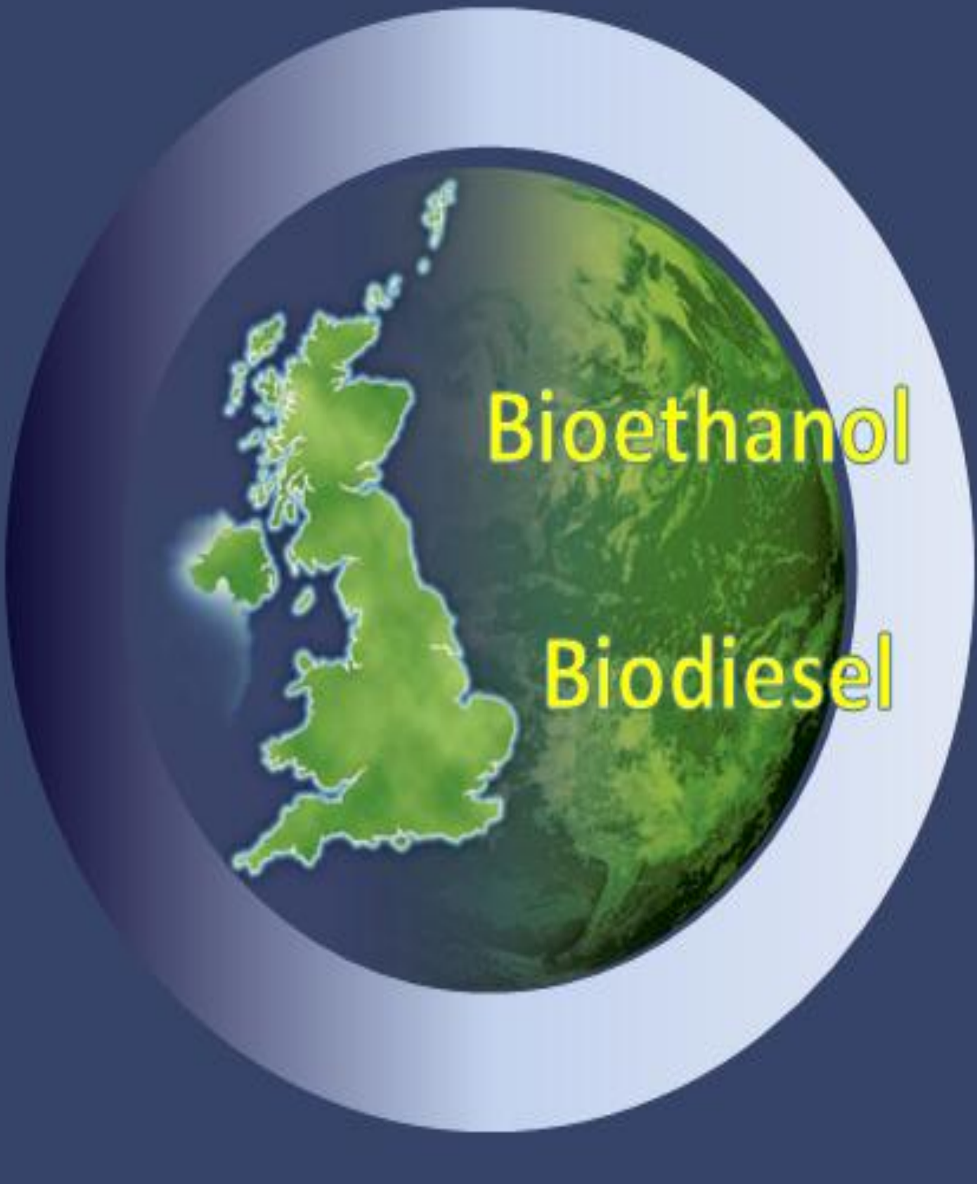
The global biodiversity footprint of UK biofuel consumption



Joint Nature Conservation Committee

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Contents

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1. Summary

Global biofuels trends – demand and supply

The use of biofuels as a substitute for liquid transport fuels has been proposed as a means to reduce greenhouse gas emissions, attain fuel security and enhance rural incomes. Biofuels derived from agricultural crops, rather than recycled materials, have a land use requirement. This requirement may be met by use of existing agricultural land, with diversion of crops into biofuels, or conversion of new land to agricultural. These land use changes have the potential to affect biodiversity in the countries concerned. This report quantifies the land use requirement to supply biofuels to the United Kingdom identifying countries and biomes/ecosystems concerned. Quantifying the land use footprint associated with UK biofuels consumption provides a mechanism for identifying where in the world biodiversity impacts are occurring now or may occur in the future.

Future liquid biofuel (bioethanol and biodiesel) demand will be dependent on two factors: global consumption of transport fuels and mandatory substitution levels. Global biofuels substitution in the transport sector in 2008 was 2.85% and this is likely reach 7% by 2020 with annual global biofuels demand of 150 million tonnes by that date. Until 2nd generation fuels become effectively established, global biofuel supply will be principally from food crops, the use of which will create a 'land use footprint'. The predicted 150 million tonnes biofuels demand for 2020 would require between 100 and 125 million hectares of agricultural land.

Current UK biofuels consumption

To comply with the EU Renewable Energy Directive, the UK will need to achieve a 10% substitution level (*by energy*) by 2020 which equates with approximately 13% substitution by volume. The average UK biofuels market share for the first year of the obligation was 2.6% *(volume)* with approximately 1 million tonnes supplied to the UK market. Over 80% of this fuel was biodiesel sourced from soya, oilseed rape and palm oil. Bioethanol is sourced from sugarcane and sugar beet.

The UK Renewable Fuels Agency (RFA) monitors the use of biofuels in the UK collating information on the carbon and sustainability performance of biofuels used. Most biofuels used in the UK come from primary crops (rather than recycled materials) and over 90% of biofuels are imported. This JNCC report combines the RFA data with agricultural yield and global biome data to estimate a global land footprint associated with the UK use of biofuels and determine within which global ecosystems impacts on biodiversity may occur. The global land use 'footprint' for current UK biofuels consumption has been calculated as approximately 1.4 million hectares of land.

Current patterns of UK biofuels consumption focus land use impacts on the USA and Argentina through use of soya based biodiesel. Land use impacts in the Far East are less important. As a result, UK biofuels use is currently exerting significantly more pressure on temperate grassland ecosystems than tropical forests. In land use terms, pressure on tropical forest is less than one tenth that being exerted on temperate grassland by current biofuels use.

Future biofuels consumption

Assuming that the UK meets the EU obligation arising from the Renewable Energy Directive, the UK will require approximately 6 million tonnes of biofuel in 2020. The global land use requirement to supply this fuel could increase from the current 1.4 million hectares to between 4 and 8 million hectares depending principally upon the feedstock used. High use of palm oil and sugar cane will minimise land use requirements but focus

such impacts on tropical forests. Use of European wheat and North and South American soya will maximise land use impacts, which would mainly fall within temperate grasslands. In 2020, ecosystem impacts will be spread over a wider global area than at present with eastern European and western Russia increasingly affected by UK use of biofuels. Temperate grasslands in the northern and southern hemispheres, currently receiving much of the impact, are likely to come under even greater pressure. Future tropical forest impacts (dependent on the relative use of palm oil for biodiesel compared with soya and rapeseed) are likely to be spread across South East Asia (Malaysia, Indonesia, PNG) and South America (Ecuador, Colombia) and in newly emerging sub-Saharan African palm oil producers.

Increasing domestic production of biofuels has been suggested as a way to reduce the overseas impact of UK biofuel use. The close link between food production and biofuels through 1st generation biofuels suggests that this will only happen if there is an overall increase in UK production of key crops such as wheat and oilseed rape. In the absence of such an increase the domestic use of such crops for biofuels will require the food industry to increase imports. Imported food commodities are not subjected to the same reporting requirements as biofuels. The best environmental option to manage the global impacts of UK biofuels use is to maximise the imports of biofuels which are monitored and minimise food imports which are not.

The global biodiversity impacts of the UK's biofuel use cannot be judged by land use requirement alone. A large land use requirement in one country does not automatically imply a more significant biodiversity impact than in other countries where land requirement is smaller. Impacts on biodiversity will be specific to each area and can arise from land use change, use of non-native species or GMO crops, impacts on soil function, use of water resources or pollution. Quantifying land requirements to supply the UK with biofuels allows an assessment to be made of the potential scale of these impacts, highlighting the countries and biomes likely to be affected and identifying where more detailed impact assessment should be undertaken. Future JNCC reports will track changes in the UK use of biofuels and the changing pattern of global biodiversity impacts that may arise.

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2. Global biofuels trends – demand and supply

2.1 Global background

The use of biofuels (bioethanol and biodiesel) as a substitute for transport fuels has been proposed as a means to reduce greenhouse gas emissions, attain fuel security and enhance rural incomes. These benefits have been given a different emphasis by different countries at different times over the last few years as biofuels policies were established, feasibility studies published and policies adjusted. The scientific evidence emerging in 2008, and major economic events, made it a crucial year for biofuels in terms of both industry and government aspirations. Initial optimism on the part of industry and some governments as to the potential for biofuels to substitute for fossil transport fuels has now been moderated. The key events of 2008 which impacted upon biofuel demand, supply and sustainability issues were:

- The rapid increase and subsequent collapse in oil prices;
- The rapid increase in food commodity prices, including important biofuel feedstocks;
- The appearance of a range of scientific studies (including the UK's Gallagher Review[1]);
- The global financial crisis.

The less ambitious biofuel substitution targets and less optimistic production scenarios that emerged from 2008 reflected the new technical and economic realities. In early 2009 the biofuels industry was in difficulties worldwide because of the combination of low oil prices, restricted access to financing and a closer focus on sustainability criteria when setting substitution targets. The net effect of these events will be to check the growth of the industry and global biofuel production. Nevertheless, the combined market for biodiesel and ethanol is forecast to reach $247 billion by 2020, compared to $76 billion in 2010[2].

The International Energy Authority projects that total global demand for primary fuels (oil, natural gas, and coal) will grow at an average growth rate of 1.6% per year to 2020 and beyond. The majority of this growth will occur in developing countries, particularly in China. Demand for oil alone will rise at an average of 1% per year from the current 4 billion tonnes a year to 4.5 billion tonnes in 2030. About 75% of the projected increase in oil demand will come from the transportation sector offering significant scope for biofuel substitution.

2.2 Global demand for biofuels liquids

Future biofuel demand will be dependent on two factors: global consumption of transport fuels and mandatory substitution levels. Liquid transport biofuels are principally partial substitutes for fossil diesel and petrol fuels. Although some vehicle engines can use near pure biofuels the vast majority of the world's vehicle fleet cannot utilise fuels with more than a 10% biofuels component. These technical limitations imposed by current engine design create a 'blending ceiling' which will limit biofuel demand until a new generation of engines becomes widely available. As a result, biofuel consumption over the coming decade will be determined by total petrol and diesel consumption and this blending ceiling.

[1] http://www.renewablefuelsagency.org/reportsandpublications/reviewoftheindirecteffectsofbiofuels.cfm
[2] http://www.pikeresearch.com/research/biofuels-markets-and-technologies. This estimate assumes an average value of EU1000 per tonne of biofuel.

The EU has set a 10% biofuel substitution target for 2020 and the International Energy Agency predicts a range of substitution levels from approximately 14% for the Americas down to 3% for Africa by that time. Global biofuels substitution in 2008 was 2.85%. Above 10% substitution in the Americas is possible by use of flex fuel vehicles in Brazil and a likely increase in the blending ceiling in the USA[3]. For this report a global substitution of biofuels for fossil transport fuels of 7% by 2020 is taken as the basis for discussion of supply, demand and sustainability. This implies biofuel demand of 150 million tonnes by that date[4].

