Research Paper

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Agricultural Commodity Supply Chains

Trade, Consumption and Deforestation

Contents

Summary

- Clearance of forests for agriculture is a major cause of deforestation worldwide; the three most significant commodities in this regard are palm oil, soy and beef, which between them accounted for an estimated 76 per cent of the deforestation associated with agriculture in 1990–2008. International markets are an important driver of demand, particularly for palm oil and soy.

- Global production of palm oil has grown strongly for several decades, more than doubling over the period 2000–13. Oil palm has a much higher yield than do other oilseeds, and palm oil is extremely versatile, being used in a huge range of processed foods, cosmetics, detergents and many industrial applications; it is also used for biofuels.

- Indonesia and Malaysia between them account for more than 80 per cent of palm oil production, and are likely to continue to dominate world exports. The European Union (EU), India and China are the main consumers, importing almost 60 per cent of the market; EU demand is driven significantly by biofuel policy, while India and China use palm oil mainly as a cooking oil and in processed foods.

- Global production of soybeans has roughly doubled since 2000, and the expansion of output has been particularly rapid in South America; Brazil and Argentina accounted for almost 50 per cent of global production in 2013. Overwhelmingly the main importer is China (which imported 43 per cent of all soy traded internationally in 2014), mainly for animal feed for its growing meat industry. The EU is the second largest importer, using soy for animal feed and biofuel.

- In contrast, consumption and production of beef has grown only slowly. Major producers are the US, Brazil, the EU and China; principal exporters are Brazil, India, Australia and the US. The US and the EU are still major consumers, although – as in most developed countries – consumption is falling slightly; other significant consumers include Brazil, India, Pakistan and China. Russia and Japan are also significant importers.

- Three main factors underlie the growth in both consumption and production of palm oil and soy: population growth; changing dietary preferences; and policy support for biofuels. The first two are just as relevant to beef.

- Continued growth in world population and the expansion of the global middle class, with accompanying higher consumption levels of processed food and meat, will continue to drive demand upwards – strongly for palm oil and soy, more weakly for beef. The sharp decline in international commodities prices since 2011 may slow down the rate of expansion but does not alter these fundamentals. Given the difficulty of increasing yields, particularly in developing countries, the further expansion of agricultural land into forest areas is inevitable.

- None the less, three other factors may restrict this growth: the private-sector commitments and government policies that are being developed with the aim of decoupling agricultural production from deforestation; a loss of support for biofuels, most notably in the EU; and health concerns, particularly over the consumption of palm oil and beef.

1. Introduction

The linkage between agriculture and deforestation is well known: recent studies have variously estimated that, worldwide, agriculture is responsible for between 53 per cent and 80 per cent of total deforestation.[1] The main contributors are pasture and feed for cattle, which together account for more than half of agricultural deforestation worldwide, and the cultivation of soy and oil palm; other important crops in this regard include maize, rice, sugar cane, cocoa, tea and coffee.

Although for most of these commodities the volume of domestic consumption is larger than that of exports, international trade is nevertheless significant, particularly for soy and palm oil. As global consumption of food has increased, driven by a growing population and a rising middle class with a larger appetite for meat, an increasingly globalized economy has seen international markets for agricultural products grow substantially. Demand for transport biofuels, stimulated by concerns over climate change and energy security, have also played a role in expanding the markets for palm oil and soy.

Although the rate of deforestation worldwide has fallen in recent years, it remains at an unsustainably high level, with serious impacts in terms of climate change, local environments and rural livelihoods. Accordingly, there is growing interest in exploring measures that could be taken by countries importing agricultural commodities to reduce their impact on forests, and to provide incentives for production without deforestation.[2] Many private companies have already adopted commitments in this respect, with many pledging to achieve zero net deforestation in their supply chains by 2020. The New York Declaration on Forests, signed by governments, corporations and non-governmental organizations (NGOs) at the UN Climate Summit in September 2014, includes the commitment to 'support and help meet the private-sector goal of eliminating deforestation from the production of agricultural commodities such as palm oil, soy, paper and beef products by no later than 2020, recognizing that many companies have even more ambitious targets'.[3] The UN Sustainable Development Goals (SDGs), which entered effect in January 2016, include the ambitious target of ending deforestation by 2020 (SDG 15.2).[4]

The ability of governments and corporations to reduce or end this link between agriculture and deforestation depends on the nature of the international supply chains, the uses of the commodities, the consumers and producers involved, and likely future developments. This paper aims to provide background for this debate, including an overview of the patterns of production and consumption of, and trade in, the three main deforestation-related commodities – palm oil, soy and beef. The paper begins with an analysis of the global impact of these commodities on forests, and concludes with a discussion of likely future trends. It draws on a previous publication by Chatham

[1] These findings are summarized below, in the section The Impacts of Agriculture on Deforestation.
[2] For a longer discussion, see Brack, D. and Bailey, R. (2013), *Ending Global Deforestation: Policy Options for Consumer Countries*. London & Washington, DC: Chatham House & Forest Trends; and Walker, N., Patel, S., Davies, F., Milledge, S., and Hulse, J. (2013), *Demand-side Interventions to Reduce Deforestation and Forest Degradation*. London: IIED.
[3] Climate Summit (2014), *Forests: Action Statements and Action Plans*. New York: United Nations.
[4] SDG 15.2: 'By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.' For further details, see https://sustainabledevelopment.un.org/topics.

House and Forest Trends, *Ending Global Deforestation: Policy Options for Consumer Countries*, which was primarily aimed at exploring options for governments; it updates the analysis of agricultural supply chains included there and supplements the earlier work with discussion of likely future developments.

About the Chatham House Resource Trade Database

This paper uses data from the Chatham House Resource Trade Database to illustrate global trade in palm oil, soy, and beef and leather between 2000 and 2014. The database tracks bilateral trade in natural resources and resource products between more than 200 countries and territories over the period 2000–14. It covers the weight and value of trade in over 1,200 different types of natural resources and resource products, including agricultural, fishery and forest products, fossil fuels and metals. It allows for a detailed examination of new and growing resource-related dependencies among countries and regions, and of flows of resources through global value chains. Further details on the data used in this paper are available in Annex 2.

2. The Impacts of Agriculture on Deforestation

While there are many drivers of global deforestation, including mining, infrastructure development, urban expansion, timber and logging activities, and fuelwood collection and charcoal production, a series of studies in recent years have all emphasized the dominant role of agricultural expansion. Precise estimates differ because of differences in the time and geographical periods covered, their methodologies and difficulties in obtaining robust data:

- A 2012 synthesis report produced for the British and Norwegian governments, covering the period 2000–10, estimated that agriculture was responsible for about 80 per cent of global deforestation.[5] This drew heavily on a detailed study, also published in 2012, using REDD+ readiness activity reports, UNFCCC national communications and CIFOR country profiles, which concluded that 73 per cent of tropical and sub-tropical deforestation in the decade to 2010 was caused by agriculture, including 40 per cent from commercial agriculture and the rest from local or subsistence agriculture.[6]

- A study for the European Commission concerning the impact of EU consumption on deforestation, published in 2013, estimated that 53 per cent of the global deforestation recorded from 1990 to 2008 was due to agricultural expansion.[7] The study included a comprehensive analysis of the deforestation associated with individual commodities, broken down by countries of production and consumption; further details are included throughout this paper.

- A 2014 report for Forest Trends, which focused mainly on illegalities in the conversion of forests to other uses, concluded that 71 per cent of all tropical deforestation between 2000 and 2012 was caused by commercial agriculture; most of this (49 per cent) was associated with illegal conversion of forests, and 24 per cent was the direct result of illegal conversion for export markets.[8]

- A 2014 study for the Center for Global Development (CGD) examined specifically deforestation resulting from the four main forest-risk commodities (beef, soy, palm oil and wood products) produced for export in eight case countries: Argentina, Bolivia, Brazil, Paraguay, the Democratic Republic of the Congo, Indonesia, Malaysia and Papua New Guinea over the period 2000–09. (These eight countries between them accounted for the vast bulk of global palm oil, soy and beef exports.) The study concluded that roughly a third of tropical deforestation, and its associated carbon emissions, could be attributed to the four commodities in the eight countries.[9]

[5] Kissinger, G., Herold, M. and de Sy, V. (2012), *Drivers of Deforestation and Degradation: A Synthesis Report for REDD+ Policy-Makers*. Vancouver: Lexeme Consulting.
[6] Hosonuma N., Herold M., de Sy V., De Fries R.S., Brockhaus M., Verchot L., Angelsen A., Romijn E. (2012). 'An assessment of deforestation and forest degradation drivers in developing countries', *Environmental Research Letters,* 7(4), 044009.
[7] European Commission (2013), *The Impact of EU Consumption on Deforestation: Comprehensive analysis of the impact of EU consumption on deforestation*. Technical Report - 2013 – 063. Brussels: European Commission.
[8] Lawson, S. et al. (2014), *Consumer Goods and Deforestation: An Analysis of the Extent and Nature of Illegality in Forest Conversion for Agriculture and Timber Plantations*. Washington, DC: Forest Trends.
[9] Persson, M., Henders, S., and Kastner, T. (2014), *Trading Forests: Quantifying the Contribution of Global Commodity Markets to Emissions from Tropical Deforestation*. Washington, DC: Center for Global Development.

In addition to the direct conversion of forest to agriculture, in some cases land may be converted to agriculture after deforestation has occurred as a result of other factors – such as government policies promoting economic growth or rural development.

The 2013 study of the impact of EU consumption on deforestation provided a detailed analysis by agricultural activity. The estimated 53 per cent of global deforestation attributed to the conversion of forest to agriculture in the period 1990–2008 equates to some 127.6 million hectares (ha), or an average of 7 million ha per year. Of this total, 46 per cent (58.2 million ha) was due to livestock (mainly cattle) pasture; a further 11 per cent was accounted for by crops for animal feed – for pigs and poultry (8 per cent) as well as for cattle (3 per cent). The remainder (69.4 million ha) was due to crop production; the crops most heavily associated with deforestation were soybeans, accounting for 19 per cent of embodied deforestation in crops, maize (11 per cent), oil palm (8 per cent), rice (6 per cent) and sugar cane (5 per cent). It is clear that meat production has the biggest overall impact, and within that category beef consumption is the single biggest component, accounting for almost 27 per cent of total global deforestation over the study period.[10] Palm oil and soy production have since both continued to expand more strongly than other commodities, so now represent higher proportions of the total.

This analysis is supported by the CGD study of eight key countries, which concluded that beef was the leading source of deforestation and associated carbon emissions, accounting for half of total emissions (739 $MtCO_2$, of which 645 $MtCO_2$ was in Brazil) and for more than two-thirds of deforestation (2.6 million ha). Soy had the second largest deforestation footprint (0.5 million ha).[11]

The increasing liberalization of trade policy has clearly affected the extent and magnitude of deforestation. Globalized demand has meant that the drivers of deforestation have become 'mobile', in effect moved around the world by market forces,[12] creating an ever-increasing incentive to convert forests to more profitable uses. Nevertheless, it remains the case that the bulk of deforestation from agriculture arises from domestic use in the producing country: in the European Commission study, about one-third of the deforestation embodied in crop production, and just 8 per cent of the deforestation embodied in ruminant livestock products, was traded internationally.[13] Oil crops such as soy and palm oil accounted for the majority (almost two-thirds) of the deforestation embodied in exported crop commodities. While South American countries had experienced approximately one-third of total global deforestation, they accounted for almost two-thirds of the global trade in crop products associated with deforestation; this was largely due to exports of soy, mainly to China.

The EU is an important source of demand for many agricultural commodities associated with deforestation. The European Commission study concluded that over the period 1990–2008 the EU-27[14] imported crop and livestock products associated with 9 million ha of deforestation, amounting to almost 36 per cent of embodied deforestation in crop and livestock products traded between regions. Over this period the EU-27 was the largest global net importer of embodied deforestation,

[10] European Commission (2013).
[11] Persson, Henders and Kastner (2014), pp. 16–17.
[12] Boucher, D., May-Tobin, C., Lininger, K. and Roquemore, S. (2011), *The Root of the Problem: What's Driving Deforestation Today?* Washington, DC: Union of Concerned Scientists, p. 9.
[13] Unless otherwise noted, all figures in this section: European Commission (2013), pp. 22–36.
[14] The current members of the EU minus Croatia, which joined after the study period.

with an impact almost double that of the next largest region, East Asia. However, the rapid expansion of the Chinese economy in the later years of the study period and since means that China is almost certainly now a larger importer than the EU; for example, Chinese imports of soy increased almost sevenfold between 2000 and 2014. The EU none the less remains a larger importer of palm oil.

The main embodied-deforestation crops imported into the EU were soy and palm oil, which together accounted for almost 70 per cent of the EU's 'deforestation footprint'. Ruminant livestock products, mainly beef and leather, were also an important contributor, and the EU was responsible for importing over a quarter of the global export of the deforestation associated with these commodities. The main commodities imported into the EU, with their sources of origin, that contributed to deforestation were, in descending order: soybean cake and soybeans from Brazil; meat products from Brazil; soybean cake and soybeans from Argentina; palm oil from Indonesia; soybeans from Paraguay; cocoa beans from Ghana; nuts from Brazil; palm oil from Malaysia; and cocoa beans from Nigeria.

Thus, a large majority of the EU's deforestation footprint derived from Brazil, with 50 per cent being embodied in imports of Brazilian soy, beef and leather products. Brazil was the largest exporter of deforestation into the EU by a factor of five; the next most significant exporters were Argentina, Nigeria, Indonesia and Paraguay, which between them accounted for 25 per cent of the EU deforestation footprint, mainly arising from oil crops such as soy and palm oil.

These findings are again supported by the CGD study, according to which, on average, a third of the analysed deforestation was embodied in agricultural exports, mainly to the EU and China. In all but two of the eight countries included in its analysis – the exceptions being Bolivia and Brazil – export markets were the dominant drivers of forest clearance. If Brazilian beef was excluded, on average 57 per cent of deforestation attributed to the four case commodities was embodied in exports.[15]

Although the main use of palm oil and soy is as food for humans or animals, increased biofuel use, in the EU and elsewhere, is also clearly helping to drive deforestation, both directly and indirectly. A 2011 study concluded that biodiesel from oil palm may have been responsible for as much as 2.8 per cent of direct deforestation in Indonesia, and 6.5 per cent in Malaysia; and that biodiesel from soybeans in Mato Grosso, Brazil, may have been responsible for up to 5.9 per cent of direct deforestation. The same study found that indirect deforestation, such as from the clearance of forests for food crops displaced by palm oil, was significant and likely to grow in the future.[16]

[15] Persson, Henders and Kastner (2014), pp. 16–23.
[16] Gao, Y., Skutsch, M., Masera, O., and Pacheco, P. (2011), *A Global Analysis of Deforestation due to Biofuel Development*. Bogor: CIFOR, pp. ix–x.

3. Palm Oil

According to the European Commission study on the impact of EU consumption on deforestation, palm oil was the fourth highest agricultural product in terms of impact, accounting for 8 per cent of the global deforestation taking place between 1990 and 2008.[17] Palm oil, which is more heavily traded internationally than are some other products, accounted for about 10 per cent of the deforestation embodied in EU imports over the same period – the second most important in this regard.[18] Consumption of, and trade in, palm oil has expanded significantly in recent years, meaning that these figures almost certainly underestimate the current contribution of palm oil to deforestation.

Palm oil and palm kernel oil – both edible highly saturated fats – are products of the African oil palm (*Elaeis guineensis*), a palm native to west and southwest Africa which was introduced into plantations in Indonesia and Malaysia in the late 19th and early 20th centuries; these two countries dominate the international market, although production is increasing rapidly in a number of countries in sub-Saharan Africa and Latin America.[19]

Compared with other oil seeds, such as soy, rapeseed or sunflower seed, oil palm has a much higher yield, in terms of volume of oil produced per hectare per year (five times that of soy, for example), while production costs are lower, mainly reflecting low labour costs in the countries in which oil palm is grown. Palm oil is also extremely versatile; it can be easily separated into solid (stearin) and liquid (olein) components for use in hard products such as soaps and margarines or liquid products such as oils and lubricants. Its high saturated fat content makes it well suited to margarine manufacture, particularly as a substitute for hydrogenated fats or 'trans-fatty acids' now known to be particularly bad for cardiovascular health. It is also an excellent cooking oil, with a high smoke point and a high level of stability, making it resistant to oxidation. As a result, palm oil is a ubiquitous ingredient of processed foods, cosmetics, detergents and many industrial applications; according to one estimate, as much as half of all packaged products in developed country supermarkets contain palm oil or palm oil derivatives.[20]

Global demand for palm oil has seen strong and sustained growth. The principal consumers are the EU, India and China, which together accounted for almost 60 per cent of worldwide imports in 2013. Growth in demand in both India and China has been correlated with increasing incomes and urbanization and an associated dietary shift towards processed foods; and palm oil has also increased in popularity as a cooking oil. In the EU, by contrast, demand growth is primarily 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.

[17] European Commission (2013), p. 21.
[18] Ibid., p. 24.
[19] The description of the palm oil supply chain contained in this section is an abbreviated version of that included in the appendix to Brack and Bailey, 2013. Compared with that paper, this section contains more (and updated) details on production, export and import data, and on the national situations of key countries.
[20] van Gelder, J.W. (2004), *Greasy Palms: European Buyers of Indonesian Palm Oil*. London: Friends of the Earth, pp. 6–11.

Palm oil production

In response to this rapidly growing demand, global production of palm oil has grown strongly for several decades, with aggregate output more than doubling over the period 2000–13 (with a dip in 2007/08, during the global recession). More recently, however, prices have fallen sharply, along with those of other agricultural commodities. Over-production in response to high prices, coupled with several years of good harvests, led to a fall in the price of crude palm oil of more than 50 per cent between early 2011 and late 2015.[21] However, significant falls in the production of other vegetable oils, particularly rape, sunflower and cottonseed, seem likely to ensure that palm oil production may continue to expand, albeit at a slower rate than in the recent past.[22] In the short term, a more significant impact can be anticipated from droughts caused by the El Niño weather cycle in 2015–16, expected to be one of the most severe on record.

Although models vary by country, oil palm production commonly includes a significant smallholder component; it is estimated that smallholders account for a third of global palm oil supply.[23] In Papua New Guinea, Indonesia and Malaysia smallholdings account for over 40 per cent of production area, and in Thailand for as much as 75 per cent; plantation companies produce the remainder.[24] In reality, however, independent smallholders tend to be tied to plantations, as the fresh oil palm fruit bunch must be processed within 24 hours of harvesting to prevent spoilage, meaning that there is often only one possible buyer, the plantation mill.

At the mills, the fresh fruit bunch is pressed to release crude palm oil, while the kernels are crushed to produce palm kernel oil and palm kernel meal – the three basic feedstocks for the huge variety of manufacturing processes and industrial applications in which palm oil is used. Refining of crude palm oil and palm kernel oil sometimes takes place locally in Indonesia and Malaysia at plants operated by the large palm oil companies, although higher tariffs on refined oils in consumer markets mean that considerable refining capacity also exists at major import destinations such as Rotterdam. A relatively small number of companies operate refineries, making this one of the most concentrated stages of the value chain. See Figure 3.1 for a summary of the palm oil supply chain.

For the whole of the period since 2000, Indonesia and Malaysia between them have accounted for more than 80 per cent of global palm oil production and exports. Although production is expanding in a number of other countries, including Thailand, Nigeria, Colombia and Cameroon, this has not succeeded in breaking the dominance of the top two producers and exporters (see Figures 3.2–3.6).

[21] Index Mundi (2015), Commodity Price Indices: Crude Palm Oil Futures End of Day Settlement Price, at http://www.indexmundi.com/commodities/.
[22] FAO, (2015), *Food Outlook: Biannual Report on Global Food Markets,* Rome: FAO, p. 40.
[23] FSG (2011), *Improving the Livelihoods of Palm Oil Smallholders: The Role of the Private Sector*, Washington, DC: IFC.
[24] Ibid.

Figure 3.1: Palm oil supply chain

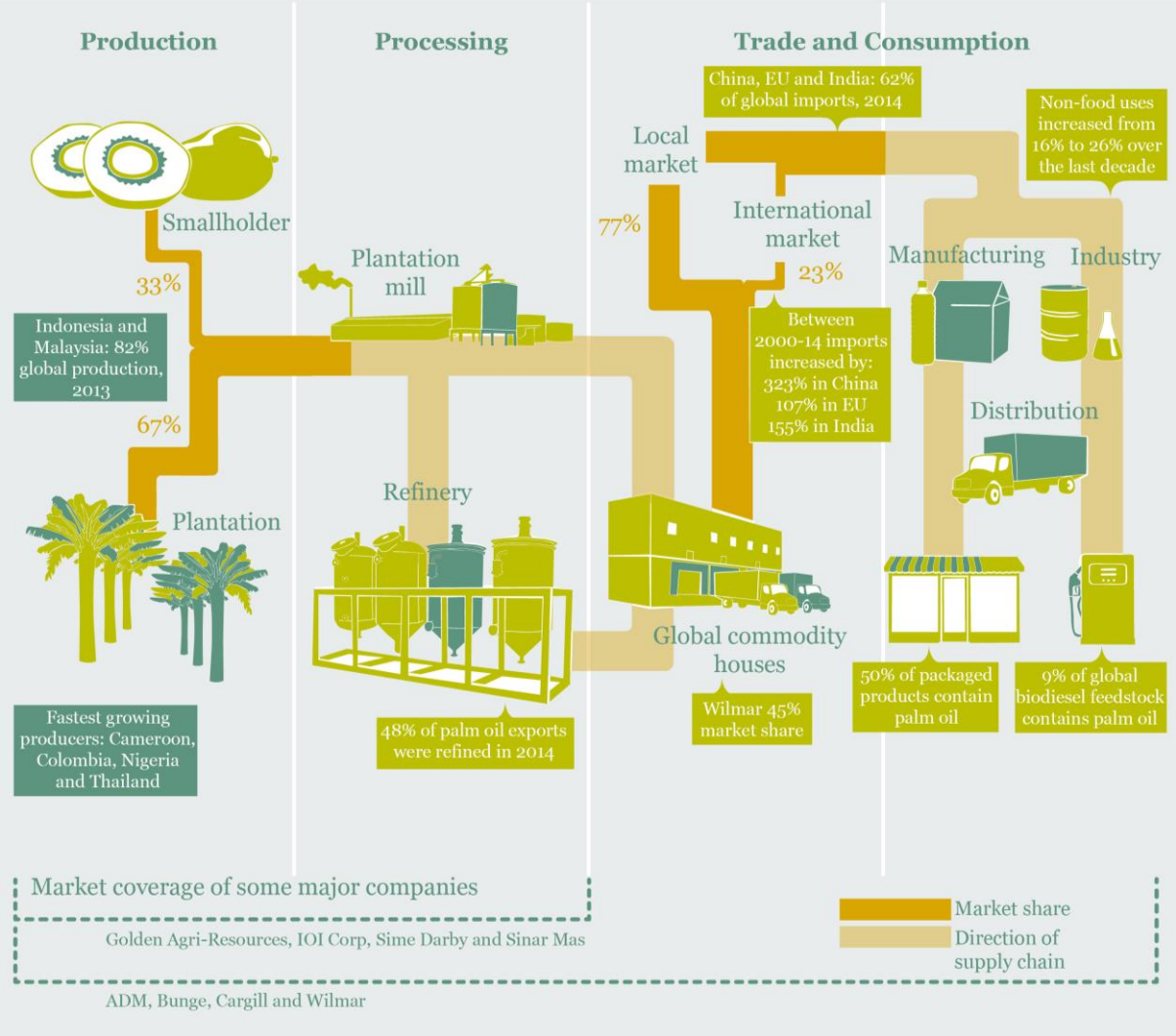
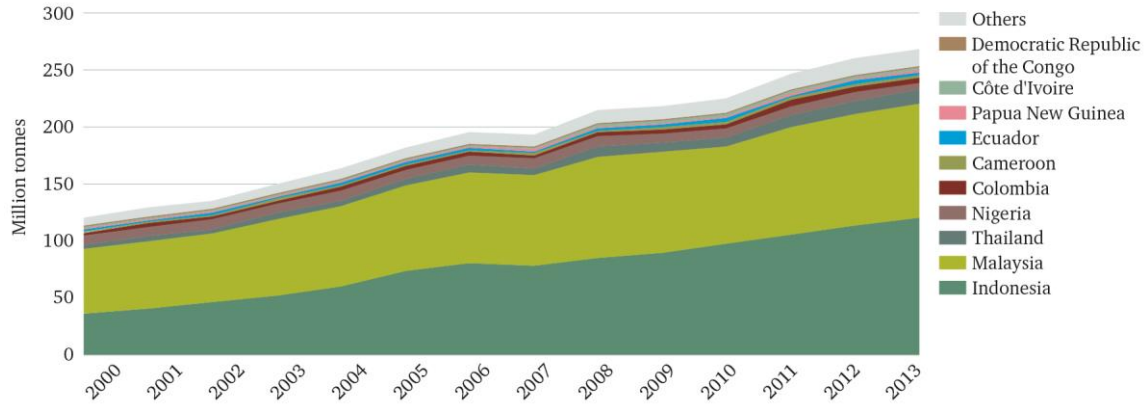
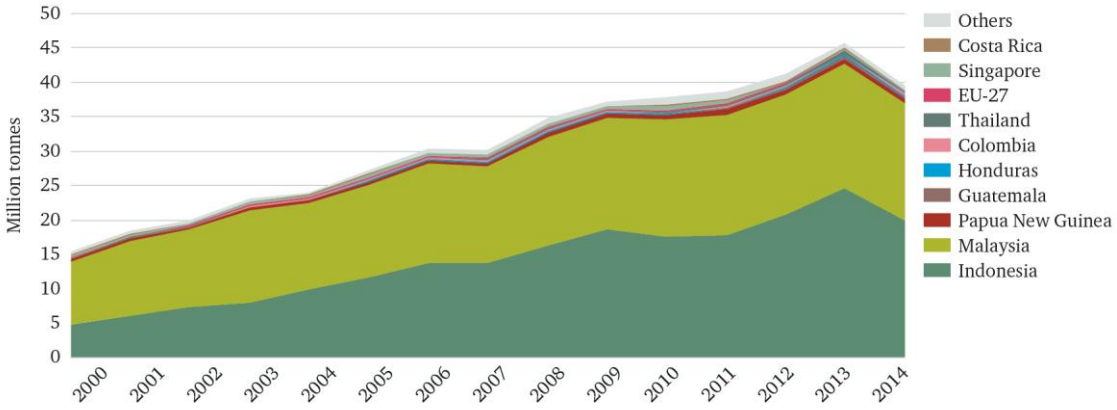


Figure 3.2: Palm fruit producers, 2000–13



Source: Chatham House analysis of FAOSTAT data.

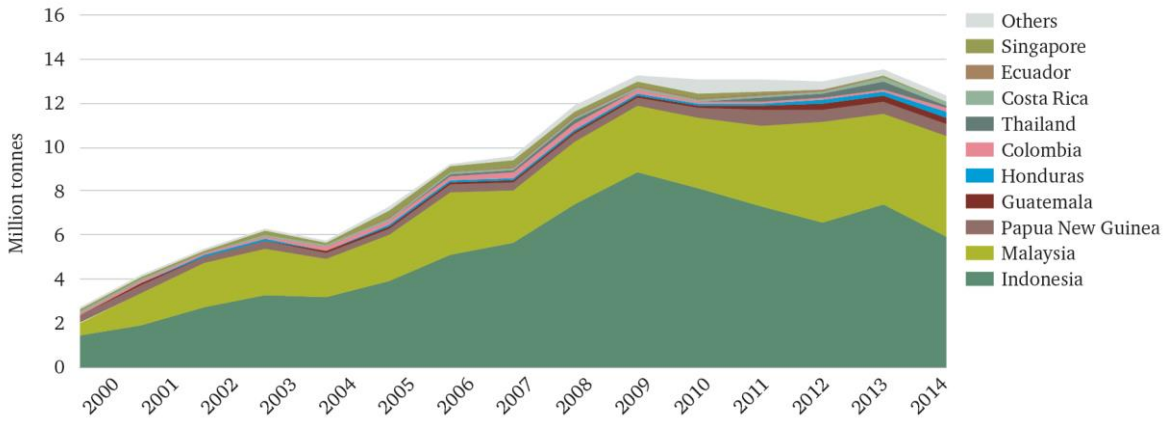
Figure 3.3: Exporters of palm oil and derivative products, 2000–14



Source: Chatham House Resource Trade Database.[25]

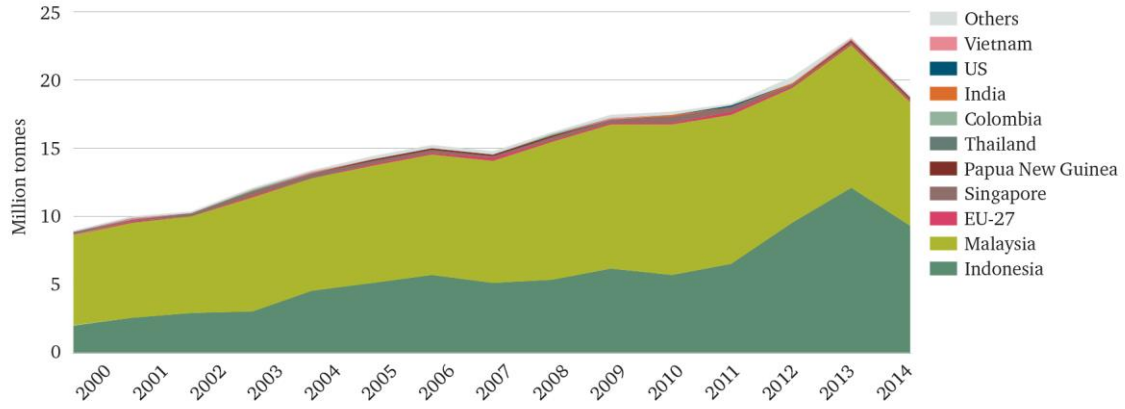
[25] More details on the data used in this paper are available in Annex 2.

