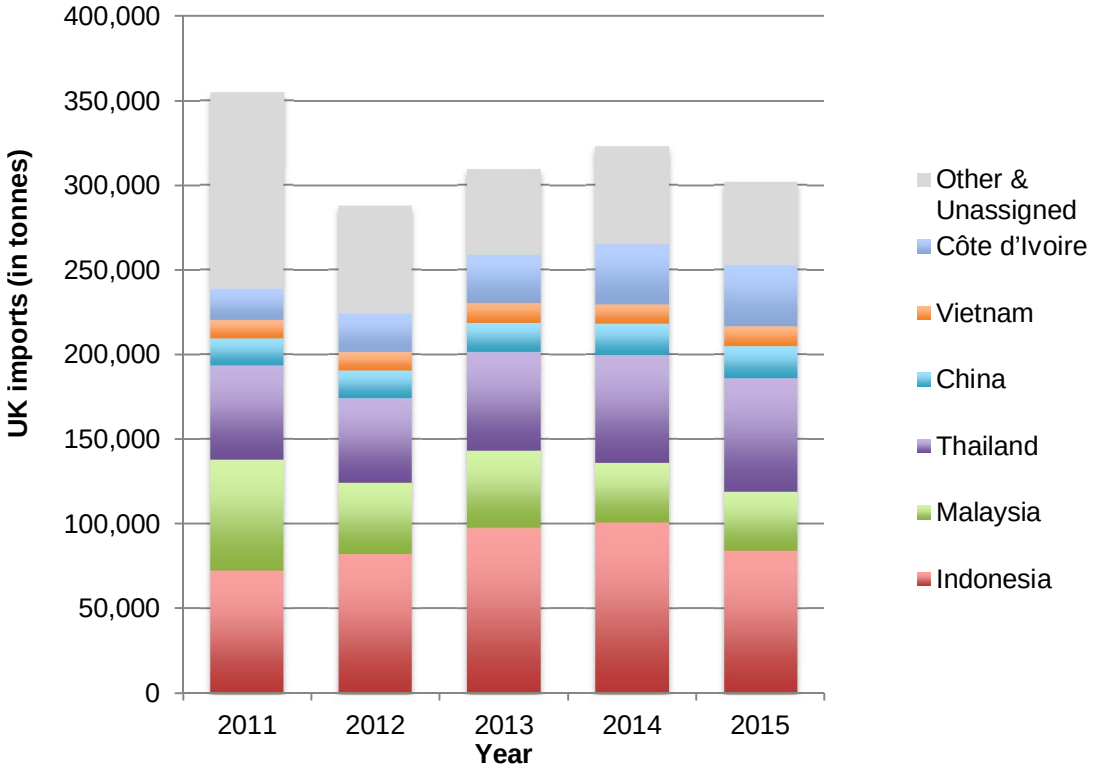


Table 15. Estimated imports of natural rubber by product

Import category	Short description	(In tonnes) 2011	2012	2013	2014	2015	2011–2015 Average	%	Data quality
Raw material	Natural rubber latex	67,922	67,648	95,520	91,488	77,280	79,972	21	High: import data
	Other forms of natural rubber	58,022	25,776	4,235	6,111	3,671	19,563	5	High: import data
	Smoked sheets	56	815	120	374	498	373	0	High: import data
	TSNR	69,026	52,781	54,981	65,646	61,724	60,832	16	High: import data
Tyres	Car tyres	52,894	47,600	51,395	53,671	53,314	51,775	14	Medium: assumes 14% of tyre is natural rubber
	Lorry tyres	27,028	22,876	25,945	25,636	26,082	26,459	7	Medium: assumes 27% of tyre is natural rubber
Other	Compounded rubber	13,204	10,500	11,564	11,393	11,158	11,564	3	Low: assumes 20% of compounded rubber is natural rubber as per car tyres
	Other rubber goods	129,127	118,556	115,806	130,071	123,069	123,326	33	Low: Assumes that globally 50% of natural rubber is used in tyres, so 'uplifts' this category to account for this
Total		**417,278**	**346,552**	**359,566**	**384,390**	**356,796**	**372,917**		

9.1.4.3 Data transparency

Between 2011 and 2015 the UK imported an average of 367,000 tonnes of natural rubber per year. Of this, 43% was directly imported from Indonesia, Côte d'Ivoire, Thailand, Malaysia and Ghana. The remaining 57% is embedded within products – especially tyres – that are principally imported from the EU and China. Estimating the provenance of these imports requires assumptions to be made.

9.2 Risk analysis

9.2.1 Links between production and deforestation

An estimated one million hectares of secondary forest and subsistence crop land in China, Laos, Thailand, Vietnam, Cambodia and Myanmar have been converted to rubber trees over the last few decades.[218] A recent estimate that 'up to 8.5 million hectares of additional rubber plantations will be required to meet demand by 2024' points to the serious threat that this expansion is likely to have on biodiversity.[219] The same study found that since there are no market prohibitions or deterrents on growing rubber trees on deforested land, some growers are replacing oil palm with rubber on deforested land. In Malaysia, while less important than other drivers such as palm oil, expansion of the area of rubber plantations has been cited as one of the causes of deforestation in Sabah.[220]

9.2.2 Social issues associated with production

Land grabs for rubber plantations have been associated with loss of land and livelihood for people in south-east Asia. Two Vietnamese companies, HAGL and Vietnam Rubber Group, have been accused of land grabs to create rubber plantations in Cambodia and Laos,[221,222] and a Chinese company has been reported as having been granted a concession to establish rubber on land traditionally owned by the Khmu ethnic minority in northern Laos.[223]

The US Department of Labour lists Cambodia, Indonesia, Liberia, the Philippines, and Myanmar as using child labour in the production of rubber; it also lists Myanmar as using forced labour in the production of natural rubber.[224]

9.2.3 The UK's rubber footprint

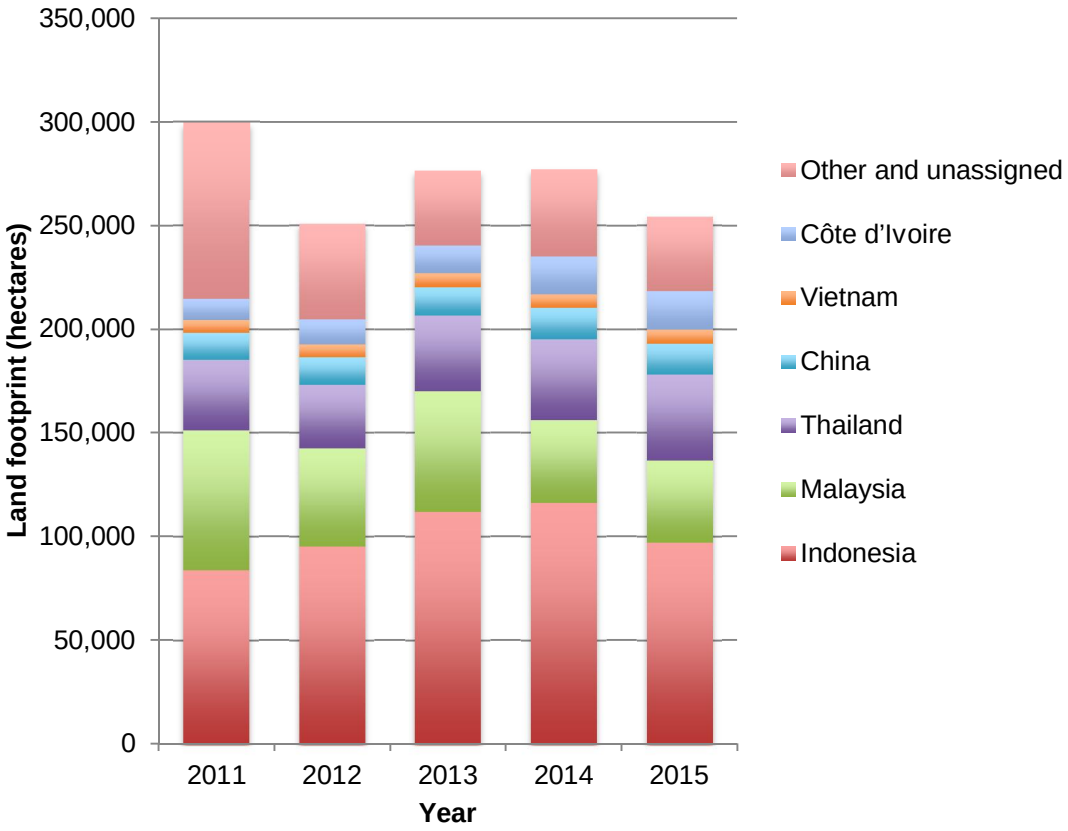
The evidence cited above suggests that rubber cultivation is in some cases associated with serious human rights abuses. However, rubber cultivation also provides a livelihood for millions of smallholders in countries such as Indonesia, which is the top exporting country to the UK (Figure 55).

The estimated imports of natural rubber, summarised by product type in Table 15 and by country of origin in Figure 55, were divided by the producer country's yield[225] to derive an

[218] Li, Z. and Fox, J.M. (2012). Mapping rubber tree growth in mainland Southeast Asia using time-series MODIS 250 m NDVI and statistical data. *Applied Geography*, 32, 420–432.
[219] https://www.uea.ac.uk/about/-/expanding-rubber-plantations-catastrophic-for-endangered-species-in-southeast-asia
[220] Ratnasingham, J., et al. (2012). Production potential of rubberwood in Malaysia: its economic challenges. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 40(2), 317–322; and Sabah Forestry Department (2013). *Annual Report 2013*.
[221] https://www.globalwitness.org/en/campaigns/land-deals/rubberbarons/
[222] http://www.bbc.co.uk/news/world-asia-22509425
[223] McAllister, K. (2015). Rubber, rights and resistance: the evolution of local struggles against a Chinese rubber concession in Northern Laos. *Journal of Peasant Studies*, 42(3-4), 1–21
[224] http://www.dol.gov/ilab/reports/child-labor/list-of-goods/
[225] Source: FAO STAT. (last accessed 29 June 2016).

estimate of the land required to supply the UK's demand for rubber.[226] Between 2011 and 2015, this area of land was on average over 270,000 hectares each year (Figure 56). In 2013, the global harvested area of natural rubber[227] was 10.3 million hectares, making the UK's footprint equivalent to 2.7% of the global harvested area.

Figure 56: The estimated land area required to supply the UK's demand for natural rubber



[226] Note that this simple method of calculating the land footprint is possible for rubber, because unlike many commodities (such as soy, palm oil, cocoa, and beef and leather), imported rubber in whatever form is derived from latex rather than fractions of it.
[227] FAO STAT (last accessed 18 November 2016).