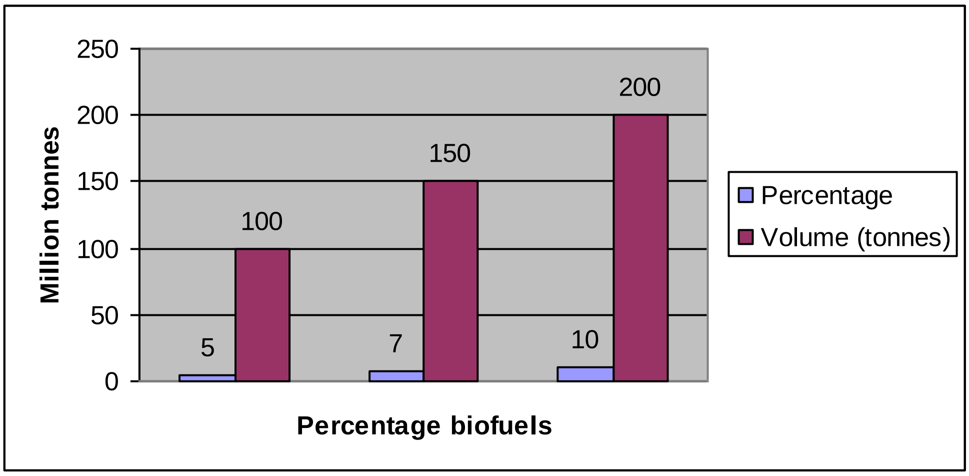

Figure 1: Global biofuels demand (2020) under different levels of substitution

Region	Tonnes biofuels
USA	84
Central & South America	24
EU	36
Rest of World	18
Total	**162**

Table 1: Projected biofuels demand in 2020 according to region. Source US DoE

In addition to scenarios for total liquid biofuels demand and supply, different scenarios for the use of bioethanol and biodiesel are also possible. Currently global bioethanol production predominates (52 million tonnes bioethanol versus 13 million tonnes of biodiesel in 2008) but in the EU biodiesel use exceeds bioethanol. This EU biodiesel bias reflects the current oversupply of petrol within the EU and undersupply of diesel which encourages the fuel industry to extend the diesel supply by substitution of biodiesel but discourages use of ethanol. In the UK, 84% of biofuels used in 2008 was biodiesel.

In 2020 it seems probable that bioethanol will continue to dominate global biofuel supply and the US Department of Energy assumes a 70% share for this fuel. Fuel use projections for the UK for 2020 suggest 60% of UK land transport fuels will be diesel driving a continued predominance of biodiesel over ethanol as a biofuel substitute.

[3] In the USA a ceiling of 15% is currently being considered.
[4] The US Department of Energy estimates a global requirement of 160 million tonnes by 2020.

2.3 EU demand

The EU Renewable Energy Directive (RED) complimented by the Fuel Quality Directive (FQD) will be transposed into national legislation in 2010. The RED introduces mandatory blending of biofuels with petrol and diesel but also requires biofuels to be certified as sustainable whether produced in the EU or imported. These criteria are designed to ensure that only sustainably produced biofuels can be used to fulfil national renewable energy targets. The EU has set a 20% overall share for renewable energy by 2020 with a 10% (energy) biofuel substitution.

The RED sets minimum Greenhouse Gas Emission reductions from biofuels, relative to fossil fuels. These are set on a sliding scale, 35% in 2010 rising to 50% by 2017 for existing producers. New producers in 2017 will have to achieve 60% reduction. There is also an incentive for biofuels produced from waste, residues, non-food cellulose and ligno-cellulosic materials. These will count double towards the target and in practice a Member State could use 5% of such biofuels and meet its '10%' obligation.

The Fuel Quality Directive will permit biofuel mixes up to 10%. Electric and hydrogen fuels are eligible but these are likely to contribute only small amounts of energy to land transport in the EU by 2020 and at least 90% of the renewable transport fuels will come from biofuels. Based on fuel consumption forecasts for the EU this will create a 40 million tonne biofuel demand by 2020.

Current biofuel substitution in the EU is approximately 3.2% representing 10 million tonnes biofuels use[5] with biodiesel accounting for 72% of consumption and 24% bioethanol. Direct use of vegetable oils (principally rapeseed oils) as fuel represents 10%of usage[6].

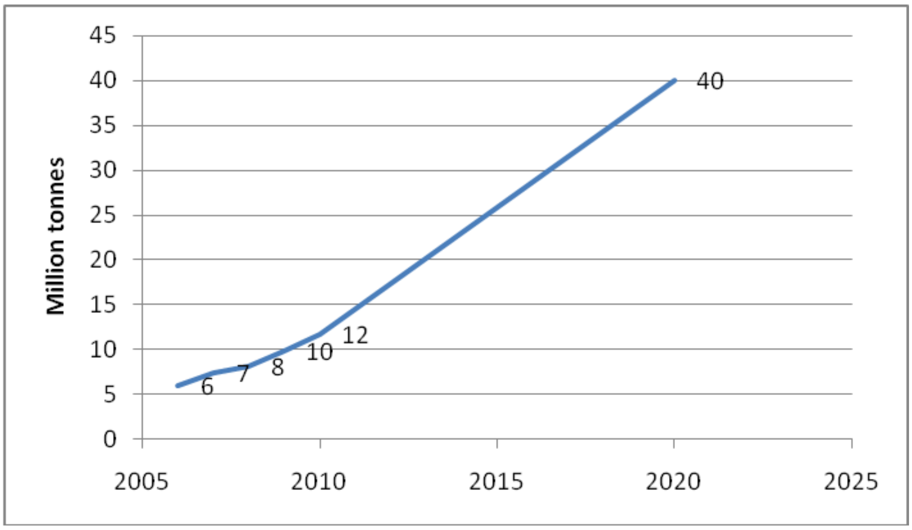

Figure 2: Growth in biofuel use in the EU. Values in million tonnes. Source US Gain report

[5] With a current total EU land transport fuel use of approximately 300 million tonnes
[6] GAIN Report, USDA. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/General%20Report_The%20Hague_Netherlands-Germany%20EU-27_6-15-2009.pdf

2.4 Global supply of liquid biofuels

i. Geography

The US DOE predicts that the U.S. and Brazil will account for more than half of world production of total biofuels in 2020 although the EU will be a major biodiesel producer. Other countries are already emerging as important local producers of fuels for their own markets and as potential future exporters. FAO modelling of potential bioenergy yields for different global regions using available land area and climatic factors, emphasises the importance of South America, Sub-Saharan Africa and the CIS as the main potential biomass producers outside the USA. The US Department of Energy estimates that by 2020, 25% of global biofuel production will come from these sources (Figure 5).

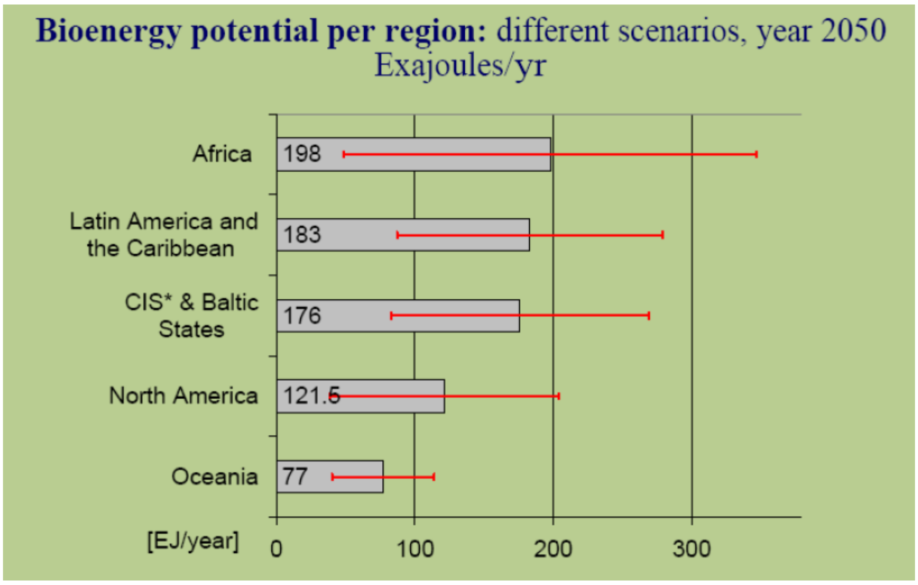

Figure 3: Regional global bioenergy potential. Source FAO.

Geopolitical summary:

- In 2020 the major producers of biofuels in 2020 will be the USA, the EU and Brazil but only the latter is likely to be a significant exporter into world markets. South America, Sub-Saharan Africa and the CIS states are likely to see a major growth in biofuels production for export;
- In South America, Colombia and Argentina are establishing themselves as regional producers of bioethanol and biodiesel although for the foreseeable future Brazil will remain the region's most significant producer of bioethanol;
- A suite of Asian producers are emerging alongside the established palm oil producers Malaysia and Indonesia;
- Global estimates of bioenergy potential highlight several key areas where the availability of land in particular, and in some areas climatic advantage, point to Sub-Saharan Africa, South America and the CIS states as major sources for supplying global demand (Figure 3). North America and China have significant potential to supply their own demands but are likely to be net biofuels importers.