Figure 3.4: Exporters of crude palm oil, 2000–14



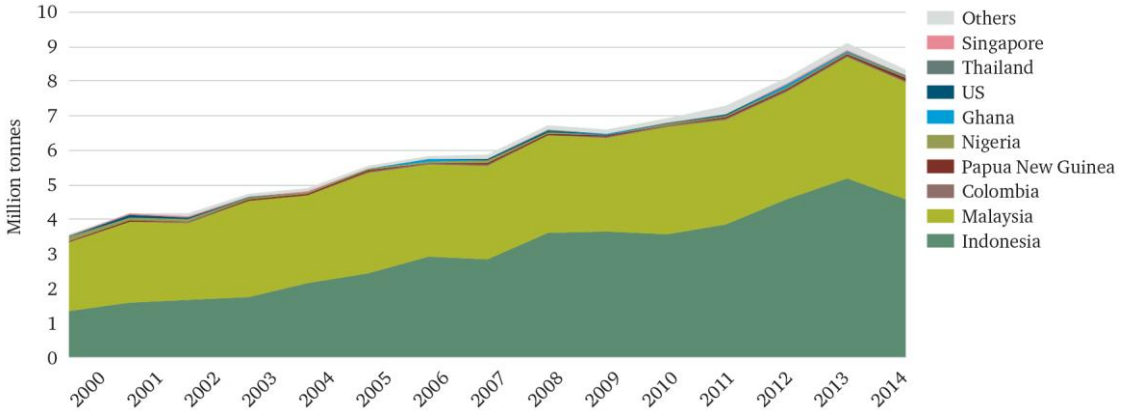
Source: Chatham House Resource Trade Database.

Figure 3.5: Exporters of refined palm oil, 2000–14



Source: Chatham House Resource Trade Database.

Figure 3.6: Exporters of palm nuts and kernels and derivative products, 2000–14



Source: Chatham House Resource Trade Database.

The cultivation of oil palm is difficult to mechanise, and given the trees' productive lifespan of about 30 years, the industry has a long innovation cycle. Most of the expansion in global palm oil production has resulted from increased planted area; improvements in yields have been relatively slow compared with many other crops.[26] Indeed, analysis by the Rights and Resources Initiative (RRI) suggests that palm oil production in Indonesia and Malaysia may already be past its peak, as a result of high production costs and the low availability of land.[27] The projected decline in productivity in both these countries has led the industry to seek new, low-cost frontiers in Africa and Latin America.

There is a large gap between achievable and actual yields: while around 7 tonnes per hectare is possible in optimum conditions, most larger plantations in Indonesia and Malaysia generally produce 3.5–4 tonnes per hectare, while smallholder farmers achieve less than 2 tonnes per hectare.[28] There may therefore be potential for increasing yield by replacing smallholder production with plantations run by agribusiness companies with better access to capital and technology – although the negative impacts on smallholder and local community livelihoods may well prove politically unacceptable.

Indonesia

Palm oil production in Indonesia has been driven by both domestic and export demand, and encouraged by government subsidies, the easy availability of land, land rights of up to 90 years and a low-cost labour force.[29] The robust rate of expansion experienced since 2000 – averaging about 12 per cent per year – may now be beginning to slow, partly because of falling world prices but also as a result of land conflicts around indigenous peoples' rights, concerns with regard to overlapping concessions, and government policy to protect the remaining forests – which led, in 2011, to a moratorium on the award of new licences in primary natural forests and peat lands. However, the impact of the moratorium has been constrained by its various exemptions, by the availability of undeveloped land, and also by weaknesses in governance and law enforcement.[30] Furthermore, the government's own production target of 40 million tonnes of crude palm oil annually by 2020 implies almost a doubling in the area under oil palm cultivation from about 8 million ha in 2010 to 15 million ha in 2020.[31]

Until 2011 Indonesia used high levels of export duty to restrict exports of processed palm oil, with the aim of maintaining adequate supplies of domestic cooking oil. In that year, however, the government reduced export tariffs for processed palm oil (from 25 per cent to 13 per cent) while raising them for crude oil. Indonesia's exports of processed palm oil subsequently increased, which had the effect of reducing Malaysian dominance of the market (see Figure 3.5). (See also the section below for a summary of Malaysia's tariff structure.) At the same time, palm oil companies increased

[26] Kongsager, R. and Reenberg, A. (2012). *Contemporary land-use transitions: The global oil palm expansion*. GLP Report No. 4. Copenhagen: GLP-IPO.
[27] Rhein, M. (2014), *Industrial Oil Palm Development: Liberia's Path to Sustained Economic Development and Shared Prosperity? Lessons from the East*. Washington, DC: Rights and Resources Initiative.
28 WWF, CDC and FMO, (2012), *Profitability and Sustainability in Palm Oil Production: Analysis of Incremental Financial Costs and Benefits of RSPO Compliance*, Washington DC: WWF.
[29] PwC (2010), *Palm oil plantation: Industry lanscape* [sic], *regulatory and financial overview*. Jakarta: PwC Indonesia.
[30] Wiyono, I.E. and Slette, J. (2013), *Indonesia: Oilseeds and Products Annual 2013*. GAIN Report ID1316. Washington, DC: USDA.
[31] Bromokusumo, A.K. and Slette, J. (2013), *Indonesia: Oilseeds and Products Annual 2010*. GAIN Report ID1008. Washington, DC: USDA.

significantly their investment in refineries,[32] more than doubling refining capacity to 45 million tonnes, or 80 per cent of total world output, between 2012 and 2014.[33]

Malaysia

Malaysia's palm oil industry started to expand before that of Indonesia, averaging 7 per cent annual growth from 1979 to 2010, as a result of substantial public and private investment and abundant land and labour resources. It may now be reaching its limit, however.[34] The government's aim of retaining 50 per cent of total land area as forest constrains the potential for further expansion:[35] palm oil plantations currently account for 5 million ha, allowing for only a further 600,000 ha to be exploited if the forest target is to be adhered to.[36] Rising production costs and labour shortages are also weakening Malaysia's competitive position in the market.[37]

Since the 1960s, Malaysia has adopted a fairly consistently export-oriented policy for processed palm oil; this is exempt from export duties, while crude palm oil has been subject to an export tariff of 10–30 per cent (depending on price).[38] Processing of palm oil in Malaysia has thus been encouraged, bringing accompanying gains in terms of value added and employment, as well as global market share (see Figure 3.5).[39] The country's lead was, however, eroded once Indonesia revised its own tariff structure; in response, in early 2015 Malaysia significantly reduced export duty on crude palm oil (the rate varies with market conditions, and has been as low as zero), resulting in a rise in exports.

Emerging producers

Given expanding world markets and possible slowdowns in productivity and growth in Indonesia and Malaysia, production and exports are expanding elsewhere, including most significantly in Thailand, Nigeria, Colombia and Cameroon (see Figures 3.2–3.6 above and 3.7 below). Production is also growing fast, albeit from a low base, in several countries in Latin America. As can be seen from Figure 3.1, however, these are all relatively small players; the largest, Thailand, accounted for less than 5 per cent of world production in 2013.

[32] See http://www.reuters.com/article/2011/08/26/indonesia-palmoil-tax-idUSL4E7JQ13320110826.
[33] See http://www.indonesia-investments.com/business/commodities/palm-oil/item166.
[34] USDA (2011), *Malaysia: Obstacles May Reduce Future Palm Oil Production Growth*, 28 June 2011, at http://www.pecad.fas.usda.gov/highlights/2011/06/Malaysia/.
[35] USDA (2011).
[36] EU Delegation to Malaysia (2012), *The Malaysian Palm Oil Sector – Overview*. Rome: Agenzia ICE.
[37] USDA (2012), *Malaysia: Stagnating Palm Oil Yields Impede Growth*, 11 December 2012, at http://www.pecad.fas.usda.gov/highlights/2012/12/Malaysia/.
[38] EU Delegation to Malaysia (2012), pp. 9–12.
[39] Fyfe, A. (2012), 'Export restrictions on natural resources: the case of Indonesia and Vietnam', *Bridges Trade BioRes*, 6(4).

Figure 3.7: New frontiers for palm oil

Source: Modified from GRAIN (2014), *Planet Palm Oil. Peasants pay the price for cheap vegetable oil*. Barcelona: GRAIN.

Many of these countries provide subsidies for the production of palm oil. The expansion of the industry is generally encouraged in order to stimulate rural development and poverty reduction and to reduce dependence on imports; some emerging producers also encourage the use of palm oil in biofuels, through either regulation or subsidy or both.

In West Africa, there has been some interest in inward investment in Cameroon, Ghana and Liberia, particularly by Southeast Asian companies,[40] but serious conflicts over land rights have inhibited development, particularly in Cameroon and Liberia, and may permanently prevent major production. In Latin America, Colombia and Brazil both have potential to emerge as major producers, given high yields in Colombia as a result of experimentation with varieties and plantation systems,[41] and high availability of land and investment in Brazil. In Oceania, Papua New Guinea has substantial potential for oil palm cultivation, but poor levels of governance has led to government-issued leases apparently being used simply to clear the forest.[42] In India, meanwhile, increasing imports of vegetable oils have contributed to plans to expand oil palm cultivation, but the fall in prices of imports from Indonesia and Malaysia since 2011 has undermined this strategy.

Palm oil consumption

The commodities that result from oil palm refining are used widely in manufacturing and industry and are predominantly traded by major global multi-commodity houses such as Cargill, ADM, Bunge and Louis Dreyfus, as well as Wilmar International, the largest global palm oil trader;

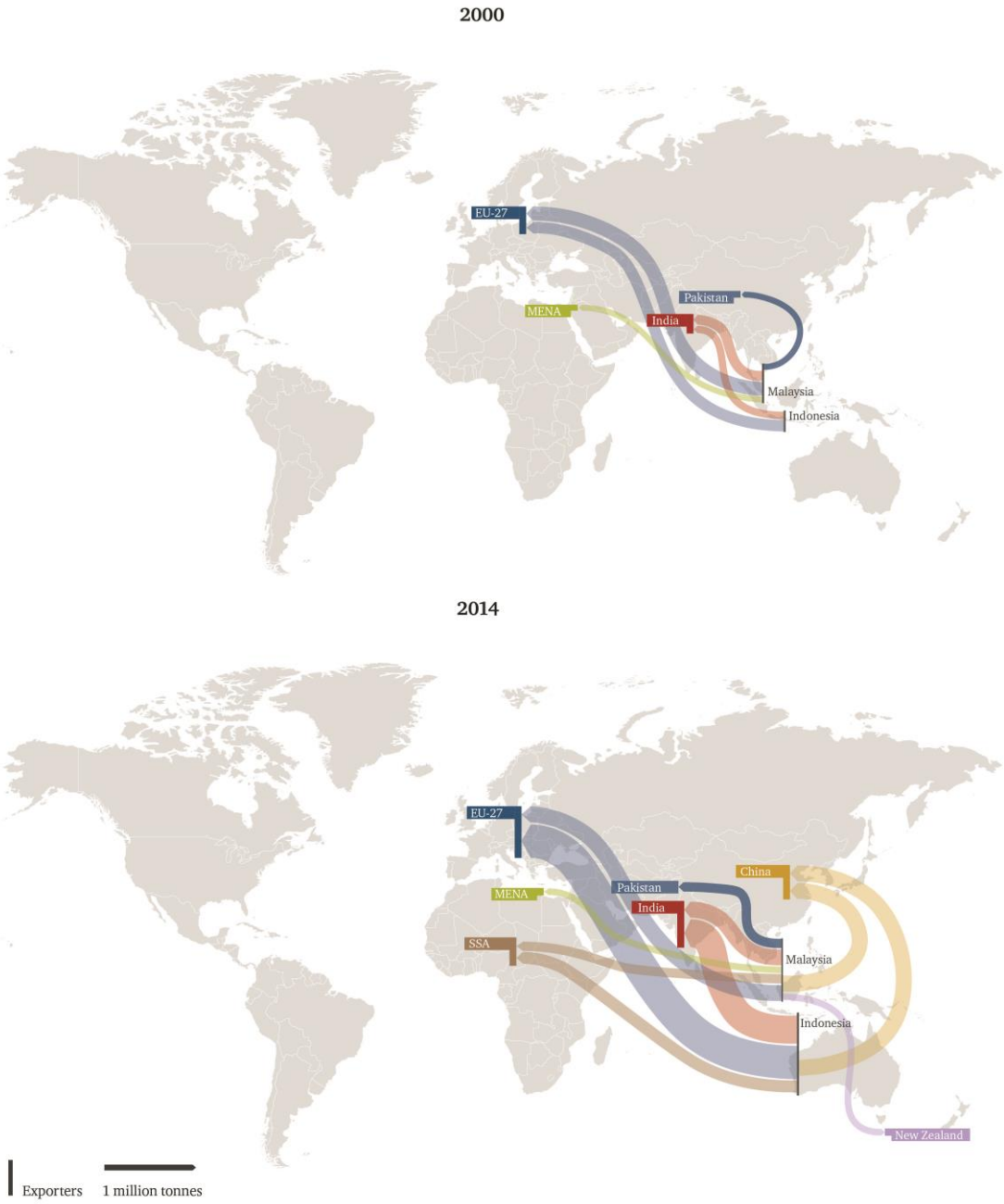
[40] Hoyle, D. and Levang, P. (2012), *Oil palm development in Cameroon*. Yaoundé: WWF.
[41] Pacheco, P. (2012), *Soybean and oil palm expansion in South America: A review of main trends and implications*. Working Paper 90. Bogor: CIFOR.
[42] GRAIN (2014), *Planet Palm Oil. Peasants pay the price for cheap vegetable oil.* Barcelona: GRAIN.

smaller trading operations do, however, also exist. These large traders commonly integrate downstream into palm oil production and refining. The major palm oil companies are the most vertically integrated: businesses such as Wilmar and IOI are not only among the largest plantation owners and refiners, but are also active upstream in oleochemical production. Non-food uses of palm oil have increased from 16 to 26 per cent of total consumption in the last decade, largely as a result of rising demand for biofuels.[43] There are biodiesel plants using palm oil in Indonesia, Malaysia and Singapore, and also at import destinations such as Rotterdam; the EU is the world's largest producer and consumer of biodiesel. Palm oil is also used for electricity generation.

As noted above, global demand for palm oil has seen strong and sustained growth, averaging 8 per cent per year over the last three decades. The maps in Figure 3.8 below show the global trade in palm oil and derivative products in 2000 and in 2014. The principal importers are the EU, India and China, which together accounted for more than 60 per cent of global imports in 2014, and were responsible for over half of global demand growth from 2000 to 2014 (see Figures 3.9–3.12). Palm oil consumption is, however, vulnerable to competition from other vegetable oils, particularly soybean oil; the two can substitute for one another as a cooking oil and in biodiesel and food production. After record soy harvests in the US and South America in 2014 drove the price of soybean oil down faster than that of palm oil, imports of the latter fell sharply in all the three major consumer markets, and by almost 14 per cent globally.

[43] Sanders, D.J., Balagtas, J.V. and Gruere, G. (2012), *Revisiting the Palm Oil Boom in Southeast Asia: The Role of Fuel versus Food Demand Drivers*. Discussion Paper 01167. Washington, DC: IFPRI.

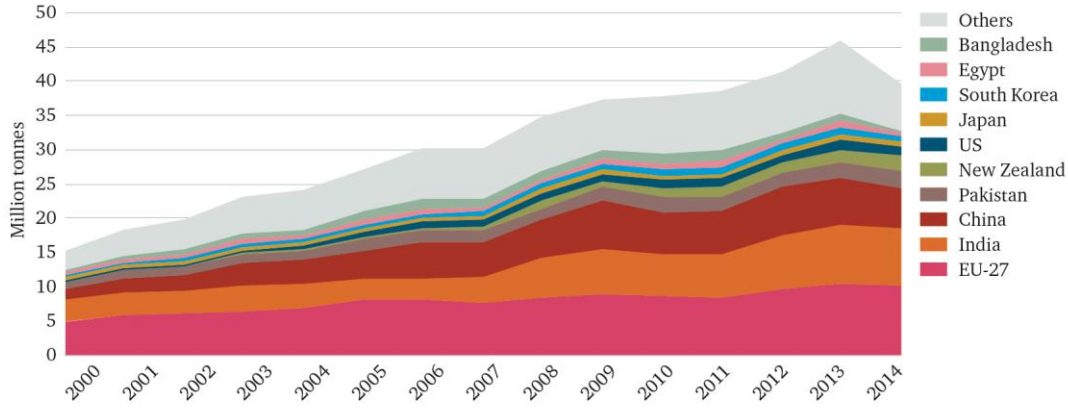
Figure 3.8: Global trade in palm oil and derivative products in 2000 and 2014[44]



Source: Chatham House Resource Trade Database.

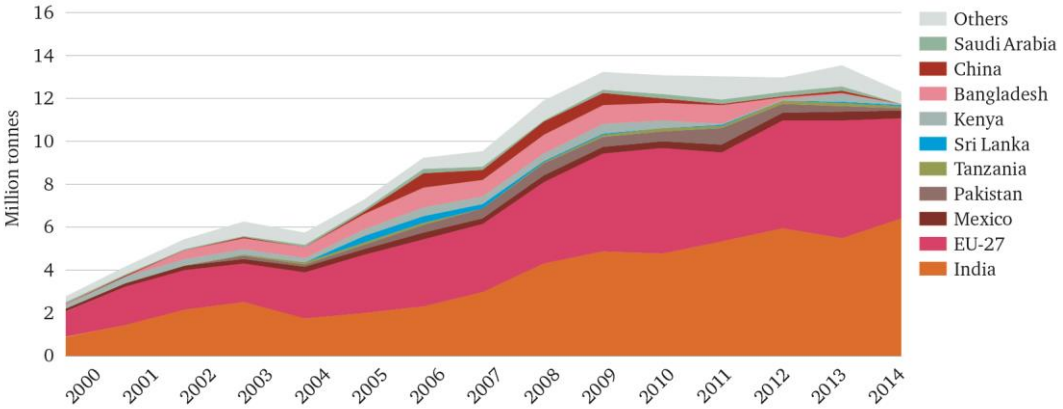
[44] Maps show trade flows only in excess of 1 million tonnes.

Figure 3.9: Importers of palm oil and derivative products, 2000–14



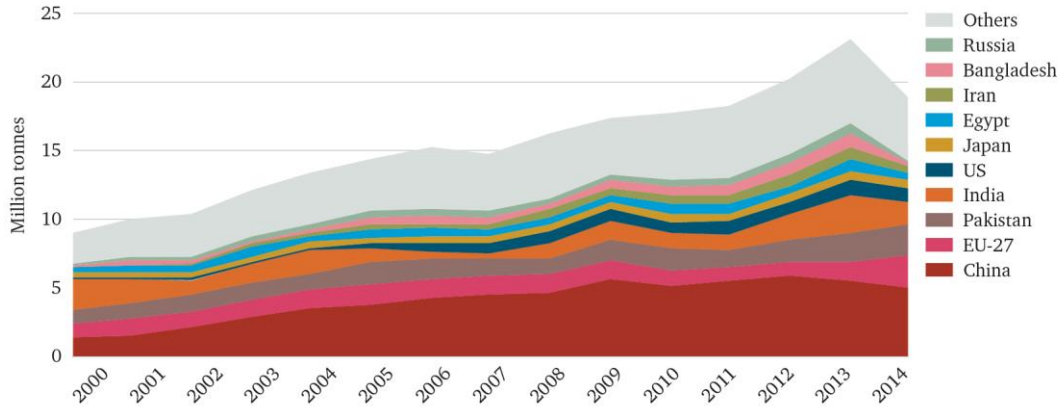
Source: Chatham House Resource Trade Database.

Figure 3.10: Importers of crude palm oil, 2000–14



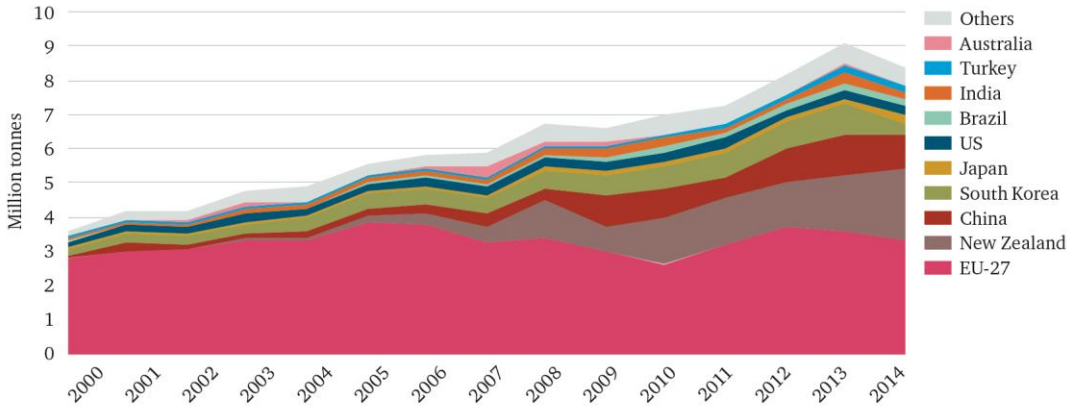
Source: Chatham House Resource Trade Database.

Figure 3.11: Importers of refined palm oil, 2000–14



Source: Chatham House Resource Trade Database.

Figure 3.12: Importers of palm nuts and kernels and derivative products, 2000–14



Source: Chatham House Resource Trade Database.

India

Palm oil is the most popular edible oil in India, with demand increasing as a result of a growing population and rising incomes. As noted above, in an attempt to reduce reliance on imports and boost domestic production, in 2012–13 India increased import duties first on processed palm oil, then on crude, and banned exports of all edible oils. In response, in September 2014 both Malaysia and Indonesia cut export tariffs to zero; and this, along with lower prices globally, pushed Indian imports to a record level.[45] As noted above, however, in 2014 the falling price of soybean oil undercut palm oil imports in most consumer countries, and particularly in India; there, soybean oil imports increased by 67 per cent, while imports of palm oil declined by 20 per cent.[46]

China

Growth in demand for palm oil in China is – similarly to the pattern in India – correlated with increasing incomes and urbanization, and an associated dietary shift towards processed foods.[47] In particular, demand for instant noodles is driving consumption (as in many other, particularly Asian, countries), and this is expected to increase further.[48] Instant noodles have a good claim to be regarded as the world's most successful industrial foodstuff: worldwide, consumption was almost 103 billion packets in 2014, equivalent to 14 servings for every person on the planet.[49] Very cheap and easy to transport and store, instant noodles are already becoming the staple food of many low-income and transient populations. Palm oil accounts for about 20 per cent of each serving.

[45] Bloomberg (2014), *Top Palm Oil Growers Scrap Export Tariffs in Buyer Battle*, 26 September 2014, at http://www.bloomberg.com/news/2014-09-26/top-palm-oil-growers-scrap-export-tariffs-in-buyer-battle.html.
[46] The Wall Street Journal (2015), *In Palm-Oil Market, Optimism Over Biodiesel Subsidy Fades*, 25 February 2015, at http://www.wsj.com/articles/biodiesel-subsidy-lifts-palm-oil-prices-1424854565.
[47] FAO (2006), *Food for the cities factsheet*. Rome: FAO.
[48] Meador, M.M. and Xinping, W. (2010), *China - Peoples Republic of: Oilseeds and Products Annual 2010*. GAIN Report CH11008. Washington, DC: USDA.
[49] See http://instantnoodles.org/noodles/expanding-market.html.

As well as food production, China's chemical industries are moving away from petroleum products for rubber, plastics and textiles, and increasingly sourcing palm oil derivatives instead.[50] The Indonesian firm GAR has invested in palm oil processing facilities in China, including a deep-sea port and oilseed crushing plants.

EU

The EU has long been the world's largest importer of palm oil, accounting for 26 per cent of global imports of palm oil and derivative products in 2014; imports more than doubled between 2000 and 2014, from 5 million tonnes to 10.3 million tonnes.[51] Of the 6 million tonnes of crude and refined palm oil imported to the EU market in 2012 (see Figures 3.9 and 3.10), the bulk – some 3.9 million tonnes – was used by the non-energy sector for food production, personal care (cosmetics, detergents) and oleochemical industries (paints, lubricants, etc.).[52] EU regulations requiring food manufacturers to label foods containing genetically modified (GM) ingredients are thought to have contributed to a shift from soybean oil to palm oil as an ingredient, as companies have struggled to source sufficient non-GM soybean oil.[53] Another contributory factor has been rising demand for animal feed in the livestock sector,[54] particularly as the poultry industry has expanded.[55]

In contrast to emerging markets such as China and India, however, the main driver of rising demand for palm oil in the EU has been biofuel policy. As a result of the 2009 Renewable Energy Directive – requiring that the EU fulfil at least 20 per cent of its total energy needs with renewables by 2020 (through specific targets for member states), and in particular that all EU countries must ensure that at least 10 per cent of their transport fuel comes from renewable sources by 2020[56] – the EU has become the world's biggest consumer of biodiesel. About 1.9 million tonnes of palm oil were used in the EU for biodiesel production in 2012 and 0.6 million tonnes directly for electricity and heat generation; a further 1.1 million tonnes was imported in the form of palm oil biodiesel.[57] (Anti-dumping duties imposed by the EU in 2013 on Indonesian biodiesel sharply reduced imports since, to an estimated 0.45 million tonnes in 2013.[58])

Sustainability standards (see further in the subsection Changing biofuel policies, below), as well as cool temperatures that can lead to problems with palm methyl ester solidifying in car engines, mean that palm oil in fact contributes a relatively small amount directly to EU biodiesel (about 14 per cent in 2012, either as feedstock or as imported biodiesel), which relies primarily on rapeseed oil.[59] However, the increasing diversion of rapeseed oil to biodiesel production has created a deficit in the EU edible oils market, which has been met through reducing exports of rapeseed oil and increasing

[50] Ooi, C.K. and Yoong, J.H. (2011), Development of Oleochemicals in China, at http://palmoilis.mpob.gov.my/publications/POD/pod56-ooi2.pdf.
[51] Krautgartner, R., et al. (2014), *EU-27 : Oilseeds and Products Annual – Record Rapeseed Production but Sunflower Production Down*. GAIN Report AU1407. Washington, DC : USDA.
[52] Gerasimchuk, I. and Peng, Y.K. (2013), The EU Biofuel Policy and Palm Oil: Cutting subsidies or cutting rainforest? Geneva: IISD., p. 6.
[53] Sanders, et al. (2012).
[54] Krautgartner, R. et al. (2011), *EU-27: Oilseeds and Products Annual - Modest Rebound in EU-27 Oilseeds Production*. GAIN Report E60016. Washington, DC: USDA.
[55] Krautgartner et al. (2014).
[56] See https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive.
[57] USDA (2014), *Indonesia Biofuels Annual 2014*, pp. 10–11 (using a conversion rate of 1 litre = 0.87 kg).
[58] Ibid.
[59] Ecofys (2014), *Renewable Energy Progress and Biofuels Sustainability*. Report for the European Commission. Utrecht: Ecofys.

imports of palm oil. Between 2000 and 2010 net EU palm oil imports rose by over 3 million tonnes – roughly the same amount as the rapeseed oil shortfall resulting from biofuel use.[60]

Emerging consumers

India, China and the EU, as the three largest importers, seem likely to continue to dominate world markets, but many other countries are also seeing rising consumption. In Pakistan – where, as in India, palm oil is popular as a cooking oil and as an ingredient – palm oil accounts for 85 per cent of imports of edible oil for domestic consumption.[61] There is also growth in demand in many sub-Saharan African countries, in the context of rising populations and levels of prosperity, and World Health Organization recommendations to use palm oil in food fortification programmes, as well as demand for halal food and non-food products by Muslim populations. Despite high levels of foreign direct investment in oil palm development in the region, which have improved output and efficiency, production is still inadequate to meet domestic demand, and Africa is a net importer.[62]

Encouragement for the use of biofuels is not restricted to the EU. Indonesia, Malaysia, Brazil and the US, among many other countries, have in place regulations supporting biofuels. In general, however, the uptake of biofuels has been lower than originally planned – for a variety of reasons including technical issues and consumer concerns over possible engine damage, distribution difficulties and, since 2014, the falling price of petroleum. In the US, as in the EU, concerns about sustainability have prevented the extensive use of palm oil directly for biodiesel, but palm oil imports have increased to fill the gap in the market left by the diversion of soybean oil to biodiesel.

