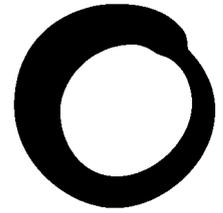


October 2010



**Friends of
the Earth**

Report

From forest to fork

The UK's contribution to deforestation in Brazil

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INTRODUCTION ¹

Deforestation in Brazil is a real and pressing problem and it is driven by market forces. Booms in commodity markets, for example for soy or biofuels, are mirrored by destruction of virgin forests, shrublands, managed forests and other habitats.

These market surges, are ultimately driven by huge demands for agricultural commodities from the EU, USA and increasingly from emerging economies such as China. As global demand for agricultural commodities grows, mega farmers and agribusinesses have cleared increasingly large areas of forest to plant commercial crops, which are more profitable than local food crops, or to make room for grazing beef cattle. These land use changes, which often encroach on previously remote areas, also require new road networks and infrastructures to be built and act as a vanguard of deforestation in the region, eventually leading to the development of human settlements in areas that were formerly uninhabited.

The combined pressure of demand for soy, meat and sugarcane for biofuel nationally and internationally, along with rising market prices for commodities, as well as a lack of clear and enforceable ownership rights to forest land in some parts of the country has made agricultural expansion a major cause of deforestation in Brazil.

Today, production of commodities such as soybeans is reaching record levels. World soybean production increased by 4.6 per cent annually from 1961 to 2007 and reached average annual production of 217.6 million tons in 2005-07. World production of soybeans is predicted to increase by 2.2 per cent annually to 371.3 million tons by 2030 (Masuda, 2009).

Brazil is the world's second biggest soybean producer, after the United States, accounting for 23 per cent of the global total. Official data shows that Mato Grosso, covering the Amazon and Cerrado habitats in south eastern Brazil, is where the vast majority of this production takes place. The area planted with soy in Mato Grosso expanded from 1.5 to 2.9 million hectares between 1990 and 2000, an average increase of 6.5 per cent per year. The pace of growth accelerated considerably between 2000 and 2005, averaging 16 per cent per year and increasing the area planted to 6.1 million hectares (SEMA-MT 2009).

Cattle ranches are also expanding rapidly and in some areas of Brazil are responsible for up to 73 per cent of deforestation. In total Brazil's cattle ranches cover an area of about 172 million hectares (IBGE 2008).

A few decades ago it seemed as if Brazil had plenty of fertile land to meet its goal of becoming the world's 'breadbasket'. It has become increasingly clear, however, that this land is pressed into service for cheap meat and biofuel crops at the expense of other vital services such as climate and ecosystem regulation, watersheds, wildlife habitat, local livelihoods and local food (Gibbs, 2010).

¹ This report was researched for Friends of the Earth by Sergio Schelsinger, independent researcher from Brazil. However the figures on deforestation from UK imports of beef and soy are the sole responsibility of Friends of the Earth.

Amazon: people and wildlife at risk

The Amazon basin – which covers 40% of South America and is where a lot of soy plantation expansion is taking place – is home to the world's largest rainforest, an ecosystem that supports perhaps a third of the world's terrestrial species, stores vast amounts of carbon, and exerts considerable influence on global weather patterns and climate.

The Amazon is one of the world's most biodiverse regions comprising a mosaic of ecosystems and vegetation types including rainforests, seasonal and deciduous forests. It is home to almost a third of the world's known species, with more than 1,300 species of bird alone. The forest is also home to around 220 groups of indigenous people who have lived in the Amazon for thousands of years.

Cerrado: a biodiversity hotspot

The Cerrado is a unique eco-region of woody savannas that are characterised by a high diversity, ranging from dense forest areas to nearly treeless grasslands. It is situated in Central Brazil, with extensions to Paraguay and Bolivia. The cerrados offer a home to 160,000 species of plants, animals and fungi, and are one of the most threatened tropical savannah regions in the world, due to human intrusions. It is internationally recognised as a biodiversity hotspot. The Cerrado is home to 40 per cent of Brazil's mammals, reptiles and fish, including a number of endangered species, such as the giant armadillo, the giant otter and the hyacinth macaw. It also provides a habitat for at-risk species such as jaguars, maned wolves and ocelots.

This land is now part of a national and international economy, and the way it is used is being driven by numerous factors including economic policy, international trade agreements, low land prices, large scale infrastructure and production systems and devaluation of the Brazilian currency (the Real). Brazil has also responded quickly to new export opportunities – capitalising, for instance, on opportunities for meat exports at times when outbreaks of diseases like foot and mouth have occurred in other markets. These market demands on the Amazon and Cerrado have made them one of the most rapidly-changing ecosystems on the planet.

The EU has played a crucial role to play in this environmental disruption. It is now one of Brazil's top trading partners for commodities such as soy, beef and ethanol. A large proportion of these commodities end up in the UK either directly as food products or indirectly as feed for our animals. The question that now arises is whether market forces should continue to dictate how best to use Brazil's land?

EXECUTIVE SUMMARY

Agricultural exports have historically been an important element of the Brazilian economy. Until the 1980s, Brazil pursued a strategy of increasing industrialisation with the aim of reducing national dependency on exports of primary products such as soy². Driven by external factors such as debt, Brazil adopted new economic policies designed to aggressively boost the growth of its agribusiness sector and with this its volume of agricultural exports. Thus in the last few decades, Brazil has become a major producer and exporter of energy (in the form of bio-ethanol and bio-diesel), food and many other agricultural products.

Today the growth and geographical spread of these farming activities in Brazil is increasingly driven by demands from overseas. Brazil, for instance, is the European Union's biggest trading partner for agricultural goods – supplying around 30 per cent of the EU's agricultural imports. The USA and China are also major importers of Brazilian agricultural products. The United Nations' Food and Agriculture Organisation (FAO) estimate that by 2020 Brazil's agricultural sector will have expanded by 40 per cent – more than any other country in the world (FAO 2010).

However, the economic gains from this growth have largely gone to big producers and exporters, and Brazil's increasing prominence as an agricultural super-power has brought with it a host of negative environmental and social effects.

Environmentally it has resulted in rampant deforestation, loss of biodiversity and the loss of vital carbon sinks. The expansion of genetically modified soy plantations has also resulted in huge increases in pesticide use because weeds have developed resistance to the pesticides used routinely with GM crops. This means a cocktail of more dangerous pesticides are being used, resulting in pollution and health problems (Friends of the Earth International, 2008). The expanding agricultural sector in Brazil is also a significant generator of greenhouse gas emissions (GHGs). This places the country in another prominent position on the international scene: that of the fourth highest emitter of greenhouse gases (MCT, 2009).

Globally the supply and production of energy, combined with industrial activities, accounts for almost half of GHG emissions (45 per cent in 2004). But in Brazil, which is home to around 30 per cent of the world's forests, farming activities and the deforestation caused by them account for 80 per cent of GHG emissions. Most of these emissions relate to "land use changes and forestry activities."³

² From the 1930s until the late 1980s 'import substitution policies' were in force in most nations in Latin America, including Brazil. During those decades Latin American countries, which exported primary products and imported almost all of the industrialised goods they consumed, were prevented from importing due to a sharp decline in sales of export goods. This situation provided the incentive for increasing domestic production of the goods they needed.

³ According to the IPCC (2001), land use changes and forestry activities include afforestation, reforestation and deforestation. Any changes in the biosphere, through land use changes such as logging, grassland conversion, and forest clearing will modify the natural balance of atmospheric gases altering both rates of emissions and sequestration by soil and plants.

Socially, negative impacts on the production of food for domestic consumption, threats to the population's food security, unemployment and other issues have all reversed with any gains made through an increasingly mechanised agricultural sector.

This report looks at two of the main farming activities which drive Brazil's export markets and which are associated with deforestation. These are:

- **Cattle ranching** – due to the amount of land it occupies (172 million hectares in 2006) and to the volume of greenhouse gas emissions associated with it (IBGE 2009).
- **Soy** – the crop occupying the largest surface area in Brazil (23 million hectares in the 2009/10 harvest) (CONAB 2010).

It also looks at the role of sugarcane, the third largest crop in Brazil (8 million hectares in the 2010/11 harvest), which has shown high levels of growth over recent years and which promises to continue growing at a rapid rate, primarily to produce bio-ethanol⁴ (CONAB 2010).

Combined, these three commodities account for more than 80 per cent of the total area occupied by all farming activities in Brazil.

Along with the USA and China, Europe plays a major role in driving the expansion of agricultural production in Brazil. Europe is one of the largest importers of soybeans and soymeal from Brazil, the largest importer of ethanol from Brazil and one of the largest global importers of beef, also importing a large amount from Brazil.

Within the EU, the UK also plays a role in increased imports from Brazil, due to its direct imports of beef and soy products. In 2009, 89 per cent of soybean imports, 34 per cent of soy oil imports and 36 per cent of soymeal imports were from Brazil. Similarly Brazil supplies 13 per cent of the UK's imports of beef, making it our second largest supplier of beef (after Ireland). The UK was also the sixth largest export market for Brazilian beef in 2009.