10 Cocoa

10.1 Overview of production, trade and use

10.1.1 Introduction

Theobroma cacao is a tropical tree species indigenous to South America.[228] Today, production has spread across the globe but cocoa's climate requirements mean that production is limited to within 20 degrees of the equator. Most cocoa is now grown in Africa, with growing production in Indonesia and some production still found in Latin America.[229]

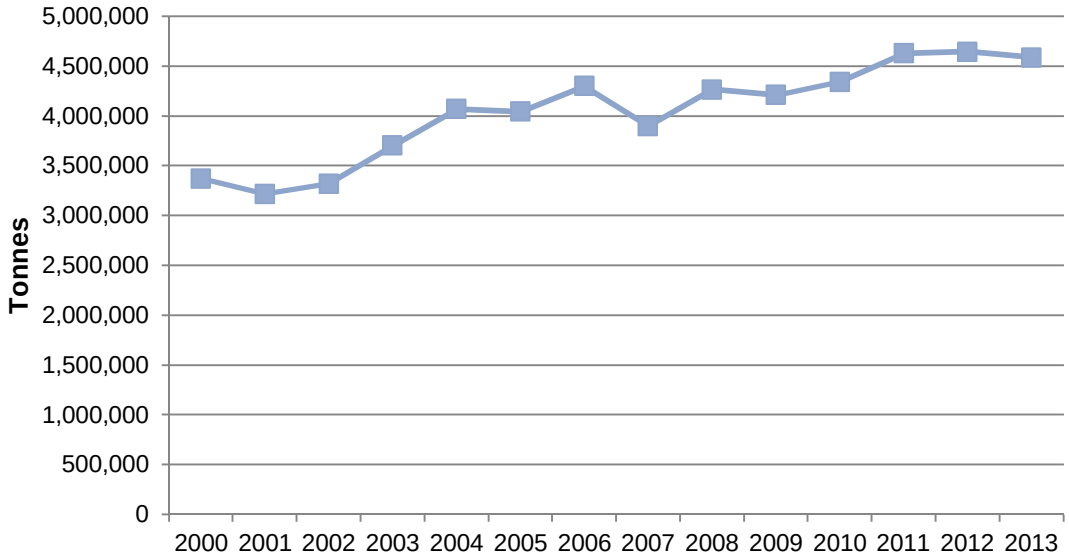
10.1.1.1 Production

Cocoa trees produce cocoa pods, which are harvested and split open to retrieve the cocoa beans and cocoa pulp inside. The beans are fermented in the pulp for several days, then cleaned and dried. At this point the farmer will sell the beans on to an exporter. Beans may be further processed in the country of origin, or exported elsewhere for continued processing.

The majority of cocoa is produced by smallholders, with more than six million smallholders producing cocoa on 2-3 hectares, contributing around 70% of global cocoa production.[230]

Global production of cocoa beans in 2013 was 4,585,552 tonnes. Production of cocoa has steadily increased over the last decade (Figure 57).

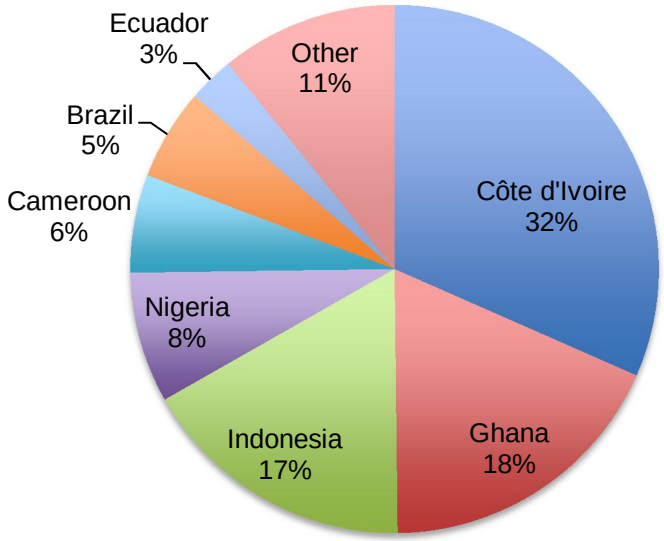
Figure 57: Global production of cocoa beans since 2000[231]



Cocoa is produced in 62 countries worldwide, but over 65% of cocoa is produced in Africa, the two largest producers being Côte d'Ivoire (32%) and Ghana (18%). Indonesia, at 17% of global production, is the third largest producer.

[228] World Cocoa Foundation, http://www.worldcocoafoundation.org/about-cocoa/history-of-cocoa/
[229] http://www.icco.org/about-cocoa/growing-cocoa.html
[230] ICCO production statistics
[231] FAOSTAT (last accessed 5 September 2016).

Figure 58: Primary cocoa producing countries, 2013[232]



10.1.1.2 Global trade

The top five exporters of cocoa include the major producing countries alongside the Netherlands (Table 16). Once cocoa raw material has arrived in the EU, a large amount of further trading occurs within the EU as cocoa is processed and manufactured into various end products. All of the top five importers are EU countries.[233]

Table 16: Major cocoa exporting countries (2013) [234]

Country	Tonnes
Côte d'Ivoire	813,891
Ghana	526,187
The Netherlands	215,717
Indonesia	188,420
Nigeria	182,900

10.1.1.3 End uses

There are a number of co-products manufactured from cocoa beans, but the primary end use is chocolate and chocolate products:

- **Cocoa liquor:** Cocoa liquor is the result of roasting and grinding cocoa nibs, and is either processed straight into chocolate, or pressed to make cocoa butter and cocoa powder.
- **Cocoa butter:** Cocoa butter is extracted through pressing cocoa liquor and is usually combined with pure cocoa liquor to be made into chocolate, but it can also be used in cosmetics. Typically, cocoa butter destined for cosmetic use is made from diseased pods, or beans that have germinated during drying, and is a relatively small-scale use.[235]

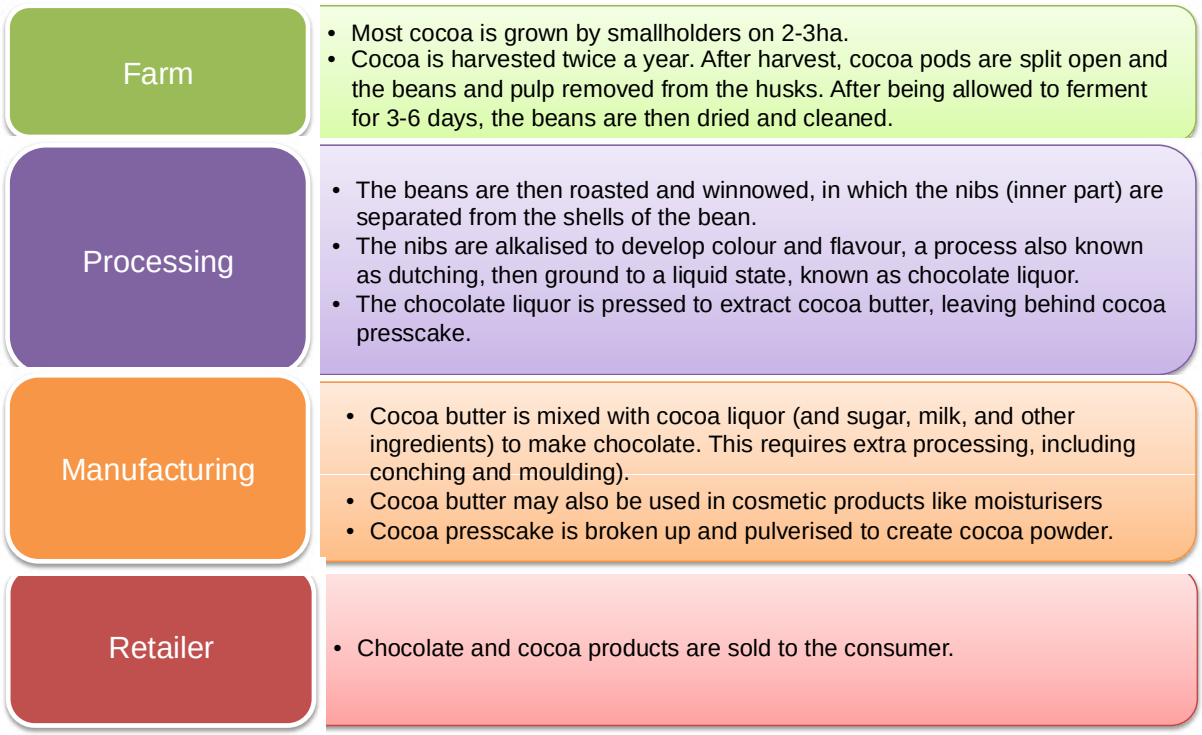
[232] *Ibid*.
[233] FAOSTAT (last accessed 5 September 2016).
[234] *Ibid*.
[235] http://www.new-ag.info/99-2/focuson/focuson6.html

- **Cocoa powder:** Cocoa powder (or 'presscake') is the resulting by-product from pressing cocoa liquor to extract cocoa butter. It is used in baking and the manufacture of other chocolate goods.
- **Cocoa pulp:** Found alongside cocoa beans inside cocoa pods. It is usually used in the fermentation of cocoa beans. However, it can be used when fresh to make soft drinks, alcohol, and pectin; these uses are small-scale and local.[236,237]
- **Cocoa pod husks and bean shells:** These by-products are high in protein and can be used in animal feed. However, to be usable, husks must be processed quickly and dried fast, which imposes severe limitations on production, as processing at this level often happens on farm.[238] With regards to the EU, pods are generally not imported, and cocoa husks are not normally available. Cocoa meal is only exceptionally used as a feeding material.[239]
- **Chocolate and chocolate goods:** Manufactured from a combination of cocoa liquor and cocoa butter, chocolate and chocolate goods are the primary end product, by volume, of cocoa beans.

10.1.2 UK supply chain

Most of the cocoa imported into the UK has arrived in the form of processed chocolate goods, at either the manufacturing or retailer stage, as shown in Figure 59.

Figure 59: Typical cocoa supply chain



[236] http://www.new-ag.info/99-2/focuson/focuson6.html
[237] http://www.foundation-imagine.org/uploads/media/Valorization_of_cocoa_byproducts_in_Cameroon.pdf
[238] http://www.new-ag.info/99-2/focuson/focuson6.html
[239] https://www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/contam_op_ej725_theobromine_en,3.pdf

10.1.3 Certification

Certification schemes in cocoa are fairly well advanced, and there are a number of both third-party and proprietary standards. The major third-party certification schemes are Fairtrade, Utz and Rainforest Alliance.

All three schemes are applicable to numerous commodities. Fairtrade[240] members must be small-scale producers, operating through a producer organisation. Members are certified against general and cocoa-specific criteria. In 2014, some 70,600 tonnes of Fairtrade cocoa was sold by certified producer organisations – around 1% of global production.[241] In the Utz[242] scheme, cocoa producers are certified against general Utz criteria as well as a cocoa-specific module. The scheme focuses on environmental sustainability and labour rights. Utz-certified cocoa is grown in 19 countries, including Côte D'Ivoire and Ghana. The Rainforest Alliance scheme, using the Sustainable Agriculture Standard, or SAN,[243] works towards environmental, social, and economic impacts. All three schemes include criteria on conservation, with varying levels of protection against deforestation.[244]

While Fairtrade includes criteria on general biodiversity conservation, which encompasses protection of areas of high conservation value (HCV) including forest, it does not have specific deforestation criteria (Table 17).[245] Utz includes specific deforestation criteria with reference to high conservation value areas and a cut-off date of 2008. SAN has a new zero deforestation standard due to launch in 2017, which will maintain a 2005 cut-off for HCV as well as cut-off date of 2014 for any conversion of natural habitat. With this new standard, SAN will effectively be zero deforestation, while Utz and Fairtrade are not.[246]

In 2011-12, an estimated 22% of the cocoa produced globally was compliant with Rainforest Alliance, Utz, Fairtrade or organic standards.[247]

Table 17. Deforestation requirements of certification standards relevant to cocoa

[240] http://www.fairtrade.org.uk/

[241] http://www.fairtrade.org.uk/~/media/fairtradeuk/farmers%20and%20workers/documents/cocoa%20commodity%20briefing_online7.pdf

[242] https://www.utz.org/what-we-offer/certification/products-we-certify/cocoa/

[243] http://www.rainforest-alliance.org/publications/sustainable-agriculture-standard

[244] http://www.standardsmap.org/compare?standards=378,71,62&standard=0&shortlist=378,71,62&product=Cocoa&origin=Any&market=Any&cbi=78:78:756

[245] http://www.fairtrade.net/fileadmin/user_upload/content/2009/standards/documents/SPO_EN.pdf

[246] http://sanstandard2017.ag/

[247] Potts, J., Lynch, M., Wilkings, A., Huppé, G., Cunningham, M., and Voora, V. (2014). *State of Sustainability Initiatives Review*. IISD & IIED.