Palm oil and deforestation

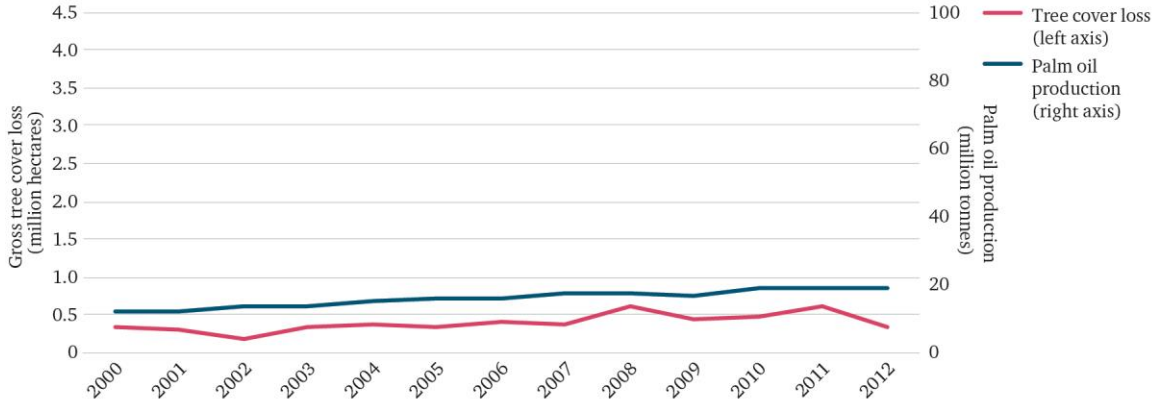
The difficulties of increasing the yield of oil palm plantations, and the consequent expansion of the industry through expanding the area under cultivation, are discussed above. Over the last three decades, the area of oil palm harvested in Malaysia has increased nearly fivefold, while palm oil yields have increased by less than 30 per cent. (Global oil crop yields increased at about three times this rate over the same period.) In Indonesia the increase in production has been entirely through expansion: the area harvested has increased 26 times over, while average yields have remained flat.[63] This expansion of oil palm plantations is therefore inextricably linked to deforestation, including the clearance and drainage of peat-swamp and lowland rainforest – some of the most biologically diverse and carbon-rich forests found on earth.[64] Almost 3 million hectares of forest in Indonesia and Malaysia have been cleared to make way for oil palm over the last 15 years, and 50–60 per cent of all oil palm expansion in the two countries has occurred at the expense of natural forest[65] (see Figures 3.13 and 3.14).

[60] ICCT (2013), *Vegetable Oil Markets and the EU biofuel mandate*. Washington, DC, San Francisco & Berlin: International Council on Clean Transportation.
[61] Rehman, M.S. (2012). *Pakistan: Oilseeds and Products Annual 2012*. Washington, DC: USDA.
[62] MASDAR (2011). Masterplan Study on the Oil Palm Industry in Ghana. Eversley: MASDAR.
[63] FAOSTAT (2015), Production: Oil, palm fruit Indonesia 1980-2012, at http://faostat3.fao.org/download/Q/QC/E
[64] Laurance, W.F., Koh, L.P., Butler, R., Sodhi, N.S., Bradshaw, C.J.A., Neide, J.D., Consunji, H. and Vega, J.M. (2010), 'Improving the Performance of the RSPO on Nature Conservation'.*Conservation Biology*, 24(2), 377-81.
[65] Lawson, S., Illegal forest conversion for industrial agriculture, and associated trade in timber and agro-commodities: The scale of the problem and potential solutions. Presentation at Chatham House, 9 July 2013.

Figure 3.13: Gross tree cover loss and production of palm oil in Indonesia, 2001–13

Source: WRI.[66]

Figure 3.14: Gross tree cover loss and production of palm oil in Malaysia, 2001–13



Source: WRI (see footnote to source for Figure 3.11).

Although other commodities are associated with deforestation, palm oil has tended to be subject to the greatest focus. The impacts on habitats have been repeatedly highlighted by NGOs campaigning against palm oil expansion – as, for example, in Greenpeace's successful 'Give the orang-utan a break' campaign in 2010 against Nestlé's use of palm oil linked to deforestation in its supply chain for Kit Kat.[67] After the world's largest palm oil trader, Wilmar, adopted a zero-deforestation commitment in December 2013, the other major global traders of palm oil followed suit, with the result that by the end of 2014 it was estimated that palm oil buyers having adopted such commitments accounted for 96 per cent of the global trade.[68] In turn, the uptake of sustainability certification schemes – overwhelmingly that of the Roundtable on Sustainable Palm Oil (RSPO) – has increased sharply (see the subsection Reducing impacts on forests, in Section 6, below).

[66] Using FAOSTAT data and Hansen, M. C., et al. (2013), "Hansen/UMD/Google/USGS/NASA Tree Cover Loss and Gain Area." University of Maryland, Google, USGS, and NASA. Accessed through Global Forest Watch www.globalforestwatch.org.
[67] See http://www.greenpeace.org.uk/files/po/index.html.
[68] Chain Reaction Research, '96% of Global Palm Oil Trade Covered by Zero-Deforestation', 8 December 2014.

As well as these corporate zero-deforestation pledges, in a number of countries industry-wide private sector initiatives aiming to source certified sustainable palm oil are under way. For example, the Dutch Task Force on Sustainable Palm Oil was established in 2010, with the aim of ensuring that all palm oil used in the Dutch market is RSPO-certified by the end of 2015; by 2014 it had achieved 72 per cent RSPO certification, from 30 per cent in 2011.[69] Similar initiatives for palm oil have been introduced in Belgium, Denmark, France, Germany and Sweden. In 2012, in an announcement made jointly with 14 trade associations and NGOs, the UK government announced that it was adopting the target of 100 per cent sourcing of credibly certified sustainable palm oil by the end of 2015.[70] Progress reports so far estimate that in 2012 some 52–60 per cent of the palm oil used in the UK was certified sustainable; in 2014 this had risen to 72–93 per cent.[71]

[69] For further information, see http://www.taskforceduurzamepalmolie.nl.
[70] UK Department for Environment, Food and Rural Affairs, (2012), *Sustainable Production of Palm Oil: UK Statement*. London: DEFRA.
[71] CPET (2015), *UK Consumption of Sustainable Palm Oil; Annual Review,* London: CPET. The figures vary depending on the baseline chosen.

4. Soy

According to the European Commission's 2013 study on the impact of EU consumption on deforestation, soy had the second highest impact of any agricultural commodity, accounting for 19 per cent of global deforestation recorded between 1990 and 2008.[72] As a heavily traded commodity, soy accounted for 47 per cent of the deforestation embodied in EU imports over the same period.[73] As with palm oil, both consumption of and trade in soy have expanded significantly in recent years (with China's imports increasing almost sevenfold between 2000 and 2014), so these figures are likely to under-represent the current contribution of soy to deforestation.

The soybean, or soya bean (*Glycine max*), is a species of legume native to East Asia, grown for its edible bean. It is an excellent source of food, containing 38 per cent protein (double the proportion of pork, and treble that of eggs), a wide range of essential amino acids and a high proportion of unsaturated fat.[74]

The raw beans are crushed and processed to produce soybean meal and soybean oil. Soybean meal accounts for about 80 per cent of soybean weight, and is used primarily for animal feed; after crushing, 70–75 per cent of the world's soy ends up as feed for chickens, pigs, cows and farmed fish. The remainder is used in a variety of industrial applications, including biodiesel production, or for direct human consumption. About 18 per cent of the processed soybean is oil, which is predominantly used for biodiesel, mainly in the EU; other uses include the production of paints, inks and resins, and soy is also used in food production, for example in the manufacture of margarines, pastry and cooking oils. Hulls, a by-product of crushing, can be used as a fibre supplement in feed and food manufacturing.

Overall, soy production has increased eightfold since the 1960s.[75] Dominated by three countries – the US, Brazil and Argentina, which together accounted for 80 per cent of global production in 2013 – the rate of expansion has been particularly rapid in the last decade in South America. More than half of Argentina's agricultural area is now used for the cultivation of soy,[76] and 80 per cent of Paraguay's, a relatively new producer.[77] Soybeans have been the most successful oilseed on world markets, with a projected share of 60 per cent of global oilseed production in 2014/15.[78]

Growth in demand is principally attributable to the increasing preference for meat among the growing middle class in emerging economies, which has brought with it higher demand for animal feed. Foremost among the consumers driving this trend has been China, which over the last decade has alone accounted for almost two-thirds of global demand growth. The EU is the second largest

[72] European Commission (2013), p. 21.
[73] Ibid., p. 24.
[74] The description of the soy supply chain contained in this section is an abbreviated version of that included in the appendix to Brack and Bailey, 2013. Compared with that paper, this section contains more (and updated) details on production, export and import data, and on the national situations of key countries
[75] Bruinsma, J. 2009. *The resource outlook to 2050: by how much do land, water and crop yields need to increase by 2050?* Paper presented at the FAO Expert Meeting, 24–26 June 2009, on 'How to Feed the World in 2050'.
[76] García-Lopez, G.A. and Arizpe, N. (2010), 'Participatory processes in the soy conflicts in Paraguay and Argentina', *Ecological Economics,* 70(2), 196-206.
[77] Earth Security Group, *Earth Security Index 2015*, p. 6.
[78] USDA, (2015), *World Agricultural Supply and Demand Estimates, November 10, 2015.* Washington, DC: USDA.

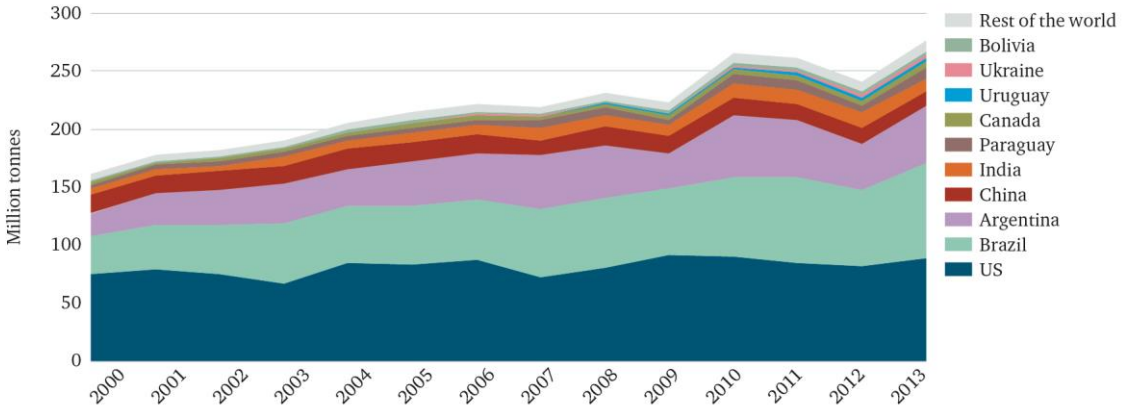
market, importing soy mostly in the form of soymeal and cake destined for use as feed for pigs, poultry and cattle, together with soybean oil for biodiesel.[79]

Soy production

Global production of soy has roughly doubled since 2000. With the end of the commodities price boom of the 2000s, together with several years of strong harvests, world prices for soy have fallen sharply (by about half) since 2011.[80] Total output has fallen only slightly, however, and the substantial devaluation of the Brazilian real during 2015 led to a rise in the country's soy production and exports. The impacts of the El Niño weather cycle of 2015–16 may include both a reduction in the production of palm oil (as a result of droughts) and an increase in that of soy (which should benefit from higher rainfall in South America).

Soy production is highly concentrated, with just three countries – the US, Brazil and Argentina – having dominated production and exports for more than a decade (see Figures 4.1–4.4). As already noted, these three accounted for 80 per cent of global production in 2013.

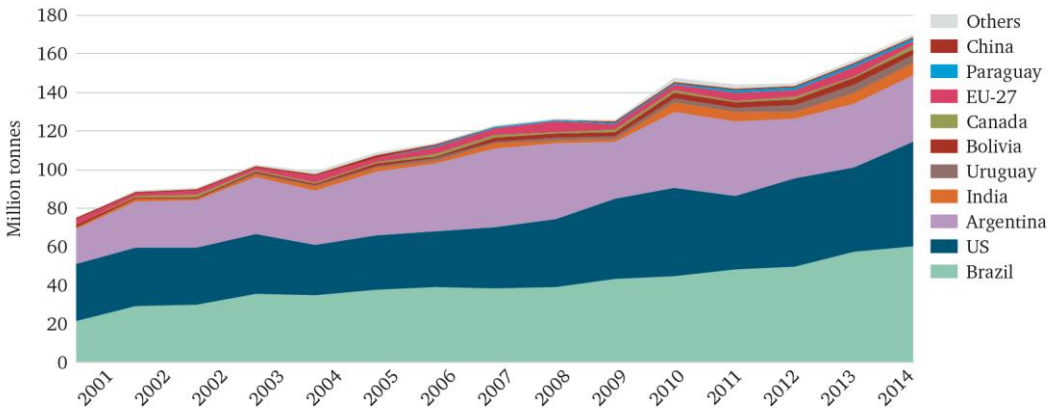
Figure 4.1: Producers of soybeans (primary) 2000–13



Source: Chatham House analysis of FAOSTAT data.

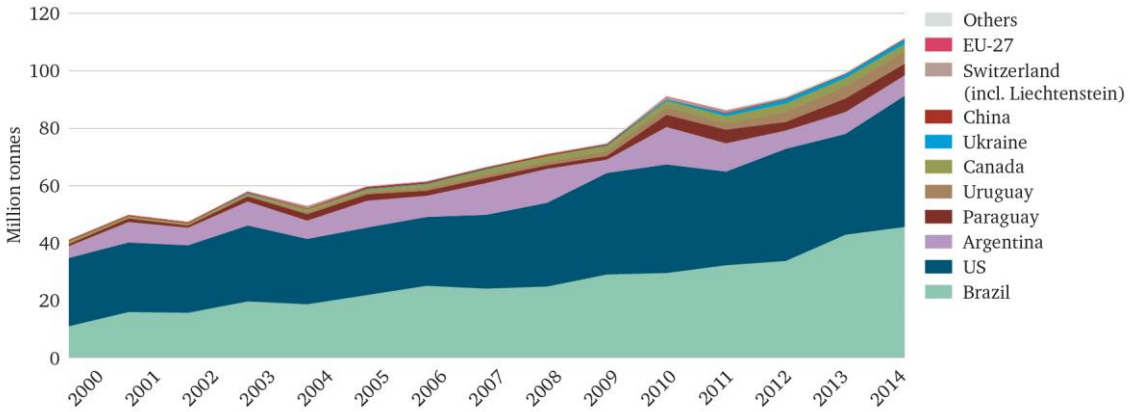
[79] Brown-Lima, C., Cooney, M. and Cleary, D. (2010), *An Overview of the Brazil-China Soybean Trade and its Strategic Implications for Conservation*. Arlington: The Nature Conservancy, p. 6.
[80] Index Mundi commodity price indices.

Figure 4.2: Exporters of soybeans and derivative products, 2000–14



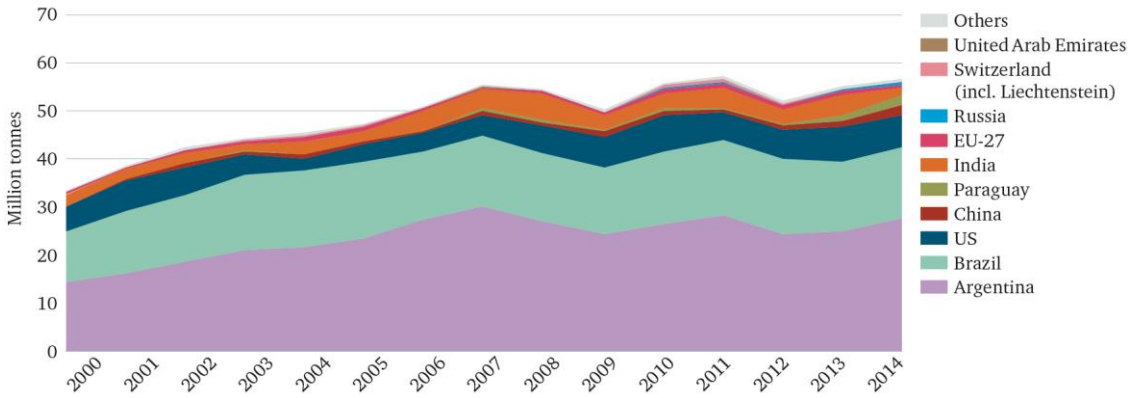
Source: Chatham House Resource Trade Database.

Figure 4.3: Exporters of raw soybeans, 2000–14



Source: Chatham House Resource Trade Database.

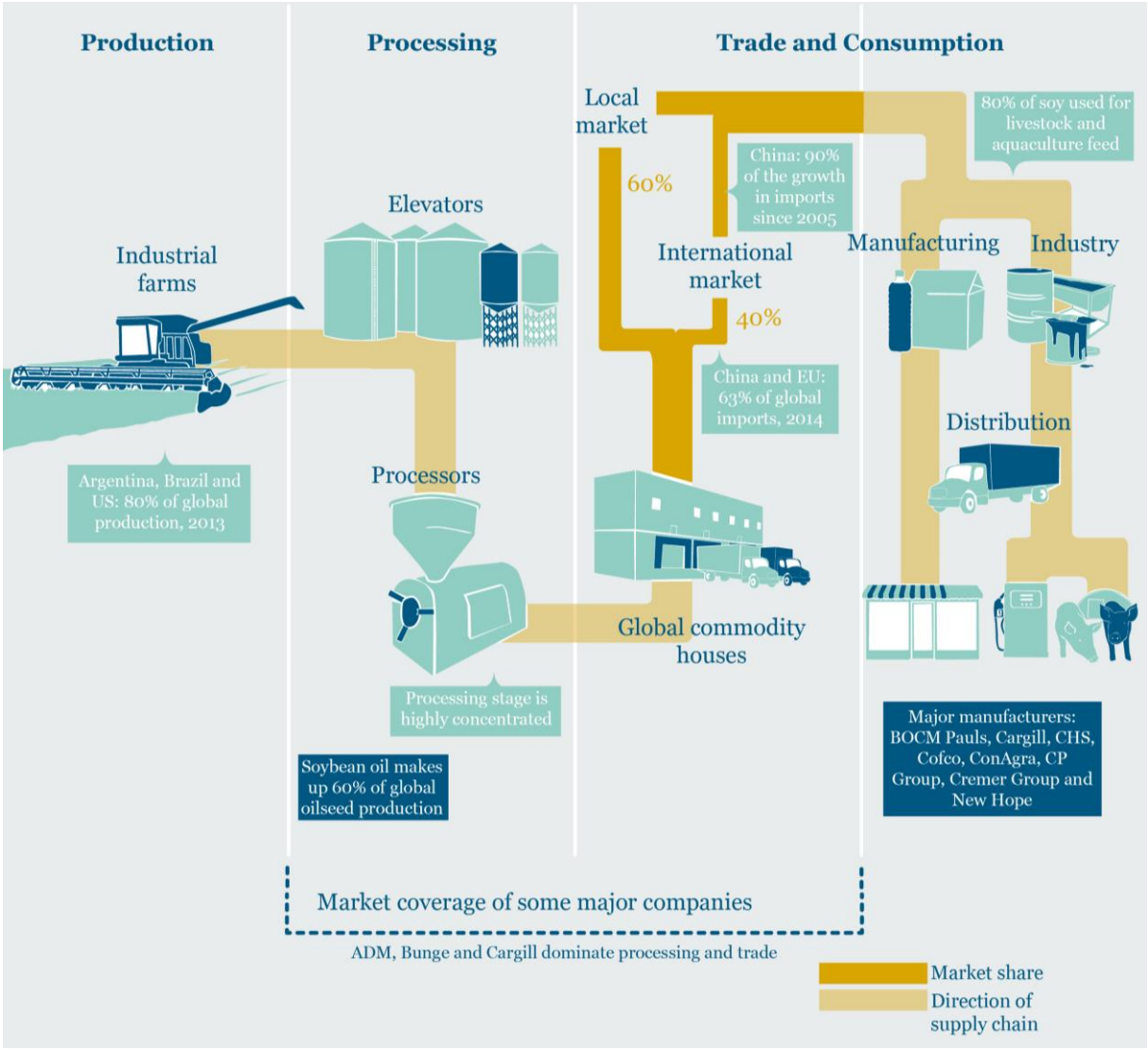
Figure 4.4: Exporters of crude soybean oil (crude, cake and other solid residues), 2000–14



Source: Chatham House Resource Trade Database.

Patterns of soybean production vary from country to country. In Brazil the sector is dominated by large industrial farms, although family farming also plays a role; in the major soybean-producing state of Mato Grosso, for example, farms may cover tens of thousands of hectares (the largest are hundreds of thousands), whereas a typical Brazilian family farm may be more like 70 hectares. Farms in Argentina are comparably vast, whereas in the United States the average farm size is less than 200 hectares. Elevators – the operations that receive, store and transport soybeans – may be operated by large farms, by cooperatives of smaller farms, or by larger processing and trading businesses such as Cargill or ADM. Processors may buy direct from producers or via elevators. The businesses crushing the soybeans to produce oil and meal, and husks as a by-product, provide the 'pinch point' of the soy supply chain, where concentration is high; the main processors and traders are agribusiness giants such as Cargill, Bunge and ADM. Thereafter, the chain fragments as the processed commodities are sold on for different purposes. See Figure 4.5 for a summary of the soy supply chain.

Figure 4.5: Soy supply chain



As with palm oil, growth in soybean production is generally expansive (in terms of area under cultivation) rather than intensive in nature. Soy has only limited potential for yield increases, owing in part to its nature as a biological nitrogen fixer, which renders it largely unresponsive to fertilizers; between 1995 and 2011 aggregate soybean yields increased by just 1 per cent in the major producing countries.[81] Unlike palm oil, yields do not vary much between the major producers (although they tend to be lower in the other producer countries), generally reaching an average of 3 tonnes per hectare, with variations mainly reflecting weather conditions.[82] Accordingly, an increasing area, mainly in South America, is being cultivated for soybean production, and further expansion will be necessary to meet projected increases in demand. The area of land cultivated for

[81] Product Board MVO, (2011), *Fact Sheet Soy*. Zoetermeer: MVO, p. 9.
[82] See, e.g. 'Brazil edges U.S. in soybean crop production', Agrinews, 19 February 2014.

soybean production more than tripled in Argentina between 1990 and 2010, and doubled in Brazil over the same period.[83]

Soybean production in the three major producers is dominated by GM strains: by 2010 the penetration of GM varieties had reached 100 per cent in Argentina, 93 per cent in the US, and 75 per cent in Brazil.[84] Although GM soy was introduced largely with the aim of achieving higher yields, the evidence suggests that, if anything, yields have tended to be lower.[85] The use of GM soy in these countries has also limited their export potential to the EU, where restrictions on GM crops are tight and where the approval process for new GM products is slow.

The extent to which the soybean market in the three major producing countries is oriented towards meeting domestic demand or exports is determined to a large extent by three factors – domestic crushing and infrastructure capacity, differential export taxes, and domestic biofuel policies – which also largely determine the ratio of primary to processed soybean products in exports. As set out below, the US, Brazil and Argentina thus differ considerably in profile.

US

Soy production in the US, the world's largest producer, is primarily oriented to the domestic market, thanks to crushing capacity and domestic biodiesel demand. For most of the period since 2000 the level of production has been at least double that of exports. Meanwhile, output has hardly grown at all, largely because US farmers have found it more profitable to expand corn production for ethanol in response to US biofuel requirements. US policy has consistently favoured ethanol over biodiesel, so while soybean oil is the largest US biodiesel feedstock, and its use is steadily growing, ethanol is far more significant, accounting for 94 per cent of all US biofuel production in 2012. In effect, US ethanol policies have displaced soybean expansion to South America.

US soybean meal is largely destined for its livestock sector and meat exports,[86] while soybean oil is consumed principally in the food manufacturing industry – which accounts for about 83 per cent of total soybean oil consumption – with the remainder being used for industrial applications and for biofuel.[87]

Brazil

Currently the world's second largest producer of soybeans, Brazil may overtake the US in the next few years. Soybean exports are a significant contributor to the national economy, accounting for around 8.5 per cent of Brazil's total export earnings in 2010.[88] However, poor transport links and weak infrastructure capacity have limited the competitiveness of Brazil's crushing industry, which is located largely inland and is poorly connected to the major ports. In March 2013 the line of trucks waiting to unload soybeans at Brazil's busiest port reached a record 15 miles in length, while a total

[83] Pacheco, (2012).
[84] James, C. (2010), *Global Status of Commercialized Biotech/GM Crops: 2010. ISAAA Brief No. 42*. Ithaca, NY: ISAAA.
[85] See, e.g., Gurian-Sherman, D. (2009), *Failure to Yield: Evaluating the Performance of Genetically Engineered Crops*. Washington, DC: Union of Concerned Scientists.
[86] Lee, B., Preston, F., Kooroshy, J., Bailey, R., & Lahn, G. (2013): *Resources Futures*, London: Chatham House.
[87] See http://soynewuses.org/.
[88] Product Board MVO (2011), p. 15.

of 212 vessels awaited loading.[89] Accordingly, the bulk of Brazilian exports (about 70 per cent) are raw soybeans (see Figures 4.2 and 4.3).

Exports of soybean oil have also failed to expand mainly because of growing domestic demand from the biofuel industry; domestic blending mandates for biodiesel were revised in 2014 to increase the required minimum percentage. This, along with similar requirements in Argentina, may open up a gap in the world market for other countries to fill; Paraguay, where processing capacity is increasing, could be one such beneficiary.[90]

Argentina

Argentina's soy industry is the most export-oriented of the three major producers; domestic consumption is limited, and higher export tariffs on primary products have encouraged the development of a considerable domestic crushing industry, mainly based close to major port facilities. Exports from Argentina are thus largely in the form of soybean meal and soybean oil, of which the country is the largest global exporter, supplying more than Brazil and the US combined (see Figure 4.4). Soy production is Argentina's largest agricultural industry and accounts for a significant share of the country's export revenue – some 25 per cent in 2010.[91] As noted, more than half of Argentina's agricultural area is now used for cultivating soy.

Argentina also produced 2.4 million tonnes of soy biodiesel in 2012 – of which 90 per cent was exported to the EU – making it the world's largest exporter of biodiesel (from any feedstock). Since 2013, however, exports have fallen, reflecting both the application of anti-dumping measures by the EU in November 2013 and the rapid fall in world petroleum prices. In 2015 the US government approved the use of Argentinian biodiesel under its Renewable Fuel Standard Program, which should have the effect of boosting exports. Domestic use of soy biodiesel has also been encouraged, in part to replace lost export markets. In addition to promoting production and domestic consumption of soybean oil, these steps should also result in increased output of soybean meal as a by-product of the biodiesel industry, the vast majority of which will be destined for export.