Although it is not the most major export partner of Brazil, the UK's impact on deforestation is significant. The UK's lack of self sufficiency in food and feed within its own borders is at least partly driving agricultural expansion. Importantly, the UK is also driving deforestation through its promotion of export- oriented agricultural development in international forums, such as in the reform of the European Common Agricultural Policy.

Other than in the Brazilian Amazon, there is very little recent direct tracking of deforestation. It is also difficult to find tracking of deforestation for specific agricultural expansion. However, a number of studies have shown a correlation between increased demand for soy, cattle ranching and sugarcane cultivation and increased deforestation. There is also some evidence of crop production pushing out other less profitable types of farming such as ranching and small scale agriculture in forest frontiers.

⁴ Maize, which also occupies a significant area in Brazil, is not studied here since in general it occupies areas already cleared for other uses.

It is extremely difficult to monitor specific cases of deforestation caused by particular crops or exports, even with satellite tracking. This is because a number of agricultural activities take place in the same areas.

In addition, the phenomenon of 'leakage' or 'indirect land use change', where more profitable crops such as soy or sugarcane replace less profitable farming activities which are then displaced into virgin forest, means that considering only direct forest conversion is misleading and in many cases a larger share of land conversion can be attributed to highly profitable commodity crops.

Despite the many uncertainties, what is clear is that the growth of large scale agriculture in Brazil, mainly due to huge demands for meat, animal feed and biofuels from the EU, USA, China and Russia are driving unsustainable rates of deforestation and social destruction. If this level of growth continues not only will Brazil be unable to meet its own GHG reduction targets, but the impact on global emissions will be considerable and the loss of biodiversity and habitat irreplaceable.

In this report we make an estimate of the possible effects of the UK imports of soy and meat on deforestation in Brazil, based on extrapolations from best available data, to illustrate the scale of change needed in the UK to halt our contribution to deforestation in Brazil.

According to our estimates, UK imports of beef and soy from Brazil in 2009 were responsible for deforestation of 3167 square kilometres, an area twice the size of Greater London.

The UK has a major opportunity to overhaul its meat and dairy sector to stop our impacts on global climate emissions and loss of biodiversity by passing the Sustainable Livestock Bill in Parliament. As international action to stop deforestation gains momentum, increasing focus will be placed on these commodity exports and the UK is placed to be ahead of the curve in developing a vibrant meat and dairy sector that is protected from shocks in international commodity markets.

THE GROWTH OF BRAZILIAN AGRICULTURE

In recent decades Brazil has pursued a strategy of increasing agricultural output with the aim of reducing national debt, tackling poverty, and lessening dependency on imports. In the last 25 years agriculture has become increasingly important to Brazil, both as a way of generating wealth and income for its population and as a way of maintaining a strong presence on the international commodities markets.

While the country did not have the infrastructure to compete with the new wave of industrialisation which has swept the world during this time – a wave that included microelectronics, computing and biotechnology – it did have land: rich forests, savannahs, scrub and a culture of agricultural production already in place.

Since the 'green revolution' of the 1970s the industrialisation of Brazilian agriculture has gained extraordinary momentum. Brazilian agricultural production, which had increased 0.7 per cent per year between 1986 and 1993, grew at an annual average of 3.7 per cent between 1993 and 2004. This strong rate of expansion continues even today, except for rare periods, such as in the wake of the global financial crisis in 2008 (Brugnaro & Bacha 2009).

Three main commodities drive Brazilian agricultural expansion: soy, beef and sugarcane.

Soy complex⁵ exports more than quadrupled between 2000 and 2009, increasing in value from US\$ 4.2 billion to US\$ 17.2 billion. Sales of beef rose from US\$ 813 million to US\$ 4.2 billion over the same period. The Brazilian government has also firmly committed to a policy of expanding the foreign market for Brazilian ethanol, produced from sugarcane.

Most of the growth in the planted area occupied by farming from 1996 onwards is attributed to soy. Without soy, the average growth of agriculture would have been 3 per cent per year. In comparison, the growth in area of land planted with soy in the same period was 5.9 per cent per year. Between 1999 and 2004 the area planted with soy expanded by 8.6 million hectares to 21.6 million hectares (Brugnaro & Bacha 2009).

Meat production also rose continually between 1986 and 2002. On average, annual growth rates were 6.8 per cent between 1986 and 1993 and 7.8 per cent between 1993 and 2002 (Brugnaro & Bacha 2009).

In 2008, Brazil became the world's third largest exporter of agricultural produce, overtaking Canada, China and Australia, and exceeded only by the United States and the European Union (O Estado de São Paulo 2010).

From the beginning of the 1990s, the possibility of agricultural expansion in Brazil stimulated the arrival of the large food multinationals, such as grain traders. In some instances, these companies even took over the role of the government in funding agricultural production for crops such as soy. Control of production, processing and trade of agriculture commodities is highly concentrated in the hand of a few multinational companies including US companies Bunge, Cargill and Archer Daniels Midland, and French company Louis Dreyfus.

A recent report notes that when public money was spent on agriculture, it was spent on research and development to identify ways of cultivating acid soils previously unsuitable for agriculture, on finding varieties of crops that suited the soil and climate, and on the adoption of conservation tillage⁶. Such investment and expansion could have, in theory, increased the income and status of the rural poor, but as the report notes, "While this was a major technological success, direct impacts on rural poverty were reduced because capital subsidies encouraged more highly mechanised forms of cultivation." (World Bank, 2010).

Brazil is predicted to experience by far the fastest growth in agriculture of any country, an expansion of more than 40 per cent by 2019 compared to the period 2007-2009 (OECD/FAO, 2010). By comparison China and India are expected to see growth of 26 per cent and 21 per cent respectively, while over the same period, net agricultural output in the EU-27 will have grown less than 4 per cent.

The growth and geographical spread of these farming activities is increasingly driven by demands from overseas. As markets grow this puts further pressure on the land.

Estimates from the Ministry of Agriculture (MAPA, 2010) suggest that:

⁵ soybeans, meal and oil

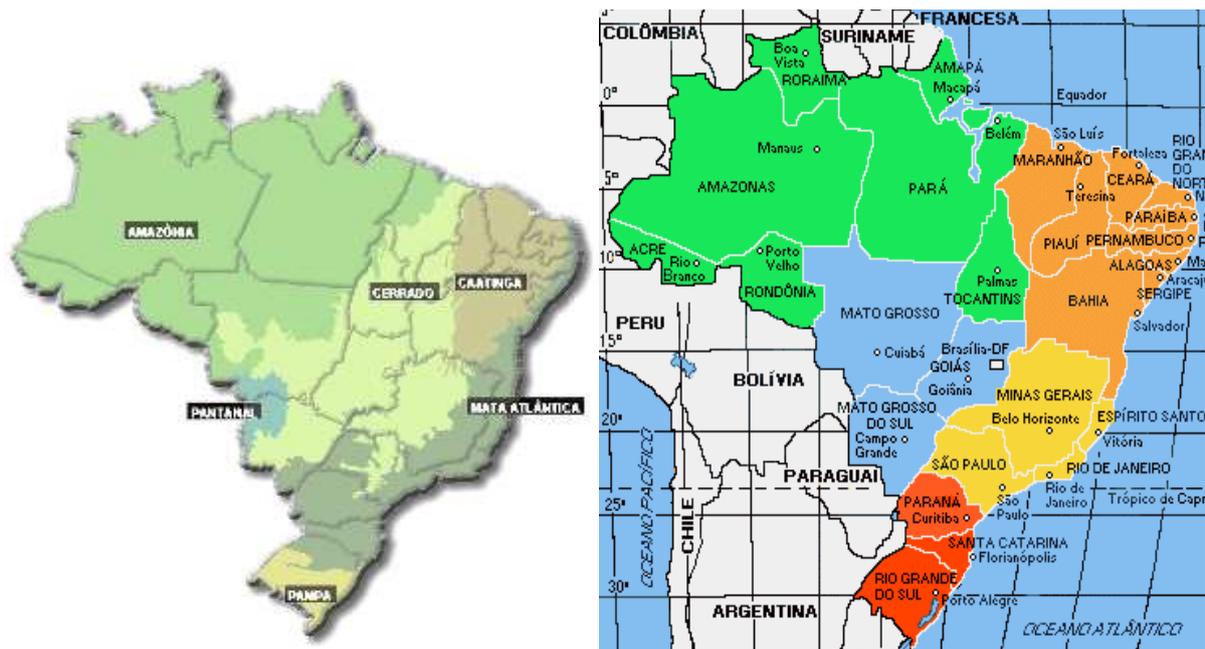
⁶ With conservation tillage crops are grown with minimal cultivation of the soil. This increases the water-holding capacity of the soil, and water losses from runoff and evaporation are reduced. However, this brings disadvantages too, including soil compaction, flooding or poor drainage, delays in planting because fields are too wet or too cold, and carryover of diseases or pests in crop residue.