Scheme	Deforestation requirements
Fairtrade[248]	3.2.33 Your members must avoid negative impacts on protected areas and in areas with high conservation value within or outside the farm or production areas from the date of application for certification. The areas that are used or converted to production of the Fairtrade crop must comply with national legislation in relation to agricultural land use. Guidance: 'Protected areas' are a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (IUCN 2008). Protected areas can be public or private biological conservation areas. You may identify protected areas with the help of local, regional or national authorities. 'Negative impact' refers to partial or complete destruction of the protected area or loss of the conservation value.
Utz[249]	I.D.113 No deforestation or degradation of primary forest occurs or has occurred since 2008. I.D.114 No deforestation or degradation of secondary forest occurs unless: – a legal land title and/or landowner permission is available, – government permits are available (if required), and – there is a report produced by an environmental expert confirming that the appropriate clearing techniques are used, and that there is compensation with reforestation activities of at least equal ecological value.
SAN[250]	2.2 Critical Criterion. From the date of application for certification onwards, the farm must not destroy any natural ecosystem. Additionally, from November 1, 2005 onwards no high value ecosystems must have been destroyed by or due to purposeful farm management activities. If any natural ecosystems have been destroyed by or due to purposeful farm management activities between November 1, 1999 and November 1, 2005, the farm must implement the following analysis and mitigations: a. Conduct an analysis of the ecosystem destruction to document the scope and ecological impact of the destruction. b. Develop a mitigation plan with advice from a competent professional that is consistent with applicable legislation and that compensates for the negative impact. c. Implement the activities of this mitigation plan, including for example the set aside of a significant percentage of the farm area for conservation purposes.

10.1.4 UK imports

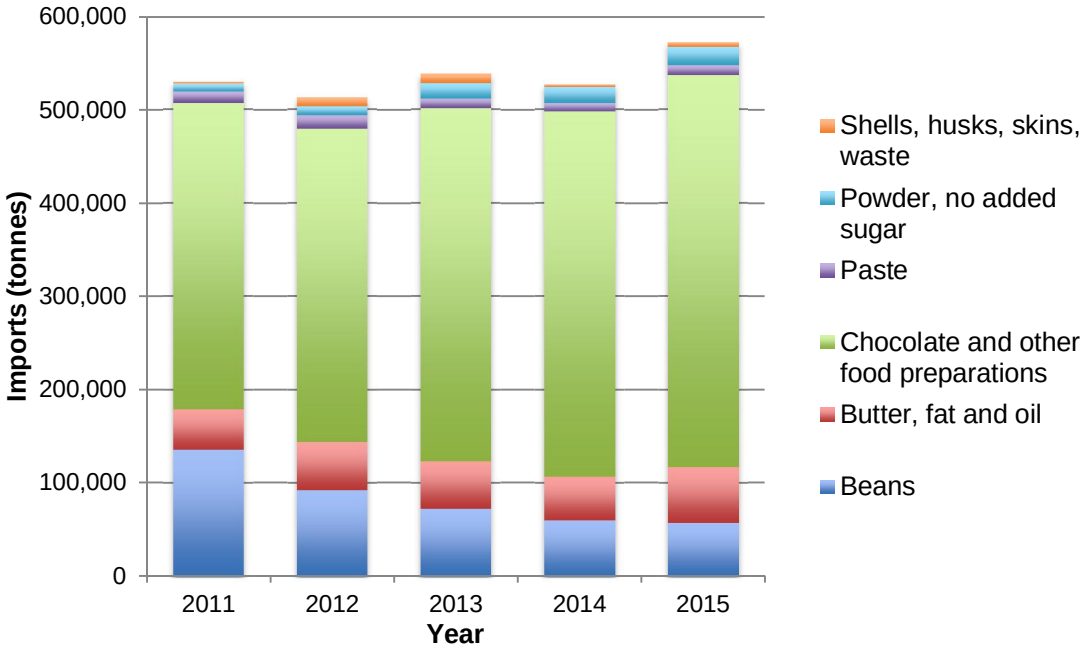
Unless otherwise stated, all data is derived from the UN Comtrade database.

10.1.4.1 Direct and indirect imports

The UK imported 146,860 tonnes of cocoa beans, liquor ('paste'), butter, powder and 420,726 tonnes of chocolate and chocolate products in 2015. Note that the palm oil used as an ingredient in chocolate is dealt with in the chapter on palm oil (Section 5). Most processing of cocoa beans occurs outside of the UK; about one quarter of cocoa imports to the UK are cocoa beans, while the rest comes to the UK in the form of processed or partly processed cocoa products (Figure 60). Overall, cocoa imports to the UK have risen slightly in overall volume over the last five years, with a marked decline in direct imports of cocoa beans.

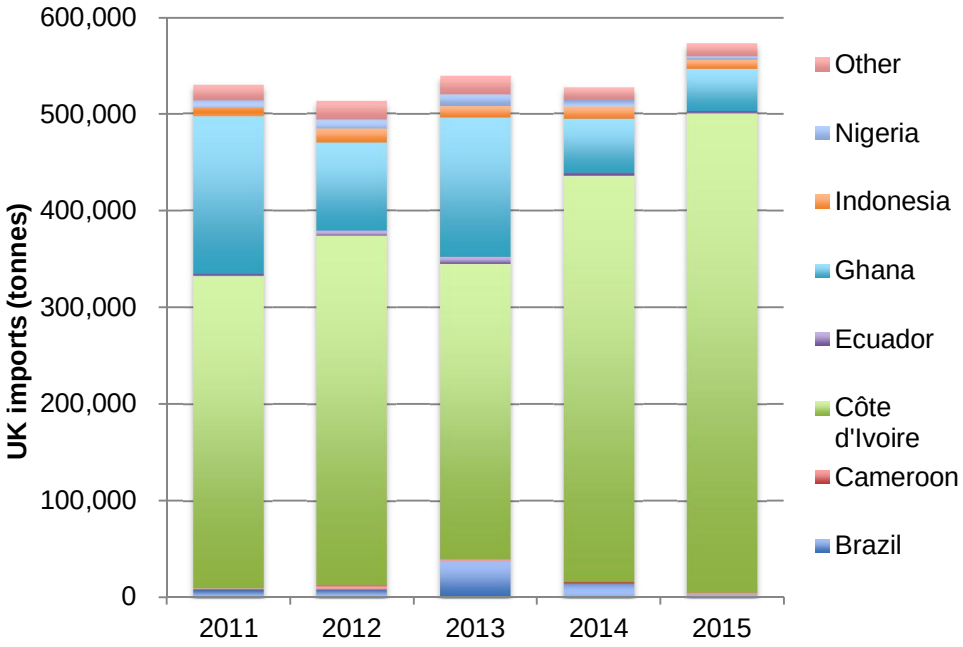
[248] https://www.fairtrade.net/fileadmin/user_upload/content/2009/standards/documents/generic-standards/SPO_EN.pdf
[249] https://utz.org/wp-content/uploads/2015/12/EN_UTZ_Core-Code-Individual-v1.1_2015.pdf
[250] http://www.san.ag/biblioteca/docs/SAN-S-1-4_Sustainable_Agriculture_Standard.pdf

Figure 60: UK imports of cocoa, 2011-15



Almost all imported cocoa beans come directly from countries of production. The majority of imported processed cocoa goods are imported from the EU (79% of total weight of imports), with the majority of EU imports coming from Côte d'Ivoire (81%), Ghana (12%), Brazil (3%) and Indonesia (2%). Adjusting for the provenance of EU exports to the UK (Figure 61) shows the dominant role that Côte d'Ivoire plays in supplying the UK with cocoa. Between 2011 and 2015 an estimated 71% of the UK's cocoa came from that country, and this increased to 86% in 2015. Over the same period, Ghana was responsible for 19% of UK imports, decreasing from 31% in 2011 to 8% in 2015. Among other producer countries, only Brazil (3%) and Indonesia (2%) contribute more than 2% towards the UK's imports.

Figure 61: Estimated provenance of the UK's Imports of cocoa and cocoa products, 2011-15[251]



[251] UN Comtrade.

10.2 Risk analysis

10.2.1 Links between production and deforestation

As a crop that needs shade, cocoa can be produced in agro-forestry systems. However, the current combination of low investment in farmers (financially and in terms of skills and management training) and ageing trees sees a reduction in yield that means farmers must expand production by planting new trees. The location of the majority of cocoa production in tropical countries with high areas of rainforest means that this expansion increases the risk of deforestation. Cocoa has driven deforestation in some major producing countries in West Africa, including Ghana and Côte d'Ivoire.[252] Cocoa-linked deforestation has also been reported in South America.[253]

All of the major certifying schemes include criteria on conservation and deforestation, but at varying levels of specificity and rigour.

10.2.2 Social issues associated with production

Cocoa cultivation provides a livelihood for millions of smallholders in countries such as Côte d'Ivoire, Indonesia, Ghana and Nigeria. However, the US Department of Labour includes cocoa from six countries – Cameroon, Côte d'Ivoire, Ghana, Guinea, Nigeria, and Sierra Leone – on their List of Goods Produced by Child Labour. Côte d'Ivoire and Nigeria are also on the list for forced labour.[254] A US Department of State report in 2011 noted 'It is estimated that some 15,000 Malian children work on Ivoirian cocoa and coffee plantations. Many are under 12 years-of-age, sold into indentured servitude for $140, and work 12-hour days for $135 to $189 per year'.[255] Child labourers on cocoa farms are typically exposed to hazardous working conditions.[256]

Cocoa farmers receive a small percentage of overall cocoa price – between 3% and 5% of the value of a chocolate bar. Low income combined with difficulties in obtaining high yields (owing to small farm size, lack of training and knowledge, and lack of infrastructure or ability to invest in production improvements) mean that many cocoa farmers rely on loans, are unable to save money, and live in poverty. [257]

Land grabs from local communities to create cocoa farms have been reported from South America, particularly Peru.[258]

10.2.3 The UK's cocoa footprint

The UK's cocoa imports of beans; cocoa liquor; butter, fat and oil; powder (no added sugar); and shells, husks, skins, waste were summed. This required assumptions about the cocoa content of the import category 'chocolate and other food preparations containing cocoa'. This was achieved by further disaggregating these imports using the HMRC database, and then using either a generic figure for sub-categories for which the cocoa content is variable (e.g. chocolate) or the reported cocoa solids content on a small sample of supermarket goods that contain chocolate for those products where chocolate is an ingredient within the product.