Emerging producers

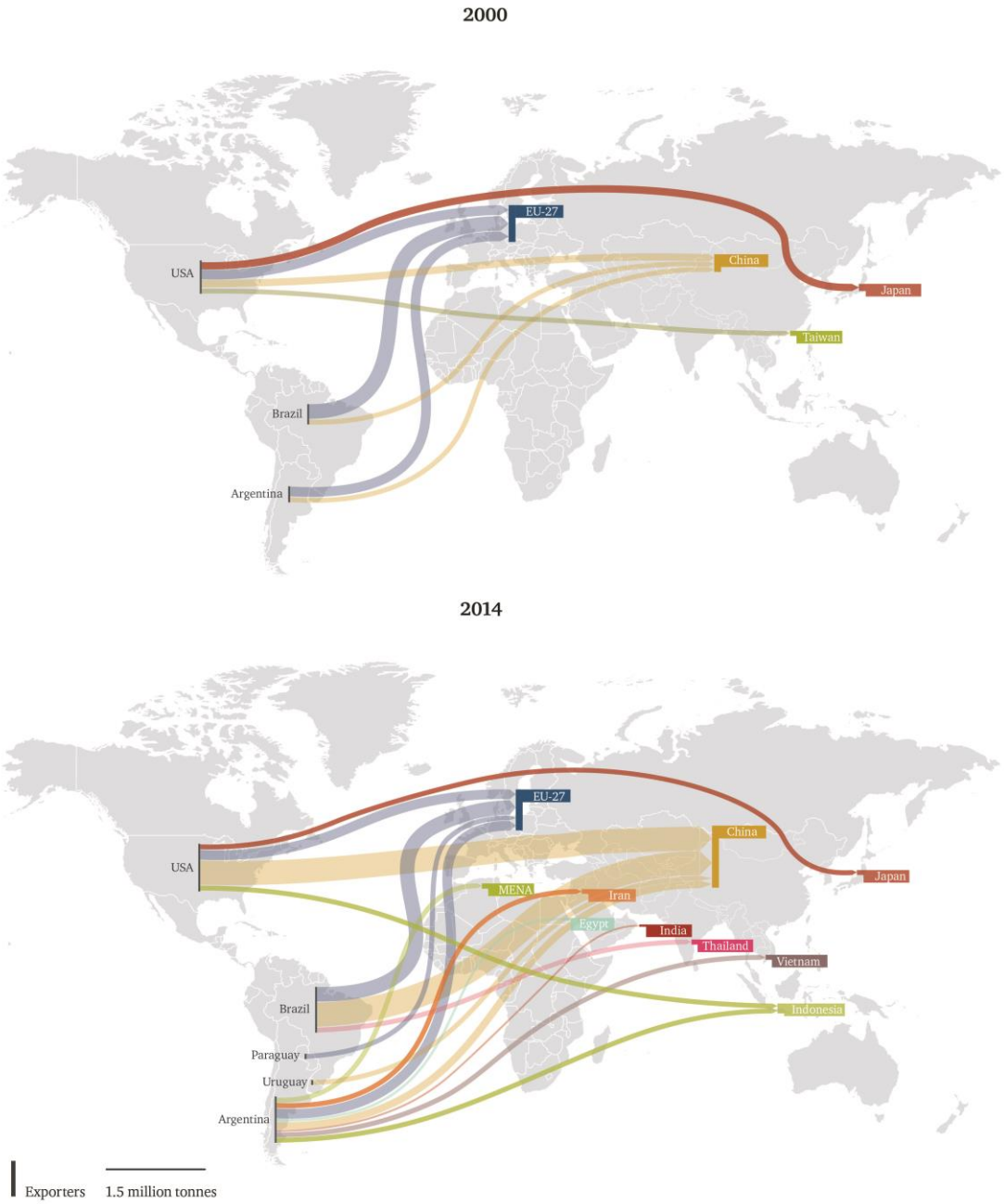
Paraguay is the world's fourth largest exporter of soybeans.[92] The planted area for soybeans has tripled in the last two decades, now accounting for 80 per cent of the country's total agricultural area. There has also been increased investment in soy processing industries and transport infrastructure, with crushing capacity doubling since 2012. Exports of soymeal and oil are accordingly likely to increase, along with demand for soybeans to feed the processing plants. Other emerging producers showing strong growth rates include India, Canada, Uruguay, Bolivia, Ukraine and Russia. There is a slower rate of growth in the EU, where cultivation of GM soy is not permitted.

[89] *Earth Security Index 2015*, p. 6.
[90] USDA (2014), Paraguay Soybeans: Crop Affected by High Summer Temperatures, 20 March 2014, http://www.pecad.fas.usda.gov/highlights/2014/03/Paraguay/.
[91] Product Board MVO 2011, p.15.
[92] USDA (2014).

Soy consumption

The maps in Figure 4.6 show the global trade in soy and derivative products in 2000 and in 2014. Global consumption of soy is concentrated among a few major importers: notably, China and the EU together accounted for 63 per cent of global imports in 2014 (see Figure 4.7). Increasing demand is driven by three key factors: a shift from non-commercial to commercial feed in the livestock sector, involving the mixing of protein-rich soybean with energy-rich grains; the move to protein-rich diets among the rapidly emerging middle classes, principally in China and India, resulting in increased demand for meat, milk and eggs; and a growing number of national biofuel support policies.

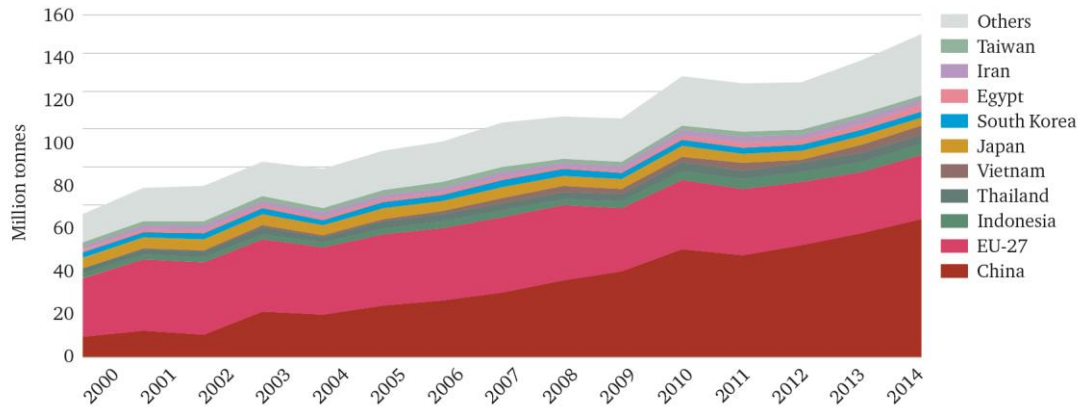
Figure 4.6: Global trade in soy and derivative products in 2000 and 2014[93]



Source: Chatham House Resource Trade Database.

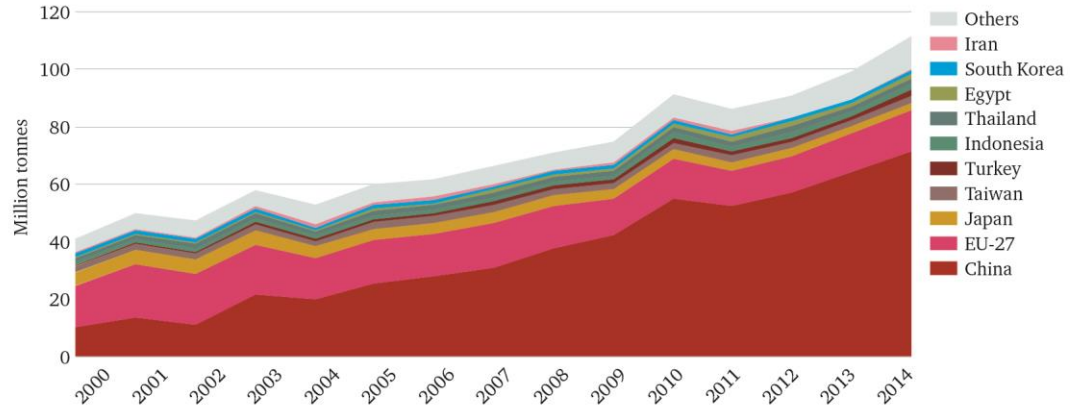
[93] Maps show trade flows only in excess of 1.5 million tonnes.

Figure 4.7: Importers of soybeans and derivative products, 2000–14



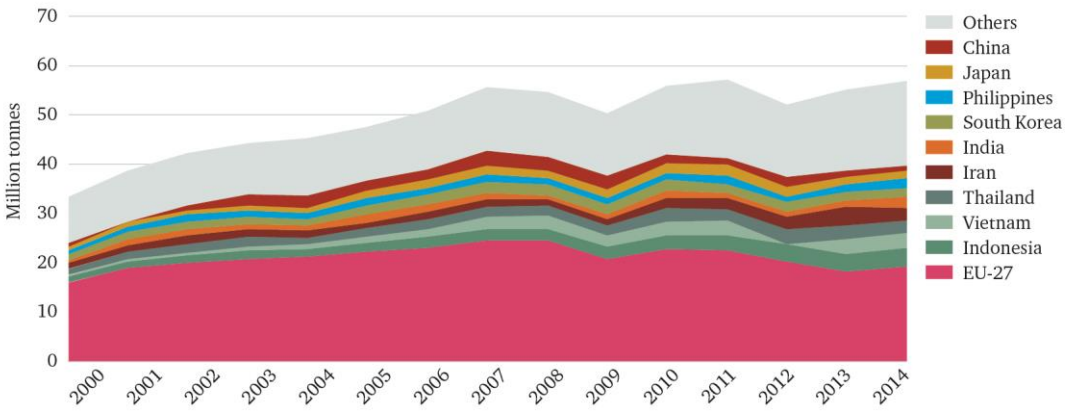
Source: Chatham House Resource Trade Database.

Figure 4.8: Importers of raw soybeans, 2000–14



Source: Chatham House Resource Trade Database.

Figure 4.9: Importers of soybean oil (crude, cake and other solid residues), 2000–14



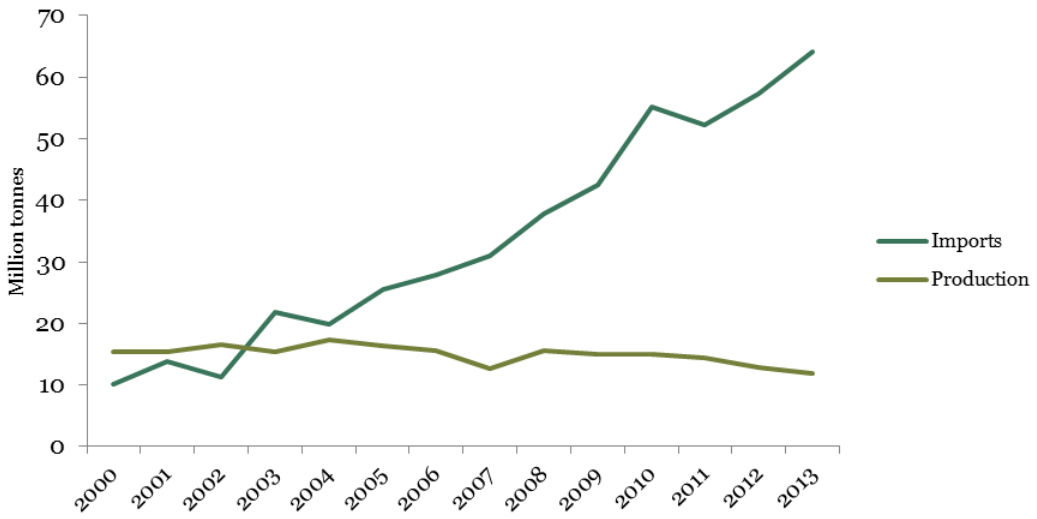
Source: Chatham House Resource Trade Database.

China

The entry of China to the market as a major consumer of soy has transformed the profile of the global trade; China alone has accounted for over 90 per cent of the total growth in imports recorded since 2005, and in 2014 the country accounted for almost 40 per cent of total world imports of the commodity. Much of this is destined for use as animal feed in the pig and poultry industries, as rising incomes have brought a shift to richer, more meat-intensive diets. China's imports of soy are projected to increase by a further 30 per cent by 2030.[94]

While the country is itself a significant producer of soybean, demand far outstrips domestic production. A policy of self-sufficiency in grain production since the 1950s, further reinforced by the impact of the 2007–08 food price crisis, has resulted in limited investment in China's own soybean production industry and rising dependence on foreign imports (see Figure 4.10).

Figure 4.10: China's soybean production and imports, 2000–13



Sources: Chatham House Resource Trade Database and FAOSTAT.

Both the small size of the average farm and the low average yield per hectare have served to further limit growth in China's domestic soy production.[95] Differential import tariffs for primary and processed soybean products have incentivized imports of soybeans as opposed to meal and oil: combined with limited domestic production growth, this has resulted in the development of a thriving crushing industry. Increased Chinese processing capacity for soybeans has been a significant factor in the global trade, and a major driver of the expansion of cultivation in South America.

[94] Masuda & Goldsmith, (2012).
[95] Product Board MVO, (2011).

EU

The EU is the world's second largest importer of soybeans and derivative products, accounting for almost 20 per cent of global imports in 2014 – although there has been a gradual fall in its overall share since 2000, when the EU imported 35 per cent of global soy exports. Demand has been primarily driven by a general deficit in protein crop production and by expanding livestock production, together with biofuel policy. EU crushing of soybeans is on a downward trend, however, as the use of soybean oil for biodiesel feedstock has declined as a proportion of the total. In 2012 soybean oil accounted for about 13 per cent of EU biodiesel consumption, either as feedstock or as imported biodiesel.[96] (Anti-dumping duties imposed by the EU in November 2013 on Argentinean biodiesel have sharply reduced imports since.) Nevertheless, the EU remains the main global consumer of soy-based biodiesel.

This decline in soybean crushing in the EU market has been accompanied by increased imports of soybean meal – although increasingly rapeseed meal (a by-product of the biodiesel production process) is being used as a substitute in animal feed – and falling imports of soybeans in their primary form (see Figure 4.8).

Emerging consumers

Indonesia, Mexico, Japan, Vietnam and Thailand all currently feature among the top 10 soybean meal importers, with a boom driven by increasing demand for meal as a feedstock for the aquaculture industry, as well as increased demand for animal protein by consumers.[97] None, however, accounts for more than about 3 per cent of the world market.

Soy and deforestation

The expansion of soy production in South America has been strongly associated with deforestation.[98] An influential paper published in 2006 established a strong correlation between international soybean prices and rates of deforestation in the Amazon basin, and used satellite imagery to show that cropland expansion, mainly for soy, was an increasing driver of deforestation between 2001 and 2004, accounting for 17 per cent of total forest loss.[99]

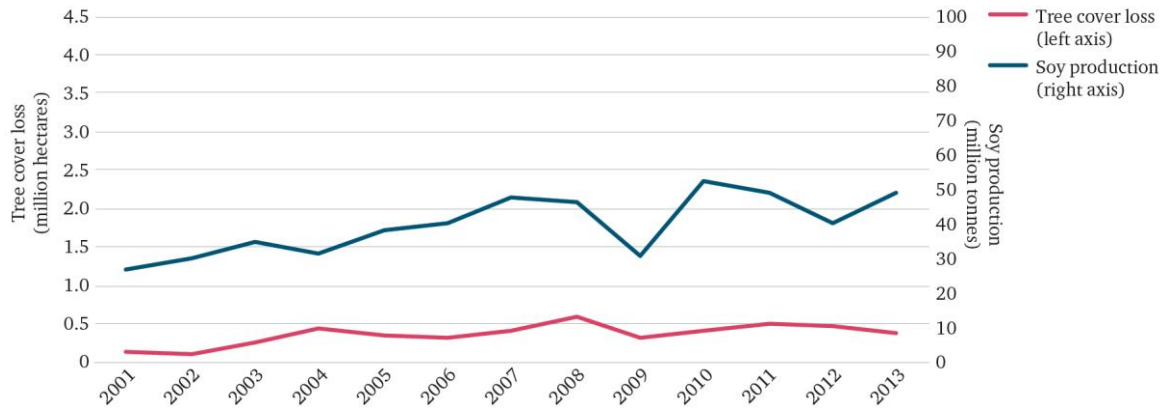
In 2006, in response to pressure from retailers and NGOs, the world's major soybean traders agreed not to purchase soy grown on lands deforested after July 2006 in the Brazilian Amazon or on farms using indentured or forced labour.[100] This was the first voluntary zero-deforestation agreement implemented in the tropics, and set the stage for supply-chain governance of other commodities such as beef and palm oil. Originally planned to last for two years, the soy moratorium has been extended on eight occasions, and under the current extension will remain in place until May 2016; after this, new arrangements are planned to ensure that soy production is compliant

[96] Ecofys (2014), *Renewable Energy Progress and Biofuels Sustainability*. Report for the European Commission. Utrecht: Ecofys.
[97] See http://uk.reuters.com/article/2014/09/30/us-china-gmo-idUKKCN0HP13X20140930.
[98] Nepstad, D.C, et al. (2006), 'Globalisation of the Amazon Soy and Beef Industries: Opportunities for Conservation', *Conservation Biology* 20: 6
[99] Morton, D.C, et al. (2006), 'Cropland expansion changes deforestation dynamics in the southern Brazilian Amazon', *Proceedings of the National Academy of Sciences of the United States of America* 103: 39.
[100] Boucher, D, (2014), 'How Brazil Has Dramatically Reduced Tropical Deforestation', *Solutions,* 5:2.

with the new Forest Code approved in May 2012.[101] These are being developed by the Soy Working Group (GTS) – the same coalition of industry associations, multinational companies, NGOs and, since 2008, government representatives that was behind the original moratorium.

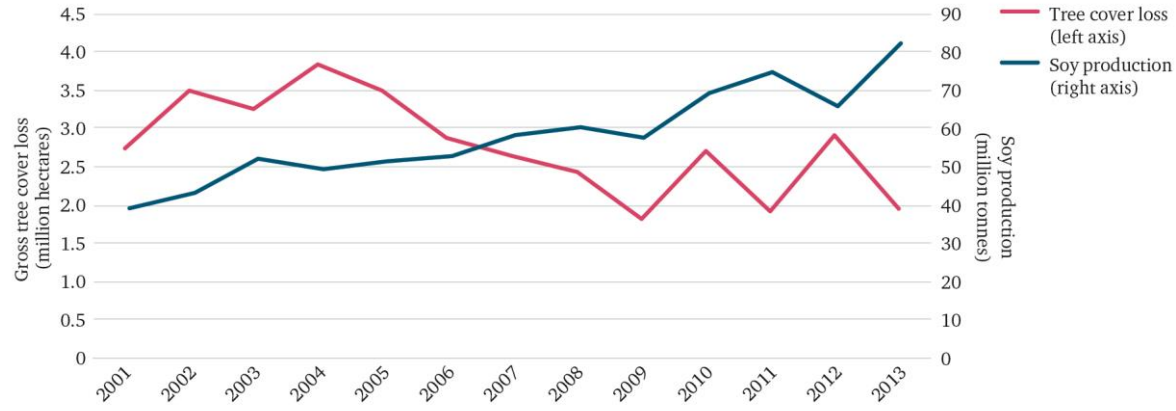
The imposition of the moratorium appears to have weakened the direct link between soybean production and deforestation: the most recent monitoring found that soybean cultivation accounted for 0.41 per cent of all deforestation since the moratorium was first implemented (0.53 per cent in the three main soy producing states).[102] Nevertheless, there is evidence that soybean expansion remains an indirect driver of deforestation, as it may displace cattle ranching towards the forest.[103] See Figures 4.11 and 4.12.

Figure 4.11: Gross tree cover loss and production of soy in Argentina, 2001–13



Source: WRI (see footnote to source for Figure 3.11).

Figure 4.12: Gross tree cover loss and production of soy in Brazil, 2001–13



Source: WRI (see footnote to source for Figure 3.11).

[101] ABIOVE, (2014).
[102] Soy Task Force, (2012), *Soy Moratorium: Mapping and Monitoring Soybean in the Amazon Biome – 5th Year*, available at: http://www.illegal-logging.info/content/soy-moratorium-mapping-and-monitoring-soybean-amazon-biome-%E2%80%93-5th-year.
[103] Barona, E., et al. (2010) 'The Role of Pasture and Soybean in Deforestation of the Brazilian Amazon', *Environmental Research Letters*, 5 (2).

Commitments to eliminate deforestation from their supply chains by companies producing or trading in soy are less extensive than those by companies trading in palm oil, but are steadily gaining ground (see the subsection Reducing impacts on forests, in Section 6, below).

5. Beef and Leather

According to the European Commission study on the impact of EU consumption on deforestation, ruminant livestock – mainly beef cattle – together with the production of cattle feed had the highest impact of any agricultural product, accounting for 49 per cent of global deforestation.[104] In contrast to palm oil and soy, however, most beef is consumed in the countries of production, and EU imports of ruminant livestock products accounted for only about 13 per cent of embodied deforestation over the same period.[105]

Also in contrast to palm oil and soy, global beef consumption is essentially stagnant, with little overall change in the last decade. In most developed countries consumption is falling slightly, although this has been mostly offset by higher consumption in emerging economies – particularly Brazil, India, Pakistan and China. As already noted, rising incomes and the growth of the middle class have led to a steady increase in meat consumption in many middle-income countries.[106]

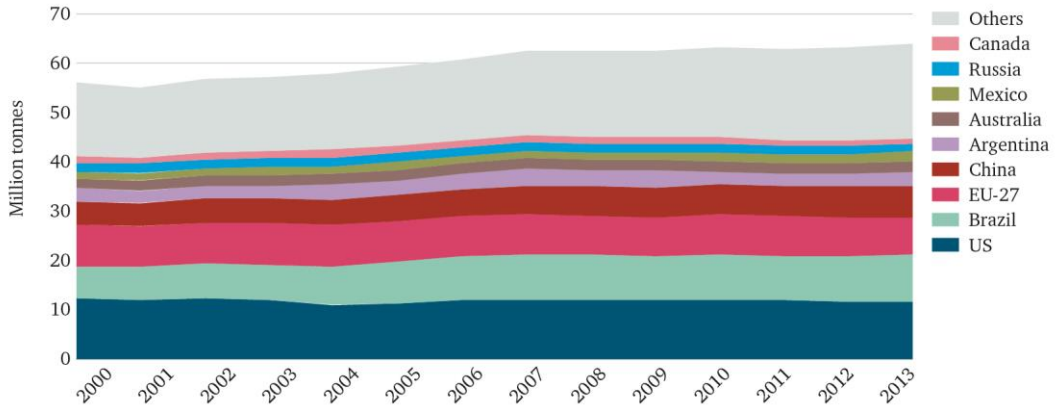
Beef

Beef production

The world's major beef producers include the US, Brazil, the EU and China, each with 10 per cent or more of global production (see Figure 5.1). Latterly, drought in the southern US in 2010–13, followed by similar conditions in northern US states in 2012–15, has kept US beef production down; in 2013 the number of cattle in the US was the lowest in 60 years. This has helped to keep world beef prices relatively high, in contrast to the pattern for many other agricultural commodities; prices increased fairly steadily from 2000 to 2014, although they fell by about 25 per cent during 2015.

[104] European Commission (2013), p. 21.
[105] Ibid., p. 24.
[106] The description of the beef and leather supply chains contained in this section is an abbreviated version of that included in the appendix to Brack and Bailey, 2013. Compared with that paper, this section contains more (and updated) details on production, export and import data, and on the national situations of key countries.

Figure 5.1: Beef producers, 2000–13 (million tonnes)



Source: Chatham House analysis of FAOSTAT data.

The profile of cattle production varies by country. Most US beef farms are small, with some 500,000 of the estimated 850,000 total managing less than 50 animals.[107] In South America cattle farms tend to be more expansive. Argentina has around 250,000 cattle farms with an average size of 600 ha. In Brazil livestock are pasture-fed on large ranches, although industrial farming techniques such as feed supplements during the dry season and feedlot operations to fatten cattle before slaughter and shorten the production cycle are becoming more common. These shifts reflect a gradual move in Brazil towards more intensive farming methods, similar to those used in the US.

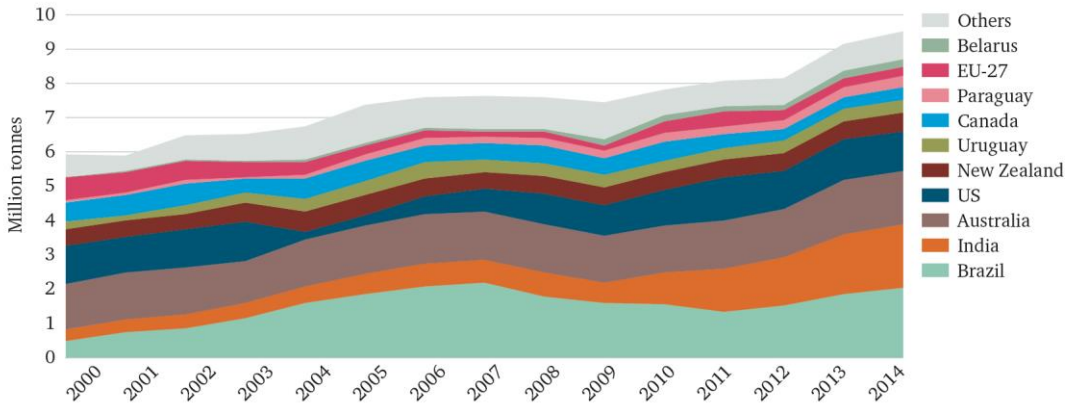
Although production is highly dispersed, supply chain concentration increases significantly among meatpackers: major business operations such as Tyson Foods, Cargill Meat Solutions, National Beef and JBS dominate processing in the US and Brazil. JBS is now the world's biggest meat producer, overwhelmingly leading the industry in its home country of Brazil and running operations in key producing countries such as Australia and Canada.[108] Processing and distribution activities have become increasingly vertically integrated, with meatpacking companies moving into food manufacturing and wholesaling. The marketing stage of the chain is similarly concentrated, with relatively small numbers of supermarkets and restaurant chains accounting for significant sales of processed beef products.

Principal beef exporters include Brazil, India, Australia and the US (see Figure 5.2). Particularly noteworthy is the growth of exports from India, given that most Indian states prohibit or severely restrict the slaughter of cattle on religious grounds; however, the dairy herd of buffalo yields a significant surplus of male calves that are increasingly slaughtered and exported as low-priced beef to markets in the Middle East, Africa and Asia.

[107] Beef is estimated to account for about 80 per cent of the US herd, according to estimates contained in Lowe, M. and Gereffi, G. (2009), *A Value Chain Analysis of the US Beef and Dairy Industries*. Durham: Center on Globalization, Governance & Competitiveness, Duke University.

[108] 'JBS: The Story Behind The World's Biggest Meat Producer', Forbes , 21 April 2011, see http://www.forbes.com/sites/kerenblankfeld/2011/04/21/jbs-the-story-behind-the-worlds-biggest-meat-producer/#2715e4857a0b60b782dac557.

Figure 5.2: Beef exporters, 2000–14 (million tonnes)



Source: Chatham House analysis of USDA FAS data.