From forest to fork

- The volume of soy that will be harvested in 2019/20 will be some 25 million tons more than in 2009/10. By 2020 Brazil's soy exports could represent 41 per cent of world trade.
- For meat, production is expected to increase from 8 million tons in 2009/10 to around 10 million in 2019/20, growing at a rate of 2.15 per cent per year. By 2020 Brazil is expected to export more than 3 million tons of beef, equivalent to 43 per cent of world trade.
- Production of sugarcane in 2019/20 is expected to reach 893 million tons, 56 per cent higher than the 2008/09 harvest (571 million tons).

The combined expansion of these sectors will result in increasing pressure on the Midwest region, where the largest beef cattle herds and the largest planted area of soy are concentrated. These are expanding into areas of the Cerrado and Amazonian Rainforest and currently sugarcane is also expanding into areas of the Cerrado. In Mato Grosso do Sul, there is also an increase in planted forests in areas of the Cerrado and the Pantanal.

This expansion will also impact the North region, in particular the states of Pará and Rondônia where the areas occupied by beef cattle and soy are growing simultaneously. Another focal point is Tocantins state, which possesses the third largest number of beef cattle and the largest area planted with soy in the region (Schlesinger, 2009).



Europe's Role

Brazil is the European Union's biggest trading partner for agricultural goods – supplying around 30 per cent of the EU's agricultural imports. It is likely that the EU's dependence on Brazil, which already accounts for around 30 per cent of its agricultural imports, will also grow significantly over this time period (European Trade Commission, 2010).

The UK is also a trading partner with Brazil for soy and beef. In 2009, 89 per cent of UK soybean imports, 34 per cent of soy oil imports and 36 per cent of soymeal imports were from Brazil. Similarly Brazil supplies 13 per cent of our imports of beef, making it our second

largest supplier of beef, after Ireland. The UK was also the sixth largest export market for Brazilian beef in 2009.

Although it is not the most major export partner of Brazil, the UK's impact on deforestation is significant. The UK's negligence of self sufficiency in food and feed within its own borders is at least partly driving agricultural expansion. Importantly, the UK is also driving deforestation through its promotion of export- oriented agricultural development in international forums, such as in the reform of the European Common Agricultural Policy.

Deforestation from soy and cattle ranching

It is through deforestation and the burning of vegetation that Brazil is now the fourth largest emitter of GHGs in the world. Deforestation has other consequences too, including loss of biodiversity and altering the microclimate as well as social impacts such as loss of employment and, in many cases, loss of small scale farmers and indigenous communities' homes as they are driven off the land by large agricultural concerns.

Although it has been argued that Brazil's increasing agricultural output has been met by re-appropriating previously cleared land for different uses – e.g. from soy cultivation to cattle range, or vice versa – and not at the expense of intact forest, a number of studies confirm that large-scale agro-industrial expansion is the dominant driver of deforestation in this decade (Nepstad, 2008; Hansen, 2008).

Over recent decades, cattle and soy have been the largest drivers of deforestation and vegetation burning, particularly in the Cerrado and Amazonia, but also in the Pantanal. In Legal Amazonia⁷, 83 per cent of which is covered by forest, cattle ranching and soy production account for 36 per cent and 39 per cent of land use respectively (Embrapa, 2008).

In these regions soy and cattle ranching are now competing as the main causes of deforestation in terms of the speed of their expansion (Gibbs, 2010). In any given area it is the marketplace which pushes one ahead of the other. Indeed, as one report suggests, “forests fall as commodity markets boom” (Instituto Nacional de Pesquisas Espaciais, 2009).

Although agricultural expansion is a major driver of tropical deforestation (FAO, 2005; Geist 2001) in South America, not all expansion results in the loss of intact forests: shrublands, pasture, logged or regrowing forests, degraded land, and shifting cultivation fields are all sources for new permanent agriculture (Morton 2006).

This destruction of existing habitats sits in marked contrast to land use in developed countries. Data shows that developing countries have expanded their permanent croplands by 10.1 per cent during the current decade alone, while permanent cropland areas in developed countries remained generally stable (FAO 2009).

⁷ Legal Amazonia includes all seven states of the North Region: Acre, Amapá, Amazonas, Pará, Rondônia, Roraima and Tocantins as well as Mato Grosso state in the Center-West Region and most of Maranhão state in the Northeast Region.

In Latin America, it has recently been estimated that, between 1980 and 2000, more than 80 per cent of new agricultural land came from intact as well as disturbed forests (Gibbs, 2010).

Below we look in detail at soy and beef production in Brazil, how it impacts the environment and what role the EU, and in particular the UK, has in driving deforestation and land use changes across Brazil.

Soy: rise of the Brazilian super crop

Soy production is highly concentrated in a small number of countries. The United States, Brazil and Argentina together are responsible for 82 per cent of world production and 90 per cent of exports.

While the EU is the biggest overall importer of Brazilian soy, individual markets for soy beans, soy meal and soy oil vary considerably. China and the European Union, for example, are the largest buyers of soy beans. On the other hand, China buys relatively low quantities of meal, while the European Union is the largest importer. In particular the Netherlands, France and Germany act as hubs for soy imports and in turn export soybeans and meal directly to the UK and other countries, and also indirectly through exports of poultry and pig meat to the UK. The biggest buyers of soy oil are China, Iran and Bangladesh (Product Board for Margarine, Fats and Oils, 2009; USDA EU-27 Oilseeds Report, 2009).

Soy is planted throughout Brazil, accounting for half of the total area planted with grains. Over the last 20 years, soy complex has represented on average 9 per cent of Brazil's total exports and more than 20 per cent of agricultural exports. In 2009 this share rose to 11.3 per cent and 27.3 per cent, respectively.

By 2009 soy was one of Brazil's main exports.

Production is more highly concentrated in the Midwest region of the country (Cerrado and Amazon), which accounts for 47 per cent of production, followed by the South (36 per cent) (Mata Atlantica and Pampa habitats, Northeast (8 per cent), Southeast (7 per cent) and North (2 per cent) (CONAB, 2010).

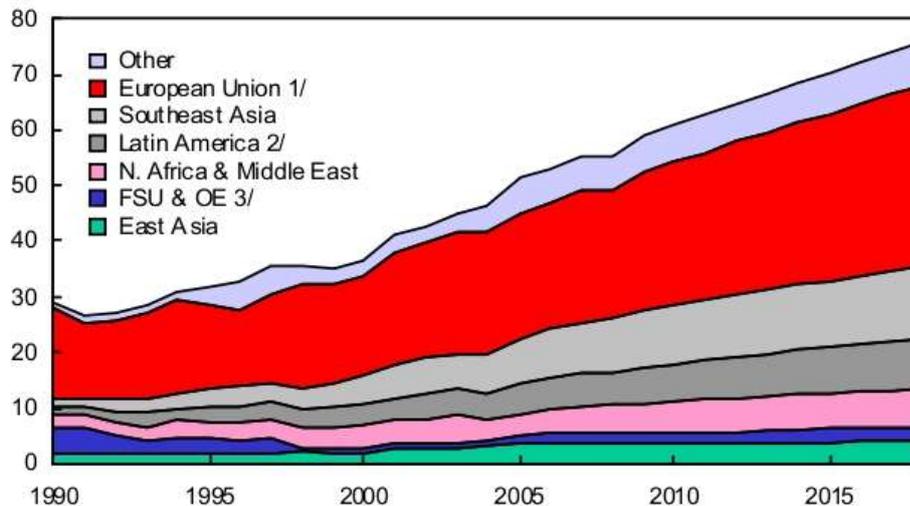
Projections indicate that the volume of soya set to be harvested in the 2019/20 agricultural year will be some 25 million tons higher than the 2008/09 harvest, reaching 82 million tons and growing at an annual average of around 3 per cent (MAPA 2010). This means that by 2019, the area planted with soy will increase to 26.85 million hectares, an area larger than the area of the UK.

Exports are expected to keep pace with production at around 38 million tons by 2020 – an increase of 10.3 million tons over 2009 levels. By 2020 Brazil's soy exports should represent 41 per cent of world trade in this commodity (MAPA, 2010).

The increase in land area used for production can be seen across all the soy-producing states with the exception of Mato Grosso do Sul, where the crop area ranks second to sugarcane due to the establishment of new sugar and ethanol production plants. The largest growth is seen in Paraná state, where crop production is predicted to expand by 421,600 hectares to a total of 4.49 million hectares, followed by Mato Grosso, expanding by 332,200 hectares to 6.16 million; Rio Grande do Sul, increasing by 153,700 hectares to 3.98 million;

and Goiás, increasing by 152,800 hectares to a total area of 2.46 million (CONAB, March 2010).

In the UK alone, more than 789,000 tonnes of soybeans were imported from Brazil in 2009 – about 89 per cent of the UK’s total soybean imports. In addition, 34 per cent of soy oil for the British market comes from Brazil as does 35 per cent of soy meal (Van Gelder, 2010).