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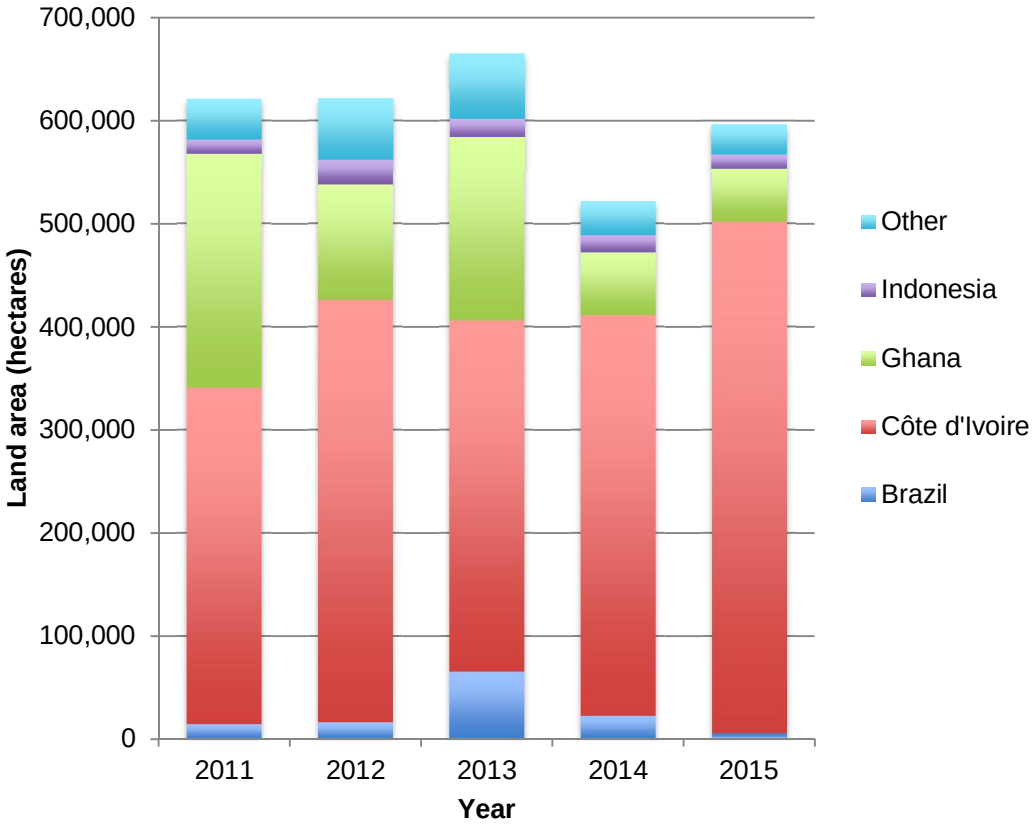
[252] http://www.euredd.efi.int/cotedivoire
[253] https://news.mongabay.com/2015/04/court-rules-deforestation-of-peruvian-rainforest-for-chocolate-was-legal/
[254] https://www.dol.gov/ilab/reports/child-labor/list-of-goods
[255] http://www.state.gov/j/drl/rls/hrrpt/2000/af/773.htm
[256] ILO (2007). *Rooting out Child Labour from Cocoa Farms. Paper No. 2: Health and Safety Hazards*. International Labour Organization.
[257] http://www.fairtrade.org.uk/~/media/fairtradeuk/farmers%20and%20workers/documents/cocoa%20commodity%20briefing_online7.pdf
[258] https://news.mongabay.com/2015/04/court-rules-deforestation-of-peruvian-rainforest-for-chocolate-was-legal/

Imported fractions of cocoa were assigned yields in the same manner described for soy (see Section 4.2.3), with yield assigned to the fractions of cocoa beans according to the following conversion factors: cocoa liquor 0.8; cocoa butter 0.376; cocoa powder 0.424, shell 0.2.[259]

The estimated land footprint required to supply the UK's imports of cocoa and its products averaged 605,000 hectares per year between 2011 and 2015 (Figure 62). Côte d'Ivoire dominates the land footprint, with an average of 390,000 hectares each year. The land footprint in Ghana has declined dramatically from over 200,000 hectares in 2011 to just over 50,000 hectares in 2015. In 2013, the global harvested area was 10 million hectares,[260] and the UK's estimated imports accounted for around 6% of this area.

Figure 62: Estimated land required to supply the UK's cocoa imports



[259] Fairtrade International (2013). Questions & Answers: Cocoa conversion rates for mass balance. 19 December 2013. Available at http://www.fairtrade.net/fileadmin/user_upload/content/2009/standards/documents/2013-12-19_EN_CocoaMBConversionRates_Q_ADocument_final.pdf Yield data was obtained from FAO STAT, last accessed 05 September 2016. Note that FAO production data for cocoa is only available from 2011–2013, so for 2014–2015 the country's average yield of 2011–2013 was applied

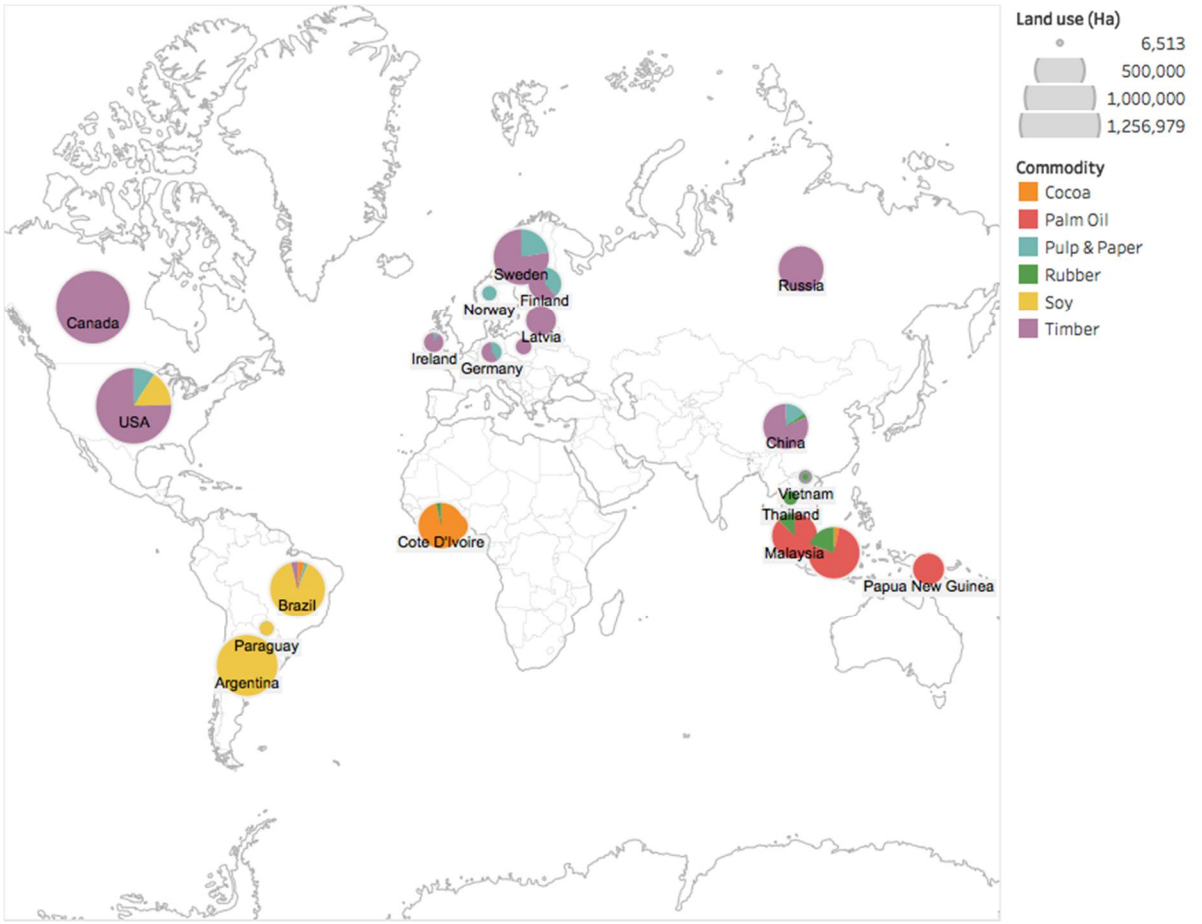
[260] FAO STAT (last accessed 6 September 2016).

11 The UK's forest-risk commodity land footprint

Figure 63 shows the estimated total land area required to supply the UK with its imports of timber, soy, palm oil, pulp and paper, rubber, and cocoa, with beef and and leather shown in

Figure 64. The estimates are likely to be low-end estimates, as the assumptions made in their calculation are largely conservative (e.g. only major categories of import have been assessed for each commodity, not every possible end use). There is a clear concentration of land use associated with UK imports in North America, South America, the EU, and East Asia, with outliers associated with beef and leather in southern Africa and Australia.

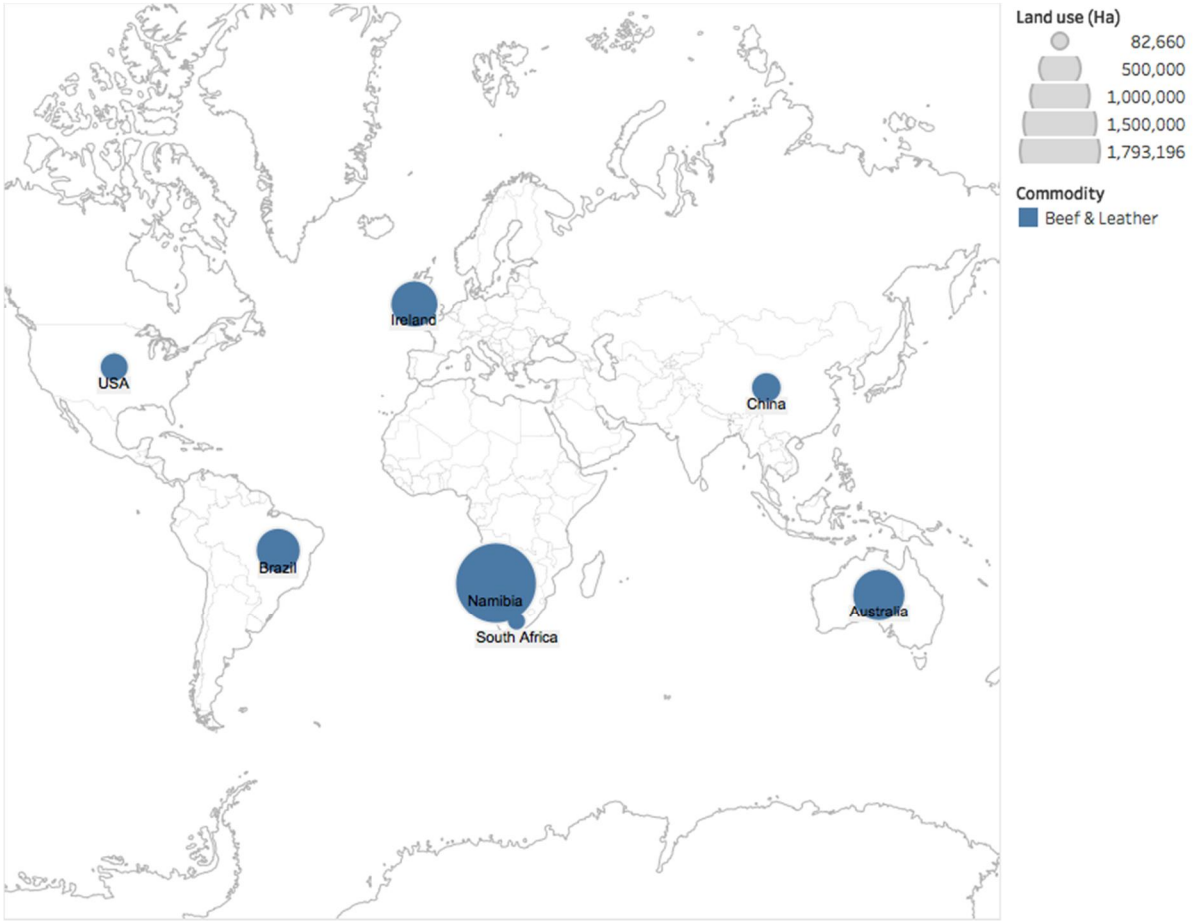
Figure 63: Estimated footprint of the UK's imports of deforestation risk commodities (annual average 2011-15, excluding beef and leather)



The combination of beef and leather has the highest land footprint, despite the relatively low import volumes, reflecting the significant land requirement for cattle, but is consistent with recent research on the role of commodities in land use change.[261] Timber has the second highest land footprint, a result of significant imports combined with a (generally) large land requirement for production. It is also the only commodity that has seen a large increase – almost doubling during the five years from 2011 to 2015, largely due to a surge in fuelwood imports. The high land footprint of soy and palm oil reflect the large quantities imported, principally for animal feed (soy) and in the food sector (palm oil).