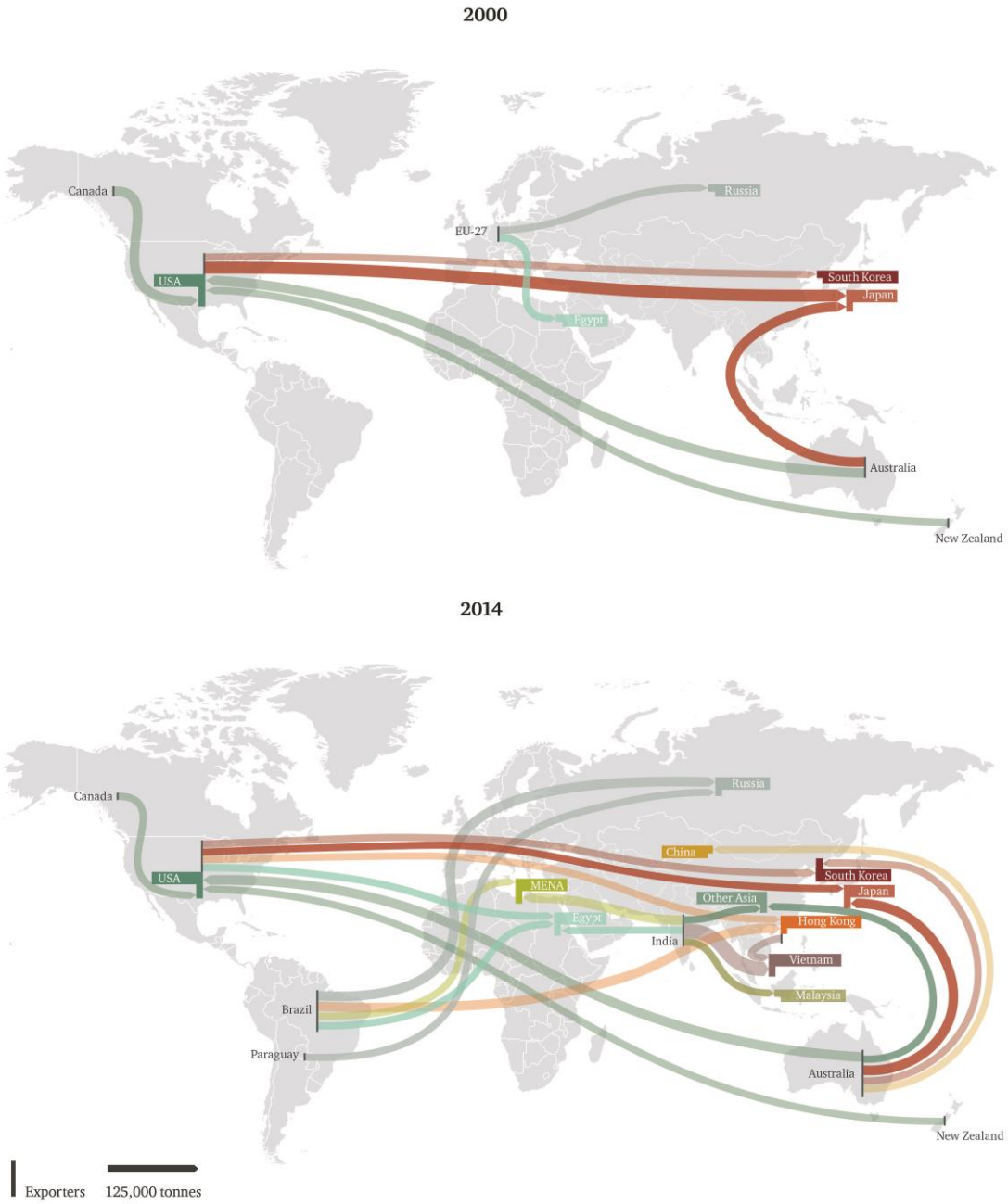
Beef production in Brazil is primarily for domestic consumption. Only about 15 per cent of output is exported, but with this share Brazil is nevertheless the world's biggest exporter – primarily to Russia, the Middle East, North Africa, the EU, Venezuela, Chile and Hong Kong. Russia tends to take the highest proportion by weight, and the EU the greatest share by value. In general, since it typically exports low-value cuts, Brazilian beef exports tend to have lower export values than do those of other major exporters such as the US and Australia; there are also concerns about foot-and-mouth disease and about sanitary problems in the slaughter process.

Beef consumption

Global beef consumption peaked at about 58 million tonnes CWE (carcass weight equivalent) in 2007, and has since declined slightly to stand at around 57 million tonnes in 2014 (see Figure 5.4). In most developed countries consumption is falling: US and EU consumption has declined by about 2 per cent annually since 2007. It is unclear to what extent this reflects greater awareness of the health risks associated with high levels of consumption of red meat; economic difficulties and falling real incomes since the global recession of 2007–08 are also likely to have played a major part.

Declining consumption in the developed world has been partially offset by increasing consumption in emerging economies, particularly in Brazil (now the second biggest consumer of beef, after the US) but also in India, Pakistan and China. The maps in Figure 5.3 below show the global trade in beef in 2000 and in 2014.

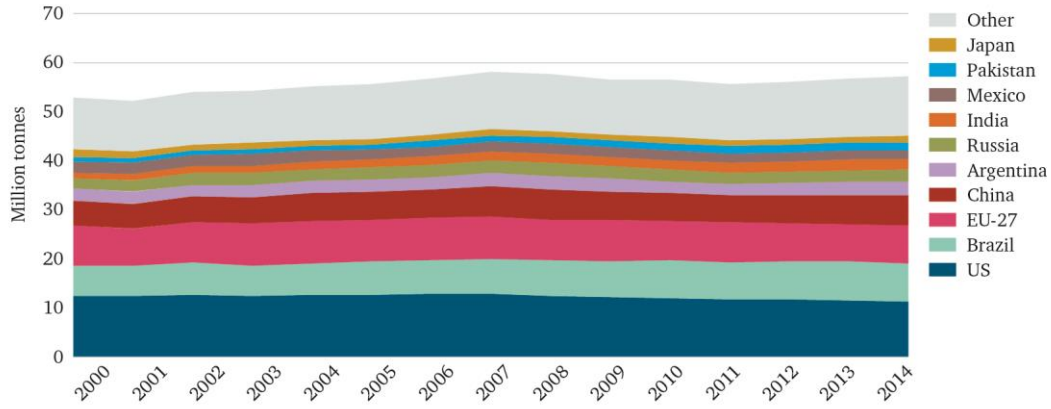
Figure 5.3: Global trade in beef in 2000 and 2014[109]



Source: Chatham House Resource Trade Database.

[109] Maps show trade flows only in excess of 125,000 tonnes.

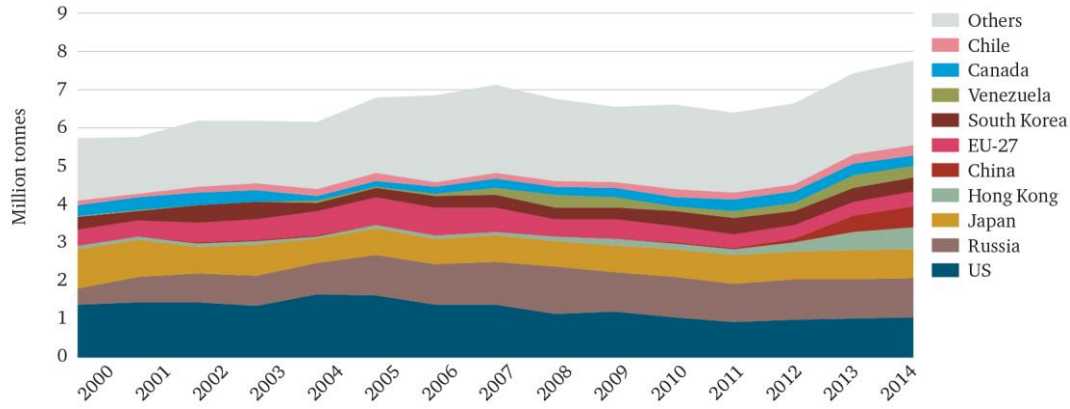
Figure 5.4: Beef consumers, 2000–14



Source: Chatham House analysis of USDA FAS data.

Globally, trade in beef represents about 10 per cent of production, with the major producers typically being also major consumers. The largest importers of beef are currently the US and Russia. Other major importers include Japan and South Korea, with the mainland Chinese and Hong Kong markets also having grown very rapidly since 2011 (see Figure 5.5).

Figure 5.5: Beef importers, 2000–14



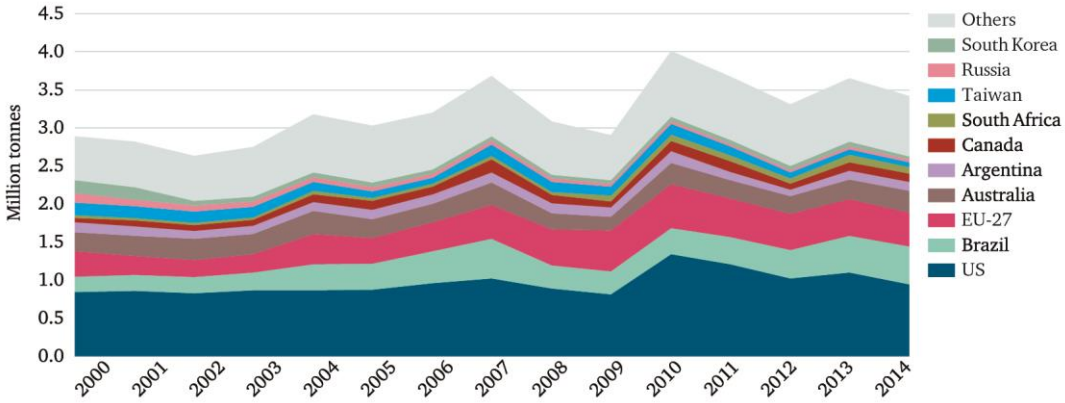
Source: Chatham House analysis of USDA FAS data.

Leather

As a by-product of beef (and to a lesser extent dairy) production, output of leather is largely determined by that of beef; leather accounts for only about 10 per cent of the slaughter value. Production is therefore essentially inelastic, being determined by the dynamics of the beef chain. This also means that the two commodities have similar production footprints in the first instance,

as slaughter and hide production are coincident.[110] The major producers of bovine hides in 2011 were Brazil (14 per cent of worldwide production by wet-salted weight), the US (also 14 per cent), the EU (12 per cent), China (11 per cent), and Argentina and India (5 per cent each).[111] The major exporters were the US, the EU, Brazil and Australia (see Figure 5.6).

Figure 5.6: Exporters of bovine hides and leather, 2000–14

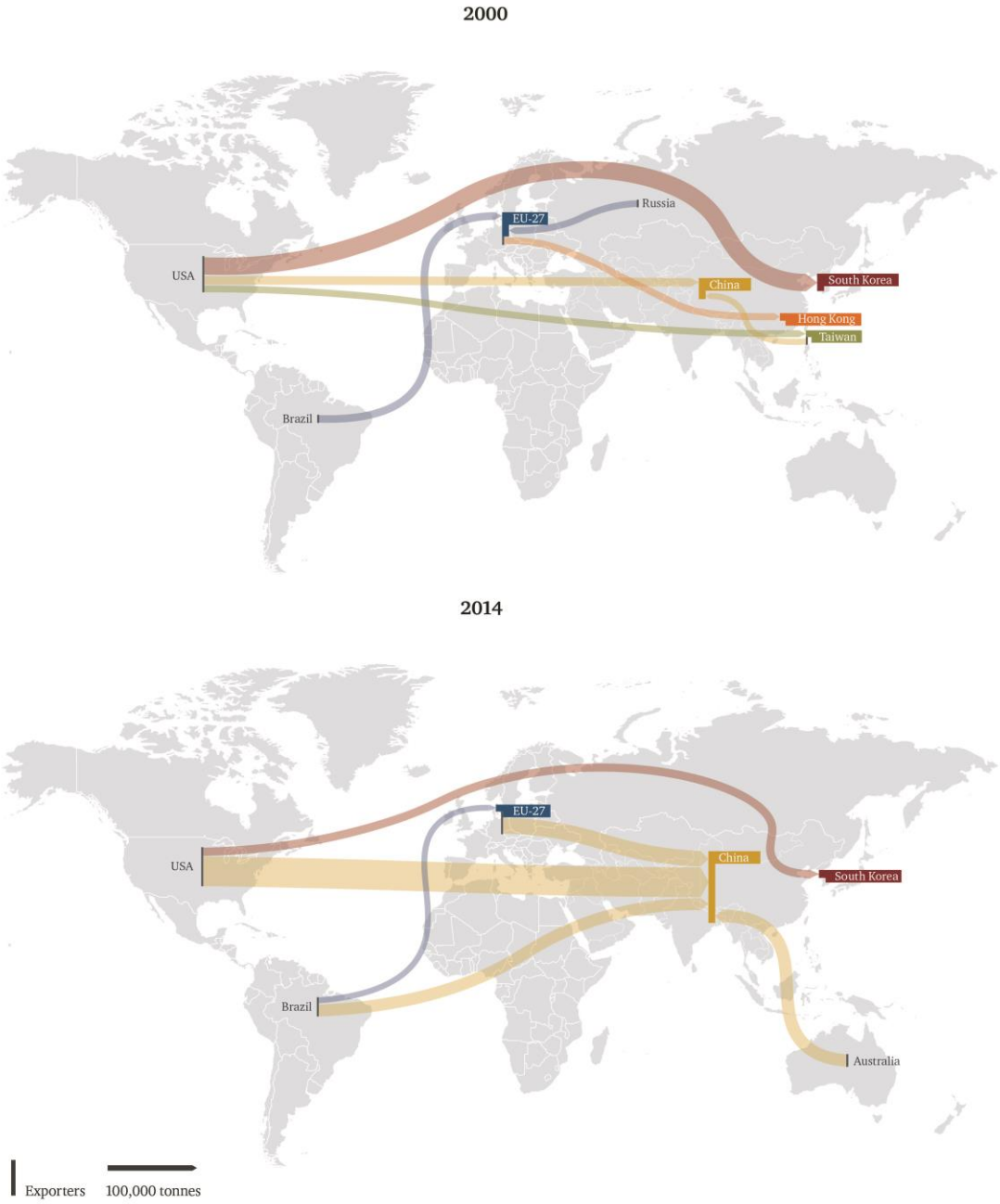


Source: Chatham House Resource Trade Database.

The maps in Figure 5.7 below show the global trade in leather in 2000 and in 2014. The principal importers of bovine hides are those countries with significant leather manufacturing industries – principally China, Hong Kong and the EU (mainly Italy, which is a global leader in high value-added and luxury leather goods) (see Figure 5.8). China accounted for more than 45 per cent of all leather shoes manufactured worldwide in 2014, and as such is not only a major producer of tanned leather but also a major importer.[112] Other significant manufacturing hubs include Brazil, Mexico, India, Indonesia and Vietnam.[113]

[110] Small differences may arise depending on whether leather production is from dairy herds or from exported cattle, for example.
[111] FAO (2011), *World statistical compendium for raw hides and skins, leather and leather footwear 1992–2011*. Rome: FAO.
[112] UN COMTRADE, 2015.
[113] Ibid.

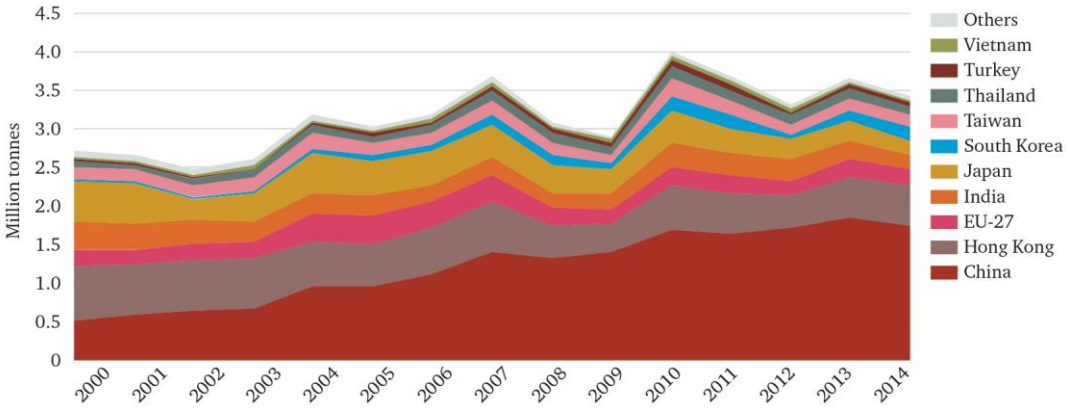
Figure 5.7: Global trade in leather in 2000 and 2014[114]



Source: Chatham House Resource Trade Database.

[114] Maps show trade flows only in excess of 100,000 tonnes.

Figure 5.8: Importers of bovine hides and leather, 2000–14

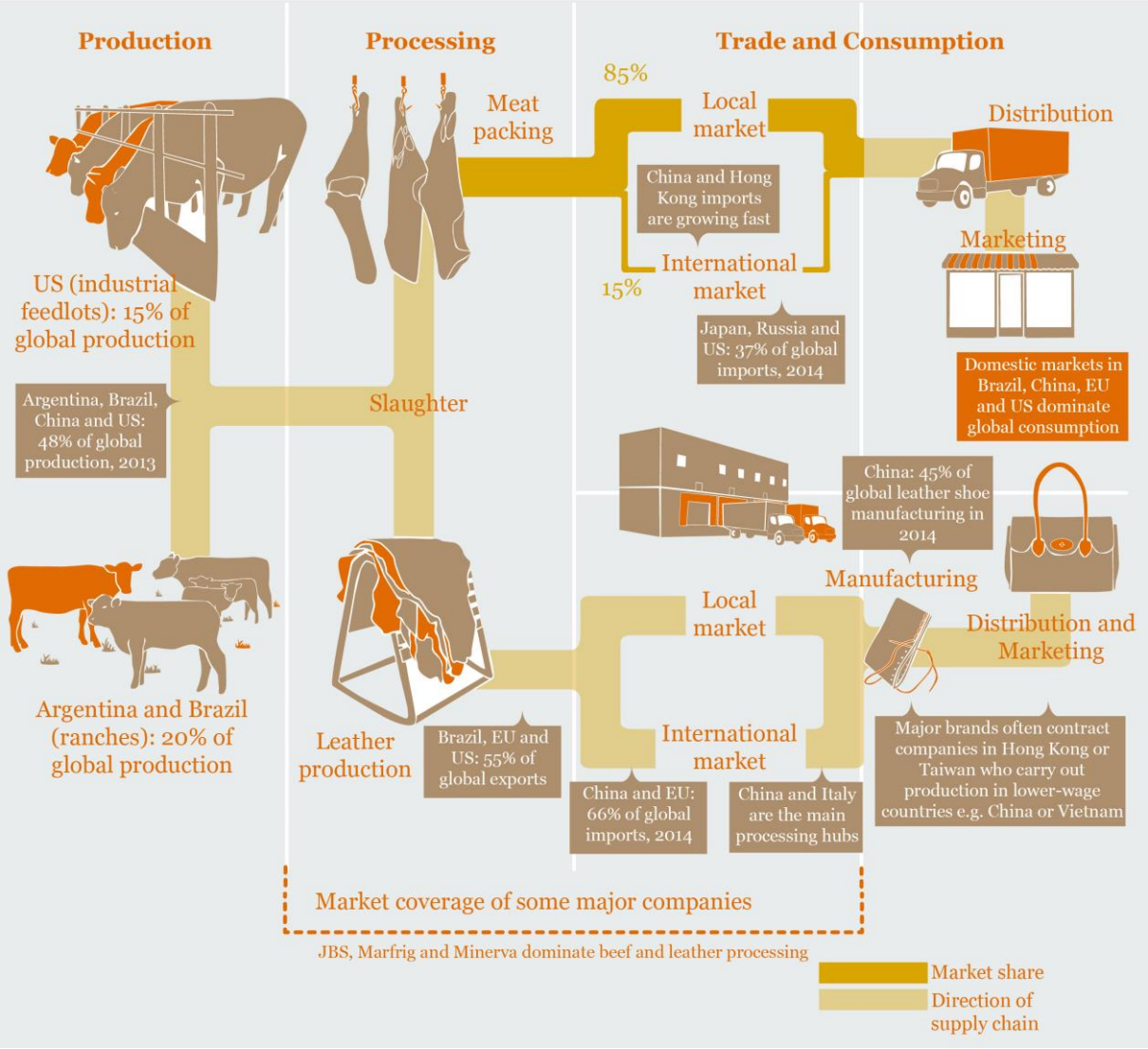


Source: Chatham House Resource Trade Database.

Manufacturing increasingly takes place under contract arrangements with branded footwear or leather goods companies that also undertake branding, marketing and distribution. Such arrangements are often triangular: for example, developed-country brands contract companies in Hong Kong or Taiwan which then carry out production in affiliated factories in lower-wage centres such as mainland China or Vietnam.[115] See Figure 5.9 below for a summary of the beef and leather supply chain.

[115] López, A., Ramos, D. and Simkievich, C. (2008), *A Study of the Impact of China's Global Economic Expansion on Argentina: Leather Value Chain Analysis*. Buenos Aires: CENIT.

Figure 5.9: Beef and leather supply chain

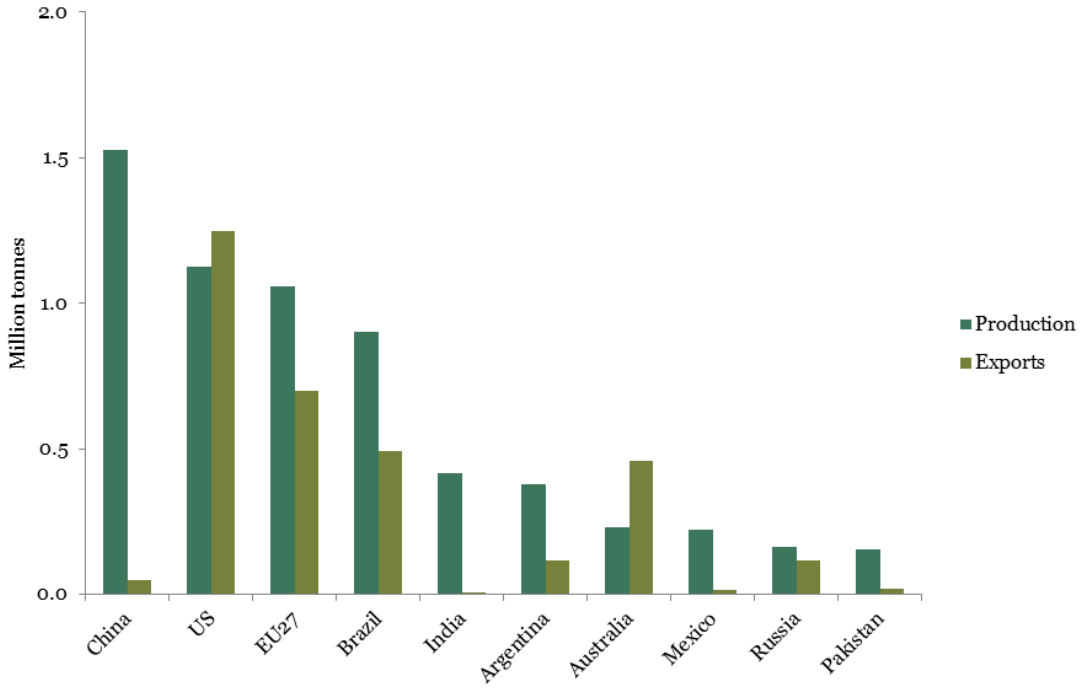


Brazil is a major actor in the first three stages of the leather supply chain – production, slaughter and processing – on a volume basis accounting for 14 per cent of hide production (the world's largest producer), and 12 per cent of light leather production (third globally, behind China and the EU).[116] Brazil tends not to export (lower-value-added) hides for tanning overseas, however; instead, nearly all hides produced in Brazil are processed domestically and exported as leather.[117] The beef and leather supply chains therefore differ significantly in the degree to which they extend beyond Brazil's borders. Whereas only about 15 per cent of beef is exported, the vast majority of leather is

[116] FAO (2011).
[117] Ibid.

shipped overseas. Other major leather producers and exporters are the EU, China, the US and Argentina (see Figure 5.10).[118]

Figure 5.10: Leather production and exports (million tonnes), 2013



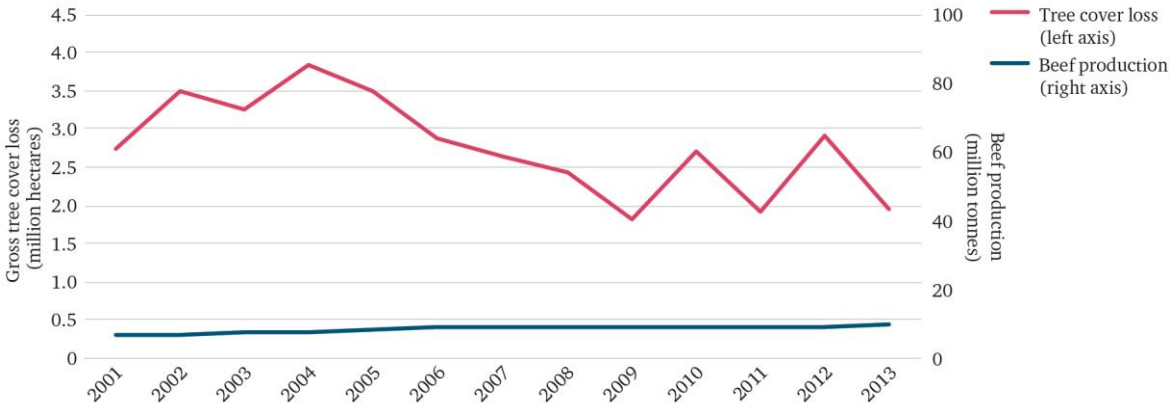
Sources: FAO and Chatham House Resource Trade Database.

Beef and deforestation

It is in South America, and principally Brazil, that cattle production has been most closely linked to deforestation. In the four decades from 1970 more than 90 per cent of the Brazilian rainforest cleared was to make way for cattle ranches.[119] The Brazilian herd was estimated at 147 million head in 1990, but had grown to over 200 million head by 2011.[120] Estimates suggest that 93 per cent of this increase has occurred in the Amazon region,[121] with pastures for ranching occupying 75 per cent of all deforested areas in the Amazon[122] (see Figure 5.11).

[118] Chatham House Resource Trade Database, BACI, COMTRADE.
[119] Embassy of Brazil in London (2009), *Farming in Brazil*, http://www.brazil.org.uk/resources/documents/bs-secondary08.pdf.
[120] Associação Brasileira das Indústrias Exportadoras de Carne (ABIEC) (2011), *Brazilian Beef Profile 2011*, at http://www.abiec.com.br/download/ fluxo_eng.pdf.
[121] Bowman, M. S., Soares-Filho, B. S., Merry, F. D., Nepstad, D. C., Rodrigues, H., and Almeida, O. T. (2012). 'Persistence of cattle ranching in the Brazilian Amazon: a spatial analysis of the rationale for beef production.' *Land Use Policy*, 29(3), 558–68.
[122] Barreto, P. and Silva, D. (2009), *The challenges to more sustainable ranching in the Amazon*. Belém: IMAZON.

Figure 5.11: Gross tree cover loss and production of beef in Brazil, 2001–13



Source: WRI (see footnote to source for Figure 3.11).

The Brazilian beef industry argues that it has achieved this growth without expansion in grazing area by increasing productivity. However, the position of ranching at the agricultural frontier in the Amazon means that rapid expansion in other agricultural sub-sectors – most notably soy and sugar cane – can push ranching further into the rainforest even if the aggregate grazing area has declined.

As with palm oil and soy, private-sector voluntary initiatives for beef and leather have tended to follow on from action by NGOs – principally Greenpeace, which has published two reports linking deforestation to beef and cattle production in the Amazon. In response to the first of these, *Slaughtering the Amazon* (2009), major brands such as Timberland, Clarks, Nike, Adidas and supermarkets including Walmart and Carrefour announced deforestation pledges whereby they would cancel contracts with suppliers implicated in deforestation. This led the major Brazilian beef and leather processors JBS, Minerva and Marfrig to agree, in the same year, a moratorium[123] on the purchase of cattle from ranches on recently deforested and indigenous land.

A subsequent Greenpeace report, *Broken Promises* (2011), detailed how JBS had continued to purchase cattle from ranches occupying indigenous lands in contravention of the agreement. In 2013 the Brazilian Association of Supermarkets, which represents some 2,800 supermarkets, effectively joined the moratorium, agreeing not to stock beef linked to deforestation in the Amazon rainforest; meat of unknown origin was also to be rejected by the organization's members.[124](For further details, see the subsection Reducing impacts on forests, in Section 6, below.)

As the beef moratorium has been implemented much more recently than the soy moratorium, there is relatively little evidence yet as to its effectiveness. None the less, a 2015 analysis of the implementation of zero-deforestation agreements, focusing on JBS, demonstrated that these significantly and rapidly changed meatpacker and rancher behaviour in the state of Pará, with sales

[123] Termed the G4 agreement: a fourth member, Bertin, was subsequently acquired by JBS.
[124] Mongabay (2013), *Brazilian supermarkets ban beef linked to Amazon deforestation*, 27 March 2013, at http://news.mongabay.com/2013/03/brazilian-supermarkets-ban-beef-linked-to-amazon-deforestation/.

from direct suppliers with deforestation effectively blocked.[125] Overall, the rate of deforestation in the Amazon has dropped markedly since 2004, though it has turned up again since 2013.[126]

In 2013 the luxury goods brand Gucci announced a line of 'zero deforestation' handbags, each with a 'passport' documenting the product's supply chain beginning at the ranch that produced the leather. The line uses only leather sourced from ranches that have been certified by the Rainforest Alliance (and also only organic cotton).[127]

[125] Gibbs, H. K., et al. (2015), Did Ranchers and Slaughterhouses Respond to Zero Deforestation Agreements in the Brazilian Amazon? *Conservation Letters*
[126] See, *Guardian* (2015), 'Amazon deforestation report is major setback for Brazil ahead of climate talks', 27 November 2015.
[127] Mongabay (2013), *Gucci launches "zero deforestation" handbag*, 7 March 2013, http://news.mongabay.com/2013/03/gucci-launches-zero-deforestation-handbag/.

6. Future Trends

The previous three sections have presented information on recent and current developments for the production and consumption of palm oil, soy and beef. This section considers a range of factors likely to affect future developments in production and consumption.

Future growth in consumption and production

Three main factors underlie the growth in consumption and production of palm oil and soy: population growth; changing dietary preferences; and policy support for biofuels. The first two are just as relevant to beef.