Global soybean meal imports (millions of tons) ⁸ Source USDA, 2009

Soy: a major driver of deforestation

Grain cultivation primarily takes place in the Cerrado portion of Legal Amazonia⁹ (16 per cent of the region), which encompasses Mato Grosso, Tocantins and the south of Maranhão, as well as areas that were once Amazonian rainforest, such as the Santarém region (Pará) (Instituto Brasileiro de Geografia e Estatística, IBGE 2008; Embrapa 2008). This expansion has been taking place in areas traditionally occupied by extensive cattle ranching or previously covered in Cerrado vegetation or, at a lower scale, in Amazonian rainforest.

In both Mato Grosso and Rondônia along the “arc of deforestation” in south-eastern Brazil, dramatic increases in soy cultivation and pasture have resulted in a relatively higher rate of clearing intact forest (Gibbs 2010).

Whereas a mixture of maize, cassava, rice, and sugarcane dominate throughout the rest of South America (Monfreda, 2008) in this area in particular, soy is the principle crop. Moreover, a much higher proportion of available land (forest, pasture, and shrubland) has been cleared in this soy-producing area than elsewhere in Brazil (Gibbs, 2010).

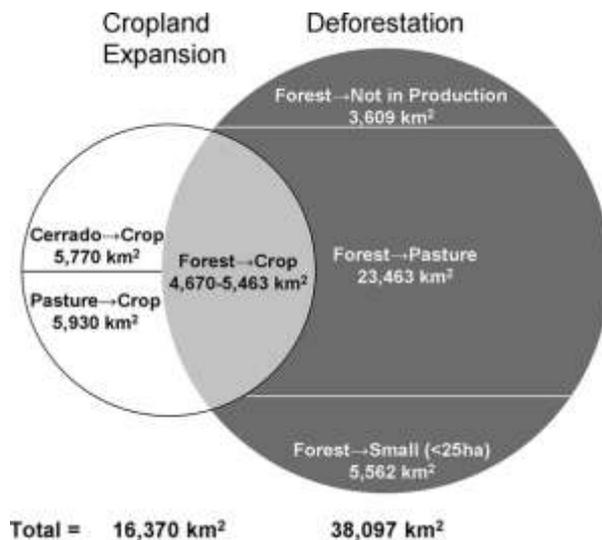
Currently the regions where soya dominates are the Midwest (Mato Grosso, Mato Grosso do Sul and Goiás), Northeast (Bahia, Maranhão and Piauí) and North (Tocantins). Mato Grosso is the largest of these with 27 per cent of the total area planted with soya (CONAB 2009) and

⁸ 1/ EU-27 excludes intra-trade after 2002, EU-15 intra-trade before 2003, Slovenia before 1992. 2/ Includes Mexico. 3/ Former Soviet Union and other Europe; prior to 1999, includes Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia. USDA, 2009. USDA Long-term projections February 2009: Agricultural Trade (<http://www.ers.usda.gov/Publications/OCE091/OCE091f.pdf>)

⁹ Map of Legal Amazonia - Agricultural Frontier. Available at: http://www.ibge.gov.br/home/geociencias/geografia/mapas_doc3.shtm, accessed on 04/02/10.

expansion of 16 per cent per year between 2000 and 2005, increasing the area planted to 6.1 million hectares (SEMA-MT 2009).

In 2003, when the price of soy on the international market hit its peak, direct conversion of forested land to crop production accounted for almost a quarter of the entire area deforested in Mato Grosso, while conversion of forest to pasture accounted for the other 75 per cent (Morton, 2006). During the same period there was a 12 per cent fall in the conversion of forest to pasture, while the conversion of forest to crop land grew by 10 per cent (Morton 2006).



Relationship between cropland expansion and deforestation in Mato Grosso, Brazil, during 2001–2004. Source: Morton, 2006

A study published in 2006 by the US National Academy of Sciences, and based on satellite images shows that between 2001 and 2004, in Mato Grosso state alone, 540,000 hectares of forest were converted directly to soy fields (Morton, 2006).

UK deforestation from soy demand

In 2009, the United Kingdom imported 898,000 tonnes of soybeans, 104,000 tonnes of soy oil and 1,895,000 tonnes of soy meal. Of these, 89 per cent of soybean imports, 34 per cent of soy oil imports and 36 per cent of soy meal imports were from Brazil. So the UK livestock sector is hugely dependent on imports from Brazil for animal feed supplies.

Using the average soybean yield for each of the soy-producing countries, it is possible to calculate the acreage needed in Brazil to produce UK imports of soy products.

Soybeans are processed into two primary products: soy meal and soy oil, and as soy meal cannot be produced without producing soy oil, part of the acreages needed to grow soybeans has to be assigned to the production of soy meal and part to the production of soy oil. In order to calculate the acreages needed, we have to convert the volumes of soy oil and soy meal into amounts of soybeans. For this purpose we assume that 1,000 tonnes of soy oil equals 1,687 tonnes of soybeans, and 1,000 tonnes of soy meal equals 872 tonnes of soybeans. See Appendix 1 for a detailed description of the calculation method.

Using this calculation, a total of 948,055 hectares of land was needed to provide the United Kingdom's soy imports in 2009 – 493,795 hectares in Brazil (52 per cent) and 378,274 hectares (40 per cent) in Argentina, together comprising 92 per cent of the total acreages needed.

There is little information available on which area of Brazil British imports of soy are grown in, but we can attribute the acreage grown for the UK to the main areas in which soy is grown in Brazil, 47 per cent the Midwest region comprising the Cerrado and Amazon habitats and 36 per cent the south comprising the Mata Atlantica and Pampa.

Therefore, in 2009 we attribute 232,084 hectares of land in Midwest region of Brazil and 177,766 hectares in South to produce soy for the UK.

The best estimates of expansion and deforestation caused by soy using satellite imaging are from 2001-2006 in Mato Grosso state. Between 2001 and 2004, cropland expansion was 3,132,000 hectares, mostly for soy planting. The study shows that during this time direct conversion of tropical forests to cropland exceeded 540,000 hectares and conversion of cerrado grasslands to agriculture took an additional 939,600 hectares (Morton 2006).

The study also found that the mean annual soybean price during 2001–2004 was directly related to the amount of deforestation for cropland in Mato Grosso.

Using this ratio of deforestation per hectare of crop expansion, we can estimate the amount of deforestation caused by UK soy imports. The UK could be responsible for up to 40,479 hectares of deforestation in forests and 69,625 hectares in cerrado biomes in 2009 – or 110,104 hectares in total.

However, while the figures in the study are based on cropland expansion over a number of years, the UK figures we have used are based on UK soy imports for one year, 2009. Therefore we can more accurately estimate deforestation by looking at the increase in UK imports of soybeans from Brazil between 2008/09. In 2008, UK imports of soy beans from Brazil were 591,848 tonnes, and 754,486 tonnes in 2009 (DEFRA 2010)

Therefore 162,638 tonnes more of soybeans were imported into the UK in 2009. Based on an average yield for soybeans in Brazil of 2.93 tonnes per hectare (Oil World 2010), the land area required to produce our imports was 55,508 hectares.

Assuming the same ratio of deforestation to crop expansion as above, 9,570 hectares of deforestation in forests and 16,652 in grassland Cerrado was caused due to our imports of soy in 2009.

Currently, large parts of the Cerrado and Amazon are already deforested. Estimates from 2002 suggest that nearly 40 per cent of the Cerrado and 50 per cent of the Amazon are already destroyed. However these are also the biomes under the most pressure from soy, cattle and sugarcane and there is evidence that new planting is also coming at the expense of forests and grasslands.

With regard to the Southern biomes of Mata Atlantica and Pampa, a large part of the forest was destroyed by soy and coffee plantations in the Sixties and Seventies. Estimates from 2002 suggest that 73 per cent of the Atlantic forest and 64 per cent of the Pampa in Brazil

has already been destroyed, but recent anecdotal evidence shows that nearly 90 per cent of the Atlantic forest is already destroyed (MMA, 2007).

Therefore new planting in these regions is unlikely to cause direct deforestation but is still likely to do so through indirect impacts, since the South is a major area of expansion for sugarcane.

If we assume the same ratio of deforestation in the Mata Atlantica and Pampa, then 2009 UK soy imports would be responsible for 12,259 hectares of deforestation in the South region of Brazil.

However, considering the above, we could revise direct deforestation figures in the South of Brazil from soy to 68 per cent of this figure – 8338 hectares.

Cattle: a growing threat

Beef production and consumption are extremely concentrated in a small number of countries. Together the four largest herds (India, Brazil, China and the US) currently make up two thirds of the world's cattle livestock.

World production of beef has increased 12 per cent over the last 20 years, rising from 51 million tons (carcass weight equivalent)¹⁰ in 1990 to 57 million in 2009. Since 2006, global production of beef has been around 56 to 58 million tons per year. (USDA, 2009)

The biggest growth in production over recent years has taken place: (i) in the United States, reflecting the recovery in its productive base, after being struck by outbreaks of mad cow disease (BSE) in 2004; (ii) in Brazil, responding to the growing domestic and international demand; and (iii) in China, responding to the strong growth in domestic consumption.