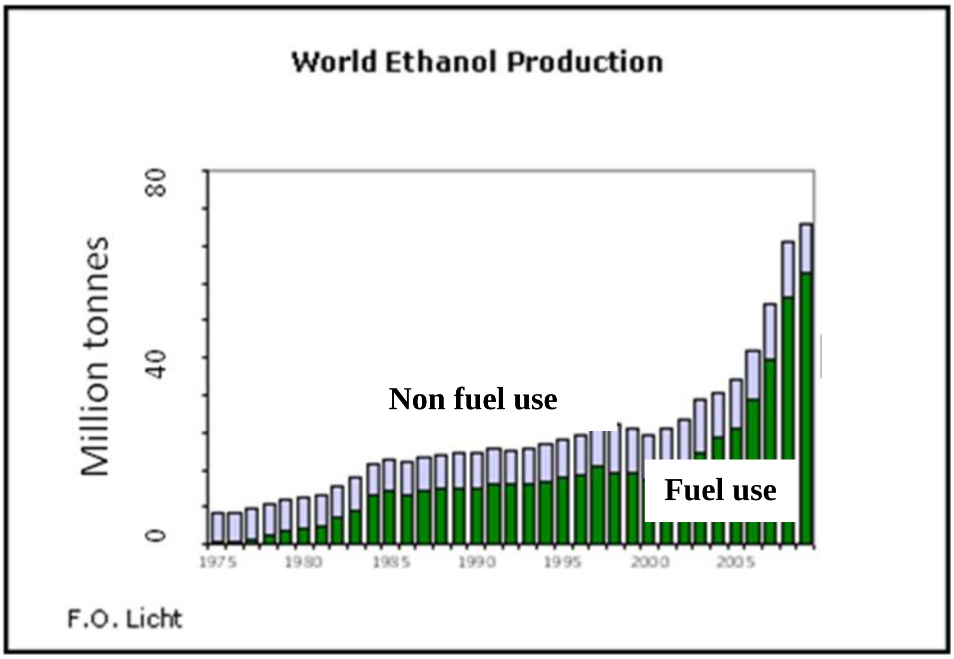

Figure 4: World Ethanol production Source: F O Licht

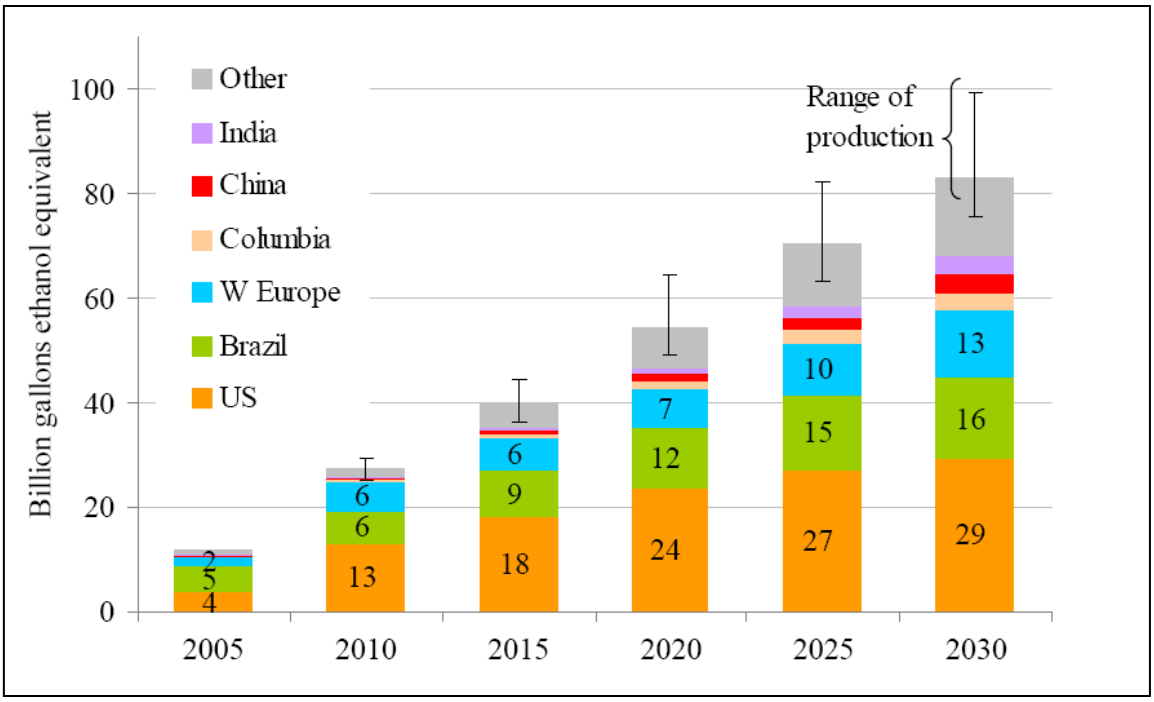

Figure 5: Major potential producers of biofuels. Source US Department of Energy

ii. Feedstocks

Current biofuel production is based primarily on food crops grown for starch, sugar and oil content (Figure 7). Fuels from such sources use well established, and economically viable, fermentation, distillation and esterification processes. These are referred to as first generation biofuels. Almost all bioethanol is derived from maize (USA) and sugar cane (Brazil) with cereal crops, cassava, sugarbeet and other crops providing local sources. Cellulosic sources of bioethanol – second generation fuels involving use of advanced enzyme systems – are insignificant at present. Biodiesel is derived from a wider range of sources than ethanol with the three principal sources being soya (from North and South America), rapeseed (Europe) and palm oil (South East Asia). The use of waste products is more important in biodiesel production (waste cooking oil, tallow) than bioethanol but remains a limited source.

Biofuels feedstock summary:

- 1st generation biofuels, utilising food crops, will predominate until 2020, supply from these sources peaking at approximately by that date;
- Under optimistic scenarios 2nd generation fuels may provide 25% of global demand by 2020;
- Ethanol production will dominate biofuels production in 2020 representing 70% of supply;
- After 2020, biofuels growth will be through second generation technology, using cellulosic materials such as forest and farm wastes to produce both ethanol and biodiesel possibly contributing an additional 150 million tonnes of biofuels by 2030.

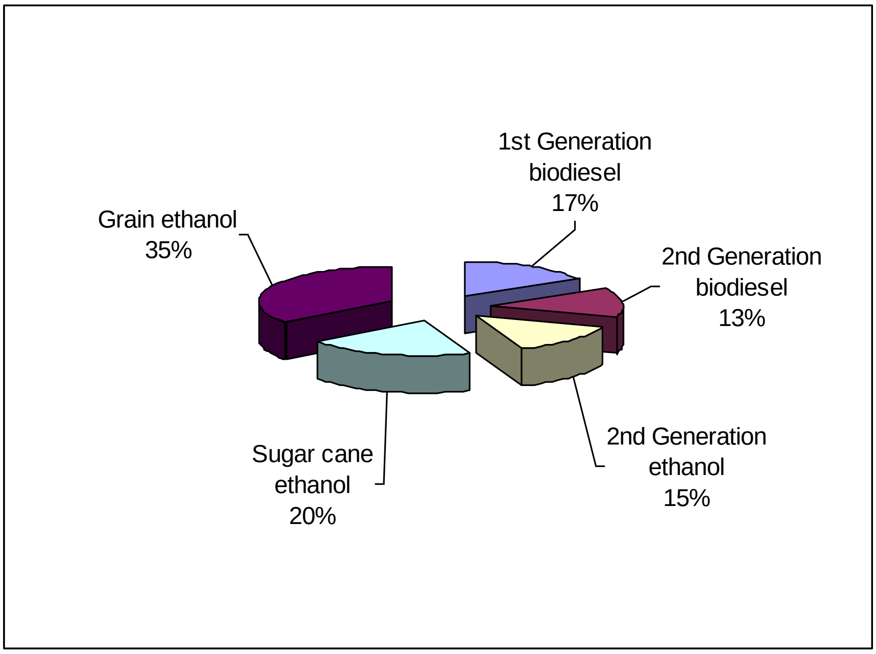

Figure 6: Likely global share of different biofuels type for 2020. Based on US Department of Energy data.

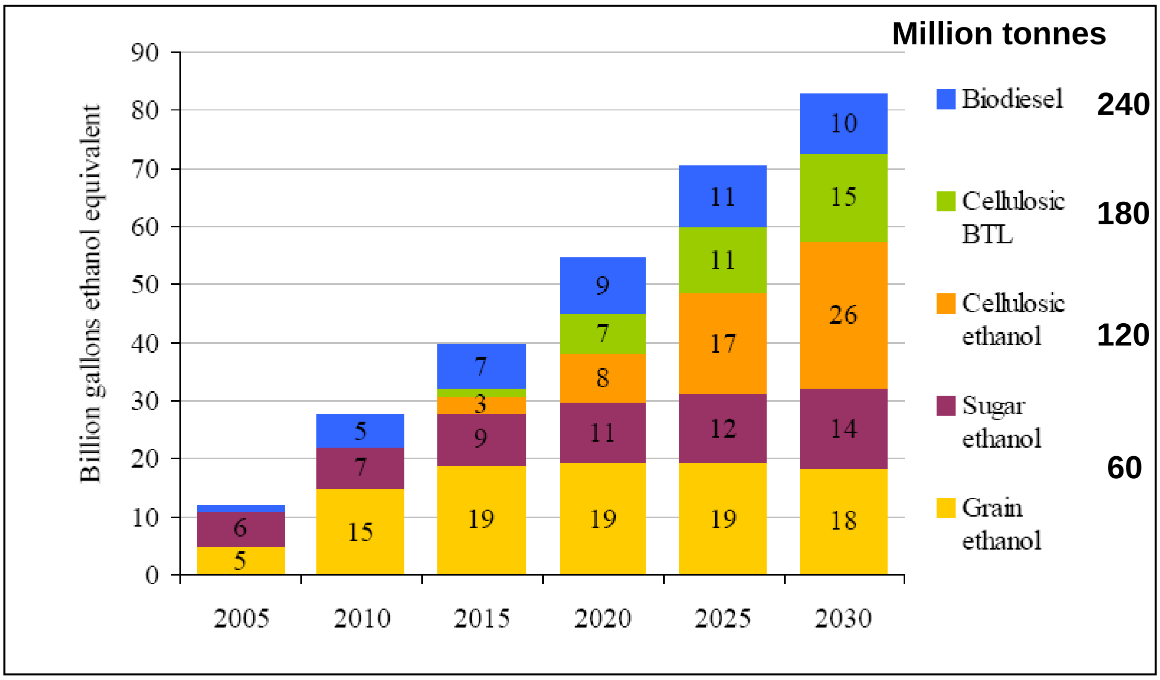

Figure 7: Major potential feedstocks for biofuels. Source US Department of Energy

iii. Land use

Estimates of land use requirements to meet global biofuel demand can be made on the basis of biofuels yields for the key crops concerned. Early estimates of land requirements to satisfy global biofuel demand were based on simple assumptions and caused concern about a growing conflict between food and biofuel production. Recent land use calculations highlight co-product offsets where the production of animal feeds from biofuel crop residues may reduce land use requirements elsewhere[7]. Factoring in these co-product offsets can reduce land use by 20% (Figure 8).

Early land use estimates were also focussed on 1st generation biofuels using food crops. Second generation biofuels using a wider range of biomass material, in particular cellulose, have a higher yield per hectare and can reduce land requirements for bioenergy production by 40%. Second generation biofuels, and the associated benefits, are unlikely to be widely developed before 2020.

Using Gallagher Report data, world biofuels demand of 150 million tonnes in 2020 would require approximately 125 million hectares of land but allowing for co-product offset this could be reduced to a net 100 million hectares[8]. On the same basis, EU consumption of 40 million tonnes biofuels in 2020 would require a net 27 million hectares globally. Beyond 2020 the increased use of second generation biofuels could increase global biofuels supply without the need for further expansion of land devoted to biofuels.

Biofuels land use summary:

- Using 1st generation biofuel technology 150 million tonnes of global biofuel demand in 2020 would require between approximately 100 and 125 million hectares of land depending on the co-product offset achieved;
- If second generation fuels are available in significant quantities by that time combined co-product offset and second generation efficiencies could reduce this to 100 million hectares or less;

[7] http://www.renewablefuelsagency.org/reportsandpublications/reviewoftheindirecteffectsofbiofuels.cfm
[8] Representing biofuel yield of 1.2 tonnes per hectare and 1.5 tonnes per hectare respectively.

- First generation biofuel production is likely to peak by 2020 after which growth will be in second generation, fuels using cellulosic materials such as forest and farm wastes to produce both ethanol and biodiesel contributing an additional 150 million tonnes of biofuels by 2030;
- Increased biofuel demand beyond 2020 – possibly reaching a total of 250 million tonnes by 2030 – may require no more additional land over and above the 2020 requirement as the benefits of 2nd generation biofuels become pervasive and yields increase.