The world's population exceeded 7 billion in 2011, and is currently growing by approximately 74 million people per year. Assuming a fall in the average fertility rate, current UN projections are that the world population will reach 9 billion by about 2050.[128] Almost all this growth will be in developing countries, which are expected to account for 7.8 billion people in 2050; the population of the more developed regions will remain mostly unchanged, at 1.2 billion.

Accompanying this global population increase is an anticipated rise in income. The size of the 'global middle class' is projected to increase from 1.8 billion in 2009 to 3.2 billion by 2020 and to 4.9 billion by 2030, with the bulk of this growth occurring in Asia.[129] Richer households tend to consume more food in total, including more processed foods (a development also reflecting greater urbanization) and more meat; in 2014 average per capita meat consumption in China was about a third that in the EU.[130] It is possible that health concerns may inhibit significant growth in beef consumption (see below), but soy currently plays a major part in feed for pork, chicken and farmed fish.

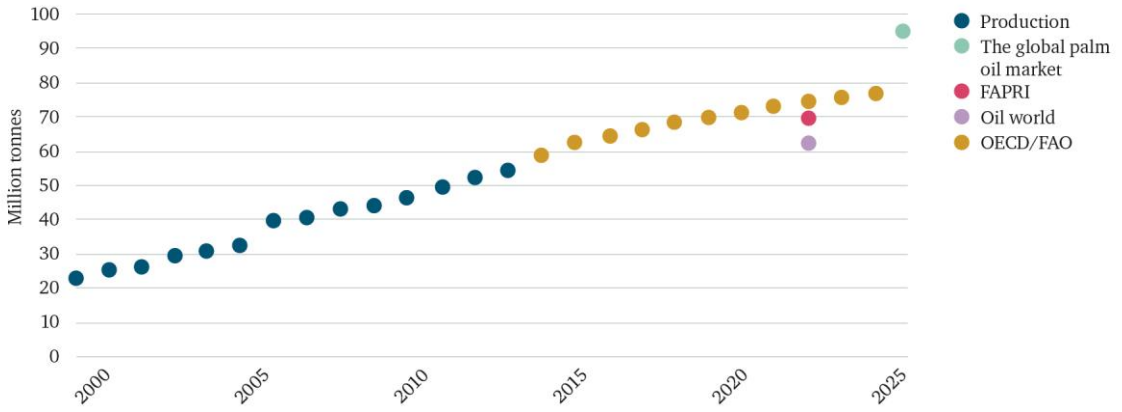
There is no reason to think that either of these drivers influencing the increasing global consumption of palm oil, soy and beef will disappear, although income growth rates will of course be subject to fluctuations accompanying economic growth and recession. The third major driver, biofuels policy, may change; this is considered in more detail below (see the subsection Changing biofuel policies).

In the context of the three factors set out above, palm oil and soy have been two of the most successful global agricultural crops in recent times, reflecting mainly their high yields (of oil and protein, respectively) and their diversity of uses, as well as low labour costs in their countries of production. Although projections of future patterns of supply and demand are obviously subject to considerable uncertainty, all suggest that production levels will continue to increase.

[128] United Nations, *World Population Prospects*.
[129] *OECD Observer*, 'An emerging middle class'.
[130] OECD Data, Agricultural Output.

A 2011 projection for growth in palm oil production suggested a 45 per cent increase over 15 years, from 48 million tonnes in 2010/11 to an estimated 70 million tonnes in 2025–26.[131] A 2012 projection suggested growth of 32 per cent by 2020,[132] while another in 2015 projected 32 per cent growth from 2012–14 to 2024.[133] A further analysis, in 2015, suggested much faster growth, of 73 per cent between 2014 and 2022 (see Figure 6.1).[134] As discussed earlier in this paper, all projections show Malaysia and Indonesia continuing to dominate the market.[135]

Figure 6.1: Projections for global palm oil production in 2020 and 2022, by source

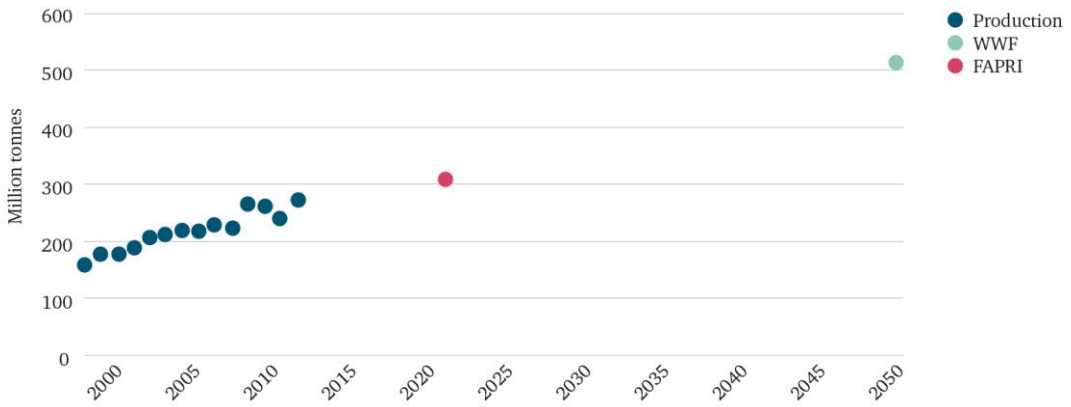


Sources: FAO, FAPRI, 2011; 'World Supply and Demand Balance', Oil World, 2012. www.oilworld.biz; Grand View Research, The Global Palm Oil Market (July 2015); OECD/Food and Agriculture Organization of the United Nations (2015), *OECD-FAO Agricultural Outlook 2015*, OECD Publishing, Paris.

Projections for rates of growth in soy production are somewhat lower. A 2012 estimate suggested that global soybean production would grow by 12 per cent over the seven years from 2014–15 to 2021–22, to reach more than 307 million tonnes in 2022.[136] A synthesis of various projections that was published by WWF in 2014 estimated growth in global output from 270 million tonnes in 2012 to 514 million tonnes in 2050 – i.e. a 90 per cent increase in just under four decades (see Figure 6.2).[137]

[131] FAPRI (2011).
[132] 'World Supply and Demand Balance', *Oil World*, 2012, www.oilworld.biz.
[133] OECD/Food and Agriculture Organization of the United Nations (2015), *OECD-FAO Agricultural Outlook 2015*,OECD Publishing, Paris.
[134] Grand View Research, *The Global Palm Oil Market* (July 2015).
[135] The 2011 FAPRI projection suggested that the two countries would account for 88 per cent of production in 2025–26, actually higher than their joint share today; this seems highly unlikely, and the figures used appear to over-estimate the two countries' share of production throughout the time series.
[136] FAPRI-ISU (2012).
[137] WWF (2014), *The Growth of Soy: Impacts and Solutions*.

Figure 6.2: Projections for global soybean production in 2022 and 2050, by source



Sources: FAO, FAPRI-ISU, 2012 and WWF, *The Growth of Soy: Impacts and Solutions* (2014)

As in the case of palm oil, the three major producers – the US, Brazil and Argentina – are projected to remain the same, with volumes produced in other countries remaining much smaller in comparison. Of the top three, Argentina seems likely to be the main source of future growth in production and exports, at least in the short term, given planned and likely improvements in infrastructure (highways and ports), irrigation, crop rotation and genetics.[138]

Most – but not all – of these projections were drawn up based on growth rates recorded before the significant falls in world commodity prices since 2011. Such falls may slow the projected growth in output in the short term; conversely, of course, cheaper products may accelerate the growth of consumption, in turn encouraging more production. Most agricultural commodities are liable to price fluctuations of this kind (though the most recent have been particularly pronounced), and the fundamental drivers of demand, population and income growth remain largely unaltered.

Projections for future growth in beef consumption and production are quite different. An OECD-FAO analysis published in 2015 suggested that at the global level per capita beef consumption would remain more or less level for the next ten years.[139] In developed countries, consumption per capita was expected to decline by almost 2 per cent by 2024, though this would be offset by an increase in developing country consumption of approximately 6 per cent (which would still leave per capita consumption in the developing world about a third that of developed countries). Asia dominated the anticipated growth in consumption, accounting for more than half of the additional beef consumed over the next decade. The overall expansion in global production and consumption, of about 5 per cent over the decade, was driven largely by population growth.

If projections for the growth in agricultural commodity output are accurate, the future pressures on forests will be enormous. More than 80 per cent of growth in global demand over the next 15 years for agricultural and timber products will be in developing countries, where the technical, social and

[138] USDA, (2014), Commodity Intelligence Report: Dryness Continues in Argentina; Soybean Plantings May Increase, with Corn Lower, see: http://www.pecad.fas.usda.gov/highlights/2014/01/Argentina/.
[139] OECD/FAO (2015), *OECD-FAO Agricultural Outlook, OECD Agriculture statistics* (database), http://dx.doi.org/10.1787/agr-outl-data-en, p. 7.

economic challenges in achieving improvements in crop yields are great.[140] As one recent study concluded: 'To avoid crop expansion and just meet projected crop needs by increasing production, it is predicted that crop yields would need to increase by an estimated 32 per cent more from 2006 to 2050 than they did from 1962 to 2006 during the height of the "green revolution". Reaching such increases in yields is highly unlikely.'[141] Expansion of agricultural land into the forest is therefore inevitable.

Three other factors, however, may inhibit or change the pattern of this potential growth in consumption and production: policies aimed at reducing the impact on forests; changes in biofuel policies; and concerns over health impacts. These are considered in more detail below.

One additional major factor (or set of factors) is difficult to estimate: the impacts of environmental change. Chief among these is climate change, which has the potential to cause very widespread disruption to agricultural production in most of the countries considered in this paper. A consolidated study on the impact of global climate change on agriculture, published in 2013, found that by 2100 the impact of climate change on crop yields for high-emission climate scenarios ranged between –30 and –60 per cent for soybean; however, this was likely to be partially offset by the beneficial effects of CO_2 fertilization, resulting in a net impact of between 0 and –30 per cent.[142] In the shorter term, impacts can be expected from more local and regional phenomena, including the El Niño effect and the widespread forest fires burning in areas of Indonesia most recently in 2015 (probably caused in large part by 'slash-and-burn' clearance of forests for palm oil).

Reducing impacts on forests

Growing awareness of the linkages between agricultural production and deforestation, as described throughout this paper, has stimulated a series of responses, in particular by the private sector, but also sometimes by governments, aimed at reducing the impact of agriculture on forests.[143]

The main private-sector responses so far include:

- Commitments to reduce or eliminate deforestation from their supply chains: adopted by companies such as Unilever, Nestlé, Cargill, Mondelēz, Walmart and the member companies of the Consumer Goods Forum, all of which have pledged to achieve zero net deforestation in their supply chains by 2020.[144] The main impact so far has been on palm oil; as noted above, by the end of 2014 an estimated 96 per cent of the global palm oil trade was covered by zero-deforestation commitments adopted by the main palm oil buyers. (See Table 6.1 for more details.)

[140] Gabrielle Kissinger, *Fiscal incentives for agricultural commodity production: Options to forge compatibility with REDD+* (UN-REDD Policy Brief 7, September 2015), p. 1.
[141] Ibid.
[142] FAO, (2015), *Climate change and food systems: global assessments and implications for food security and trade*, p. 34.
[143] For more detail see, Brack and Bailey (2013).
[144] See http://www.theconsumergoodsforum.com/strategic-focus/sustainability/board-resolution-on-deforestation.

- Voluntary initiatives to encourage companies and investors to report on their exposure to forest-risk commodities, including in particular CDP's forests programme, which tracks exposure to timber, palm oil, soy and cattle.[145]

- Websites established to track these private-sector commitments, including in particular the Global Canopy Programme's Forest 500 site (http://forest500.org), and Forest Trends' Supply Change project (supply-change.org).

- National industry initiatives aiming to source certified sustainable commodities – such as the Dutch Task Force on Sustainable Palm Oil's target of 100 per cent RSPO-certified palm oil by the end of 2015, and the similar initiatives under way in Belgium, Denmark, France, Germany and Sweden.

Government responses within consumer countries include:

- Government use of public procurement policy to source certified sustainable commodities, as in the UK for palm oil (in a joint initiative with industry).

- Public-private initiatives aimed at building coalitions for action, such as the Dutch IDH (Sustainable Trade Initiative),[146] or providing forums for discussion and coordination of action, such as the Tropical Forest Alliance 2020.[147]

- The use of development assistance specifically to target the impact of agriculture on deforestation, for example the UK government's new Investments in Forests and Sustainable Land Use (IFSLU) programme.[148]

In producer countries, the most striking measures taken by governments have been the moratoriums – either on the sale of products grown on deforested land (as for soy and beef in Brazil), or on the further award of production or plantation licences (as for palm oil in Indonesia). In addition, many national- and local-level initiatives are under way to reduce the impact of agriculture on deforestation, some with international donor support.

At the global level, international declarations and targets include the New York Declaration on Forests, agreed in 2014, and the new UN SDGs, effective from January 2016. Many international institutions are working in the area, examples being the UN Development Programme's (UNDP) Green Commodities Programme;[149] and the REDD+ programmes, coordinated by the UN and the World Bank, aiming to reduce greenhouse gas emissions from deforestation and forest degradation.

One outcome of all these activities has been an increase in the uptake of certification schemes intended to identify commodities produced in a sustainable manner and track them through the supply chain.[150] For palm oil, overwhelmingly the main certification scheme is the RSPO, which

[145] See https://www.cdp.net/en-US/Programmes/Pages/forests.aspx.
[146] See http://www.idhsustainabletrade.com.
[147] See http://www.tfa2020.com.
[148] See http://devtracker.dfid.gov.uk/projects/GB-1-202745/.
[149] See http://www.undp.org/ourwork/environmentandenergy/projects_and_initiatives/green-commodities-programme.html.
[150] For more details, see Brack (2015), *Reducing Deforestation in Agricultural Commodity Supply Chains: Using Public Procurement Policy*, London: Chatham House, pp. 20–22.

accounted for an estimated 20 per cent of the global market as at January 2016.[151] The RSPO certification scheme requires members to adhere to 43 sustainability criteria, including the requirement that any new plantings since November 2005 must not replace primary forest or any area required to maintain or enhance one or more high conservation values. Other palm oil certification schemes include the Indonesian Sustainable Palm Oil (ISPO) scheme (which is primarily a legality rather than sustainability standard), the Sustainable Agriculture Network standard associated with the Rainforest Alliance certified label, and organic (originally standards certified by voluntary organizations, but now in many countries replaced by national legislative requirements).

Soy is much less likely to be certified than palm oil; the main certification schemes – the Round Table on Responsible Soy (RTRS), International Sustainability & Carbon Certification (ISCC) and the ProTerra Standard – together accounted for only about 2–3 per cent of the global market in 2013.[152] RTRS membership is currently growing very rapidly, however, and there is also an increasing availability of organic and Fairtrade (standards set by Fairtrade International) soy. US producers, however, are very unlikely to be certified: deforestation is seen (not unreasonably) as a South American problem that is not relevant to US production. All of these schemes apart from Fairtrade have specific criteria related to deforestation; Fairtrade has more generic requirements to avoid negative impacts on protected areas and areas of high conservation value.

Beef is even less likely to be certified for sustainability standards than is soy. The Global Roundtable for Sustainable Beef (GRSB), founded in 2012, approved principles and criteria for sustainable beef in November 2014.[153] The GRSB is not working towards a global certification scheme, promoting instead regional and national initiatives. Small volumes of Rainforest Alliance-certified beef (using the Sustainable Agriculture Network standard) are available, and larger volumes of organic beef. The Leather Working Group (LWG) audits about 20 per cent of the supply chain for footwear leather (or around 10 per cent of global leather production); however, it only requires traceability back to the slaughterhouse for hides originating in Brazil, and operations earlier in the supply chain go unchecked.

Over-reliance on certification schemes can be problematic, particularly where these are not sufficiently robust to affect rates of deforestation. Doubts have been expressed in particular over the ability of the RSPO scheme to prevent deforestation. For example, although the RSPO standard forbids planting on primary forest that has never been logged, this potentially allows forest that has been logged, or is undergoing rehabilitation, to be cleared. Furthermore, it does not require segregation throughout the supply chain, allowing so-called 'mass balance' and 'book and claim' (similar to offset) systems.[154] Certification schemes can also be expensive and difficult to implement, particularly for smallholders.

Partly in response to these challenges, the Palm Oil Innovation Group (POIG) was launched in 2013 with the aim of demonstrating new models for sustainable palm oil production, improving on RSPO

[151] See http://www.rspo.org/about/impacts.
[152] KPMG (2013), *A Roadmap to Responsible Soy: Approaches to increase certification and reduce risk*, p. 4.
[153] See http://grsbeef.org/Resources/Documents/GRSB%20Principles%20and%20Criteria%20for%20Global%20Sustainable%20Beef_091514.pdf.
[154] See for example Greenpeace (2013), *Certifying Destruction: Why consumer companies need to go beyond the RSPO to stop forest destruction*. Amsterdam: Greenpeace International. It should be noted that the RSPO has disputed some of the assertions in this report.

principles and criteria. In particular, the POIG aims to break the link between palm oil expansion and deforestation, and to improve forest conservation.[155] Other approaches include development of the concept of high carbon stock (HSC), intended to distinguish between forest areas for protection and otherwise degraded lands with low carbon and biodiversity values that may be developed – taking into account not only environmental concerns, but also socio-economic and political factors in developing and emerging economies. Two different groups of stakeholders, each drawn from a range of palm oil industries (growers, traders and end users), research institutes and NGOs, are currently working on developing this approach.[156] A similar concept of high conservation value (HCV) forest is also being developed, and already features in the principles and criteria of several certification schemes, as well as in the commitments of many companies and financial institutions.[157]

It should be noted that initiatives such as these do not enjoy universal endorsement. The Indonesian government in particular has gone to some lengths to promote palm oil as an environmentally and socially beneficial product, focusing on its high yield (and therefore low land requirements) compared with other oilseeds, and its contribution to rural development. In late 2015 Indonesia and Malaysia together announced the establishment of a new Council of Palm Oil Producer Countries (CPOPC), with the stated aim of managing palm oil production and stock in the global market in a similar way as OPEC does for petroleum production.[158] The initiative was stimulated in part by falling world prices for palm oil, but also in response to resentment at the extensive adoption of zero-deforestation pledges by private companies. According to Indonesia's minister responsible for natural resources, in October 2015, 'This is an example of how to fight for our sovereignty. We are the biggest palm oil producer. Why (should) the consumers from the developed countries set the standard for us as they want?'[159] It was reported at this time that the government had asked palm oil firms to exempt smallholders from commitments on sustainable forest practices.[160]

More broadly, this underscores the fact that the vast majority of the activities described above are mainly European and North American initiatives (by both companies and governments). The Brazilian moratoriums on soy and beef are perhaps the major exception to this, but it should be recognized that many of the approaches listed above have little purchase in many key emerging economies, in particular China and India. However, the zero-deforestation commitments made by the major palm oil traders include several Asia-based companies, and in any case are now so extensive that they cover almost the entire global market.

[155] 'Joint Statement: Palm oil companies join NGOs to find palm oil solutions', 28 June 2013, available at http://www.ran.org/joint-statement-palm-oil-companies-join-ngos-find-palm-oil-solutions.
[156] See http://www.carbonstockstudy.com/home and http://highcarbonstock.org.
[157] See https://www.hcvnetwork.org.
[158] PressTV, 'Indonesia, Malaysia agree to set up palm oil council to regulate prices', 22 November 2015, http://217.218.67.231/Detail/2015/11/22/438733/Indonesia-Malaysia-palm-oil-council.
[159] Reuters, 'New palm oil council would drop "no deforestation" pledge – Indonesia', 14 October 2015.
[160] Reuters, 'Big palm oil's pledge to preserve forests vexes Indonesia', 7 October 2015.

Table 6.1: Commitments on deforestation made by selected major companies along the palm oil, soy and beef and leather supply chains

Company	Pledge	Measures and progress	Supply chain coverage
Palm oil supply chain			
ADM	No deforestation by 2015 of HCS and HCV forests.[a]	Work with suppliers to ensure compliance by 2015. No quantification of progress yet.	Transit, primary processing
Cargill	No deforestation across the entire supply chain by 2030. No deforestation of HCV lands or HCS areas and no development on peatland. 100% palm oil traceable to the mill by December 2015; and 100% palm oil traceable to sustainably managed plantations by 2020.	Work with suppliers, scientists, governments and NGOs to meet targets. Publish semi-annual progress reports.[b]	Production, transit, primary processing
Golden Agri-Resources (GAR)	No deforestation (no target year) of HCS forests (>35 tC/ha).[c]	Measures focus on downstream of supply chain. No quantification of progress.[d] Difficulties remain.[e]	Production
IOI Group	No deforestation (no target year) of HCS and HCV forests.[f]	Measures in own production (downstream) and product tracing.[g] No quantification. Still deemed to have serious supply issues.[h]	Production, transit, primary processing
Nestlé	No deforestation by 2020.[i]	Sourcing guidelines; engage suppliers; annual improvement targets. Progress: 28% in 2014 (self-reported).[j]	Secondary processing
Unilever	Zero net deforestation associated with palm oil by 2020.[k] 100% of raw agricultural materials sourced sustainably by 2020.	100% of palm oil from sustainably certified traceable sources in 2013 and 2014 (self-reported).[l]	Secondary processing
Wilmar	No deforestation by 2015 of HCS forests (including degraded forests).[m]	Focuses on downstream of supply chain, with measures on production level. No reporting on progress.[n]	Production, transit, primary processing
Soy supply chain			
Bunge	No deforestation for all commodities except palm oil by 2016.[o]	Measures focus on encouraging suppliers, develop action plans and operationalize them before the goal year (2016).	Transit, primary processing
Cargill	Non deforestation for Amazonian soy by 2008.[p]	Target achieved in 2008 (self-reported).	Transit, primary processing
Kraft Heinz	No pledge	No pledge	Secondary processing
Unilever	No deforestation for four commodities (palm oil, soy, paper and board, and beef) by 2020.[q]	Implementation at suppliers, industry-wide improvement of current standards. Progress: 14% for soy (2013, self-reported).[r]	Secondary processing
Beef and leather supply chains			
Adidas Group	No deforestation in the Amazon biome from 2010 onwards.	Work with suppliers within the LWG to ensure traceability. 99% of leather LWG-certified silver-rated or above in 2014.[s]	Secondary processing
JBS	No deforestation for all raw materials (no target year).[t]	Encourage higher production per ha; procurement policy; independent auditing.	Primary processing
Kering	No leather from sources that convert sensitive ecosystems (e.g. forests).[u]	Sourcing only domestic livestock; supply-chain mapping. Progress: Implementation for bovine leather, but not yet for other sources.	Retail
Marfrig	No new deforestation from 2009 onwards.[v]	MRV using GIS satellite data; exclusion of suppliers.[w] Progress: Implemented for direct, but not indirect, suppliers.	Primary processing

McDonald's	No-deforestation of HCS or HCS forests in 2030.[x]	Work with suppliers to identify and address existing regulation gaps.[y]	Retail
Minerva	No new deforestation from 2009 onwards.[z]	No reporting on measures or progress.	Primary processing
Tyson Foods	No pledge.	No pledge.	Primary processing
Yum! Brands	No pledge.	No pledge.	Secondary processing, retail

a High Carbon Stock (HCS) and High Conservation Value (HCV) forests, as defined in ADM (2015), *Our Commitment to No-Deforestation*, at http://www.adm.com/en-US/company/Documents/ADM%20No%20Deforestation%20Policy.pdf.
b Cargill, (2015),Cargill Palm Oil Progress Update: August 2015, available here: http://www.cargill.com/connections/cargill-marks-sustainable-palm-oil-progress-in-first-half-of-2015/index.jsp.
c Golden Agri-Resources (2011), *Forest Conservation Policy*, at http://www.goldenagri.com.sg/pdfs/sustain_policies/1._GAR_Forest_Conservation_Policy_-_updated_links_10_Jan_2014.pdf.
d Supply Change (2015), *Golden Agri-Resources Profile*, accessed 20 November 2015, at http://www.supply-change.org/company/golden-agri-resources.
e Greenpeace (2014), *Golden Agri Resources: A progress report*. Amsterdam: Greenpeace International.
f IOI Group (2015), *Sustainability Policy Statement*, at http://www.ioigroup.com/Content/S/PDF/IOI%20Sustainability%20Policy%20Statement.pdf.
g IOI Group (2015), *Sustainability Policy Statement*, at http://www.ioigroup.com/Content/S/PDF/IOI%20Sustainability%20Policy%20Statement.pdf.
h Hurowitz, G. (2015), *The Green Tigers: Which Southeast Asian Companies Will Prosper in the New Age of Forest Conservation?* January 2015 Update. Washington, DC: Forest Heroes.
i Nestlé (2013), *Nestlé Commitment on Deforestation and Forest Stewardship*, at http://www.nestle.com/asset-library/Documents/Library/Documents/Corporate_Social_Responsibility/Commitment-on-Deforestation-2013.pdf.
j Supply Change (2015), Nestle Company Profile, accessed 20-11-2015, at http://www.supply-change.org/company/nestle.
k Unilever, (2014), Unilever's Position on Eliminating deforestation, available at https://www.unilever.com/sustainable-living/transformational-change/eliminating-deforestation/
l Supply Change, 2015. Unilever Profile, available at: http://www.supply-change.org/company/unilever#company-Palm.
m Wilmar (2013), *No Deforestation, No Peat, No Exploitation Policy*, at http://www.wilmar-international.com/wp-content/uploads/2012/11/No-Deforestation-No-Peat-No-Exploitation-Policy.pdf.
n Supply Change (2015), *Wilmar Profile*, accessed 20 November 2015, at http://www.supply-change.org/company/wilmar-international.
o Bunge (2015), Commitment to Sustainable Value Chains, at http://www.bunge.com/citizenship/files/Sustainability-Commitments.pdf.
p Supply Change (2015), Cargill Company Profile, accessed 20-11-2015, at http://www.supply-change.org/company/cargill#company-Soy.
q Unilever (2015), Eliminating Deforestation, accessed 20-11-2015, at https://www.unilever.com/sustainable-living/transformational-change/eliminating-deforestation/.
r Supply Change (2015), Unilever Company Profile, accessed 20-11-2015, at http://www.supply-change.org/company/unilever#company-Soy.
s Supply Change, (2015) *Adidas Profile*, available at: http://www.supply-change.org/company/adidas#company-Cattle.
t JBS (2014), *Annual and Sustainability Report 2013*, at http://annualreport.jbs.com.br/eng/downloads/JBS_RAS_2013_ING.pdf.
u Kering (2014), *Sustainability Targets: Progress Report May 2014*, at http://www.kering.com/sites/default/files/document/kering_sustainability_targets_progress_report_may_2014.pdf.
v Marfrig (2015), *For the second consecutive year, an independent audit has reasserted Marfrig's good sustainability practices in the Amazon region*, accessed 25-11-2015, at http://www.marfrig.com.br/en/documentos?id=725.
w Marfrig (2015), *Workplan Marfrig Global Foods: Minimal Criteria for Cattle Operations and Beef Products on Industrial Scale in the Amazon Biome*, at http://www.marfrig.com.br/Uploads/Arquivos/en/Marfrig_Workplan_Final_2015.pdf.
x McDonald's (2015), *McDonald's Corporation Commitment on Deforestation*, at http://www.aboutmcdonalds.com/content/dam/AboutMcDonalds/2.0/pdfs/Commitment_on_Deforestation.pdf.
y McDonald's (2015), *Supporting Addendum: McDonald's Corporation Commitment on Deforestation*, at http://www.aboutmcdonalds.com/content/dam/AboutMcDonalds/2.0/pdfs/Commitment_on_Deforestation_Addendum.pdf.
z Minerva (2009), Minerva signs environmental agreement, at http://www.mzweb.com.br/minerva2012/web/arquivos/Minerva_CM_acordo_ambiental_20091005_eng.pdf.

Changing biofuel policies

Government support for biofuels has been one of the major drivers of the consumption of palm oil and soy in a wide range of countries – most notably the EU, but also in many producer countries including Argentina, Brazil, Indonesia and Malaysia. Between 2000 and 2012 global consumption of biofuels grew more than sixfold.[161] Total global production was expected to have fallen from 2014 to 2015, however, for the first time since support policies became widespread.[162] During 2015 mandatory minimum blending requirements were increased in only three countries (Indonesia,

[161] See US Energy Information Administration, International Energy Statistics – Biofuels Consumption, at http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=79&pid=79&aid=2&cid=ww,&syid=2000&eyid=2012&unit=TBPD#.
[162] FAO, (2015), *Food Outlook October 2015*, p. 41.