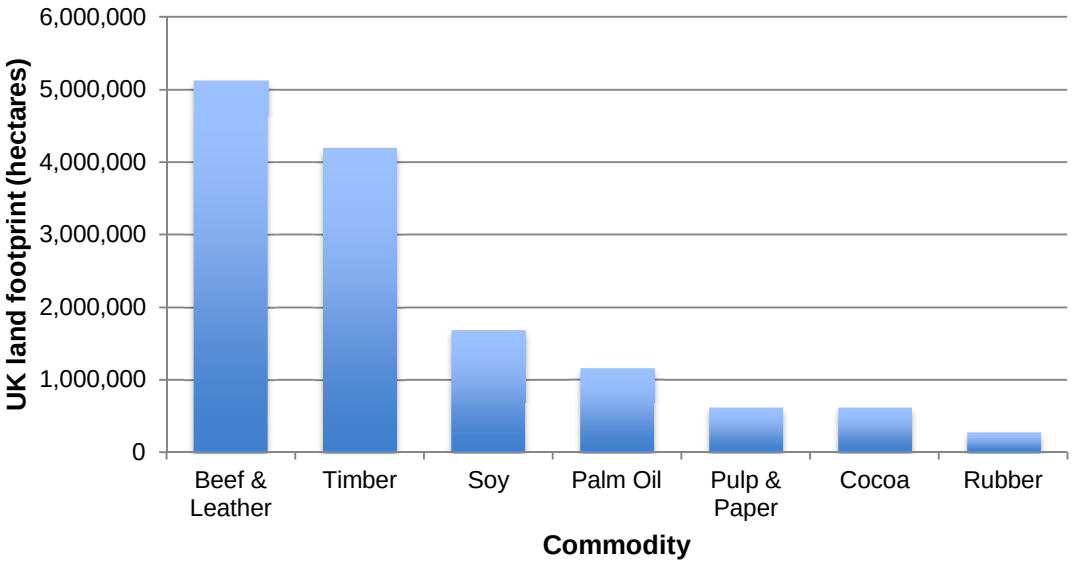
[261] Henders, S., Persson, U.M., and Kastner, T. (2015). Trading forests: Land-use change and carbon emissions embodied in production and exports of forest-risk commodities. *Environmental Research Letters*, 10.

Figure 64: Estimated footprint of the UK's imports of beef and leather (annual average 2011-15)



The overall land footprint of these commodities averages 13.6 million hectares each year, between 2011 and 2015 (Figure 65). This is equivalent to a land area more than half the size of the UK, or more than six times the size of Wales.

Figure 65: Average land area required to supply the UK with imports of deforestation-risk commodities, 2011-15



12 Deforestation risk index

12.1 Overview of deforestation risk index

The land footprint of a commodity is an estimate of how much land is required to produce imports. However, the likelihood of these imports being associated with deforestation and social issues depends on the production systems in the countries in which they were produced. For example, production of a commodity in a country that has strong labour laws that are well implemented is less likely to be associated with labour problems than the same commodity produced in a country with poorly implemented and weaker regulations.

A risk-based approach is used to illustrate the potential association of the UK's imports of commodities with social issues and deforestation. To achieve this we have assigned a risk rating to each exporting country according to indicators of deforestation (area of forest cover loss and percentage of natural forest loss) and social risk (rule of law and labour rights). The land footprint of the UK's imports is then apportioned to risk categories based on which trading partners dominate for each commodity. This risk-based approach is preferred to direct estimation of deforestation because:

- The link between deforestation and commodity production is often indirect: an area of forest can go through several phases of degradation, conversion and cropping before the commodity in question is cultivated on the land.
- The country of origin of most imports can be estimated with few assumptions, but imports are not traceable to the level of individual farms, and hence to specific instances of deforestation. Although research is advancing the knowledge on the sub-national provenance of commodities, the most sophisticated modelling is confined to single commodities from single countries,[262] and broader attempts to quantify the area of deforestation embedded in imports remain highly dependent on multiple assumptions.

12.1.1 Overview of method

Four factors were used to indicate deforestation and social risk in producer countries.

- **Extent of deforestation**. This provides an indication of the total extent of the deforestation problem in producer countries. It uses remote sensing data that does not distinguish between forest type, and is only looking at area of loss, not the balance between loss and gain. The data used is the area of land with that has lost forest cover, with a threshold of 10% forest cover, and between the years 2011 and 2014 (data from 2015 was not available at time of writing).[263]
- **Rate of deforestation**. This is a measure of the proportion of change in net natural forest area (i.e. loss + gain) in each producer country between 2010 and 2015.[264] Use of this second deforestation indicator helps to balance out the risk weighting, as large countries will tend to score high on the first indicator, whereas countries that are losing a large proportion of their small remaining forest extent score highly on rate of deforestation.

[262] For example, the SEI's modelling of soy provenance in Brazil: see Godar, J., Persson, U.M., Tizado, E.J., and Meyfroidt, P. (2015). Towards more accurate and policy relevant footprint analyses: Tracing fine-scale socio-environmental impacts of production to consumption. *Ecological Economics*, 112, 25-35.
[263] Global Forest Watch. http://data.globalforestwatch.org/
[264] FAO FLUDE data: http://www.fao.org/forest-resources-assessment/explore-data/en/

- **Rule of Law.** No single global data set is available that captures the range of social problems that have been associated with production of the commodities analysed here, which include land grabs, forced labour, child labour, and terms and conditions of labour below international norms. The World Bank's Rule of Law governance indicator is used as a proxy for the likelihood of the range of social issues within an exporting country. This provides a score for each country on the perceptions of the extent to which citizens, government officials, and enterprises have confidence in and abide by the rules of society.[265] This indicator is commonly used in global analysis of social issues, including other assessments of deforestation (e.g. the Forest 500).[266]
- **Labour standards.** The International Trade Union Confederation (ITUC) documents violations of internationally recognised labour rights by governments and employers and uses these records to score countries, providing a measure of the likelihood of serious workers' rights violations, including forced labour, violence and the denial of the right to free association.[267] Note that Papua New Guinea was not assessed by the ITUC and so was nominally scored as 'medium' in this research.

The value of each indicator in each country was scored on a three-point scale (high = 3 to low =1) according to the thresholds described in Table 18. These thresholds were selected according to the data range of producer countries that export to the UK to clearly distinguish between high and low impact. For example, Brazil lost 9.4 million hectares of forest with >10% tree cover between 2011 and 2014, compared with Ireland's 18,000 hectares – these are scored 'high' and 'low' respectively.

Table 18: Deforestation risk scoring framework

Factor	Description	Rationale	Scoring		
			High risk (=3)	Medium risk (=2)	Low risk (=1)
Deforestation extent	Area of forest cover loss 2011-15 (GFW)	Amount of deforestation	≥1m ha	500,000 to 1m ha	<500,000ha
Deforestation rate	% net natural forest loss 2010-15 (FAO)	Rate of deforestation	≥1%	0% to 1%	<0%
Labour rights	Labour standards score (ITUC)	Perception of how well basic labour rights are implemented	4-5	2-3	=1
Rule of Law	World Bank Rule of Law score (WB)	Perception of how good laws are and how well they are implemented	<-0.3	-0.3 to 1	≥1

Finally, an overall country risk score was calculated by summing the scores for the individual indicators. This score was used to develop five risk categories, which are colour coded to aid visual inspection of the results (Table 19).

[265] http://databank.worldbank.org/data/databases/rule-of-law
[266] http://forest500.org/
[267] ITUC (2016). *Global Rights Index: The World's Worst Countries for Workers*. International Trade Union Confederation, https://www.ituc-csi.org/IMG/pdf/survey_ra_2016_eng.pdf

Table 19: Country risk categories

Risk category	Score
Very high risk	≥11
High risk	9-10
Medium risk	7-8
Medium–low risk	5-6
Low risk	4

12.2 Country risk rating

The country risk scores and overall risk rating are presented in Table 20. Only one country, Germany, scored the minimum overall score (4) and was assigned low risk status. However, a number of countries including Ireland, Finland, Australia and Norway achieved a medium–low risk rating as they typically scored low or medium on all indicators. Argentina, Brazil, Côte d'Ivoire, Indonesia, Malaysia and Paraguay were rated as very high risk, scoring high for three or all four indicators.

Table 20: Country risk ratings for producer countries of all commodities

Country	Tree cover change (ha) GFW	Deforestation rate (%) FAO	Labour standards (score) IUTC	Rule of Law (score) WB	Overall score
Argentina	1,597,666	5.5	3	-0.9	11
Australia	839,279	-1.2	3	1.9	6
Brazil	9,409,340	1.2	4	-0.1	11
Canada	20,062,126	0.6	2	1.9	8
China	2,142,551	-1.4	5	-0.3	10
Côte d'Ivoire	2,156,772	0.2%	4	-0.6	11
Finland	629,261	0.0	1	2.1	5
Germany	92,877	-0.1	1	3.7	4
Ghana	358,063	-0.9	4	0.0	7
Indonesia	6,487,141	4.0	5	-0.3	12
Ireland	18,278	0.0	2	1.8	5
Latvia	134,226	-0.7	2	0.9	6
Malaysia	7,575,795	1.3	5	0.6	11
Namibia	2,020	5.1	4	0.1	9
Norway	127,349	0.5	1	2.0	5
Papua New Guinea	267,959	0.0	–	-0.8	8
Paraguay	1,608,837	9.9	4	-0.7	12
Poland	194,837	-5.8	3	0.8	6
Russia	18,280,516	0.1	3	-1.4	10
South Africa	371,060	0.0	4	0.2	7
Sweden	840,494	7.6	1	2.0	7
Thailand	430,973	-1.2	5	-0.2	7
USA	7,079,378	-0.2	3	1.6	7
Vietnam	646,164	-7.8	5	-0.3	9

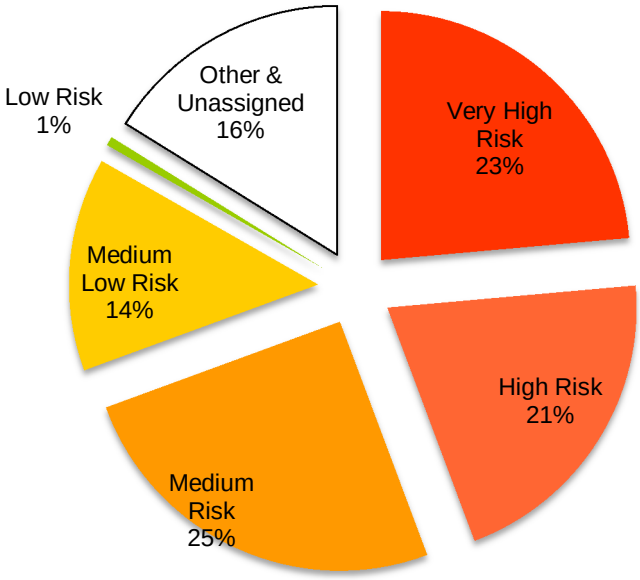
The degree of risk of the UK's imports being associated with deforestation and social exploitation is related to the risk rating of the exporting country and the amount of production in that country that is required to fulfil the UK's demand. The UK's land footprint, for all commodities combined and for each commodity separately, is allocated to these risk categories to illustrate this risk in the section below.