The rise in global production has largely been driven by the increase in the demand for meat-based protein at global level, recently in developing countries including Brazil and India, but historically by high per capita consumption in the industrialised world.

In 2009 just five countries accounted for more than half of worldwide imports of beef. The United States and Russia lead this ranking with one third from total world imports of 6.6 million tons in 2009. (USDA, 2010)

The market share of the five biggest suppliers is even greater than imports with these countries accounting for 68 per cent of exports. Brazil is the largest exporter (nearly 1.6 million tons), followed by Australia (1.4 million tons), from total world exports of 7.5 million tons. (USDA, 2010)

Brazil's cattle herd – around 200 million heads – occupied 172.3 million hectares in 2006., The largest cattle herds are found in the states of Mato Grosso (12.9 per cent), Minas Gerais (11.1 per cent) and Mato Grosso do Sul (11.1 per cent). (IBGE, 2009)

By comparing the 2008 data with that was obtained in 2007, we can see a regional fall in cattle herds in the Southeast (-2 per cent), due to increased planting of sugarcane with the largest reduction observed in São Paulo (- 5.1 per cent). The other regions of the country showed an increase in cattle herd sizes: North (3.3 per cent), Northeast (0.5 per cent), South

¹⁰ Carcass weight equivalent. Weight of deboned meat equivalent to the weight of boned carcass

(4 per cent) and Midwest (1.2 per cent) (IBGE 2009). This is consistent with the expansion of pastureland into previously virgin forests, shrublands and savannahs.

Cattle: dynamics of deforestation

Cattle ranching is becoming an increasingly dominant factor in deforestation and its impact has accelerated greatly in recent years. 73 per cent of the region’s 74 million heads of cattle occupy areas that were once forest. (SEMA-MT 2009) (IBGE 2008)

As with soy, the expansion of cattle ranching in Brazil has led to forest clearing but also the clearing of other types of land such as shrublands.

Ministry of Agriculture figures show that the national beef cattle herd grew by 147 million heads between 1990 and 2006 to around 200 million. Eighty per cent of this growth took place in Legal Amazonia whose herd leapt from 26 million heads (18 per cent of the national total) to 73 million, equivalent to 36 per cent of the national total. Mato Grosso contains the highest number of cattle in the country: its beef cattle herd rose from 9 million heads to 27 million between 1990 and 2005, maintaining an average pace of growth of roughly 7.5 per cent per year (MAPA 2010).

Pará, also in Amazonia will soon have the largest beef cattle herd in the country. Mato Grosso and Pará combined account for around 60 per cent of the region’s overall herd, with Rondônia also increasing rapidly.

A 2009 study on emissions caused by cattle ranching in Brazil, covering the period 2003-2008, identified ranching as the main factor responsible for the emissions related to deforestation and burning, in both the Cerrado and in Amazonia. (Bustamante, Nobre & Smeraldi 2009)

The data suggest that almost 56.5 per cent of the new deforestation in the Cerrado (8.5 million hectares) can be directly linked to the expansion in cattle ranching. In the case of Amazonia, growth in pasture areas was over 8.2 million hectares, or 75 per cent of the 11 million hectares deforested during the period. (Bustamante, Nobre & Smeraldi 2009)

Deforestation from Brazilian meat exports to the UK

A large part of Brazilian production of beef is for domestic consumption. Its main export partners for beef are Russia, USA and increasingly China. However the UK is the 6th largest export market for beef from Brazil importing 48,009 tonnes of beef in 2009. Brazil is the second largest supplier of beef (after Ireland) to the UK supplying 13 per cent of our imports.

Brazilian beef exports by destination - 2009
The ten largest importers

Country	Thousand net ton.	US\$ thousand
Russia	334,069	952,812
Hong-Kong	207,394	612,136
Iran	36,961	335,352
USA	44,284	231,820
Egypt	81,598	217,175
U. Kingdom	48,009	168,163
Venezuela	36,961	165,013
Italy	24,809	159,203

Algeria	51,139	142,300
Netherlands	21,825	126,808

Source: Abiec, based in Secex/Mdic (www.abiec.com.br)

The acreages needed for beef production are determined by the land used to farm the cattle and the land used for crops to feed the animals. There are large differences in land use between the various countries and regions exporting beef, because of differences in livestock farming systems.

In order to calculate the land use for beef imported by the United Kingdom, we have used figures based on the land use of beef from a report by the Dutch consultancy Blonk Milieu Advies¹¹. This study provides data on the land use for beef in Brazil, Ireland and the Netherlands, based on information about the livestock farming systems used in these countries.

Intensive livestock farming is based to a large extent on imports of feed ingredients from various parts of the world. As the growing of these feed ingredients requires agricultural acreages as well, the land use for intensive livestock growing systems is differentiated per region by Blonk Milieu Advies. (see Appendix 2)

The land used by UK beef imports in 2009 in Brazil was 2,011,589 hectares. However it is not always possible to directly convert production figures per year into hectareage of land used because all cattle from a herd are not necessarily slaughtered every year. Therefore this figure for hectareage assumes total conversion of the cattle herd into beef at the end of the year.

As discussed above, the evidence available on deforestation from cattle ranching in Brazil, particularly in the Brazilian Amazon, is strong. Legal Amazonia contains 36 per cent of cattle ranching in Brazil and 73 per cent of them occupy areas that were once forest.

We can estimate the proportion of cattle in the different habitats of Brazil based on figures from IBGE – the Brazilian Institute of Geography and Statistics.

Cattle herd - Brazil - thousand heads					
	2005	2006	2007	2008	
Brazil	207,157	205,886	199,752	202,287	
North	41,489	41,060	37,866	39,119	19.3%
Northeast	26,969	27,881	28,711	28,852	14.2%
Southeast	38,944	39,209	38,587	37,820	18.6%
South	27,770	27,200	26,500	27,566	13.6%
Midwest	71,985	70,536	68,088	68,930	34%

Source: IBGE - Municipal Livestock Study

The North and Midwest regions covering the Amazon and Cerrado together make up 53 per cent of heads of cattle in Brazil. Again, it is not possible to specifically track where beef

¹¹ A Dutch consultancy that specialises in identifying and assessing environmental and other sustainability aspects of agricultural production and consumption chains

imports in UK come from, but evidence from export figures for Mato Grosso and Rhodonia states in the Legal Amazon at least show the UK as a main export destination for cattle from these states. (Smeraldi, 2007) If we use the figures from IBGE, attributing 53 per cent of UK land use for beef imports to these regions means the UK used 1,066,142 hectares of land in Cerrado and Amazon for its beef imports in 2009.

Recent research examining deforestation by cattle ranching in the Amazon and Cerrado between 2003 and 2008 suggests that 56 per cent of new deforestation in the Cerrado and 75 per cent of new deforestation in the Amazon can be directly linked to expansion in cattle ranching.¹²

It is difficult to estimate exactly how much of the land used for cattle ranching for British meat consumption is directly responsible for deforestation, rather than existing deforested land. We have assumed that the majority of this land use is responsible for deforestation based on the fact that the majority of expansion in cattle ranching in Brazil – especially in the Amazon – has been to satisfy export demand.

According to IBGE, 73 per cent of cattle heads in the Legal Amazon occupy areas that were once forested. The Legal Amazon includes all the states of the North as well as Mato Grosso and most of Maranhão. If we use this figure directly as indicative of a proportion of deforestation from cattle ranching, then the UK would be responsible for 73% of 2,011,589 hectares or 778,284 hectares of deforestation in the region for its beef imports in 2009.

However this figure estimates UK deforestation over a period of time longer than one year. In addition the North and Midwest regions of Brazil encompass an area larger than the Legal Amazon.

Another more accurate estimation would be to allocate 36 per cent of UK land use in Midwest region to the Legal Amazon as this is the percentage of cattle in the Legal Amazon rather than 53 per cent based on the table above – (383,811.12 hectares), and 73 per cent of that to direct deforestation. In this case 281,082 hectares of deforestation would be allocated to UK imports of beef from Brazil in 2009.

However, this leaves out Mato Grosso do Sul, which holds the 3rd largest cattle herd in Brazil and is part of the cerrado and Pantanal biomes which are experiencing among the highest rates of deforestation in Brazil.

Deforestation from Pork and poultry meat imports into the UK

Most of UK imports of pork and poultry meat come from other countries in the EU, although Brazil supplies 4 per cent of UK poultry meat, 25,000 tonnes. The Netherlands is the largest supplier of poultry meat to the United Kingdom (See appendix 4).

However, pork and poultry meat production in other western European countries is also heavily dependent on soy imports from South America, as well as direct imports of pork and poultry from Brazil.

¹² As the full results and methodology of this study have not been published we cannot use these figures in our calculations.

Therefore we can estimate land use abroad in different countries for imports of pork and poultry meat. This is outlined in the table below:

Table 1 Land use required per region to produce poultry and pork meat

Type of meat	Production country	Land use required per region (m ² / tonnes)						
		North America	South America	Europe	Asia	Australia	Unknown	Total
Chicken	Netherlands	366	2,627	1,533	6	0	27	4,559
Chicken	Brazil		7,300					7,300
Pork	Netherlands	341	3,023	2,572	1,372	37	322	7,668

Source: *Milieueffecten van Nederlandse consumptie van eiwitrijke producten, Gevolgen van vervanging van dierlijke eiwitten anno 2008*, Blonk Milieu Advies, October 2008.