Malaysia and South Africa), while targets and subsidies were scaled back or delayed in several others. The main reason is overwhelmingly the sharp drop in the price of petroleum, which more than halved during the last six months of 2014. Despite falls in the prices of palm oil and soy (and other vegetable oils), the price gap between conventional fuels and biofuels widened and support policies became more expensive for governments and/or motorists.

In addition, the EU biofuels policy framework is changing significantly. As noted above, the 2009 Renewable Energy Directive has been a main driver of demand for palm oil and soy in the EU. The directive contains sustainability criteria designed to ensure that the biofuels used to meet the targets for the use of renewable energy deliver significant greenhouse gas savings compared with the fossil fuels they replace (at least 35 per cent, rising to 50 per cent in 2017; and, for new installations, 60 per cent in 2018), and that they have not been produced from land converted from primary forests, wetlands, peatlands or protected areas. Biofuels that do not meet these criteria can still be used, but they do not count towards the renewable energy target, and are not eligible for the incentives made available by EU member states, which include favourable tax treatment and minimum blending requirements. Compliance with the criteria has to be proved by the suppliers of biofuels, which can either carry out their own calculations of greenhouse gas savings or use default values provided by the European Commission.

The default value for palm oil biodiesel is 19 per cent, which is clearly below the 35 per cent minimum threshold – i.e. palm oil does not meet the sustainability criteria – although if it is manufactured with methane capture at the mill the default value rises to 56 per cent. The default value for soy is 31 per cent, also below the sustainability threshold. However, this default value was calculated assuming soybeans were shipped from Brazil (embodying relatively high transport-related emissions) and then transformed into soybean oil and biodiesel in the EU; importing soy biodiesel itself into the EU has lower transport-related emissions and therefore could demonstrate a higher emissions saving. Blends of rapeseed oil, palm oil and soybean oil can also exceed the threshold.

These emissions figures were based on the assumption that any changes in land use arising from biofuel production cause no increase in net carbon emissions. The demand for biofuels has been so high, however, that land that would otherwise have been used for food production has increasingly been diverted to biofuels; and, in turn, forest has been converted to farmland for food crops. Research has highlighted how the increase in emissions caused by this indirect land use change (ILUC) could have a significant impact on the net emissions of greenhouse gases from biofuel production – possibly even leading to biofuel use resulting in higher emissions than the fossil fuels that they replace.[163]

Accordingly, in October 2012 the European Commission published a proposal to introduce ILUC factors to modify the emission figures for all land-based biofuels. However, this was to be for reporting purposes only, rather than a modification of the sustainability criteria: if the ILUC factors were to be included in the sustainability criteria, this would result in both palm oil and soybean oil

[163] See for example Bowyer, C. (2010), *Anticipated Indirect Land Use Change Associated with Expanded Use of Biofuels and Bioliquids in the EU – An Analysis of the National Renewable Energy Action Plans*. London: IEEP.

being disqualified as a feedstock for biodiesel.[164] After considerable debate, the new regulations were finally agreed in July 2015; it was confirmed that ILUC factors would be restricted to reporting only, but a cap of 7 per cent was placed on the contribution of land-based biofuels towards the 10 per cent renewable energy target in transport (member states are to be allowed to set a lower cap). This is intended to limit EU consumption of land-based biofuels and to open up more of the market to non-land-based biofuels from algae, waste and residues. All support for land-based biofuels is to be ended after 2020.[165] It seems likely, then, that EU demand for biofuels, and therefore for palm oil and soybean oil, will slacken and fall off. Whether this lost demand will be replaced by demand from other countries – be this for biofuels or for other uses – is not yet clear, and will depend to a large extent on future movements in the price of petroleum. The OECD-FAO study published in 2015 projected continuing growth in biofuel consumption out to 2024, but more slowly after 2020, at an average annual growth of 1.1 per cent a year for the period 2020–24, compared an average 3.2 per cent a year for the period 2016–20.[166]

Similar debates have been under way in the US; as in the EU, the inclusion of ILUC factors has been controversial, with the basic approach often being challenged by the biofuels industry. Recent scientific studies have also suggested that some of the ILUC factors originally estimated may have been too high, although the factors depend on a wide range of considerations, including the source crop and country. For example, while the expansion of palm oil cultivation in Southeast Asia does generally involve forest clearance, soy cultivation in Brazil may expand on to land previously cleared – such as for cattle pasture – or may increase as a result of more intensive production, with a lower impact on deforestation.[167] In any case, in 2012 the US Environmental Protection Agency (EPA) ruled that biodiesel from palm oil did not satisfy the sustainability criteria set in the US Renewable Fuel Standard (RFS),[168] although in 2015 the EPA did approve the use of Argentinian soy biodiesel.[169] In practice, the RFS heavily incentivizes corn production for ethanol (the latter accounted for 94 per cent of US biofuel in 2012), rather than biodiesel, although this may change in the future given current debates over the maximum percentage of ethanol allowed in the fuel mix.

Health concerns

Concerns over the potential impacts on health of the three commodities discussed in this paper may also inhibit their uptake.

In the unprocessed form of palm oil, there is evidence that its consumption carries benefits to health, including a reduction in blood pressure and a lower risk of arterial thrombosis. Once palm oil is processed, however, it oxidizes, and there is growing evidence for its toxic impacts on the

[164] European Commission (2012), *Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/ EC on the promotion of the use of energy from renewable sources*. COM(2012) 595 final, 17 October 2012, available at http://ec.europa.eu/clima/policies/transport/fuel/docs/com_2012_595_en.pdf.
[165] Biomass Magazine (2015), *EU Agricultural Council adopts ILUC biofuel rules*, 14 July 2015, at http://biomassmagazine.com/articles/12164/eu-agricultural-council-adopts-iluc-biofuel-rules.
[166] OECD/FAO (2015), *OECD-FAO Agricultural Outlook 2015–2024*, p. 134.
[167] See, e.g., Martin, J. (2015), *The Latest on Biofuels and Land Use: Progress to Report, but Challenges Remain*, 23 January 2015, at http://blog.ucsusa.org/the-latest-on-biofuels-and-land-use-797.
[168] 'EPA Rejects Palm-Oil Based Biodiesel for Renewable Fuels Program' Bloomberg, 27 January 2012, see http://www.bloomberg.com/news/articles/2012-01-27/epa-rejects-palm-oil-based-biodiesel-for-renewable-fuels-program.
[169] EPA, (2015), Approval Letter for an Alternative Renewable Biomass Tracking Program, see http://www.epa.gov/renewable-fuel-standard-program/approval-letter-alternative-renewable-biomass-tracking-program.

reproductive system and organs such as the kidneys and lungs.[170] (This is particularly ironic, since palm oil has often been promoted as an alternative to trans fats – see below). As a result, health professionals are beginning to issue warnings against the excessive consumption of palm oil. The Australian government and the Australian National Heart Foundation, for example, have both warned against palm oil consumption. In 2012 the French senate debated a proposal for a tax on palm oil (the so-called 'Nutella tax'), including on health grounds, which would have quadrupled its previous level of taxation, although the amendment was eventually defeated; one of the arguments against was that palm oil was not the only vegetable oil to cause health problems. EU Regulation 1169/2011, on the provision of food information to consumers, came into force in December 2014, requiring food labels to indicate which specific vegetable oils are included in the product; simply using the term 'vegetable oil' (as permitted under the previous regulations) is no longer sufficient. It is too early to tell, however, whether this will have any impact on the market.

Partially hydrogenated soybean oil was developed to replace saturated fats, such as butter and lard, in food products; it has long been popular among food manufacturers for its low cost and its flexibility in meeting the demands of a wide variety of applications. However, partially hydrogenated soybean oil is also a primary source of trans fats, which raise levels of LDL cholesterol and increase the risk of cardiovascular disease.[171] As a result, regulations requiring labelling of foodstuffs containing more than a specified level of trans fats were introduced in the US in 2006, and the US government is now introducing regulations to ban their use. Food manufacturers began to replace soy with other vegetable oils, such as palm oil or sunflower oil, and the soy industry began work on developing new varieties that avoided the need for hydrogenation. Denmark, Austria, Hungary, Iceland, Norway and Switzerland have all introduced maximum limits on trans fats that effectively ban them from human consumption; other countries, including the UK, have preferred to encourage voluntary action by industry. As noted in Section 4, however, soy is not widely used for foodstuffs for human consumption.

The adverse effects on health of the excessive consumption of meat are rather more widely recognized. Over-consumption of red meat, particularly in processed forms, is directly associated with increased risks of type 2 diabetes, cardiovascular disease and certain types of cancer, and has also been identified as a major contributor to obesity, an increasingly serious problem in most developed countries. Health concerns such as these are generally believed to be the main reason for the slight fall in consumption of beef in many developed countries (as noted in Section 5). However, consumption arising from increasing incomes and changing diets in emerging economies is already more than offsetting this fall, and in total, global consumption of all types of meat is forecast to increase by 76 per cent on recent levels by mid-century.[172] A recent study for Chatham House (focusing on the links between livestock and climate change as well as diet) concluded, however, that public awareness campaigns and regulations highlighting the impacts on diet and climate change would not necessarily be as unpopular as is usually believed: 'Governments overestimate the

[170] See, for example, Ebong, P.E., Owu, D.U. and Isong, E.U. (1999), 'Influence of palm oil (Elaesis guineensis) on health', *Plant Foods for Human Nutrition*, 53(3), pp. 209–22.
[171] See http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyEating/Trans-Fats_UCM_301120_Article.jsp#.Vpjjak9tbhw.
[172] Rob Bailey, Antony Froggatt and Laura Wellesley, *Livestock – Climate Change's Forgotten Sector* (2014); estimate based on FAO projections for 2050 against a baseline of 2005–07 from FAO (2012).

risk of public backlash and their inaction signals to publics that the issue is unimportant or undeserving of concern.'[173]

Conclusions

Overall, as discussed above, there seems little reason to assume that demand for these three key commodities associated with deforestation will not continue to grow (strongly for palm oil and soy, more weakly for beef). The drivers of an increasing global population and an expanding middle class with a growing appetite for meat and for processed and convenience foods will continue to underpin strong growth in demand for palm oil for foodstuffs, and soy for animal feed. Similar growth in demand can be expected for the many industrial and cosmetic uses of palm oil. The commodities price crash since 2011 may slow down this rate of growth temporarily, but does not alter the underlying fundamentals.

The future demand for palm oil and soy as biofuels is less certain. The long-running debate in the EU over its biofuels policy has now finally been resolved with an end to all support for land-crop-based biofuels – including palm oil and soy – from 2020. This should remove a major global source of demand, return European rapeseed and other vegetable oils to the foodstuffs market, thereby reducing EU demand for imports of palm oil, and may slow down the expansion of palm oil and, to a lesser extent, soy, production. However, these developments seem unlikely to be mirrored in other jurisdictions with support for biofuels, including the US, Brazil, Argentina, Malaysia and Indonesia, implying that global demand for biofuels may start to turn up again after the transitional period resulting from the EU policy change.

Thus there seems little prospect of the impacts on deforestation falling as a result of lower demand for these commodities from final consumers. There is, however, considerable scope for reducing food waste, currently running at an estimated one-third of the total volume of food produced for human consumption.[174] The EU, for example, is taking steps as part of its Roadmap to a Resource Efficient Europe[175] to tackle food waste by setting targets and encouraging member states to increase their ambition in this regard.[176]

The other possible set of policy measures lies in decoupling production from deforestation, a process for which, once again, there is considerable scope. Brazil's success in its target of reducing the rate of deforestation in the Amazon by 70 per cent by 2013, compared with the average level in 1996–2005, while at the same time increasing production of beef and soy, shows what can be achieved (although there are far more examples of where increased production has been accompanied by rising deforestation). The increasing number of private-sector and certification initiatives, noted throughout this paper, and the growing interest among governments in adopting public policy initiatives to this end – partly spurred by the implications of deforestation for climate change – give reasons for hope that progress can be made in the future.

[173] Laura Wellesley, Catherine Happer and Antony Froggatt, *Changing Climate, Changing Diets: Pathways to Lower Meat Consumption* (November 2015), p. vii.
[174] FAO (2011), *Global food losses and food waste – Extent, causes and prevention.* Rome: FAO.
[175] See http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm.
[176] For a full discussion of this issue, see Mowat and Meissner Pritchard, (2015), *Less and Better: Making EU Consumption Policies Work for People and Forests,* Brussels, Moreton in Marsh: FERN

Annex 1: Tables

Note: The tables below are numbered according to the related figures in the main text.

Table 3.2: Top 10 palm fruit producers 2000–13 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Indonesia	36.38	40.95	46.80	52.60	60.43	74.00	80.25	78.00	85.00	90.00	97.80	105.00	113.00	120.00
Malaysia	56.60	58.95	59.55	66.78	69.88	74.80	79.40	79.10	88.67	87.83	84.97	94.56	97.70	100.00
Thailand	3.34	4.10	4.00	4.90	5.18	5.00	6.72	6.39	9.27	8.16	8.22	10.78	11.36	12.81
Nigeria	8.22	8.50	8.50	8.63	8.70	8.50	8.30	8.50	8.50	8.50	8.00	8.00	8.10	5.00
Colombia	2.47	2.60	2.60	2.58	3.11	3.27	3.20	3.20	3.20	3.20	3.10	4.61	4.67	4.99
Cameroon	1.10	1.15	1.15	1.20	1.20	1.45	1.50	1.55	1.56	1.60	2.20	2.40	2.50	2.45
Ecuador	1.34	1.42	1.65	1.52	1.84	1.55	1.67	1.81	2.20	2.23	2.85	2.10	2.65	2.32
PNG	1.25	1.22	1.18	1.20	1.25	1.30	1.35	1.40	1.70	1.73	1.85	2.00	2.05	2.10
Côte d'Ivoire	1.13	0.99	1.16	1.03	1.31	1.23	1.33	1.36	1.42	1.75	1.57	1.64	1.84	1.90
DRC	1.12	1.09	1.05	1.07	1.08	1.09	1.11	1.12	1.13	1.15	1.16	1.30	1.38	1.36
Others	7.41	7.77	7.82	8.64	9.30	9.61	10.71	10.55	11.48	12.15	12.85	13.44	14.17	14.62
World total	120.36	128.73	135.46	150.14	163.27	181.82	195.53	192.98	214.14	218.29	224.57	245.82	259.42	267.55

Source: Chatham House analysis of FAOSTAT data.

Table 3.3: Top 10 exporters of palm oil and derivative products, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Indonesia	4.84	6.13	7.39	8.09	9.93	11.56	13.83	13.65	16.36	18.69	17.49	17.71	20.72	24.69	19.86
Malaysia	9.12	10.80	11.23	13.27	12.52	13.56	14.35	14.07	15.78	16.27	17.20	17.59	17.52	18.13	17.08
PNG	0.33	0.38	0.35	0.40	0.36	0.41	0.44	0.50	0.49	0.47	0.56	0.83	0.64	0.62	0.60
Guatemala	0.02	0.03	0.04	0.05	0.04	0.04	0.08	0.08	0.13	0.13	0.12	0.18	0.23	0.31	0.36
Honduras	0.01	0.02	0.03	0.09	0.07	0.12	0.10	0.11	0.12	0.11	0.13	0.12	0.23	0.20	0.26
Colombia	0.10	0.09	0.09	0.10	0.20	0.24	0.21	0.29	0.27	0.21	0.11	0.16	0.17	0.18	0.25
Thailand	0.04	0.06	0.05	0.08	0.04	0.01	0.09	0.15	0.27	0.06	0.07	0.23	0.21	0.46	0.20
EU-27	0.10	0.08	0.06	0.13	0.09	0.12	0.13	0.15	0.12	0.12	0.17	0.28	0.18	0.13	0.15
Singapore	0.29	0.27	0.25	0.50	0.34	0.57	0.49	0.46	0.43	0.46	0.73	0.43	0.17	0.24	0.13
Costa Rica	0.08	0.07	0.07	0.09	0.14	0.12	0.10	0.13	0.12	0.11	0.14	0.16	0.18	0.16	0.13
Others	0.43	0.49	0.41	0.37	0.35	0.48	0.48	0.66	0.74	0.65	1.10	0.96	1.10	0.72	0.55
World total	15.36	18.42	19.97	23.17	24.07	27.24	30.31	30.26	34.85	37.29	37.80	38.63	41.35	45.83	39.56

Source: Chatham House Resource Trade Database.

Table 3.4: Top 10 exporters of crude palm oil, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Indonesia	1.43	1.89	2.78	3.27	3.23	3.91	5.14	5.62	7.38	8.83	8.14	7.32	6.60	7.39	5.90
Malaysia	0.62	1.52	1.93	2.15	1.74	2.12	2.83	2.39	2.82	3.01	3.17	3.64	4.57	4.15	4.64
PNG	0.30	0.35	0.33	0.32	0.27	0.31	0.36	0.41	0.40	0.39	0.48	0.73	0.56	0.52	0.50
Guatemala	0.02	0.03	0.04	0.04	0.04	0.04	0.07	0.07	0.12	0.12	0.10	0.16	0.21	0.28	0.32
Honduras	0.01	0.02	0.03	0.09	0.07	0.11	0.09	0.11	0.11	0.10	0.11	0.10	0.20	0.17	0.23
Colombia	0.08	0.07	0.07	0.07	0.17	0.20	0.16	0.23	0.22	0.16	0.06	0.10	0.09	0.11	0.17
Thailand	0.02	0.04	0.02	0.05	0.00	0.00	0.08	0.12	0.21	0.04	0.04	0.20	0.18	0.42	0.17
Costa Rica	0.07	0.06	0.06	0.07	0.10	0.10	0.09	0.11	0.10	0.09	0.11	0.13	0.15	0.13	0.10
Ecuador	0.01	0.00	0.00	0.01	0.00	0.07	0.02	0.10	0.09	0.05	0.01	0.07	0.10	0.05	0.04
Singapore	0.09	0.09	0.05	0.13	0.08	0.29	0.27	0.26	0.19	0.23	0.24	0.07	0.01	0.08	0.01
Others	0.12	0.11	0.12	0.10	0.08	0.15	0.13	0.14	0.25	0.22	0.66	0.52	0.31	0.28	0.23
World total	2.77	4.19	5.42	6.29	5.76	7.29	9.26	9.55	11.89	13.23	13.10	13.05	12.97	13.56	12.30

Source: Chatham House Resource Trade Database.

Table 3.5: Top 10 exporters of refined palm oil, 2000–13 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Indonesia	2.07	2.65	2.96	3.07	4.55	5.21	5.78	5.17	5.37	6.21	5.79	6.53	9.54	12.12	9.38
Malaysia	6.52	6.95	7.06	8.35	8.25	8.52	8.83	8.98	10.14	10.54	10.92	10.93	9.84	10.46	9.04
EU-27	0.09	0.07	0.05	0.08	0.07	0.09	0.12	0.14	0.12	0.11	0.14	0.20	0.14	0.11	0.13
Singapore	0.17	0.17	0.17	0.34	0.23	0.26	0.21	0.18	0.23	0.22	0.48	0.34	0.13	0.15	0.12
PNG	0.00	0.00		0.05	0.07	0.08	0.05	0.04	0.06	0.05	0.04	0.03	0.03	0.05	0.05
Thailand	0.01	0.01	0.02	0.02	0.03	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.02
Colombia	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.02
India	0.00	0.02	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.05	0.06	0.01
US	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.03	0.02	0.03	0.01	0.02	0.01
Vietnam	0.05	0.05	0.01	0.02	0.04	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.08	0.10	0.08	0.17	0.15	0.18	0.17	0.19	0.21	0.23	0.28	0.20	0.41	0.13	0.12
World total	9.00	10.03	10.37	12.13	13.43	14.39	15.22	14.79	16.22	17.43	17.74	18.31	20.21	23.15	18.90

Source: Chatham House Resource Trade Database.

Table 3.6: Top 10 exporters of palm nut and kernels, and derivative products, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Indonesia	4.84	6.13	7.39	8.09	9.93	11.56	13.83	13.65	16.36	18.69	17.49	17.71	20.72	24.69	19.86
Malaysia	9.12	10.80	11.23	13.27	12.52	13.56	14.35	14.07	15.78	16.27	17.20	17.59	17.52	18.13	17.08
PNG	0.33	0.38	0.35	0.40	0.36	0.41	0.44	0.50	0.49	0.47	0.56	0.83	0.64	0.62	0.60
Guatemala	0.02	0.03	0.04	0.05	0.04	0.04	0.08	0.08	0.13	0.13	0.12	0.18	0.23	0.31	0.36
Honduras	0.01	0.02	0.03	0.09	0.07	0.12	0.10	0.11	0.12	0.11	0.13	0.12	0.23	0.20	0.26
Colombia	0.10	0.09	0.09	0.10	0.20	0.24	0.21	0.29	0.27	0.21	0.11	0.16	0.17	0.18	0.25
Thailand	0.04	0.06	0.05	0.08	0.04	0.01	0.09	0.15	0.27	0.06	0.07	0.23	0.21	0.46	0.20
EU-27	0.10	0.08	0.06	0.13	0.09	0.12	0.13	0.15	0.12	0.12	0.17	0.28	0.18	0.13	0.15
Singapore	0.29	0.27	0.25	0.50	0.34	0.57	0.49	0.46	0.43	0.46	0.73	0.43	0.17	0.24	0.13
Costa Rica	0.08	0.07	0.07	0.09	0.14	0.12	0.10	0.13	0.12	0.11	0.14	0.16	0.18	0.16	0.13
Others	0.43	0.49	0.41	0.37	0.35	0.48	0.48	0.66	0.74	0.65	1.10	0.96	1.10	0.72	0.55
World total	15.36	18.42	19.97	23.17	24.07	27.24	30.31	30.26	34.85	37.29	37.80	38.63	41.35	45.83	39.56

Source: Chatham House Resource Trade Database.

Table 3.9: Top 10 importers of palm oil and derivative products, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EU-27	4.98	6.01	6.11	6.36	6.87	8.08	8.28	7.81	8.56	8.87	8.61	8.35	9.66	10.52	10.33
India	3.19	3.30	3.22	3.98	3.51	3.14	2.92	3.56	5.61	6.55	6.12	6.56	7.98	8.57	8.15
China	1.42	1.83	2.29	3.15	3.67	4.14	5.26	5.31	5.59	7.23	6.21	6.23	6.97	6.82	6.01
Pakistan	1.05	1.24	1.28	1.41	1.34	1.73	1.86	1.74	1.69	1.98	2.15	2.13	2.12	2.43	2.51
New Zealand	0.01	0.04	0.05	0.06	0.10	0.22	0.32	0.48	1.13	0.73	1.37	1.39	1.35	1.61	2.11
US	0.30	0.30	0.35	0.39	0.45	0.64	0.84	0.94	1.18	1.12	1.10	1.23	1.11	1.53	1.33
Japan	0.42	0.44	0.47	0.47	0.51	0.52	0.55	0.59	0.63	0.66	0.70	0.68	0.69	0.77	0.89
South Korea	0.40	0.47	0.46	0.45	0.57	0.63	0.65	0.65	0.74	0.83	0.92	1.00	1.09	1.15	0.57
Egypt	0.42	0.48	0.52	0.82	0.41	0.66	0.66	0.62	0.61	0.64	0.89	0.93	0.61	0.90	0.57
Bangladesh	0.18	0.33	0.71	0.72	0.90	1.22	1.55	1.27	1.27	1.47	1.40	1.58	1.00	1.03	0.28
Others	2.99	3.97	4.50	5.37	5.71	6.24	7.42	7.29	7.84	7.21	8.33	8.56	8.77	10.52	6.81
World total	15.36	18.42	19.97	23.17	24.07	27.24	30.31	30.26	34.85	37.29	37.80	38.63	41.35	45.83	39.56

Source: Chatham House Resource Trade Database.

Table 3.10: Importers of crude palm oil, 2000–14

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bangladesh	0.04	0.02	0.41	0.52	0.55	0.68	0.94	0.78	0.88	0.88	0.83	0.87	0.07	0.04	0.01
China	0.02	0.03	0.02	0.03	0.01	0.10	0.65	0.44	0.61	0.58	0.18	0.07	0.06	0.09	0.00
EU-27	1.18	1.78	1.87	1.81	2.17	2.73	3.10	3.16	3.79	4.57	4.88	4.20	4.98	5.50	4.63
India	0.91	1.47	2.16	2.53	1.75	2.02	2.33	2.98	4.33	4.89	4.80	5.32	5.98	5.49	6.43
Kenya	0.16	0.28	0.28	0.25	0.18	0.34	0.38	0.36	0.37	0.46	0.36	0.08	0.06	0.38	0.02
Mexico	0.13	0.16	0.16	0.18	0.25	0.25	0.30	0.30	0.30	0.31	0.32	0.34	0.39	0.41	0.37
Pakistan	0.01	0.01	0.02	0.16	0.11	0.17	0.37	0.45	0.55	0.44	0.50	0.74	0.41	0.28	0.10
Saudi Arabia	0.09	0.09	0.05	0.05	0.07	0.13	0.19	0.16	0.06	0.16	0.19	0.19	0.21	0.23	
Sri Lanka	0.00	0.00	0.00	0.00	0.02	0.28	0.31	0.18	0.05	0.02	0.02	0.01	0.01	0.03	0.08
Tanzania	0.00	0.00	0.00	0.05	0.08	0.13	0.13	0.00	0.06	0.12	0.13	0.15	0.14	0.15	0.10
Others	0.25	0.35	0.44	0.71	0.58	0.44	0.55	0.73	0.91	0.80	0.91	1.09	0.66	0.98	0.55
World total	2.77	4.19	5.42	6.29	5.76	7.29	9.26	9.55	11.89	13.23	13.10	13.05	12.97	13.56	12.30

Source: Chatham House Resource Trade Database.

Table 3.11: Importers of refined palm oil, 2000–14

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
China	1.38	1.54	2.15	2.96	3.48	3.81	4.31	4.47	4.63	5.70	5.19	5.53	5.97	5.52	5.01
EU-27	0.98	1.23	1.19	1.20	1.38	1.51	1.40	1.39	1.40	1.30	1.09	0.98	0.97	1.41	2.38
Pakistan	1.03	1.16	1.24	1.24	1.21	1.55	1.48	1.27	1.11	1.51	1.60	1.32	1.64	2.07	2.31
India	2.24	1.77	1.00	1.33	1.66	0.99	0.46	0.44	1.13	1.42	1.10	1.10	1.83	2.75	1.53
US	0.14	0.14	0.16	0.16	0.22	0.38	0.60	0.70	0.94	0.84	0.83	0.92	0.87	1.17	1.07
Japan	0.34	0.36	0.39	0.40	0.44	0.44	0.47	0.49	0.50	0.52	0.54	0.56	0.56	0.57	0.58
Egypt	0.41	0.47	0.50	0.79	0.39	0.64	0.64	0.50	0.44	0.48	0.79	0.77	0.58	0.87	0.54
Iran	0.02	0.03	0.08	0.15	0.19	0.36	0.34	0.44	0.57	0.55	0.69	0.59	0.81	0.96	0.45
Bangladesh	0.14	0.31	0.30	0.20	0.33	0.53	0.60	0.48	0.38	0.57	0.56	0.69	0.92	0.99	0.27
Russia	0.11	0.21	0.23	0.30	0.33	0.49	0.47	0.43	0.40	0.36	0.51	0.56	0.57	0.64	0.13
Others	2.21	2.81	3.12	3.39	3.80	3.69	4.46	4.16	4.72	4.17	4.85	5.29	5.49	6.20	4.63
World total	9.00	10.03	10.37	12.13	13.43	14.39	15.22	14.79	16.22	17.43	17.74	18.31	20.21	23.15	18.90

Source: Chatham House Resource Trade Database.

Table 3.12: Top 10 importers of palm nuts and kernels, and derivative products, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EU-27	2.82	3.00	3.05	3.35	3.33	3.84	3.78	3.26	3.37	3.00	2.64	3.17	3.72	3.61	3.31
New Zealand	0.00	0.02	0.03	0.04	0.09	0.20	0.30	0.46	1.11	0.71	1.35	1.37	1.33	1.59	2.09
China	0.02	0.26	0.12	0.16	0.18	0.24	0.30	0.40	0.35	0.94	0.85	0.64	0.94	1.21	0.99
South Korea	0.22	0.27	0.27	0.27	0.37	0.43	0.45	0.46	0.56	0.60	0.68	0.73	0.80	0.88	0.33
Japan	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.07	0.10	0.12	0.13	0.10	0.12	0.19	0.30
US	0.16	0.16	0.18	0.21	0.22	0.22	0.24	0.23	0.24	0.27	0.26	0.30	0.23	0.26	0.24
Brazil	0.05	0.03	0.03	0.03	0.03	0.04	0.07	0.09	0.11	0.13	0.19	0.15	0.16	0.17	0.20
India	0.05	0.06	0.06	0.12	0.10	0.13	0.13	0.13	0.15	0.25	0.22	0.14	0.18	0.33	0.19
Turkey	0.05	0.05	0.06	0.07	0.07	0.09	0.09	0.09	0.09	0.07	0.06	0.12	0.12	0.21	0.19
Australia	0.01	0.01	0.06	0.11	0.01	0.01	0.04	0.33	0.11	0.10	0.04	0.01	0.01	0.03	0.02
Others	0.15	0.27	0.26	0.34	0.43	0.32	0.36	0.39	0.54	0.44	0.54	0.54	0.55	0.64	0.48
World total	3.60	4.20	4.17	4.75	4.88	5.56	5.83	5.91	6.74	6.63	6.96	7.27	8.17	9.12	8.36

Source: Chatham House Resource Trade Database.