12.3 Commodity risk profiles

12.3.1 All commodities

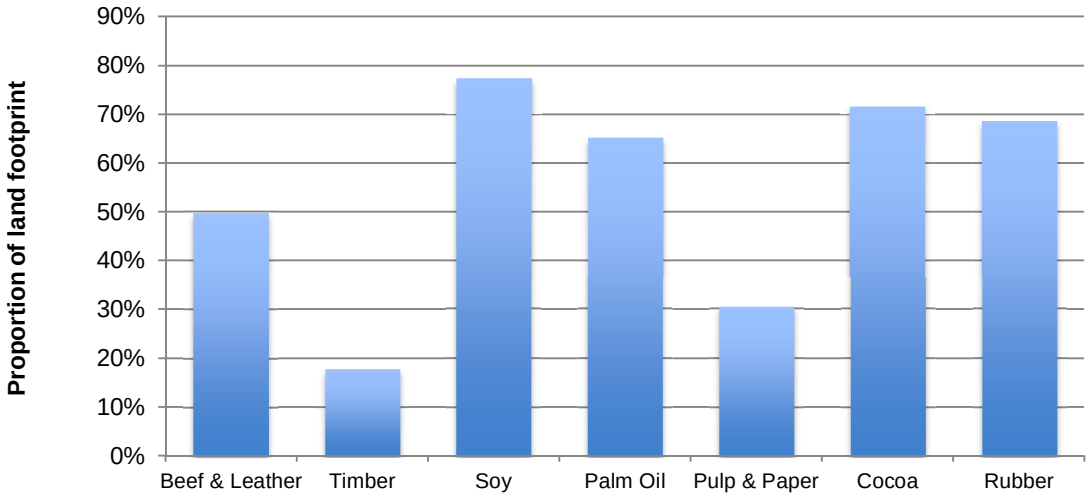
The overall risk profile of the UK's footprint for the commodities assessed in this report is given in Figure 66. Nearly half of the land area (44%, or over 6 million hectares) is in high and very high risk countries, with a further 25% (3.4 million hectares) in medium risk countries. Just 15% (approximately 2 million hectares) came from countries with low and medium–low risk ratings. The portion that is 'other and unassigned' is either imports from countries that contributed less than 2% of UK's imports for a commodity, or imports that it was not possible to allocate to a country within the limitations of this study, such as paper packaging (see Sections 4-10 above). This portion is likely to come from countries with a range of risk profiles.

Figure 66: Distribution of the UK's land footprint for imported commodities among risk categories



Looking at each of the commodities, half of the land footprint of beef and leather, and significantly more than half of the footprint of soy, palm oil, cocoa and rubber footprints are from high and very high risk countries (Figure 67).

Figure 67: Proportion of commodity footprints from high and very high risk countries

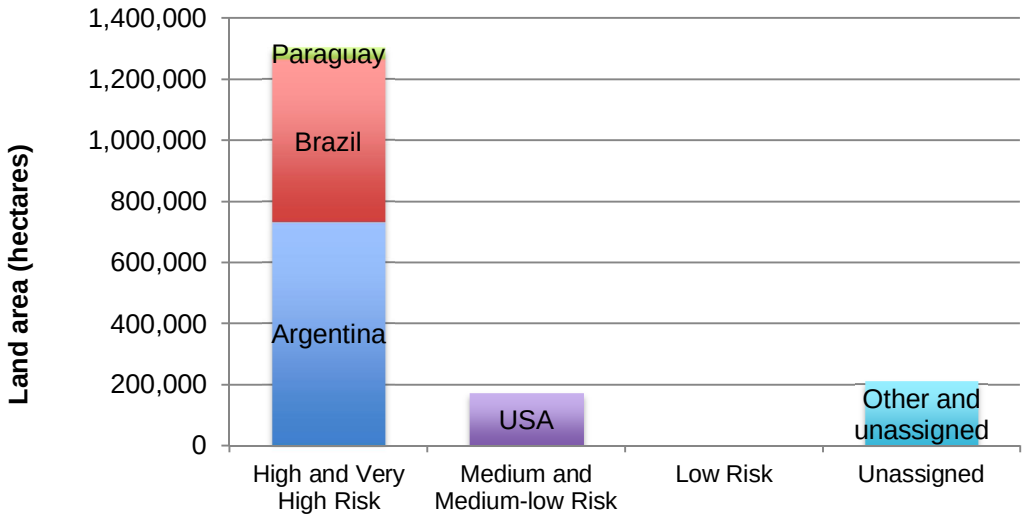


12.3.2 Soy

The UK imports most of its soy from three very high risk countries (Argentina, Brazil and Paraguay), and from the US, which ranks as medium risk (Figure 68). The majority of the overall footprint associated with the UK's imports of soy is from the three very high risk countries (Figure 69). Although the US is a significant exporter to the UK, the relatively low deforestation rate and low scores for the social risks make it a medium-risk country. Progress on credible, transparent certification with high social and deforestation safeguards (RTRS) is modest. Greater uptake of RTRS certification would undoubtedly reduce the risk of association of the UK's imports with deforestation. Little data is available on imports of certified soy.

Figure 68: Country risk ratings for soy

Figure 69: Distribution of the UK's soy land footprint by risk category



12.3.3 Palm oil

Palm oil is imported from Indonesia and Malaysia, countries that exhibit high deforestation rates and social issues, and which have very high risk ratings (Figure 70). The other major exporter is Papua New Guinea, which scores as medium risk although, as noted previously, this may be an artefact of the absence of a labour rights score for that country. As with soy, the land footprint of palm oil is overwhelmingly in very high risk countries (Figure 71).

Strong progress on certification partially ameliorates the risk, with RSPO certified palm oil currently constituting a large amount of the UK's imports. Moreover, due to the UK government and industry commitment to source and report on sustainable palm oil (now lapsed), this means that it is one of the few commodities for which the certified volume of at least some of the UK's imports are known. Further support and strengthening of RSPO would play a role in reducing this risk further, noting that currently RSPO certification does not entirely remove the risk of deforestation and social exploitation.

Figure 70: Country risk ratings for palm oil

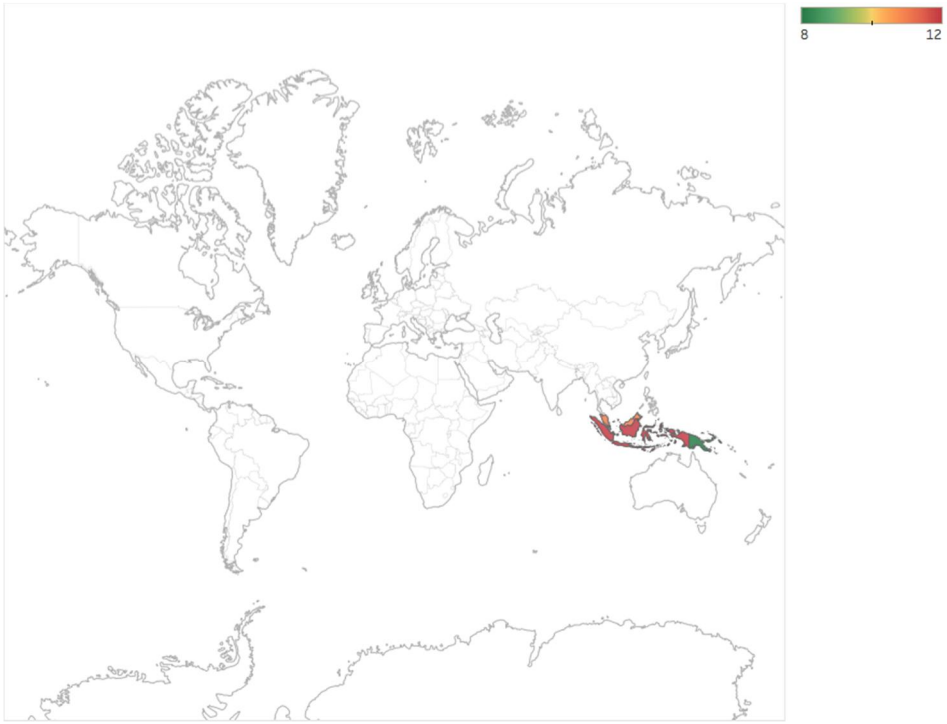
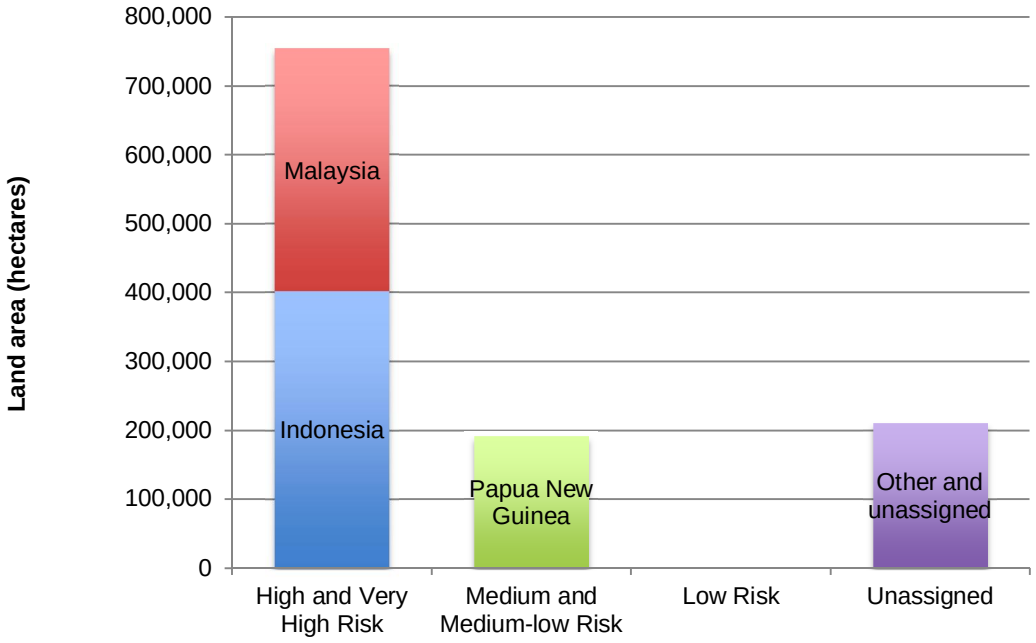


Figure 71: Distribution of the UK's palm oil land footprint by risk category



12.3.4 Timber

The UK imports timber from a wide range of countries that range from low risk (Germany) to high and very high risk, such as Brazil, China and Russia (Figure 72). The vast majority of the land footprint of the UK's timber imports is in countries with medium and medium–low risk, such as Canada, Ireland, Sweden and the US, many of which perform well on the Rule of Law score and deforestation rate, with variable scores on deforestation extent (Table 20). However, even though a modest proportion of the UK's timber footprint is from high and very high risk countries, the large volume of UK timber imports coupled with the large land area required to produce timber means that the absolute area under high and very high risk categories is high (0.75 million hectares).