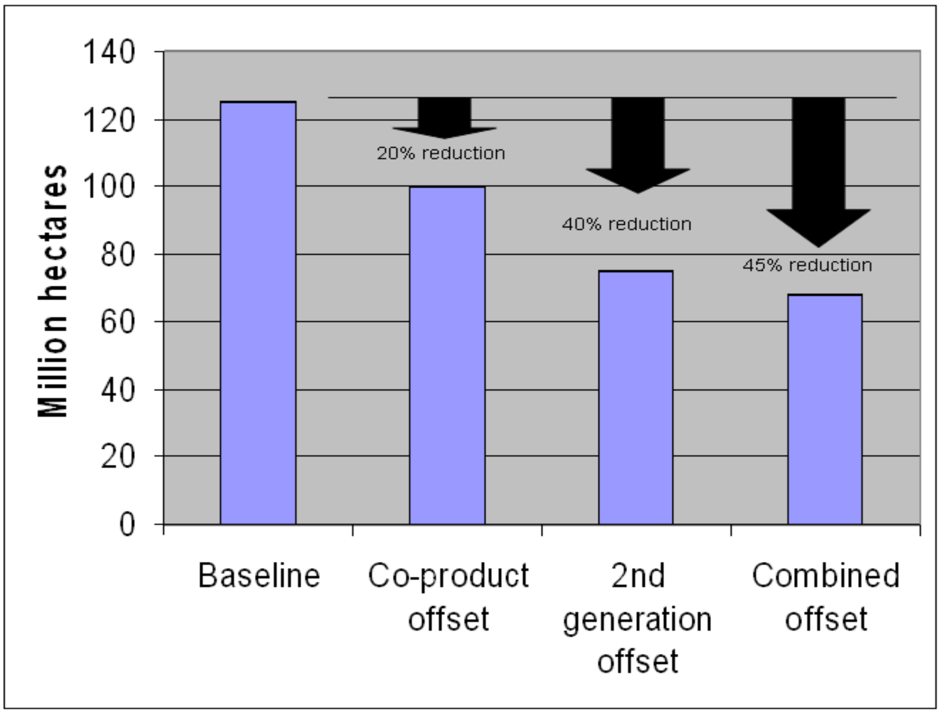

Figure 8: Global land use implications for sourcing 150 million tonnes of biofuels under different biofuels scenarios
Data from Gallagher review. Graphic by JNCC

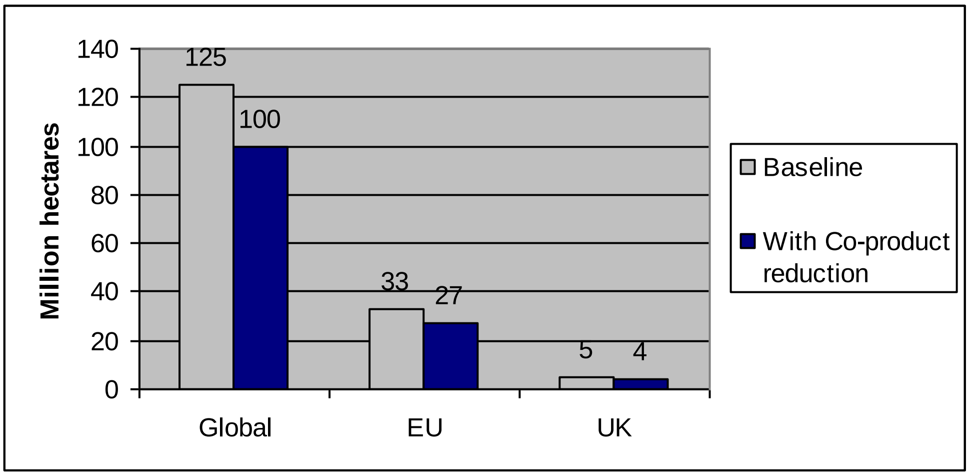

Figure 9: Potential land use requirement for biofuels production, 2020.

3. Biofuels sustainability and biodiversity

Biomass for bioenergy programmes, including use of biofuels to substitute for petrol and diesel, have raised a range of social, economic and environmental issues. Key global issues are land use change and greenhouse gas emissions both of which can be quantified. Less easy to measure are other potential impacts including impairment of soil function, water use, pollution and the use of GMOs and non-native species all of which are relevant to biodiversity.

3.1 Greenhouse gas emissions

The use of biofuels has been proposed as a means to reduce the greenhouse gas emissions (GHG) associated with burning mineral diesel and petrol (gasoline). The average carbon intensity of these fossil transport fuels is 86 kgs of CO2 equivalent for each gigajoule of energy released (Figure 12). It is against this baseline that the value of biofuels for reducing GHG emissions from the transport sector will be judged.

The cultivation, manufacturing and supplying of biofuels also generates greenhouse gases but these emissions are specific to crop, processing methods and location. GHG emissions of different biofuels can vary significantly depending on the system of cultivation, processing, and transportation of feedstock. Whilst the agri-industrial aspects of biofuels production can be analysed relatively easily, the implications of land use changes associated with biofuels production are less easy to quantify. Figure 10 illustrates the CO2 emissions associated with the production of European rapeseed biodiesel. Ignoring land-use effects, this biofuel would reduce GHG emissions by 45% relative to mineral biodiesel use. When emissions associated with land use change are considered GHG reduction is only 9%.

The EU, through the Renewable Energy Directive, has set a sliding scale of biofuels emissions targets, commencing at 35% GHG reduction required of all fuels to be used in 2010 rising to 50% by 2017 with higher reductions (60%) required for new suppliers from that date. Understanding the GHG emissions associated with individual biofuel types requires a full life cycle analysis of the production and use of the fuel. At the agricultural end of the production system this analysis must account for, and allow comparison of, fuels produced from perennial and annual crops and the implications of agricultural rotations.

Techniques for this form of analysis are currently being developed and are important for understanding the relative merits of different fuels and also for commercial and international trade reasons. Figure 11 shows the default values for the important crops used to produce EU biofuels. If these values remain unchanged many of the crops currently acceptable for biofuel production, such as rapeseed and soya, will no longer be acceptable as biofuels sources in the EU by 2015. As the GHG ceiling is raised more crops will potentially be excluded from the EU biofuels market. GHG default values when used in this way can encourage greater GHG efficiency in biofuel production but can also be seen as unfair trade and commercial barriers unless the evaluation techniques are widely accepted.

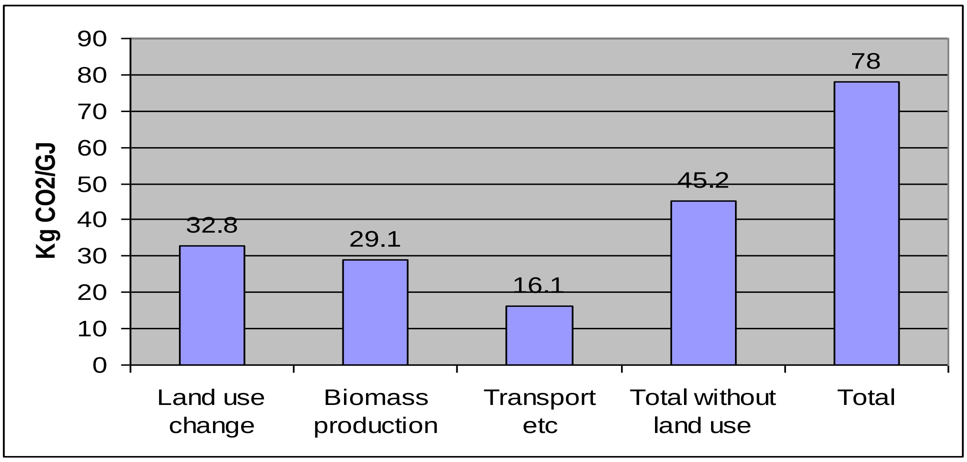

Figure 10: Greenhouse gas emissions associated with rapeseed biodiesel. Source: UFOP http://www.ufop.de/index.php

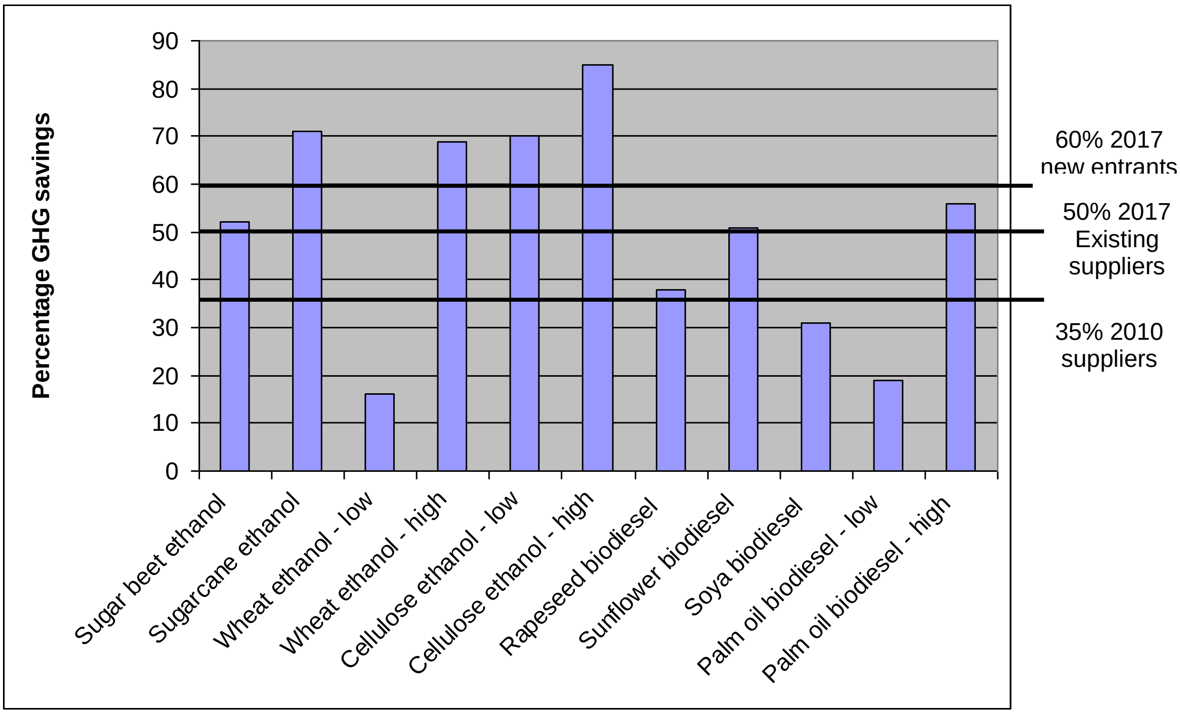

Figure 11: GHG savings from biofuels crops and EU GHG savings requirement

3.2 Land-use change

Land use change associated with increased use of biomass for fuels has raised concerns in respect of competition between food and fuel crops, loss of biodiversity associated with change of use and also the GHG emissions that can result from such change. Figures 10 and 12 illustrate the GHG emissions associated with different elements in the biofuel production chain emphasising the importance of emissions from direct land use change. Direct change is the simple switching of use from a pre-existing function directly to biofuel crop production. In an attempt to ameliorate both the GHG and biodiversity consequences of direct land use change the EU (through RED Article 17.3) is seeking to avoid use of biofuels produced on high biodiversity areas defined *'as primary forest, nature protection areas, highly biodiverse grassland and areas with high numbers of endangered species or ecosystems'*.

Indirect land use change is defined as change than can occur *'when the production of biofuel feedstock displaces agricultural activities to other areas which may as a consequence cause land-use changes such as deforestation, thereby increasing emissions'*[9]. The magnitude of these emissions is largely unknown at present and will ultimately depend on policy and management in the producing countries and the nature of the land suffering transformation. Indirect land use change could also produce biodiversity impacts that undermine the value of using biofuels for other environmental reasons.

3.3 Ecosystem impacts

The growth in the use of biofuels in recent years has exerted differential pressure on existing cropland, forests and grasslands according to crop types used for biofuels. Rapeseed and cereals use for biofuels increases pressure on existing cropland, sugar cane primarily affects grasslands, and palm oil production exerts pressure on tropical forests. Soya has an effect across all three of these land use types (Figure 13).

It is possible to quantify the pressures exerted on these land categories by identifying source countries, biomes[10] and crops and estimating the land use requirement to produce biofuels. This can be done for current consumption patterns and possible future scenarios. The way in which these pressures might be expressed – through habitat loss, soil function impacts, water use, impacts of invasive alien species/GMOs or pollution – will be case specific each acting on biodiversity in differing ways.