Table 4.1: Top 10 producers of soybeans (primary) 2000–13, (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
US	75.05	78.67	75.01	66.78	85.01	83.50	87.00	72.86	80.75	91.42	90.61	84.19	82.05	89.48
Brazil	32.73	39.06	42.77	51.92	49.55	51.18	52.46	57.86	59.83	57.35	68.76	74.82	65.85	81.72
Argentina	20.14	26.88	30.00	34.82	31.58	38.29	40.54	47.48	46.24	30.99	52.68	48.89	40.10	49.31
China	15.41	15.41	16.51	15.39	17.40	16.35	15.50	12.73	15.54	14.98	15.08	14.49	12.80	11.95
India	5.28	5.96	4.65	7.82	6.88	8.27	8.86	10.97	9.91	9.96	12.74	12.21	14.67	11.95
Paraguay	2.98	3.51	3.30	4.20	3.58	3.99	3.80	6.00	6.31	3.86	7.46	8.31	4.34	9.09
Canada	2.70	1.64	2.34	2.27	3.04	3.16	3.47	2.70	3.34	3.51	4.35	4.25	5.09	5.20
Uruguay	0.01	0.03	0.07	0.20	0.38	0.51	0.68	0.81	0.77	1.17	2.00	1.83	3.00	3.20
Ukraine	0.06	0.07	0.12	0.23	0.36	0.61	0.89	0.72	0.81	1.04	1.68	2.26	2.41	2.77
Bolivia	1.20	1.15	1.25	1.59	1.59	1.69	1.62	1.60	1.26	1.89	1.69	1.86	2.06	2.35
Others	5.74	5.87	5.66	5.42	6.15	7.00	7.16	6.01	6.51	7.24	8.09	8.78	8.60	9.01
World total	161.30	178.24	181.68	190.65	205.52	214.56	221.97	219.73	231.27	223.41	265.12	261.89	240.97	276.03

Source: Chatham House analysis of FAOSTAT data

Table 4.2: Top 10 exporters of soybeans and derivative products, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Argentina	18.55	23.45	24.49	29.71	28.17	33.15	35.06	41.38	39.11	29.14	39.52	38.36	30.88	32.61	35.02
Bolivia	21.46	28.91	29.87	35.28	34.81	37.96	39.14	38.68	39.17	43.06	44.53	47.94	49.32	57.47	60.44
Brazil	1.08	0.82	0.74	0.80	0.88	1.13	1.29	1.76	1.82	1.86	2.37	2.50	3.18	3.13	2.93
Canada	0.26	0.59	1.34	1.05	1.01	0.98	0.78	1.32	1.13	1.49	1.22	0.66	1.31	1.34	2.30
China	0.73	0.57	0.72	0.72	1.03	0.97	0.87	0.49	0.55	0.71	1.18	0.99	0.84	0.88	0.78
EU-27	2.60	1.91	2.00	1.35	3.07	2.25	4.08	3.91	5.64	2.94	3.21	4.56	3.14	4.49	1.86
India	0.76	1.32	0.90	1.70	2.27	2.06	1.79	2.31	1.95	1.72	4.46	4.96	3.28	5.94	6.10
Paraguay	0.01	0.01	0.01	0.05	0.14	0.20	0.28	0.31	0.21	0.37	0.38	1.14	1.50	1.32	1.65
Uruguay	0.01	0.03	0.13	0.36	0.69	0.82	0.97	1.12	1.22	1.54	2.74	2.35	3.47	4.33	4.12
US	29.28	30.96	29.65	31.10	25.79	27.76	28.81	31.15	35.18	42.07	46.10	38.64	46.44	43.77	53.80
Others	0.37	0.35	0.49	0.65	1.40	1.32	0.56	0.77	0.58	0.87	1.87	1.93	1.23	1.14	1.22
World total	75.12	88.91	90.33	102.77	99.26	108.60	113.63	123.21	126.57	125.77	147.58	144.03	144.57	156.41	170.21

Source: Chatham House Resource Trade Database.

Table 4.3: Top 10 exporters of raw soybeans, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Brazil	11.00	15.89	15.70	19.72	18.75	21.98	25.10	24.01	24.84	29.08	29.49	32.34	33.63	42.87	45.71
US	23.79	24.34	23.56	26.28	22.65	23.25	23.88	25.89	29.08	35.33	37.98	32.42	39.05	35.22	45.67
Argentina	4.11	7.17	5.96	8.60	6.47	9.63	7.52	11.12	12.00	4.68	13.05	9.96	6.49	7.53	7.15
Paraguay	0.71	1.26	0.82	1.56	2.26	2.01	1.76	1.71	1.27	1.34	4.11	4.67	3.03	4.60	4.04
Uruguay	0.00	0.03	0.13	0.36	0.69	0.81	0.95	1.10	1.22	1.52	2.70	2.35	3.42	4.31	4.09
Canada	1.03	0.72	0.68	0.79	0.87	1.10	1.28	1.75	1.80	1.84	2.31	2.41	3.02	2.98	2.78
Ukraine	0.01	0.00	0.00	0.04	0.06	0.19	0.27	0.30	0.19	0.29	0.34	1.10	1.44	1.22	1.51
China	0.23	0.25	0.29	0.27	0.33	0.39	0.35	0.44	0.50	0.36	0.18	0.23	0.31	0.22	0.22
Switzerland (incl. Liechtenstein)	0.00	0.00	0.03	0.10	0.49	0.14	0.13	0.10	0.12	0.14	0.67	0.53	0.10	0.08	0.09
EU-27	0.18	0.08	0.03	0.13	0.26	0.25	0.26	0.04	0.06	0.05	0.18	0.12	0.02	0.03	0.03
Others	0.21	0.11	0.04	0.13	0.23	0.17	0.09	0.13	0.09	0.32	0.23	0.15	0.46	0.47	0.41
World total	41.27	49.85	47.26	57.97	53.08	59.92	61.58	66.58	71.17	74.95	91.24	86.27	90.98	99.53	111.71

Source: Chatham House Resource Trade Database.

Table 4.4: Top 10 exporters of crude soybean oil (crude, cake and other solid residues), 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Argentina	14.43	16.25	18.51	21.10	21.62	23.50	27.50	30.21	27.09	24.43	26.45	28.39	24.27	25.03	27.83
Brazil	10.46	13.01	14.16	15.55	16.00	15.92	14.01	14.65	14.33	13.96	15.03	15.60	15.68	14.60	14.72
US	5.21	6.33	5.49	4.34	2.57	3.74	3.98	4.33	5.51	6.26	7.69	5.83	6.24	7.18	6.61
China	0.03	0.33	1.03	0.76	0.66	0.58	0.41	0.84	0.58	1.12	1.02	0.42	0.98	1.10	2.07
Paraguay	0.06	0.07	0.08	0.15	0.01	0.03	0.03	0.60	0.68	0.37	0.33	0.29	0.25	1.34	2.06
India	2.51	1.85	1.96	1.32	2.89	2.20	4.05	3.87	5.56	2.88	3.16	4.49	3.07	4.24	1.53
EU-27	0.53	0.47	0.65	0.58	0.75	0.70	0.60	0.43	0.48	0.64	0.99	0.86	0.80	0.83	0.74
Russia	0.00	0.00	0.01	0.00	0.00	-	0.00	0.02	0.07	0.12	0.11	0.07	0.13	0.32	0.57
Switzerland (incl. Liechtenstein)	0.01	0.00	0.08	0.11	0.33	0.29	0.03	0.06	0.02	0.04	0.59	0.69	0.09	0.04	0.08
United Arab Emirates	0.00	0.00	0.00	0.00	0.14	0.24	0.10	0.15	0.06	0.01	0.01	0.01	0.02	0.01	0.02
Others	0.24	0.33	0.39	0.32	0.43	0.30	0.22	0.35	0.28	0.38	0.40	0.60	0.64	0.53	0.54
World total	33.48	38.66	42.36	44.23	45.39	47.49	50.94	55.52	54.66	50.21	55.78	57.25	52.16	55.23	56.77

Source: Chatham House Resource Trade Database.

Table 4.7: Top 10 importers of soybeans and derivative products, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
China	10.86	13.90	12.14	23.85	22.31	27.45	30.09	33.94	40.44	45.09	56.88	53.67	59.15	65.50	72.72
EU-27	30.79	37.65	37.79	38.12	35.64	37.47	37.98	39.96	39.52	33.35	36.60	35.12	32.89	32.07	33.67
Indonesia	2.36	2.58	2.63	2.87	2.74	3.16	3.34	3.76	3.45	3.79	4.78	4.96	5.50	5.36	5.78
Thailand	2.54	2.95	3.22	3.59	2.61	3.41	3.73	3.67	3.71	3.66	4.33	4.29	4.97	4.54	4.85
Vietnam	0.32	0.45	0.71	1.04	0.98	1.29	1.55	2.58	3.01	2.49	3.10	4.02	1.33	4.53	4.82
Japan	5.43	5.60	5.85	5.94	5.42	5.65	5.64	5.91	5.47	5.30	5.60	4.94	4.85	4.54	4.39
South Korea	2.68	2.77	3.02	2.95	2.54	3.13	3.13	3.53	3.46	3.12	3.32	3.07	3.00	3.03	3.24
Egypt	1.54	1.76	1.69	1.47	1.39	1.71	1.33	1.68	1.31	1.39	1.80	2.64	2.91	2.63	3.22
Iran	1.71	1.89	2.24	2.42	2.69	2.00	2.52	2.49	2.01	2.28	3.32	3.32	2.66	3.89	2.82
Taiwan	2.14	2.26	2.26	2.38	2.09	2.47	2.70	2.58	2.24	2.33	2.27	2.52	2.56	2.23	2.33
Others	14.75	17.11	18.79	18.14	20.87	20.84	21.61	23.11	21.94	22.96	25.58	25.49	24.75	28.09	32.37
World total	75.12	88.91	90.33	102.77	99.26	108.60	113.63	123.21	126.57	125.77	147.58	144.03	144.57	156.41	170.21

Source: Chatham House Resource Trade Database.

Table 4.8: Top 10 importers of raw soybeans, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
China	10.17	13.78	11.31	21.78	19.89	25.48	27.89	30.94	37.72	42.45	55.07	52.29	57.29	64.22	71.51
EU-27	14.66	18.65	17.64	17.26	14.30	15.13	14.83	15.46	14.82	12.43	13.82	12.58	12.44	13.46	14.23
Japan	4.68	4.78	4.90	4.85	4.24	3.97	4.03	4.16	3.82	3.47	3.47	2.78	2.82	2.81	2.82
Taiwan	2.09	2.21	2.23	2.33	1.95	2.33	2.42	2.33	2.10	2.31	2.21	2.39	2.45	2.16	2.27
Turkey	0.36	0.34	0.59	0.80	0.69	1.06	0.98	1.15	1.19	1.00	1.73	1.25	1.26	1.09	2.11
Indonesia	1.14	1.19	1.26	1.27	1.12	1.23	1.18	1.43	1.25	1.40	1.86	1.90	1.85	1.82	2.08
Thailand	1.29	1.39	1.49	1.72	1.35	1.55	1.50	1.57	1.57	1.52	1.76	1.87	2.03	1.66	1.91
Egypt	0.19	0.37	0.33	0.33	0.37	0.87	0.72	1.20	0.84	1.01	1.19	1.32	1.97	1.27	1.50
South Korea	1.49	1.34	1.44	1.45	1.17	1.32	1.12	1.21	1.27	1.18	1.22	1.19	1.16	1.06	1.32
Iran	0.56	0.49	0.50	0.83	1.16	0.98	1.20	0.83	0.79	1.01	1.07	1.10	0.23	0.23	0.38
Others	4.63	5.30	5.58	5.35	6.83	5.99	5.71	6.32	5.80	7.18	7.83	7.59	7.47	9.76	11.58
World total	41.27	49.85	47.26	57.97	53.08	59.92	61.58	66.58	71.17	74.95	91.24	86.27	90.98	99.53	111.71

Source: Chatham House Resource Trade Database.

Table 4.9: Top 10 importers of soybean oil (crude, cake and other solid residues), 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EU-27	16.11	18.97	20.13	20.85	21.32	22.33	23.13	24.48	24.66	20.90	22.72	22.48	20.35	18.38	19.34
Indonesia	1.21	1.38	1.35	1.60	1.59	1.86	2.13	2.28	2.16	2.32	2.90	3.06	3.59	3.51	3.61
Vietnam	0.31	0.41	0.68	1.00	0.92	1.14	1.49	2.50	2.79	2.30	2.87	2.97	0.00	2.98	3.04
Thailand	1.25	1.54	1.73	1.87	1.26	1.85	2.22	2.10	2.13	2.12	2.55	2.41	2.92	2.82	2.76
Iran	1.15	1.40	1.74	1.59	1.52	1.02	1.32	1.67	1.21	1.27	2.25	2.21	2.44	3.65	2.45
India	0.48	1.24	1.21	1.02	0.99	1.61	1.54	1.24	0.75	1.01	1.49	0.99	1.22	1.20	2.23
South Korea	1.18	1.42	1.55	1.48	1.35	1.79	1.99	2.29	2.16	1.92	2.08	1.85	1.83	1.93	1.87
Philippines	0.92	1.10	1.44	1.34	1.18	1.45	1.43	1.41	1.32	1.34	1.29	1.80	1.17	1.34	1.87
Japan	0.71	0.79	0.91	1.01	1.13	1.62	1.58	1.70	1.59	1.79	2.07	2.09	2.00	1.66	1.48
China	0.69	0.11	0.83	2.07	2.42	1.97	2.19	3.00	2.72	2.64	1.80	1.38	1.86	1.26	1.18
Others	9.45	10.29	10.77	10.41	11.72	10.85	11.91	12.85	13.17	12.59	13.77	16.01	14.81	16.49	16.94
World total	33.48	38.66	42.36	44.23	45.39	47.49	50.94	55.52	54.66	50.21	55.78	57.25	52.16	55.23	56.77

Source: Chatham House Resource Trade Database.

Table 5.1: Top 10 consumers of beef, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
US	12.50	12.35	12.74	12.34	12.67	12.66	12.83	12.83	12.40	12.24	12.04	11.65	11.74	11.62	11.17
Brazil	6.11	6.20	6.45	6.29	6.42	6.80	6.97	7.14	7.25	7.37	7.59	7.73	7.85	7.89	7.93
EU-27	8.16	7.65	8.33	8.58	8.69	8.61	8.69	8.77	8.40	8.28	8.20	8.03	7.76	7.60	7.72
China	5.10	5.05	5.21	5.42	5.57	5.61	5.69	6.07	6.08	5.75	5.59	5.52	5.60	5.96	6.26
Argentina	2.55	2.52	2.36	2.43	2.52	2.45	2.55	2.80	2.76	2.76	2.35	2.32	2.46	2.66	2.70
Russia	2.01	2.24	2.39	2.44	2.42	2.56	2.48	2.54	2.71	2.51	2.49	2.35	2.41	2.39	2.39
India	1.18	1.29	1.40	1.53	1.64	1.55	1.69	1.74	1.88	1.91	1.93	1.98	2.04	2.09	2.13
Mexico	2.32	2.35	2.22	2.32	2.18	2.03	1.89	1.96	2.03	1.98	1.94	1.92	1.84	1.87	1.88
Pakistan	0.89	0.90	0.93	0.95	0.98	1.00	1.30	1.34	1.37	1.41	1.45	1.50	1.54	1.58	1.63
Japan	1.56	1.40	1.30	1.35	1.17	1.19	1.16	1.18	1.17	1.21	1.23	1.24	1.26	1.23	1.29
Other	10.49	10.22	10.57	10.67	10.94	11.16	11.58	11.65	11.65	10.99	11.63	11.48	11.62	11.94	12.16

Source: USDA.

Table 5.2: Top 10 beef producers, 2000–13 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
US	12.30	11.98	12.43	12.04	11.13	11.20	11.86	11.98	12.16	11.89	12.05	11.92	11.79	11.70
Brazil	6.58	6.82	7.14	7.23	7.77	8.59	9.02	9.30	9.02	8.94	9.12	9.03	9.31	9.68
China	4.63	4.71	4.83	5.12	5.28	5.34	5.48	5.83	5.83	6.05	6.23	6.17	6.29	6.39
Argentina	2.72	2.46	2.49	2.66	3.02	3.13	3.03	3.22	3.13	3.38	2.63	2.50	2.59	2.82
Australia	1.99	2.12	2.03	2.07	2.03	2.16	2.08	2.23	2.13	2.12	2.11	2.13	2.13	2.32
Mexico	1.41	1.44	1.47	1.50	1.54	1.56	1.61	1.64	1.67	1.70	1.74	1.80	1.82	1.81
Russia	1.89	1.87	1.96	1.99	1.95	1.79	1.70	1.69	1.77	1.74	1.73	1.63	1.64	1.63
France	1.53	1.57	1.64	1.63	1.57	1.52	1.47	1.53	1.50	1.52	1.53	1.57	1.50	1.40
Germany	1.30	1.36	1.32	1.23	1.26	1.17	1.19	1.19	1.20	1.19	1.21	1.17	1.15	1.11
Canada	1.26	1.26	1.29	1.20	1.50	1.46	1.33	1.28	1.29	1.25	1.27	1.15	1.20	1.06
Others	20.46	19.58	20.14	20.42	20.95	21.33	22.14	22.53	22.81	22.75	23.46	23.68	23.75	24.07
World total	56.07	55.18	56.74	57.10	58.01	59.25	60.92	62.41	62.52	62.52	63.07	62.75	63.18	63.98

Source: Chatham House analysis of FOASTAT data.

Table 5.4: Top 10 importers of beef, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
US	1.38	1.44	1.46	1.36	1.67	1.63	1.40	1.38	1.15	1.19	1.04	0.93	1.01	1.02	1.06
Russia	0.43	0.67	0.75	0.77	0.79	1.05	1.03	1.12	1.23	1.05	1.06	0.99	1.03	1.03	1.02
Japan	1.05	0.98	0.70	0.83	0.63	0.69	0.68	0.69	0.66	0.70	0.72	0.75	0.74	0.76	0.76
Hong Kong	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.09	0.12	0.15	0.15	0.15	0.24	0.47	0.58
China	0.02	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.03	0.10	0.41	0.55
EU-27	0.43	0.42	0.53	0.55	0.64	0.72	0.72	0.65	0.47	0.50	0.44	0.37	0.35	0.38	0.38
South Korea	0.33	0.25	0.44	0.46	0.22	0.25	0.30	0.31	0.30	0.32	0.37	0.43	0.37	0.38	0.36
Venezuela	0.00	0.00	0.00	0.01	0.05	0.03	0.05	0.19	0.32	0.25	0.14	0.20	0.22	0.33	0.30
Canada	0.29	0.33	0.34	0.30	0.12	0.15	0.18	0.24	0.23	0.25	0.24	0.28	0.30	0.30	0.29
Chile	0.12	0.12	0.14	0.18	0.18	0.21	0.12	0.15	0.13	0.17	0.19	0.18	0.19	0.25	0.26
Others	1.63	1.46	1.73	1.63	1.74	1.97	2.26	2.29	2.18	1.96	2.23	2.11	2.11	2.11	2.21
World total	5.74	5.76	6.20	6.20	6.15	6.79	6.85	7.11	6.78	6.56	6.62	6.41	6.65	7.42	7.76

Source: Chatham House analysis of USDA FAS data.

Table 5.5: Top 10 exporters of beef, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Brazil	0.49	0.74	0.87	1.16	1.61	1.85	2.08	2.19	1.80	1.60	1.56	1.34	1.52	1.85	2.03
India	0.34	0.37	0.41	0.43	0.49	0.62	0.68	0.68	0.67	0.61	0.92	1.27	1.41	1.77	1.88
Australia	1.32	1.38	1.34	1.24	1.37	1.39	1.43	1.40	1.41	1.36	1.37	1.41	1.41	1.59	1.56
US	1.12	1.03	1.11	1.14	0.21	0.32	0.52	0.65	0.91	0.88	1.04	1.26	1.11	1.17	1.14
New Zealand	0.47	0.48	0.48	0.55	0.59	0.58	0.53	0.50	0.53	0.51	0.53	0.50	0.52	0.53	0.54
Uruguay	0.24	0.15	0.23	0.28	0.35	0.42	0.46	0.39	0.36	0.38	0.35	0.32	0.36	0.34	0.39
Canada	0.56	0.62	0.66	0.41	0.60	0.60	0.48	0.46	0.49	0.48	0.52	0.43	0.34	0.33	0.36
Paraguay	0.06	0.06	0.08	0.05	0.11	0.18	0.22	0.19	0.22	0.24	0.28	0.20	0.25	0.33	0.35
EU-27	0.66	0.61	0.58	0.44	0.36	0.25	0.22	0.14	0.20	0.14	0.34	0.45	0.30	0.24	0.24
Belarus	0.02	0.03	0.04	0.06	0.07	0.08	0.09	0.09	0.09	0.16	0.18	0.15	0.16	0.22	0.23
Others	0.66	0.43	0.68	0.76	0.95	1.11	0.87	0.96	0.92	1.09	0.74	0.78	0.79	0.80	0.81
World total	5.94	5.89	6.48	6.52	6.73	7.37	7.59	7.64	7.61	7.45	7.82	8.10	8.16	9.17	9.51

Source: Chatham House analysis of USDA FAS data.

Table 5.6: Top 10 exporters of bovine hides and leather, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
US	0.84	0.86	0.83	0.87	0.87	0.87	0.96	1.03	0.89	0.82	1.34	1.21	1.03	1.10	0.94
Brazil	0.20	0.21	0.21	0.24	0.34	0.34	0.42	0.52	0.31	0.30	0.34	0.36	0.37	0.48	0.50
EU-27	0.34	0.25	0.22	0.24	0.39	0.34	0.38	0.44	0.48	0.53	0.58	0.51	0.47	0.48	0.45
Australia	0.25	0.26	0.28	0.26	0.30	0.24	0.24	0.29	0.21	0.18	0.28	0.24	0.23	0.26	0.29
Argentina	0.13	0.12	0.10	0.11	0.12	0.13	0.13	0.13	0.13	0.12	0.15	0.11	0.09	0.11	0.11
Canada	0.06	0.08	0.07	0.08	0.10	0.11	0.10	0.17	0.11	0.08	0.14	0.14	0.08	0.11	0.11
South Africa	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.04	0.08	0.08	0.08	0.07	0.10	0.09
Taiwan	0.16	0.15	0.15	0.14	0.12	0.08	0.08	0.15	0.13	0.12	0.14	0.12	0.08	0.07	0.06
Russia	0.13	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.04	0.04	0.04
South Korea	0.17	0.16	0.06	0.06	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.07	0.04
World total	2.89	2.82	2.63	2.75	3.18	3.03	3.20	3.69	3.08	2.91	4.01	3.68	3.31	3.65	3.42
Others	0.57	0.59	0.59	0.65	0.76	0.75	0.74	0.80	0.69	0.59	0.87	0.83	0.81	0.83	0.79

Source: Chatham House Resource Trade Database.

Table 5.8: Top 10 importers of bovine hides and leather, 2000–14 (million tonnes)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
China	0.51	0.60	0.64	0.67	0.95	0.97	1.11	1.42	1.33	1.41	1.70	1.63	1.71	1.85	1.74
Hong Kong	0.52	0.54	0.27	0.35	0.51	0.44	0.44	0.42	0.38	0.31	0.42	0.33	0.26	0.26	0.18
EU-27	0.71	0.65	0.67	0.66	0.59	0.54	0.61	0.63	0.42	0.38	0.57	0.54	0.44	0.52	0.53
India	0.03	0.02	0.02	0.02	0.03	0.03	0.05	0.04	0.04	0.05	0.07	0.05	0.04	0.05	0.05
Japan	0.10	0.09	0.08	0.08	0.08	0.06	0.07	0.08	0.05	0.04	0.06	0.05	0.04	0.04	0.04
South Korea	0.37	0.32	0.31	0.27	0.26	0.26	0.21	0.23	0.18	0.21	0.32	0.30	0.27	0.25	0.19
Taiwan	0.17	0.15	0.15	0.19	0.20	0.16	0.17	0.20	0.14	0.10	0.24	0.18	0.13	0.14	0.14
Thailand	0.05	0.07	0.09	0.09	0.11	0.09	0.09	0.13	0.14	0.13	0.17	0.13	0.12	0.13	0.12
Turkey	0.02	0.02	0.03	0.03	0.02	0.03	0.04	0.05	0.03	0.03	0.06	0.06	0.04	0.04	0.04
Vietnam	0.02	0.02	0.03	0.03	0.06	0.09	0.07	0.12	0.13	0.08	0.18	0.18	0.06	0.14	0.18
Others	0.22	0.20	0.20	0.21	0.37	0.37	0.35	0.36	0.24	0.17	0.24	0.22	0.18	0.24	0.21
World total	2.89	2.82	2.63	2.75	3.18	3.03	3.20	3.69	3.08	2.91	4.01	3.68	3.31	3.65	3.42

Source: Chatham House Resource Trade Database.

Table 5.10: Leather production and exports (million tonnes), 2013

	Production	Exports
China	1.53	0.05
US	1.12	1.25
EU-27	1.06	0.70
Brazil	0.90	0.49
India	0.42	0.01
Argentina	0.38	0.12
Australia	0.23	0.46
Mexico	0.22	0.01
Russia	0.16	0.12
Pakistan	0.16	0.02

Sources: FAO and Chatham House Resource Trade Database.

Annex 2: Chatham House Resource Trade Database category tree

Agricultural products		
Oilseeds		**Other agricultural products**
Soybeans	**Palm fruit**	**Skins, hides and leather**
Soya beans	Palm nuts and kernels	Bovine hides, whole, fresh or wet-salted
Soya bean flour or meal	Palm oil, crude	Bovine skins, whole, raw
Soya-bean oil-cake and other solid residues	Palm oil or fractions simply refined	Bovine hides, raw, not elsewhere specified
Soya-bean oil crude, whether or not degummed	Palm kernel or babassu oil, crude	Bovine leather, otherwise pre-tanned except whole skin
	Palm kernel & babassu oil, fractions, simply refined	Bovine and equine leather, tanned or retanned, not elsewhere specified
	Palm nut or kernel oil cake and other solid residues	Bovine leather, vegetable pre-tanned except whole skin
		Bovine and equine leather, not elsewhere specified
		Bovine and equine leather, full or split grain, not elsewhere specified
		Butts and bends, bovine, fresh or wet-salted

The table shows the various derivative products that sit under the respective agricultural products; soybeans, palm fruit and skins, hides and leather.

Abbreviations and Acronyms

CDP*	
CGD	Center for Global Development
CIFOR	Center for International Forestry Research
CPOPC	Council of Palm Oil Producer Countries
CWE	carcass weight equivalent
DRC	Democratic Republic of the Congo
EPA	[US] Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
FAPRI	Food and Agriculture Policy Research Institute
FAS	[USDA] Foreign Agricultural Service
GRSB	Global Roundtable for Sustainable Beef
GTS	Soy Working Group
ha	hectare(s)
HCS	high carbon stock
HCV	high conservation value
ILUC	indirect land use change
ISCC	International Sustainability & Carbon Certification
LWG	Leather Working Group
MENA	Middle East and North Africa
$MtCO_2$	metric tonnes of carbon dioxide
PNG	Papua New Guinea
POIG	Palm Oil Innovation Group
REDD+	[enhanced] Reducing Emissions from Deforestation and Forest Degradation

RFS	Renewable Fuel Standard
RRI	Rights and Resources Initiative
RSPO	Roundtable on Sustainable Palm Oil
RTRS	Round Table on Sustainable Soy
SSA	sub-Saharan Africa
SDGs	Sustainable Development Goals
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USDA	United States Department of Agriculture

* Stand-alone acronym; formerly Carbon Disclosure Project.

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