The large – and rapidly increasing – volumes of fuel wood imported from the US mean that environmental and social impacts in the US and other countries that supply the UK with increasing quantities of fuel wood should not be taken for granted. More generally, the significant market penetration of FSC-certified timber ameliorates risk, and increasing the market share of FSC-certified timber and timber products is a practical way to reduce the risk of deforestation and social issues being associated with UK imports.

Figure 72: Country risk ratings for timber

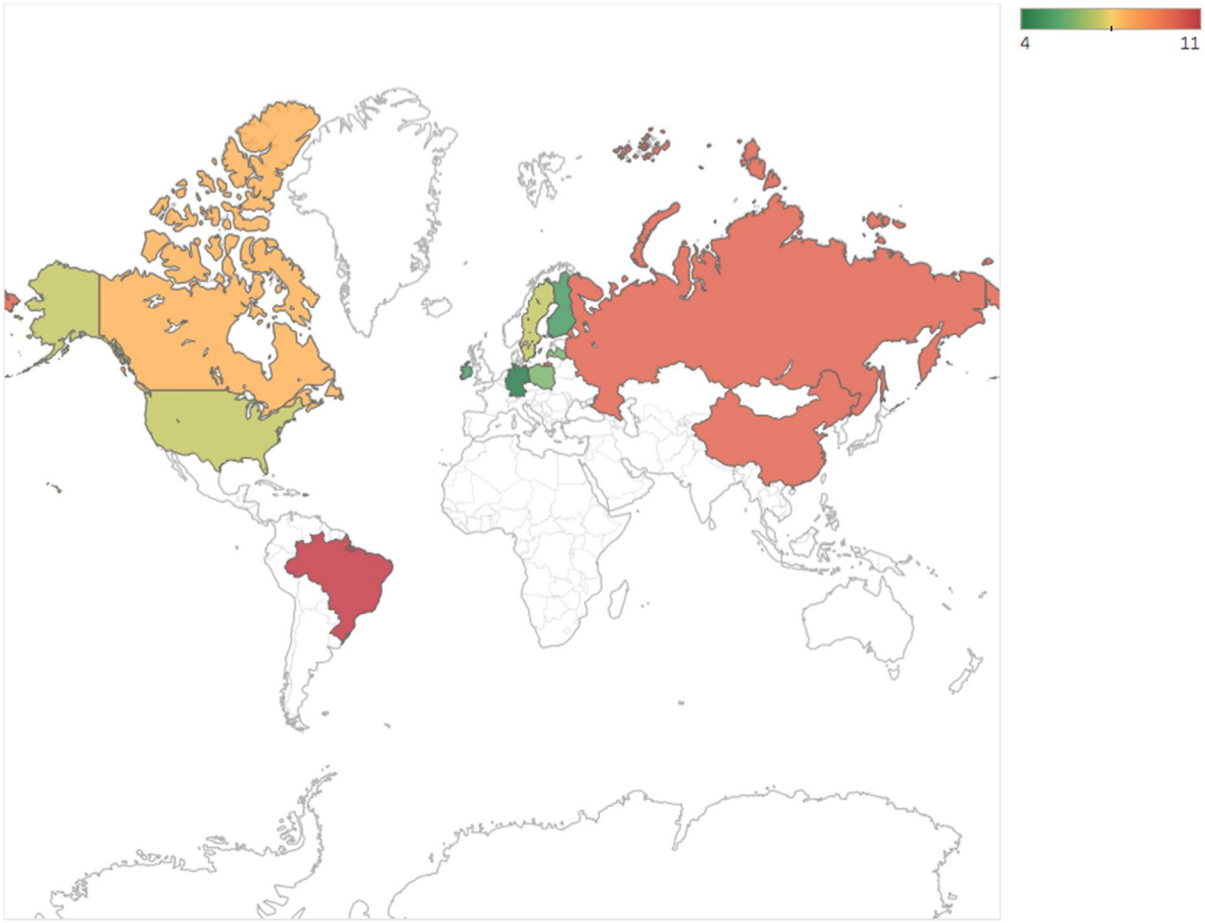
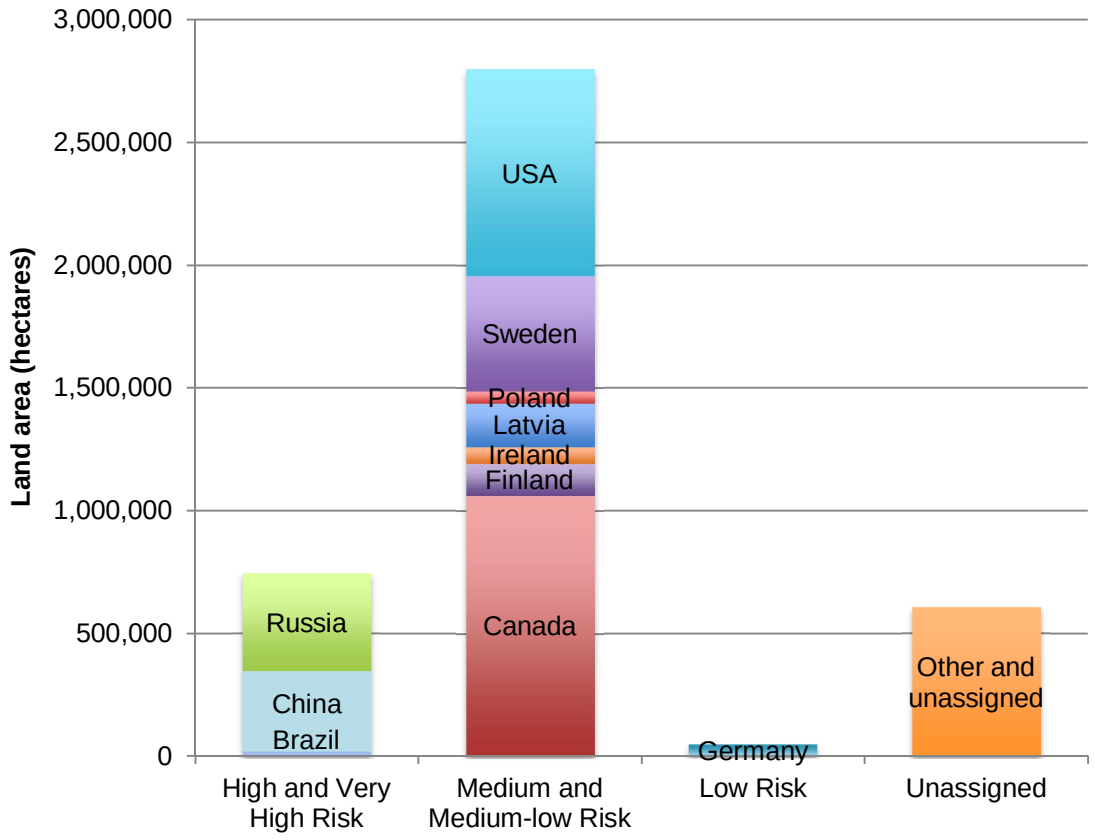


Figure 73: Distribution of the UK's timber land footprint by risk category



12.3.5 Pulp and paper

The UK imports pulp and paper products from a large range of countries with different risk profiles (Figure 74). Brazil and China can be considered very high risk countries, but they contribute a relatively modest land area in both absolute (70,000 hectares) and relative terms (12%, Figure 75). The majority of land footprint is assigned to medium–low and low risk countries in the European Union. However, caution should be applied to this, as the study methods resulted in around one fifth of imports being from minor exporting countries or being unassigned, some which will be from high-risk countries. FSC certification partially ameliorates the risks, but there is little information on the proportion of imported pulp and paper that is certified.

Figure 74: Country risk rating for pulp and paper

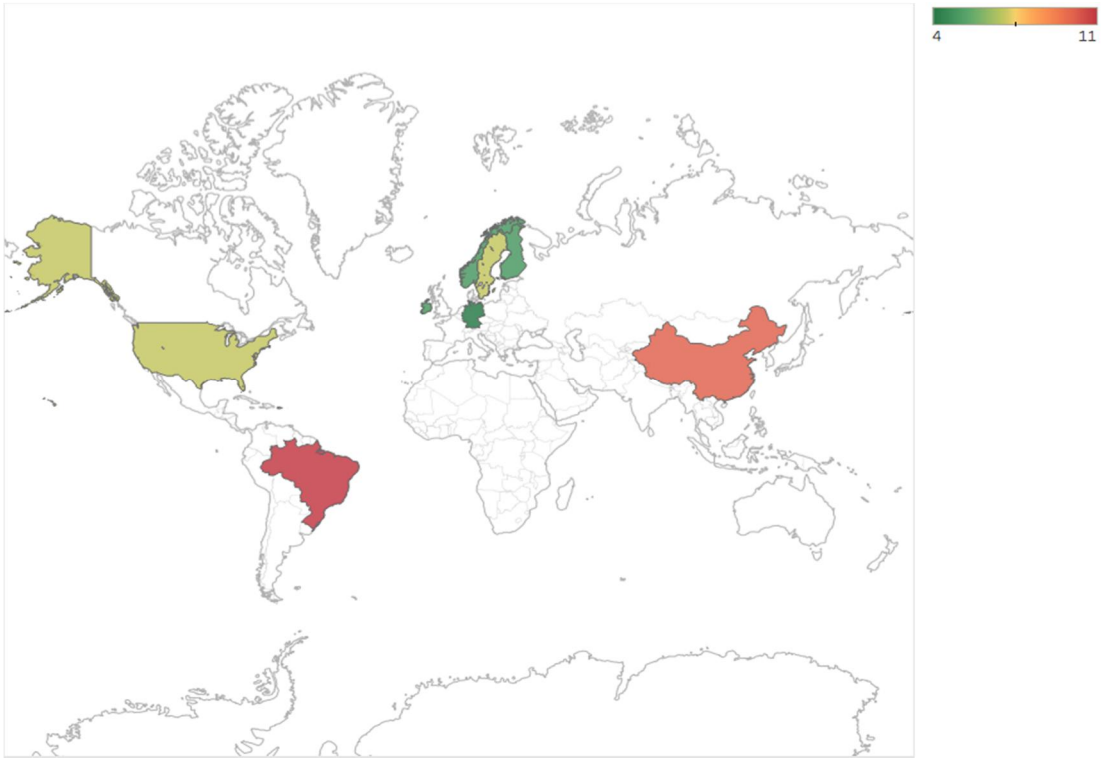
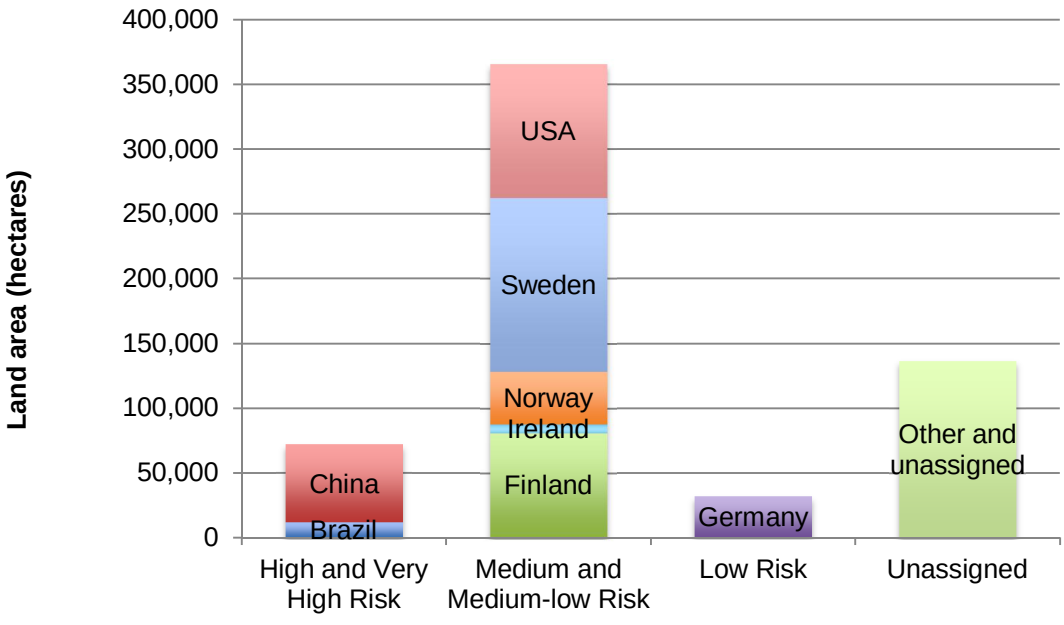