An initial JNCC review of potential biodiversity impacts of biofuels describes possible links between a set of six biofuels specific environmental 'indicators' and the MEA biodiversity loss drivers[11] (Figure 14). These biofuel 'indicators', which provide a basis for assessing the biodiversity impact of biofuel production on biodiversity, are:

- Greenhouse gas emissions associated with full life cycle of biofuel production and use;
- Land use changes associated with increased use of biomass for energy involving either new land coming into cultivation, change of

[9] European Federation for Transport and Environment. www.transportenvironment.org/Publications/prep_hand_out/lid:527

[10] *'major communities, classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment*"

[11] Tracking biofuels policy development in selected overseas economies. Phase I Data sources, global trends and overview of biodiversity impacts. JNCC 2008. http://www.jncc.gov.uk/pdf/global_BiofuelsandBiodiversity1.pdf

- crops within existing agricultural areas or intensification of agricultural effort;
- Pollution (to water and soil) arising from use of agrichemicals in bioenergy agricultural systems;
- Use of genetically modified crops and potentially invasive alien species as energy crops;
- Impairment of soil function through intensification of agricultural systems to produce energy crops;
- Overexploitation of water resources for energy crops[12].

Local impacts, occurring on the ground in agricultural systems providing UK biofuels, will be location and crop specific. This report does not attempt to describe how these individual impacts will occur in those areas which currently, or may in the future, supply the UK biofuels market. Tracking UK imported biofuels to source country allows identification of the biomes that might be affected. This analysis defines *where* but not *how* these local impacts may occur. Nor does this analysis determine *if* they will occur or if the net impact of biofuels production will be negative or positive for biodiversity in the producing regions.

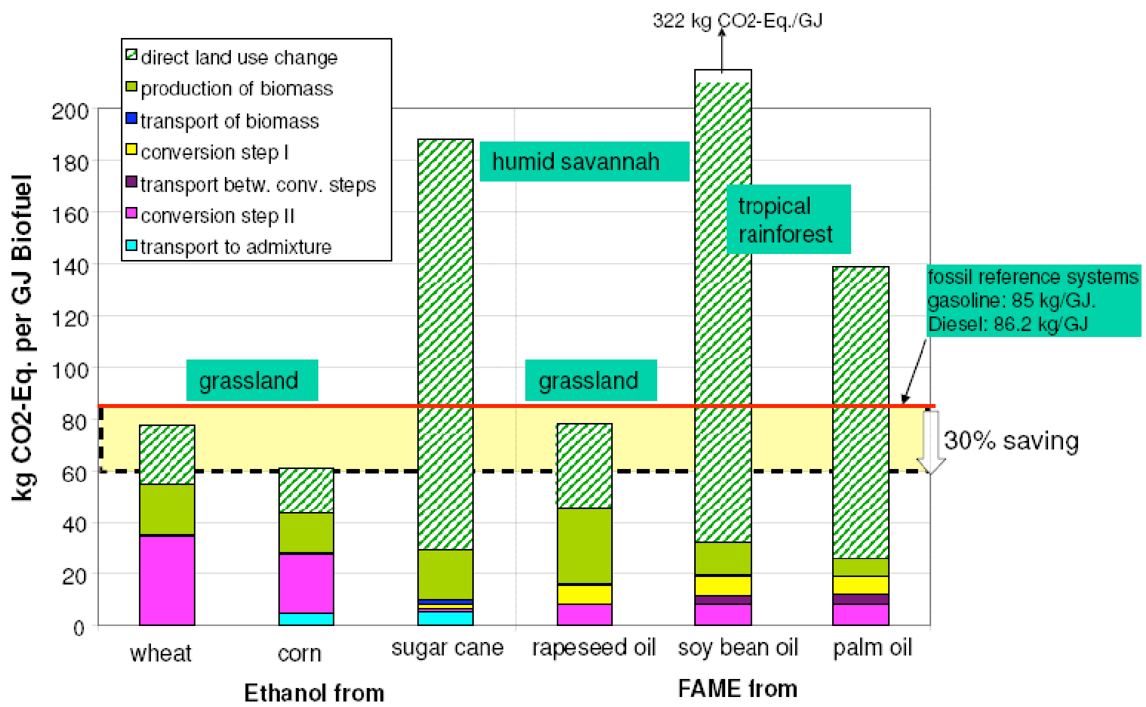

Figure 12: Significance of land use change in calculating GHG savings from biofuels
Source: European Federation for Transport and Environment
www.transportenvironment.org/Publications/prep_hand_out/lid:527

[12] Biofuels in Africa. An assessment of risks and benefits for African wetlands. Wetlands International. 2008
http://global.wetlands.org/LinkClick.aspx?fileticket=vPIIvbwvqTs%3d&tabid=56

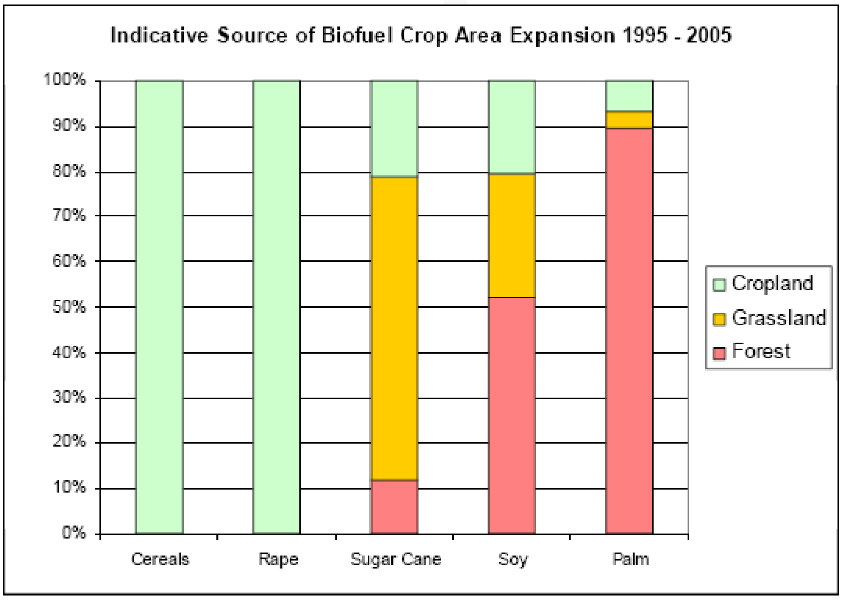

Figure 13: Global overview of land types impacted by biofuels expansion
http://www.ensusgroup.com/rightbiofuel_01.php#a1

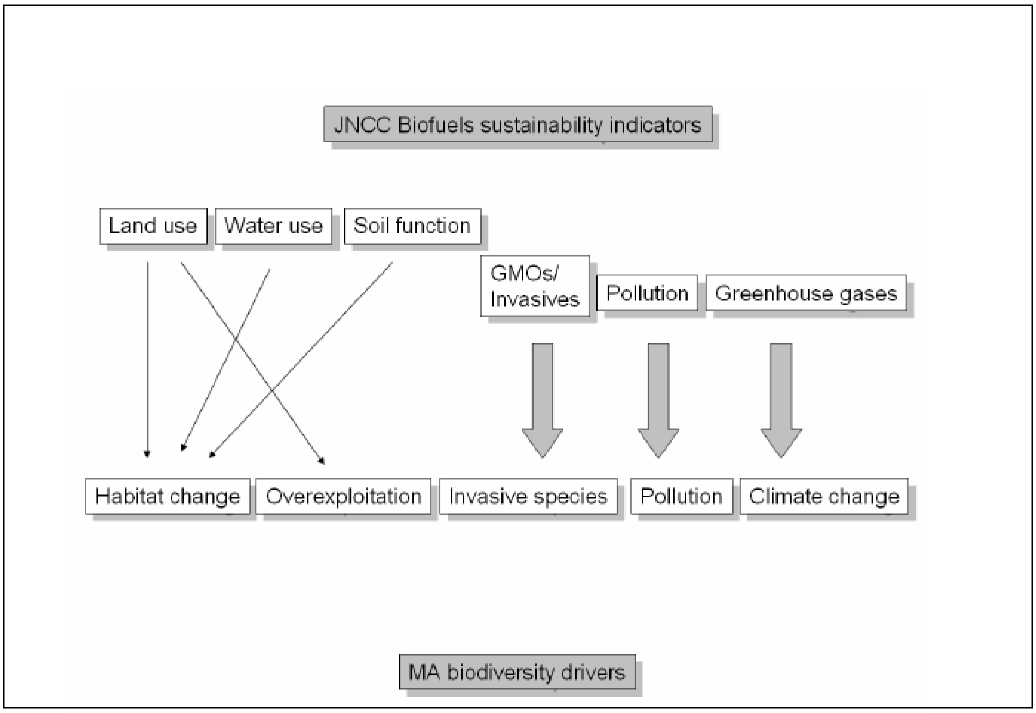

Figure 14: relationship between biofuel indicators and biodiversity drivers
http://www.jncc.gov.uk/page-4209

4. UK biofuels targets and biofuels consumption

4.1 UK targets and current consumption

Earlier sections of the report suggest that average global biofuel use for transport will be less than 10% in 2020 with higher use in the US and some South American economies and lower use in Africa. The EU has set a 10% (by energy) target for 2020 most of which will come from biofuels[13].

The UK's Renewable Transport Fuels Obligation (RTFO) requires major suppliers of fossil fuels in the UK to ensure that a specified percentage of the road fuels they supply is made up of renewable fuels. The Obligation came into effect on 15th April 2008 and the target for the first year of the obligation was 2.5% *by volume* with the original intention of increasing this to 5% by 2010/11*.* The average UK biofuels market share for the first year of the obligation was 2.6% *(volume)* with approximately 1 million tonnes supplied to the UK market[14], 84% of which was biodiesel.

As a result of the Gallagher Report, which highlighted considerable uncertainties as to the greenhouse gas reduction benefits of biofuels, the 5% target has been delayed to 2013/14 to allow government to establish the sustainability of biofuel sources. To comply with the EU Renewable Energy Directive, the UK will need to achieve a 10% substitution level (*by energy*) by 2020[15] which equates with approximately 13% substitution by volume, a year on year increase of 1% substitution.

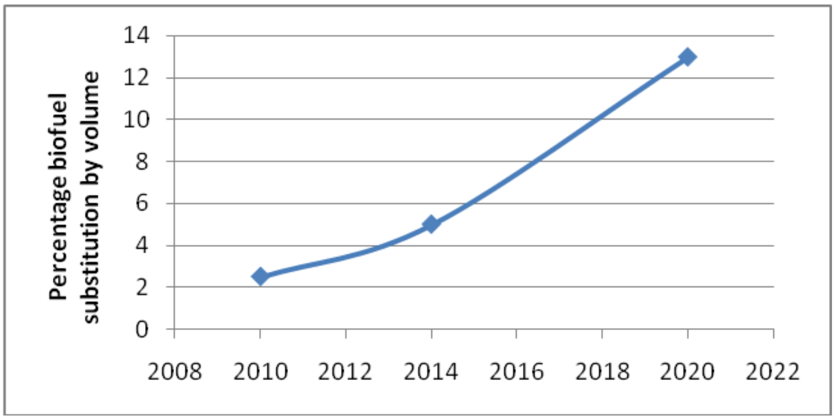

Figure 15: Projected UK biofuels substitution rate (by volume)

[13] Transport renewables can include electricity, hydrogen or biofuels – industry sources expect at least 90% to come from biofuels.
[14] 804,000 tonnes biodiesel, 137,000 tonnes bioethanol
[15] Energy content of ethanol is 61% of petroleum. 1.64 tonnes of ethanol is required to substitute for 1 tonne of ethanol. Energy content of biodiesel is 88% of mineral diesel. 1.14 tonnes of biodiesel is required to substitute for 1 tonne of mineral diesel.