According to the report, of the 7300 m² / tonne required to produce poultry and pork meat in Brazil, 1900 m² is for soy inputs, so we can ascribe a ratio of 3.84 of each meter square to soy production for feed.

According to the same report, total acreages needed in Brazil for UK imports of pork and poultry meat are 18,237 hectares.

Therefore an additional 4,749 hectares of land in Brazil is required for soy imports from poultry production into the UK.

Using the ratio as in the soy section above, we can calculate deforestation from the acreages needed for poultry and pork meat imports by the United Kingdom.

Using the same calculation as above for deforestation from soy:

2,232 hectares of land in the Midwest region and 184,331 hectares of land in the South were used to produce soy for British consumption.

This corresponds to 384 hectares of forest conversion and 669 hectares of grassland deforestation.

Sugarcane - highlighting indirect land use change

The international sugar trade shipped over 49.6 million tons in 2008, equivalent to around 31 per cent of global production. During this period, Brazil accounted for about 42 per cent of global trade. The European Union (18 per cent) and Australia (9 per cent) are the second and third largest world exporters, respectively. (Sugar Yearbook, 2008)

Although less relevant to the UK in terms of imports, sugarcane production in Brazil is also a contributing factor to deforestation. Three-quarters of world sugar production is based on sugarcane from tropical zones located in the southern hemisphere. Brazil is the world's

largest producer of sugarcane – around 30 per cent of the total harvested worldwide and derivatives. In 2007/08 the five main sugar-producing countries - Brazil, India, China, Thailand and Mexico were responsible for about 56 per cent of global production.

Sugarcane is grown in almost all of Brazil's states and occupies around 10 per cent of the country's arable surface, representing the third most important crop in terms of area occupied after soy and maize. The planted area for the 2010/11 harvest is estimated at over 8 million hectares, an increase of 9.2 per cent in the cultivated surface area. Production is forecast to be 664 million tons, representing a 10 per cent increase on the previous year. Around 90 per cent of this total will be produced in the mid-South region (South, Southeast and Midwest regions) and the remaining 10 per cent in the North and Northeast regions.

São Paulo state is the largest producer, responsible for around 55 per cent of all production in the 2010/11 harvest, followed by Minas Gerais with 8 per cent. In the same period the largest expansion of land area devoted to sugarcane was also seen in São Paulo – around 40 per cent of the total expansion in the area planted nationally (CONAB, 2010).

Sugarcane is also a feedstock for bioethanol. According to the Brazilian National Petroleum, Natural Gas and Biofuel Agency (ANP), domestic sales of ethanol totalled around 19 billion litres, while petrol sales totalled 18 billion litres. In other words, ethanol consumption in Brazil now exceeds petrol consumption, primarily because of the large number of flex-fuel vehicles (6 million units) already being used in the country, as well as the mixing of ethanol into petrol in proportions ranging from 20 to 25 per cent. (AFP 2008)

In 2009 Brazil exported 3.3 billion litres of ethanol, generating US\$ 1.34 billion in revenue. The main purchasers were the European Union, CBI,¹³ India and South Korea.

Whilst government agencies and producers argue that new crops of sugarcane are planted in previously degraded areas, and that the use of ethanol to replace petrol will help reduce overall emissions on a global scale, new data suggests this is not the case. For example, in order for Brazil to achieve its biofuel production targets for 2020, an additional 57,200 sq km of sugarcane and 108,100 sq km more soybean will have to be grown and this will likely come from newly planted land (Lapola 2010).

ENVIRONMENTAL IMPACTS

Greenhouse gas emissions

Gaining a clear picture of the destruction of natural habitats in Brazil, and the associated GHG emissions, is essential in order to better understand how to reverse the trend. However, reliable and up-to-date information on aspects such as the volume of emissions produced by the deforestation of each of the two largest habitats, indirect changes in land use, the effective emissions of each of the distinct farming activities, the use of pesticides are not available.

Aside from failing to focus on many of these issues, the most recent and complete survey on GHG emissions in Brazil, published in 2004, actually uses data from 1994 (MCT, 2004).

¹³ Caribbean Basin Initiative.

Globally, energy production and industrial activities are the biggest contributors to GHG emissions, representing 26 per cent and 19 per cent respectively. Agriculture, according to the IPCC, is responsible for 13.5 per cent of annual global emissions of carbon dioxide equivalent (CO₂e);¹⁴ This figure may be an underestimate given that it takes into account only the sector's direct emissions, formed mainly by methane (CH₄) derived from enteric gases and faeces produced by cattle, rice paddy fields and nitrous oxide (N₂O), the latter primarily released by the use of fertilizers and biomass burning. It does not include indirect emissions, for instance carbon emissions from disturbed soil, from the decomposition of plants killed by fire but not completely combusted, nitrous oxide emissions from the soils that have been treated with fertilisers due to volatilisation, leaching and surface runoff and from loss of carbon sequestration due to expansion of agriculture into Amazon rainforests and the Cerrado savannah.

Taking these inputs into account the FAO estimates that agriculture may be responsible for as much as one third of global greenhouse gas emissions (as measured in CO₂e).

In Brazil – now the world's third largest exporter of agricultural products and home to around 30 per cent of the world's remaining forests – the picture is vastly different. There, 58 per cent of the country's emissions come from changes in land use and forestry activities related to agriculture, compared to 16 per cent from energy production and 2 per cent from industrial activities.

According to the Ministry of Science and Technology (MCT 2009), these total emissions from agriculture come mainly from changes to plant and tree cover, especially deforestation in Amazonia and the Cerrado relating to soy and sugarcane production, with 22 per cent arising from other farming activities such as cattle ranching and dairy farming. In relation to farming activities, the largest proportion of emissions comes from the methane released by cattle. In terms of crop production, the intensive use of nitrogen-based fertilisers¹⁵ and pesticides – the production of which depends heavily on fossil fuels – are typical to monocropping systems, and these activities contribute significantly to raising the total volume of these emissions.¹⁶

In 2005, the Ministry of Science and Technology (MCT 2009) estimated that total emissions in Brazil at 2,200 Gton of CO₂eq, Just Amazonia and the Cerrado alone were responsible for around 816 Mton of CO₂e, or 37 per cent of Brazil's total emissions that year, and 64 per cent of the total emissions resulting from land and forest use changes (1.2 Gton of CO₂e).

The Ministry also points out that the official figures should be considered an underestimate since they did not include other sources of emissions, such as those from soils in degraded pastures, those derived from producing animal feed [used to 'finish' or fatten the animals in the few months before slaughter] and those known as 'off-farm', primarily related to the

¹⁴ CO₂e – standard unit used to measure the global warming potential of the different types of greenhouse gases whose emission levels are converted into an equivalent quantity of CO₂.

¹⁵ Application of nitrogen-based fertilisers can release nitrous oxide – a potent climate changing gas – into the atmosphere. Worldwide fertilisers are the largest source of GHG emissions – 38% according to Stern 2007.

¹⁶ An analysis by Cranfield University on behalf of the UK's Crop Protection Association concluded that pesticide manufacturing represents about 9% of the energy use of arable crops and around 3% of the 100-year Global Warming Potential (GWP) from crops (Audsley E et al, 2009)

transportation of cattle and meat and primary industrial processing of the same. Also, that the study left out deforestation to make way for pastures in other biomes besides Amazonia and the Cerrado.

Recent estimates suggest combining the emissions produced by deforestation, burning of plant cover to form pastures and livestock breeding, the total amount produced by beef cattle ranching over recent years corresponds to an average of 1.1 Gton of CO₂-eq, in round figures, in 2003. This represents around half of Brazil's total GHG emissions (Bustamante, Nobre & Smeraldi, 2009).

The hidden impact of beef and soy – indirect land use changes

Deforestation and burning are examples of obvious, direct land use changes. However, in addition to these there are less well studied, indirect changes which impact greatly on existing biomes.

For instance, in Mato Grosso, the state with the largest bovine herd and simultaneously the largest area planted with soy in the country:

“The respective contributions of cattle ranching and agriculture towards deforestation vary over time. With the peak in soy prices from 2001 to 2004, for example, the area initially increased from 310,000 to 520,000 hectares, equivalent to a growth of 69 per cent in three years. Over the same period, the direct conversion of forests into agricultural fields represented 16 per cent of deforestation in the state's forest areas, with a peak of 23 per cent in 2003. **As well as this direct conversion of forests and Cerrado, there has also been the conversion of pasture areas into crop fields in the mid-North of the state, combined with the relocation of cattle ranching to new frontiers to the far north and northwest, contributing to the expansion of cleared areas in these regions.**” [Our emphasis] (SEMA-MT 2009)

In the recent history of the occupation of areas of Cerrado and Amazonia rainforest by cattle ranching and soy production, forest clearing “functions as a kind of vanguard of deforestation” leading the way for other destructive practices. (SEMA-MT 2009)

For example, thousands of kilometres of clandestine roads are built in cleared forest, enabling the expansion of migrations and land-grabbing of public lands, as well as colonization and extensive cattle ranching projects.