Figure 75: Distribution of the UK's pulp and paper land footprint by risk category

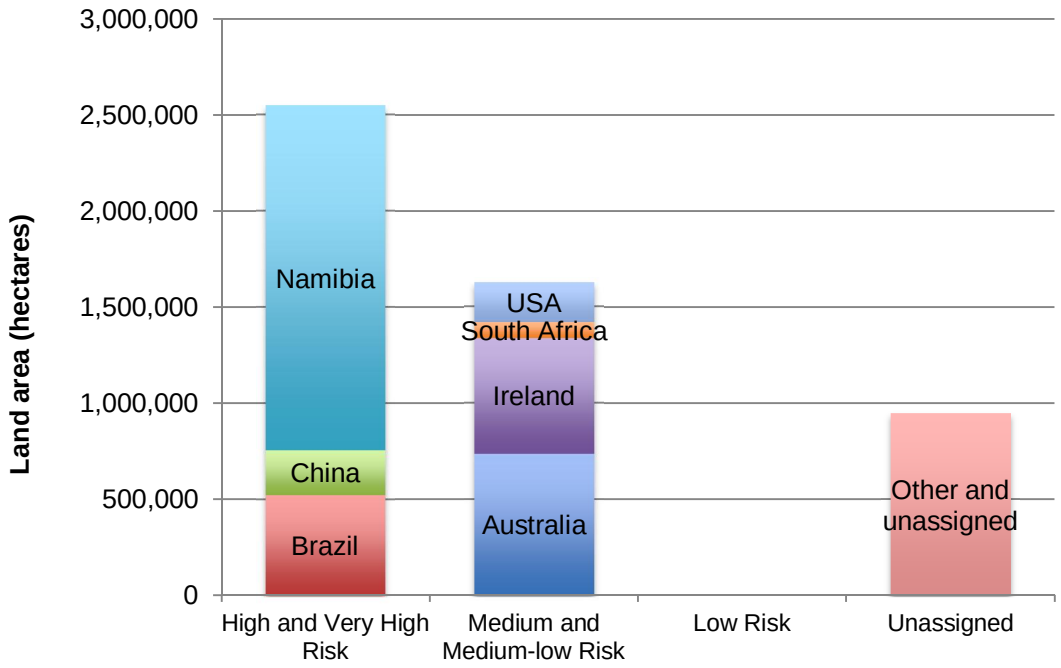


12.3.6 Beef and leather

The UK imports its beef and leather from countries that are rated high risk (e.g. China, Brazil) through to medium–low risk (e.g. Ireland) – see Figure 76. The extremely high grazing land requirements for beef and leather production mean that more than 2.5 million hectares of the UK's footprint is in very high and high risk categories: from Namibia, Brazil and China (Figure 77). Poor data on global pasture land productivity means that there is more uncertainty about the footprint of cattle products compared with other commodities within this study. Low data transparency and the absence of credible, transparent certification mean that there is also a significant need to better understand the UK's imports and introduce measures to manage risk.

Figure 76: Country risk rating for beef and leather

Figure 77: Distribution of the UK's beef and leather land footprint by risk category

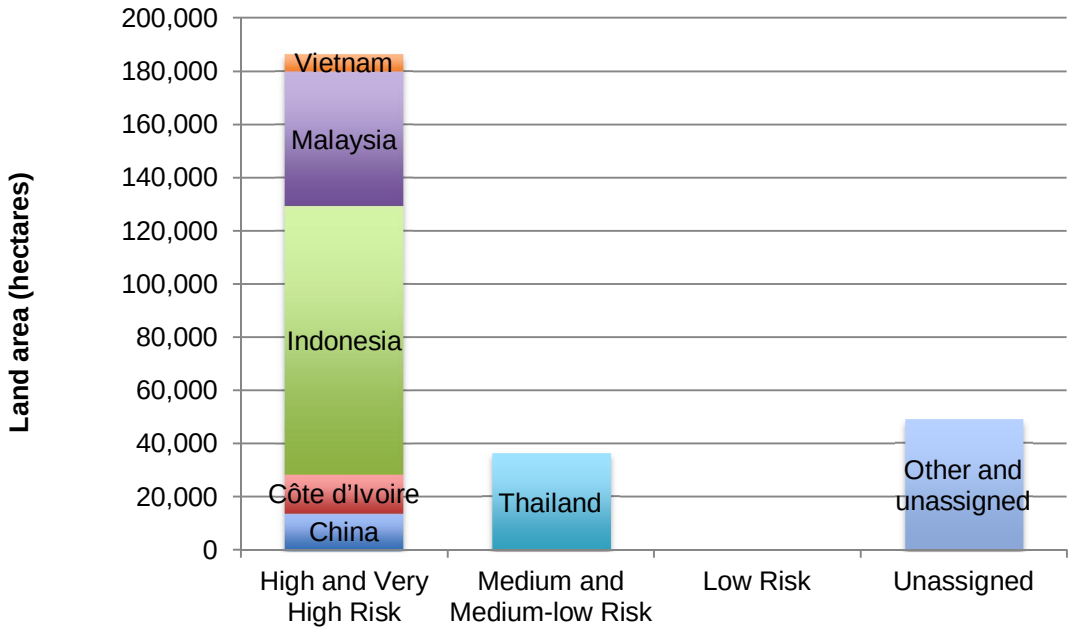


12.3.7 Rubber

Almost all of the UK's imports of natural rubber are from high and very high risk countries (Figure 78). This is due to the high deforestation and social risk scores in the major exporting countries, with only Thailand presenting a medium risk (Table 20). Indonesia presents the single largest high risk footprint for natural rubber (Figure 79). The lack of a credible, transparent certification scheme means that there are limited options for managing this risk.

Figure 78: Country risk ratings for rubber

Figure 79: Distribution of the UK's rubber land footprint by risk category

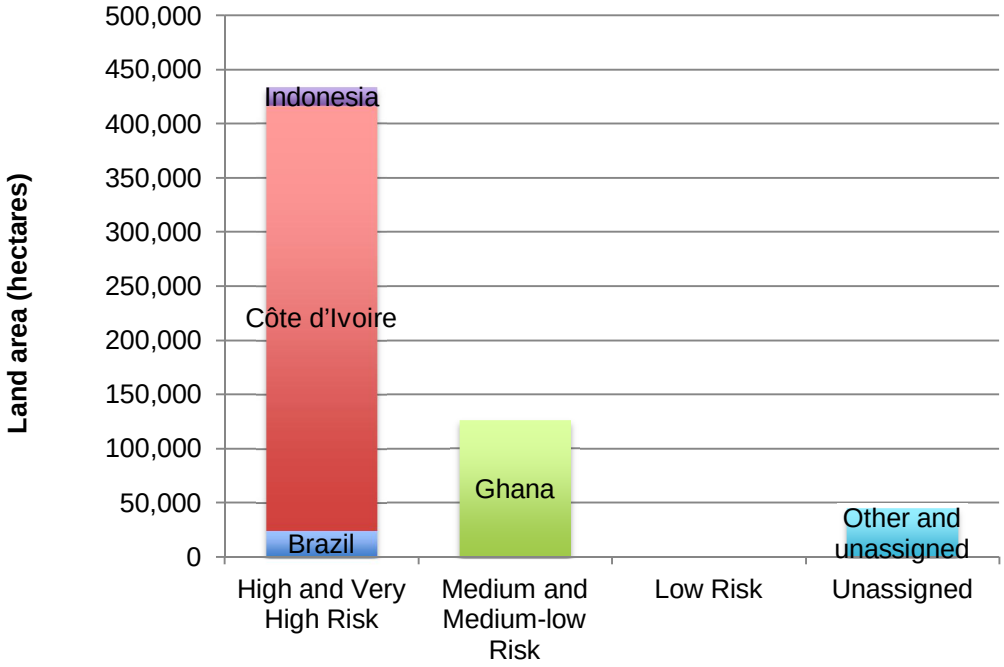


12.3.8 Cocoa

Over 71% of the cocoa imported into the UK originates from Côte d'Ivoire (Figure 80), which is regarded as a very high risk country due to its high deforestation, rule of law and labour rights scores (Table 20). The land footprints of the other very high risk producer countries (Brazil, Indonesia) are much smaller (Figure 81), and the second largest country footprint is from Ghana, a medium-risk country. In general, certification schemes that provide some social safeguards in particular (Fairtrade, Utz) are present in the sector, but there is no readily available information on the volumes of certified cocoa imported into the UK.

Figure 80: Country risk ratings for cocoa

Figure 81: Distribution of the UK's cocoa land footprint by risk categories



13 Conclusions

According to the FAO, 6.5 million hectares of natural forest – an area more than three times the size of Wales – were lost each year between 2010 and 2015.[268] This deforestation causes a loss of biodiversity, often violates the rights of local communities and indigenous peoples, and contributes to climate change. Over 70% of tropical deforestation is driven by commercial agriculture.[269] Moreover, a significant proportion of this deforestation is embedded within the global trade in commodities.

The UK's imports of commodities have certainly contributed to these losses of forest and biodiversity, and to some of the exploitative production practices associated with the production of some commodities in some countries. We find that a land area of approximately 13.6 million hectares was needed each year on average between 2011 and 2015 to supply the UK with beef, leather, palm oil, soy, timber, pulp and paper, cocoa and rubber. Approximately 44% of this land area was from countries rated as high risk or very high risk from a deforestation and social point-of-view.

For beef and leather, soy, palm oil, cocoa and rubber, at least half the land footprint was from countries rated as high risk or very high risk. In some of these commodities (e.g. palm oil) there are certification schemes with a degree of credibility and the UK government has required companies to report publicly the amount of certified imports of (some types of) the commodity they import. For other commodities there are few options for managing the risk of deforestation and social exploitation – for example rubber.

The UK government, companies, NGOs and consumers have historically taken a lead in addressing some of these issues, through initiatives such as FLEGT, the UK Statement on Sustainable Production of Palm Oil, FSC-certified timber, the Consumer Goods Forum zero net deforestation commitments, and most recently the Modern Slavery Act. Yet the problems of deforestation and social exploitation have not gone away, and there are opportunities for the UK government, companies and consumers to act in order to break the link between the UK's commodity imports and deforestation and social exploitation.

The research presented in this report is intended to underpin policy and business recommendations in this area. These are set out by WWF and RSPB in the report Risky Business (wwf.org.uk/riskybusiness).

[268] FAO (2016). *Global Forest Resource Assessment 2015: How are the World's Forests Changing?* Rome: Food and Agriculture Organization of the United Nations.

[269] Lawson, S., Blundell, S. Cabarle, B., Basik, N., Jenkins, M. and Kerstin Canby (2014). *Consumer goods and deforestation: an analysis of the extent and nature of illegality in forest conversion for agriculture and timber plantations*. Forest Trends.

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