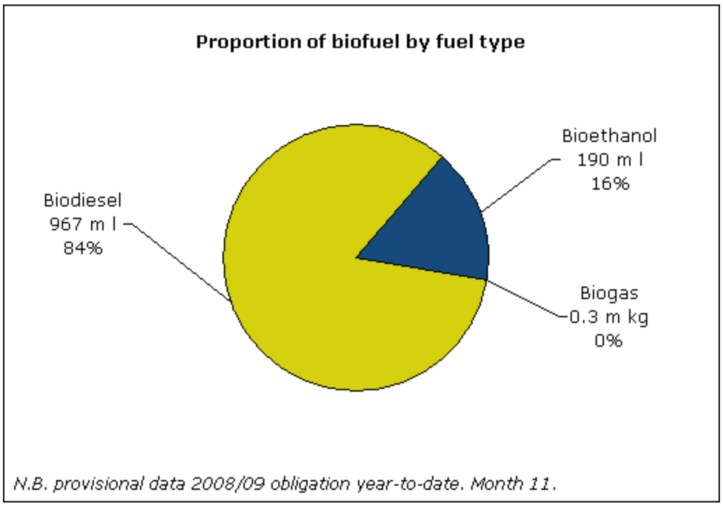

Figure 16: UK biofuel types 2008/09 . Source: UK Renewable Fuels Agency
(note volumes in litres)

4.2 Current feedstock

During the first year of the Renewable Fuels Obligation the Renewable Fuels Agency monitored biofuel use recording feedstock for over 90% of biofuels. The breakdown of feedstock types is illustrated in the following RFA sourced diagrams and the key conclusions in respect of feedstocks are as follows:

- Because biodiesel use predominates, approximately 70% of UK biofuels are sourced from three plant oils – soya, oilseed rape and palm oil;
- 80% of UK bioethanol comes from Brazilian sugarcane with the balance from UK sugar beet;
- Biodiesel has more diverse feedstocks including, in addition to the three plant oils mentioned above, tallow and cooking oil.

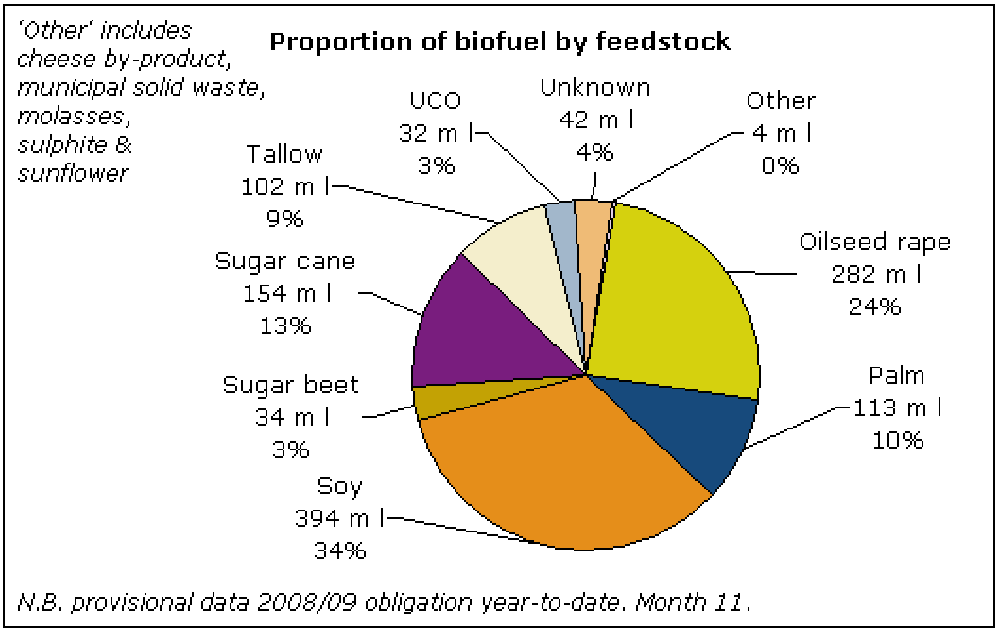

Figure 17: UK biofuel feedstock 2008/09. Source: UK Renewable Fuels Agency

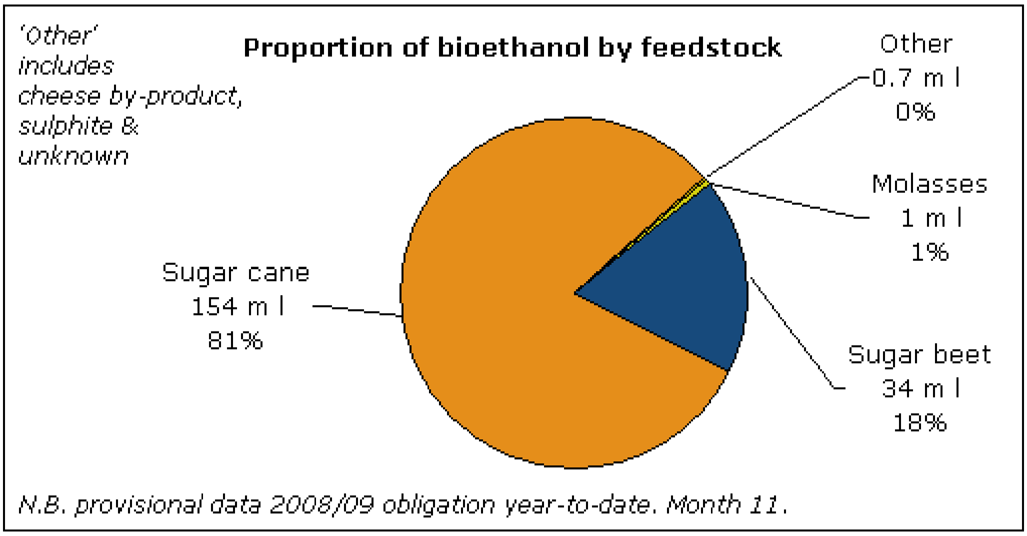

Figure 18: UK ethanol feedstock 2008/09. Source: UK Renewable Fuels Agency

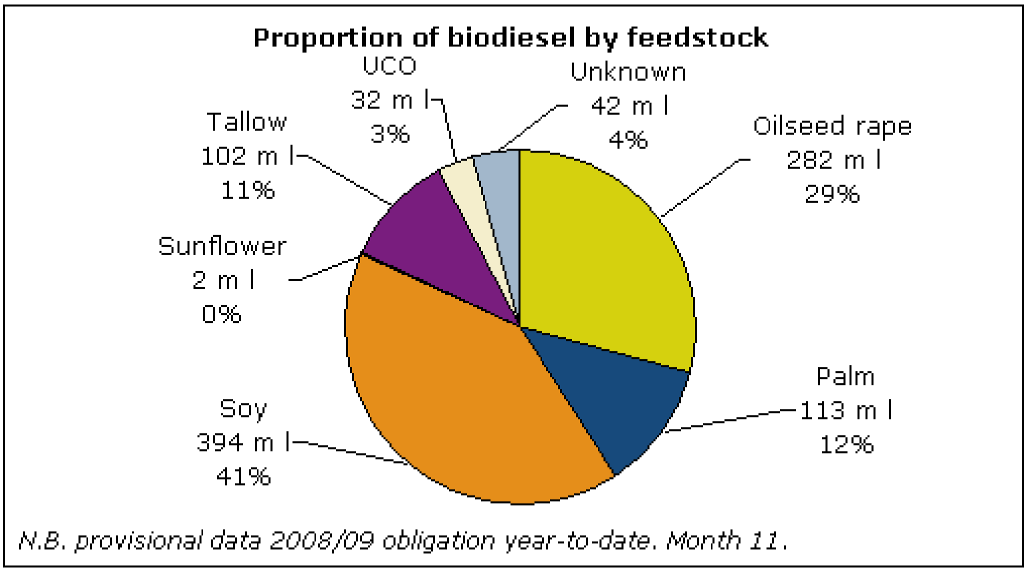

Figure 19: UK biodiesel feedstock 2008/09. Source: UK Renewable Fuels Agency

4.3 Current geographical sources

The majority of biofuel used in the UK during the first year of the RTFO has been imported with the origin of over 80% identified and RFA monthly reports provide data on the international sources for both bioethanol and biodiesel. The breakdown of the geographical origin for UK biofuels is illustrated in the following RFA sourced diagrams and the key conclusions in respect of source are as follows:

- Because biodiesel use predominates, approximately 30% of UK biofuels are sourced from the USA (soya)[16];
- Less than 10% of UK biofuel was domestically sourced;

[16] These imports to the UK include significant soya based biodiesel originally derived from Argentina. This trade was driven by tax incentives in the USA which have now lapsed.

- Bioethanol is sourced almost entirely from two sources - Brazil (80%) and domestic (19%);
- Biodiesel has more diverse feedstocks than bioethanol but the USA (soya) and Germany (OSR) were the most significant sources. UK sources for biodiesel represent only 6%.

4.4 Future UK biofuel demand

Future biofuels use in the UK will be determined by mandatory substitution levels within limits set by motor vehicle engine capacity. Current UK road transport fuels consumption is running at approximately 36 million tonnes a year with this predicted to increase to 47 million tonnes total fuel (28 million tonnes diesel, 19 million tonnes petrol) by 2020. Assuming that the UK meets the EU obligation arising from the Renewable Energy Directive, the UK will require approximately 6 million tonnes of biofuel - bioethanol and biodiesel in equal portions - approximately 13% substitution by volume.