In the State of Mato Grosso, the hotspots of deforestation have focused mainly along the Cuiabá- Santarém highway (BR-163) and BR-158 in the regions central / north and northeast, respectively. Similar expansion has also been observed in the region located east of the Xingu Indigenous Park, along the BR-158 and BR-080 roads, a region previously considered suitable for beef cattle and now being converted into an expanding area of grain farming. Human settlements are also increasing in areas such as Novo Mundo and Guarantã do Norte, as people go where the work is and move into areas that were previously uninhabited. (SEMA-MT 2009; and Alencar et al, 2004).

Expansion clears the way for various other kinds, indirectly contributing to the problem of deforestation:

“Associated with the expansion of the agricultural frontier, the spatial distribution of the deforested areas, as well as the hot spots, directly reflects the growth of activities intrinsically connected to this process, such as timber extraction and the clearing of pastures, which, along with the expansion of grains cultivation, form a mosaic of different uses of Amazonian space that has radically transformed the traditional dynamic of occupying Brazilian Amazonia.”¹⁷ (IBGE 2009)

Some of the links between sugarcane, increasing production of which is linked to increasing demand for bioethanol, and deforestation are also indirect. A recent study by researchers at the University of Kassel in Germany found that in order for Brazil to hit its biofuel production targets for 2020 an additional 57,200 sq km of sugarcane and 108,100 sq km more soybean will have to be grown (Lapola, 2010).

Much of this land is likely to come from areas previously used for cattle, driving more deforestation as more land is cleared to create rangeland. The report notes sugarcane ethanol and soybean biodiesel each contribute to nearly half of the total projected indirect deforestation in Brazil by 2020:

“In our simulations there is an expansion of 121,970 sq km of rangeland into forest areas, and 46,000 sq km into other native habitats, due to the expansion of biofuel croplands. Sugarcane ethanol and soybean biodiesel would be responsible for 41 per cent and 59 per cent of this indirect deforestation, respectively.”

Although it is often assumed that the carbon savings of switching to plant based fuels will offset any emissions from land-use changes, the German researchers concluded that when this indirect land use is considered, the report says it would take about 250 years to repay the carbon debt created by land clearance. This breaks down to 40 years of replacing gasoline with sugarcane-based ethanol and 211 years replacing diesel with soy-based biodiesel to offset the carbon emissions released and not sequestered by living forest.

By 2020 Brazilian production of sugarcane in should, according to the Ministry of Agriculture figures reach 893 million tons, 56 per cent higher than the 2008/09 harvest of 571 million tons (MAPA 2010).

The forecasts suggest that that production in São Paulo state should expand by 50 per cent over the next decade, rising from 400 million tons in 2008/09 to 602 million in 2019/20. Likewise the area planted with cane in the state should increase by 46 per cent, reaching 6.8 million hectares in 2019/20. Sugarcane is also expanding at high rates in states not traditionally associated with the crop, including Paraná, Mato Grosso, Minas Gerais and Goiás. (MAPA, 2009)

SOCIAL IMPACTS

Beef cattle ranching, along with soy and sugarcane cultivation, are mostly developed on large landholdings. Not only do these industries have an impact on the environment, they also have a marked social impact on Brazil’s rural population. The encroachment of large

¹⁷ Map of Legal Amazonia – Agricultural Frontier. Available at: http://www.ibge.gov.br/home/geociencias/geografia/mapas_doc3.shtm, accessed on 04/02/10.

agribusinesses further and further into the land-base over recent decades has had a particular impact on family farms which are generally small and medium-sized properties.¹⁸

In Brazil, these family farms account for 85 per cent of all farms. However, according to the 2006 Farming Census, “This sizeable contingent of family farmers occupies an area of 80.25 million hectares, representing 24.3 per cent of the area occupied by Brazilian farm establishments. These findings show that the structure of Brazilian agriculture is still heavily concentrated: non-family establishments, despite corresponding to just 15.6 per cent of the total number of establishments, account for 75.7 per cent of the occupied area. The average area of family properties was 18.37 hectares, while the average area of non-family properties was 309.18 hectares” (IBGE 2009).

In 2006, occupying a smaller share of the productive area, family agriculture was responsible for 40 per cent of the total value of production. In terms of employment (including members of the family and employees), family farming in 2006 provided work for 13 million people (around 80 per cent of the total rural workforce).

By advancing into areas previously used by agriculture, cattle ranching has become one of the major factors in the large-scale migration of rural populations. Due to the extremely extensive nature of cattle ranching in Brazil, the number of jobs created by the activity is very low relative to the area occupied. Data from the 2006 Farming Census shows that 500 hectares of pastures are needed to keep just one person in work. (IBGE, 2009)

The 2006 Farming Census also revealed that large farms occupy a significant proportion of Brazil’s agricultural land. Properties with more than a thousand hectares occupy 43 per cent of the total area, compared to the 2.7 per cent area occupied by establishments with less than 10 hectares, which represent 47 per cent of farm properties.

According to the IBGE, this increased concentration was driven by the large export crops (especially soy and maize), the professionalization of agribusiness and the advance of the farming into Amazonia and the Pantanal – led by cattle breeding and soy cultivation. (IBGE, 2009). Family farming was particularly affected by the so-called ‘green revolution,’ introduced in the 1970s with the intensive use of heavy agricultural machinery. Soy, which became the main crop grown in the South region by the middle of the decade, grew along with the green revolution.

Soy cultivation in Brazil was begun by family farmers in the South region. During this period the seasonal mixed cultivation of soy and wheat spread through the states of Paraná and Rio Grande do Sul with soy planted in summer and wheat in winter. Here food crops other than wheat (such as maize, beans and manioc) were replaced by soy plantations.

Increasing cultivation of soy led to the regional concentration of mechanised agriculture in the Midsouth of the country. However this modernization and the rise in domestic income – per capita GDP rose by an average of 6 per cent per year – were not mirrored by a

¹⁸ The concept of family farming is defined under Brazilian law. In general terms, the family farmer runs his or her establishment in conjunction with their family. At the same time, the size of the property cannot be greater than four fiscal modules. The size of the fiscal module varies according to the municipality in which the farm is located. Usually the family smallholding does not exceed 200 hectares. Exceptions exist, however, as in the case of the Amazonian region.

satisfactory growth in production for the domestic market, which is fed mostly by family farming (Goldin & Rezende 1993).

The expansion of soy from Brazil's South towards the Midwest involved the concentration of production in large properties. Southern soy growers frequently swapped smaller properties in their home state for larger and cheaper lands in the Midwest. Bigger properties enabled, indeed required, the use of modern machinery developed for large-scale production.

This dynamic involving the expansion in soy production and its associated land market has had a heavy impact on small and medium-sized properties. Large-scale expansion poses obstacles to the survival of rural smallholdings. To achieve current levels of productivity, the dominant agricultural model requires a sophisticated technological base in terms of the use of inputs and equipment. The new technologies, developed for an agricultural model based on large properties, demand ever larger amounts of capital from the producer.

Small producers find it difficult to keep up with these technological innovations. It becomes necessary, and expensive, to acquire the latest and most sophisticated sprayers, harvesters, spreaders and tractors. Faced with this situation, just two options remain for them: either rent neighbouring lands as a way of expanding the area under cultivation, or sell the landholding, allowing the small producer to purchase larger areas in more distant regions, a strategy very frequently used to amplify the scale of production.

Thus even today, Maurício Torres (2005) observes, "the occupation of Amazonia also ignored the centuries-long presence of a traditional peasantry whose land and resources, conceived to be of common use, were founded on agroforestry systems that included Brazil nut harvesting, rubber tapping, fishing and hunting. The first impacts of the expanding economic frontier were felt precisely by these groups, almost exterminating them or expelling them further away (into the forest) or towards the cities."

In various regions of Brazil soy expansion threatens the population's food security since its cultivation has prompted a decline in the cultivation of other products important to the local diet, like beans, maize and certain fruits. In various municipalities in the state of Pará in Amazonia, this decline, which is well above the state, regional and national averages, has been documented over the same period in which soy mono-cropping has expanded, between 2001 and 2004. (Schlesinger & Noronha, 2006)

Another concern is the rapid increase in the value of lands close to the areas of expansion of the large monocrops, the most recent case being sugarcane for the production of ethanol. This explains the significant rise in land values that occurred in various regions of the country, especially in 2007. The newspaper *O Globo* reported that the average rise in land values in Brazil from July 2006 to June 2007 was 11.64 per cent. (*O Globo* 2007) The regions showing the highest price rises were precisely those where sugarcane had expanded more intensely: the Southeast (17 per cent), Midwest (12.2 per cent) and South (11.64 per cent), while in the North it was just 2.2 per cent and in the Northeast, 5.0 per cent.