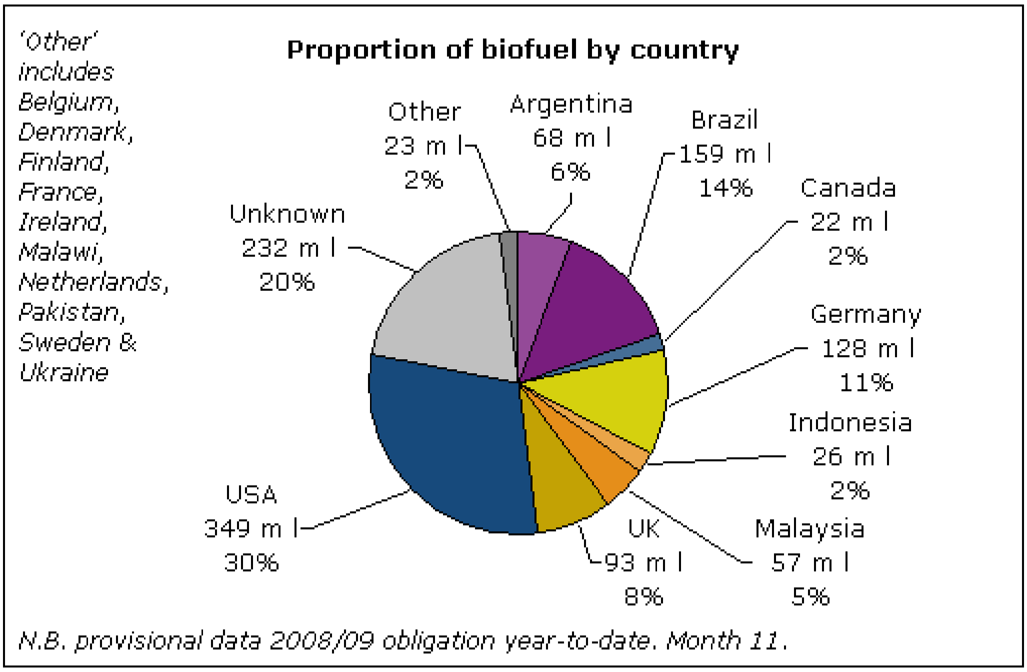

Figure 20: UK biofuel sources 2008/09. Source: UK Renewable Fuels Agency

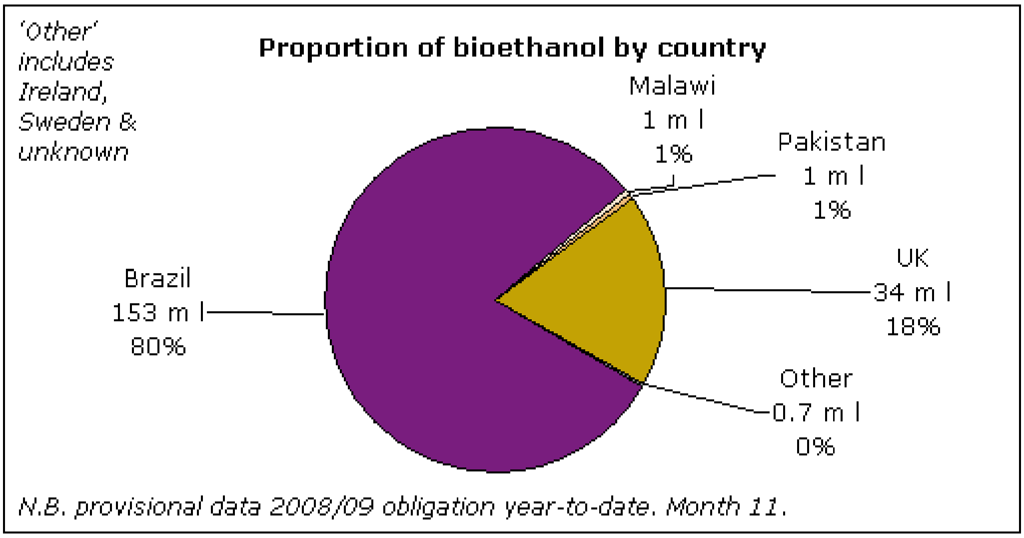

Figure 21: UK bioethanol sources 2008/09. Source: UK Renewable Fuels Agency

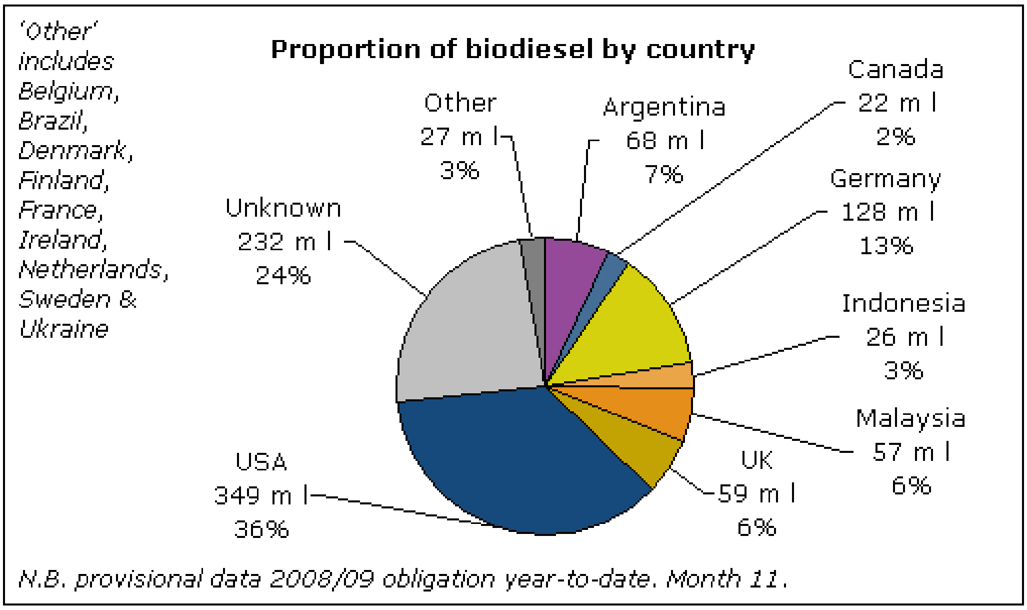

Figure 22: UK biodiesel sources 2008/09. Source: UK Renewable Fuels Agency

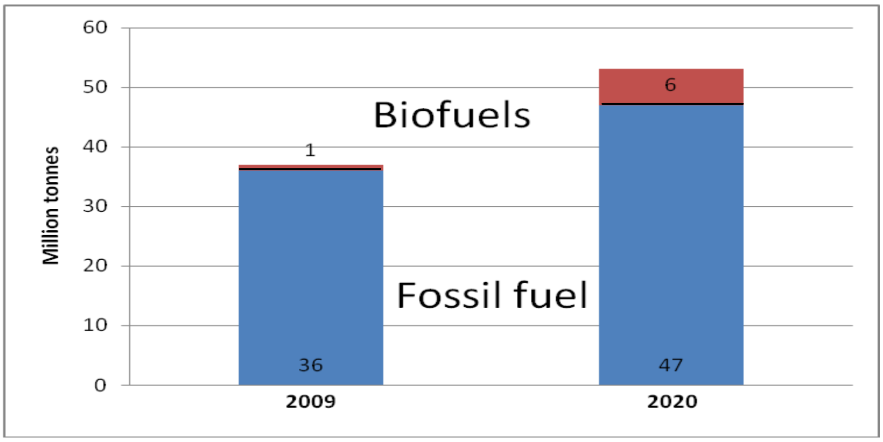

Figure 23: Actual and projected UK transport fuel use

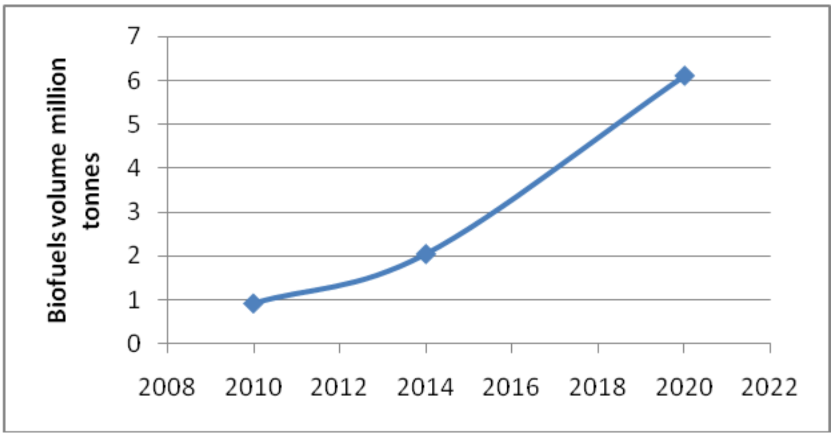

Figure 24: Projected UK biofuels use (volume)

5. Monitoring the environmental implications of UK consumption

5.1 Background

The UK Renewable Fuels Agency provides information on the carbon and sustainability performance of renewable fuels supplied under the RTFO. The data is derived from the monthly reports on biofuels provided by individual fuel suppliers. The data covers direct environmental impacts that can arise through biofuels production either through carbon emissions or direct land use change. Indirect land-use change, and impacts on commodity and food prices, will be monitored separately. The RTFO embodies seven sustainability principles (five environmental and two social) which have been used to define the RTFO 'sustainability meta-standard'. Existing certification schemes, such as the Round Table for Sustainable Palm Oil Production, are assessed against the RTFO principles and can be used to report on the sustainability of UK biofuels use.

There are significant gaps in data reporting at present but government has targets for improved reporting over the next two years along with targets for improved Greenhouse Gas (GHG) performance for biofuels used in the UK.

5.2 Previous land-use

The RFA currently uses five land-use categories:

1. unknown
2. cropland
3. grassland - agricultural use
4. grassland - non-agricultural use
5. forestland.

The breakdown of land-use is illustrated in the following RFA sourced diagrams and the key conclusions are as follows:

- A significant proportion of biofuel (42%) comes from sources where previous land-use is 'unknown'. For bioethanol over 50% falls into this category;
- For bioethanol and biodiesel 47% comes from land previously used for food crops;
- Where previous land use is recorded, less than 1% of biofuels come from converted grassland where conversion is likely to release significant greenhouse gas volumes.

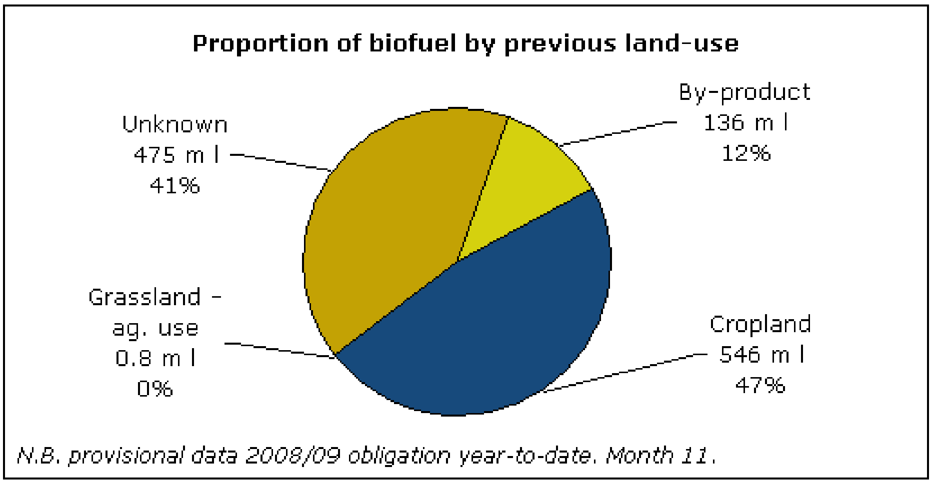

Figure 25: UK biofuel sources according to land-use 2008/09. Source: UK Renewable Fuels Agency

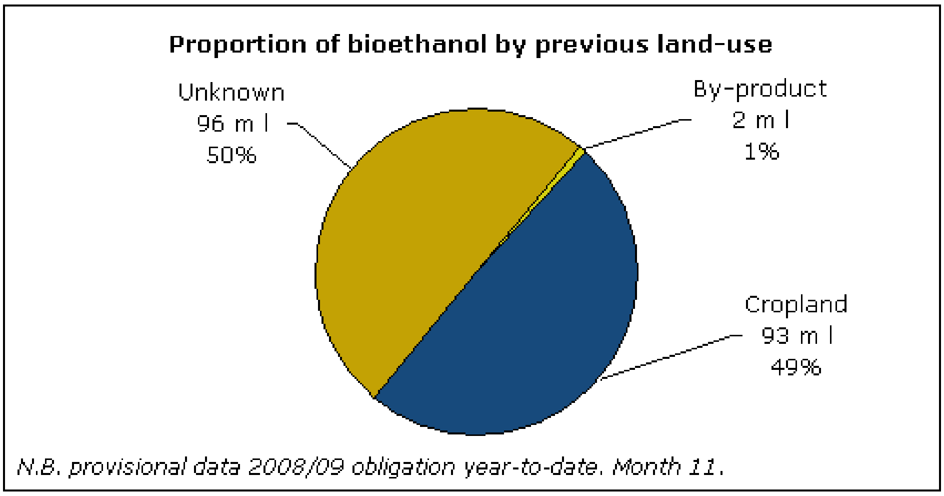

Figure 26: UK bioethanol sources according to land-use 2008/09.
Source: UK Renewable Fuels Agency

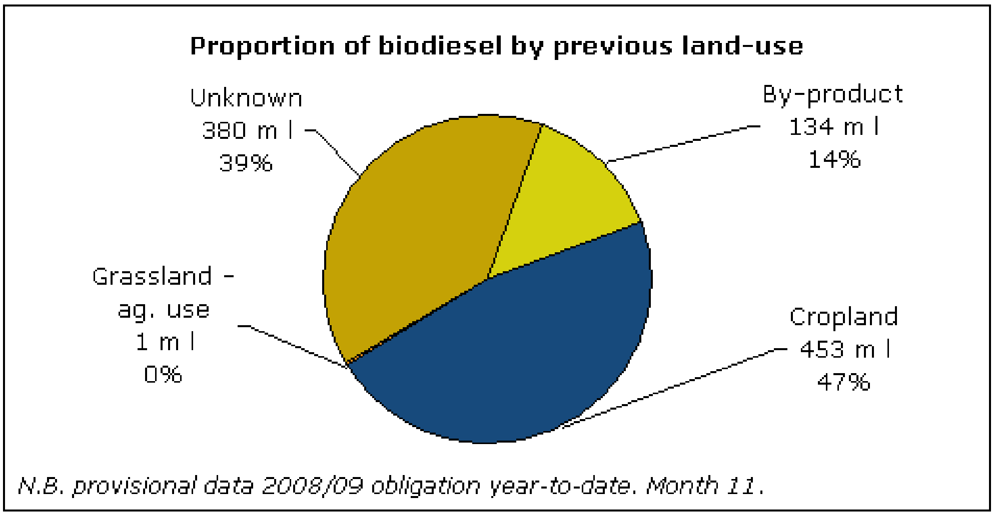

Figure 27: UK biodiesel sources according to land-use 2008/09.
Source: UK Renewable Fuels Agency

5.3 Greenhouse Gas Emissions

The UK government introduced the Renewable Transport Fuels Obligation[17] (RTFO) as part of the UK government's own programme to reduce GHG emission from the transport sector through biofuels use. The targets set by the UK require a progressive increase in GHG savings from biofuels use, aiming for 50% reduction on emissions compared with the use of equivalent volumes of fossil fuels.