In Araraquara, located in the interior of São Paulo state, grains cultivation and cattle breeding have been increasingly replaced by sugarcane, causing the price of land to rise 70 per cent over the same period. The expansion of the area planted with cane in São Paulo, and the consequent rise in land prices, is pushing other crops and areas of pasture towards

new agricultural frontiers. According to IEA-SP (Institute of Agricultural Economics), this growth in São Paulo was 54 per cent between just 2002 and 2008.¹⁹

Many crops typical to the region such as orange and coffee, as well as cattle ranching, have made way for sugarcane. Some impacts of this rapid and continuous advance are already being felt in the retail trade. The price of milk, for instance, rose around 50 per cent in the first six months of 2007. The consumer is also paying more for other basic foods like rice, beans and maize.

Based on information from the 2006 Census the Ministry of Agrarian Development points out that family farming is essential to the food security of the Brazilian population. It is responsible for 87 per cent of the national production of manioc, 70 per cent of beans, 46 per cent of maize, 38 per cent of coffee, 34 per cent of rice, 58 per cent of milk, 59 per cent of swine, 50 per cent of poultry, 30 per cent of beef and 21 per cent of wheat. In contrast, the crop least likely to be produced on family farms is soy (16 per cent).²⁰

CONCLUSION

Rapid expansion of mechanised agriculture in Brazil has devastated its natural resources and is causing large scale loss of biodiversity and climate emissions. Small family farmers and indigenous populations, who in most cases have preserved natural landscapes are losing their livelihoods and being forced off the land to make way for international agribusiness. Brazil's biomes are being increasingly recognised as key to the survival of not only the people who inhabit them but also for our planet as a whole.

A large part of Brazil's agriculture production is for export to overfed western markets – including to produce cheap meat for Europe and increasingly to fuel our cars. The rise in demand from emerging economies such as China and Brazil itself are placing added pressure on the most threatened habitats and make it more vital than ever that the industrialised world starts to reduce its high per capita demand for soy, beef and meat.

Our estimates suggest that the UK is responsible for 316,695 hectares of deforestation in 2009 from its imports of beef and soy for animal feed

As international action to stop deforestation gains momentum, increasing spotlight will be placed on these commodity exports and the UK is placed to be ahead of the curve in tackling its own consumption.

Recommendations

In order to tackle our impact on wildlife and people in Brazil, Friends of the Earth is demanding that the UK Government:

- Supports the Sustainable Livestock Bill going through parliament which should result in a comprehensive policy action plan to reduce demand for unsustainable levels of soy and livestock products. The measures could include changing agriculture

¹⁹ “Área agrícola ocupada pela cana-de-açúcar no Estado de São Paulo cresceu 54% desde 2002 e expansão ainda continua em SP.” *Folha de São Paulo*, 01/06/08.

²⁰ “Censo confirma: agricultura familiar produz mais em menor área.”

<http://www.incra.gov.br/portal/index.php?view=article&catid=1%3Aultimas&id=13181%3Acenso-confirma-agricultura-familiar-produz-mais-em-menor->, accessed on 03/10/09.

subsidies and support, food public procurement, food labelling and marketing, public awareness programmes, investment, targets and new international negotiation positions.

- Ensures that the 2013 reform of the European Common Agricultural Policy ends all hidden subsidies for factory farming and supports more home grown animal feeds and significantly reduces the adverse climate and biodiversity impact of EU livestock farming
- Scrap any volume targets for the use of bio fuels in transport
- Work in international negotiations on biodiversity loss to strengthen local communities' and Indigenous Peoples initiatives in exporting countries that have contributed to biodiversity conservation and sustainable use of biodiversity
- Support the strengthening of land rights and better governance in Brazil as well as better monitoring of biodiversity impacts and enforcement of environmental and forest protection laws
- Implement community based forest governance measures, which are proven to tackle deforestation and respect community rights
- Reject all carbon trading and offsetting schemes for forests and instead immediately start to tackle the drivers of forest loss
- Ensure that the COP 10 sets an agenda for action that will deliver conservation and sustainable use of biological diversity. This means taking on some of the thorniest problems in our society: the problems and injustices with our economic system; the undermining and lack of recognition of people's rights over their environment; and our exceeding of our planet's physical limits

APPENDICES

Appendix 1 Conversion of soy oil and soy meal into beans

Soybeans are processed into two primary products: soy meal and soy oil. Both products are sold on the market and together determine the return for the farmer, trader, crusher and other players early in the soybean chain. As soy meal cannot be produced without producing soy oil, part of the acreage needed to grow soybeans has to be assigned to the production of soy meal and part to the production of soy oil. Otherwise we would count the same ground twice.

Each year all soy farmers take the decision to plant soy or something else (as soy is an annual crop). This decision is largely based on the expected financial proceeds of the soybean crop, which is determined for 69 per cent by the financial return of the meal and by 31 per cent by the financial return of the oil (financial return = volume * price). Therefore we believe that price has to be included when calculating acreage needed for soy meal and soy oil.

The alternative is to calculate on a weight basis only, which would mean that 1 ton soy meal equals 1 ton soybeans and 1 ton soy oil also equals 1 ton soybeans. But this approach ignores the price differences between the two products. The drive to produce more soybeans is primary the expected financial proceeds of the soybeans, so it would be wrong to ignore these price differences. The net value of soybean production is determined by production costs and the prices of both soy meal and soy oil, combined according to their relative weight share in soybeans.

Table 2 Conversion to soybean equivalents

Crushing	Global output (2009, 1,000 tonnes)	Crushing ratio	Price (in \$, Oct Sept 08/09)	Value (\$ million)	%	Soybean equivalent (ton/ton)
Soybeans	194,824					
Soy meal	153,785	0.789	390	59,976	69%	0.872
Soy oil	36,016	0.185	755	27,192	31%	1.687
Total				87,168	100%	

Table 2 shows that the global soybean harvest in 2009 (194.8 million tonnes) after crushing yielded 153.8 million tonnes of soy meal and 36.0 million tonnes of soy oil. That means that

100 per cent soybeans yields 18.5 per cent soy oil and 78.9 per cent soy meal. The rest is wasted.

But because prices are very different, the contribution of soy meal and soy oil to the total value of the global soybean harvest is also different. 153.8 million tonnes of soy meal has a value of US\$ 60.0 billion, while 36 million tonnes of soy oil has a value of US\$ 27.2 billion. One can therefore assume that the total value of soybeans is determined for 31 per cent by the soy oil and for 69 per cent by the soy meal.

To produce 1,000 tons of soy meal you need 1,267 tons of soybeans ($=1,000/0.789$). Of the total value of this amount of soybeans, 69 per cent is determined by the soy meal. We therefore assume that of these 1,267 tons of soybeans, 872 tons (69 per cent) are exclusively used to produce soy meal. For conversion purposes, 1,000 tons of soy meal therefore equal 872 tons of soybeans.

To produce 1,000 tons of soy oil you need 5,405 tons of soybeans ($=1,000/0.185$). Of the total value of this amount of soybeans, 31 per cent is determined by the soy oil. We therefore assume that of these 5,405 tons of soybeans, 1,687 tons (31 per cent) are exclusively used to produce soy oil. For conversion purposes, 1,000 tons of soy oil therefore equal 1,687 tons of soybeans.

APPENDIX 2

Table 3 Land use required per region to produce beef

Country where beef is produced	Land use required per region (m ² /tonnes)						
	North America	South America	Europe	Asia	Australia	Unknown	Total
Brazil		420,219					420,219
Irish Republic	1,549	894	55,966	361	1,451	13	60,234
Netherlands	1,694	1,012	10,218	400	1,328	45	14,697

Source: *Milieueffecten van Nederlandse consumptie van eiwitrijke producten, Gevolgen van vervanging van dierlijke eiwitten anno 2008*, Blonk Milieu Advies, October 2008.

Using these figures we estimated the acreages needed for beef imports by the United Kingdom, based on the following assumptions:

- The land use of beef imports from Southern American countries other than Brazil, is equal to the land use of beef from Brazil;
- The land use of beef imports from countries in North West Europe other than the Netherlands, is equal to the land use of beef from the Netherlands;

- The land use of beef imported from other countries cannot be calculated.

The results of our land use estimates are presented in **Error! Reference source not found..**

Table 4 Acreages needed for beef imports into the UK

Country/ region were beef is produced	Acreages required per region (hectares)						
	North America	South America	Europe	Asia	Australia	Unknown	Total
Brazil	-	2,011,589	-	-	-	-	2,011,589
Irish Republic	32,548	18,785	1,175,965	7,585	30,489	273	1,265,645
Netherlands	3,854	2,302	23,244	910	3,021	102	33,433
Other countries South America	-	1,370,884	-	-	-	-	1,370,884
Other countries North West Europe	3,646	2,178	21,992	861	2,858	97	31,632
Other countries	Unknown (8% of total UK beef imports)						
Total (ha)	40,047	3,405,738	1,221,201	9,356	36,368	472	4,713,183
Total (%)	0.8%	72.3%	25.9%	0.2%	0.8%	0.0%	100%

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