For 2008/09 the use of biofuels in the UK made actual GHG savings of 46% excluding emissions from indirect land-use change which are not yet considered measurable. UK renewable Fuels Agency data reveals that GHG savings from bioethanol used in the UK are significantly greater than for biodiesel (Table 3). The initial EU requirement for a minimum of 35% GHG reductions from biofuels (which will come into force in 2010) will allow many existing feedstocks to be used (Figure 28). As the minimum UK and EU requirements for biofuels GHG reductions increases to 50% and beyond some feedstocks from some countries will be excluded (in particular for biodiesel) unless the production process becomes more GHG efficient, or life cycle assessments of GHG efficiency are revised.

	2008-09	**2009-10**	**2010-11**
Annual GHG saving of fuel supplied	40%	45%	50%

Table 2: UK targets for GHG reductions from biofuels. Source: UK Renewable Fuels Agency

Fuel type	***Carbon intensity kg(CO_{2e})/GJ***	***Average greenhouse gas saving of biofuel %***
Mineral diesel	86.2	
Biodiesel	50	**42%**
Gasoline	85	
Bioethanol	26	**70%**

Table 3: Average carbon intensity and greenhouse gas savings of UK biofuels, 2008.
Source: UK Renewable Fuels Agency

[17] http://www.renewablefuelsagency.org/aboutthertfo.cfm

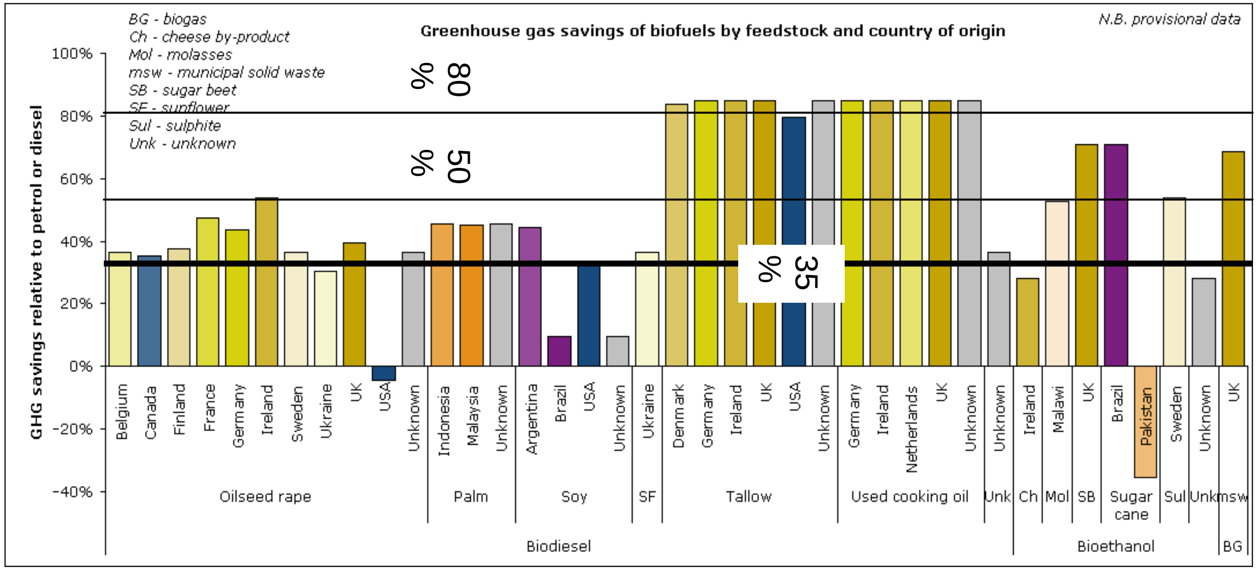

Figure 28: Greenhouse gas savings of UK biofuels by feedstock and source country. Explanatory note. 1. Highest GHG reductions (over 80%) are achieved by recycling tallow and cooking oils. –. 2. Ethanol from UK sugar beet and Brazilian sugar cane provides in excess of 50% GHG savings. 3. All forms of biodiesel derived from crops (not recycled material) currently fail to achieve greater than 50% GHG savings.

6. Global biodiversity implications of current UK biofuels consumption.

6.1 Land use requirements of current UK biofuels consumption - geography

The UK Renewable Fuels Agency (RFA) reports that approximately 1 million tonnes of biofuels were used by the UK transport sector during the initial year of monitoring. The RFA analyses UK biofuels usage in terms of volume, feedstock and source country. The RFA also records previous land use for areas producing biofuels in an attempt to identify land use change associated with biofuel production.

This report combines the RFA data with agricultural yield data and global biome, ecosystem and agricultural maps to:

1. estimate the land area required in individual source countries to supply the UK biofuels market;
2. determine which biomes these land areas lie in and therefore identify where biodiversity impacts may be occurring now or in the future.

The report summarises (Section 3) the nature of ecosystem impacts that may arise through biofuels production. Detailed analysis of these impacts in different geographical areas can only be done on a regional or national case specific basis and is beyond the scope of this report. This work therefore identifies *where* these impacts may fall, and in which biome, but does not describe the impacts in detail. However, by identifying regions and biomes currently supplying biofuels to the UK, or likely to do so in the future, it is possible to demonstrate where these impacts are occurring now or may occur in the future and which biomes will be affected. Quantifying the land use footprint in these biomes identifies the potential scale of impacts.

Figures 29 through 33 illustrate the global land requirements for current biofuels use within the UK. Key points from this analysis are:

- Approximately 80% of the 1 million tonnes of biofuels used in the UK were produced from agricultural crops (rather than recycled biomaterials) and therefore have a land use requirement;
- Total land requirement to supply these biofuels to the UK market was approximately 1.4 million hectares with an average yield of 0.6 tonnes per hectare;
- As a result of the volumes consumed and the relatively low biodiesel yield per hectare, 98% of this land use arises through biodiesel use;
- Over 90% of the UK's biofuels are imported and the land use requirement, and associated environmental impacts, are therefore predominantly overseas;
- Domestically sourced UK biofuels currently require approximately 26,000 hectares of land, only 2% of total land required to supply the UK market;
- Approximately 60% of the land required to supply the UK biofuels market lies within the 'Americas', specifically the USA, Argentina and Brazil.

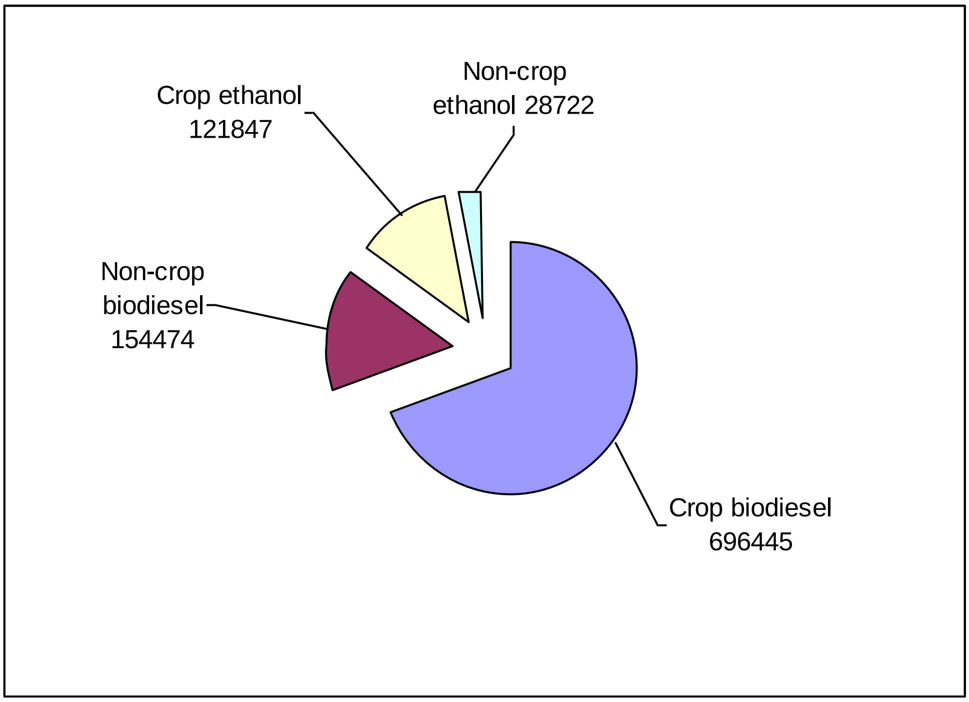

Figure 29: Source for UK biofuels
Values in tonnes

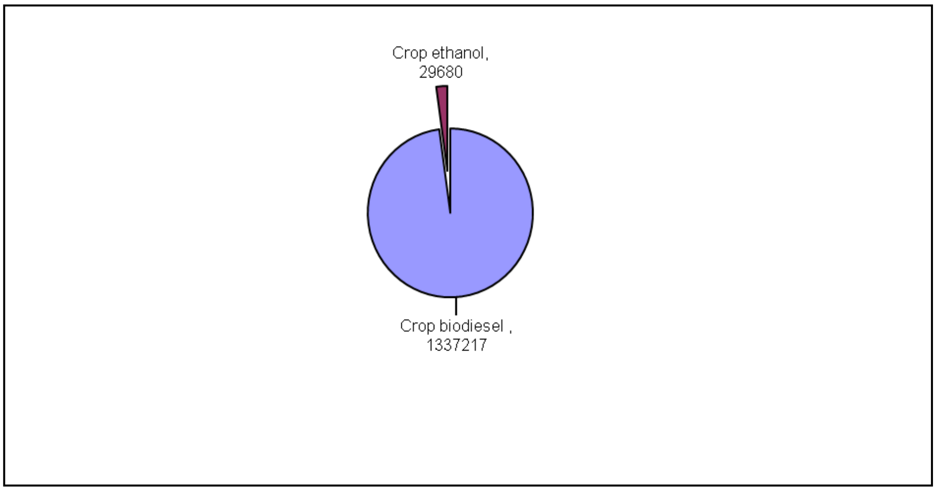

Figure 30: Total calculated land requirement to supply
UK biofuels (to March 2008)
Values in hectares

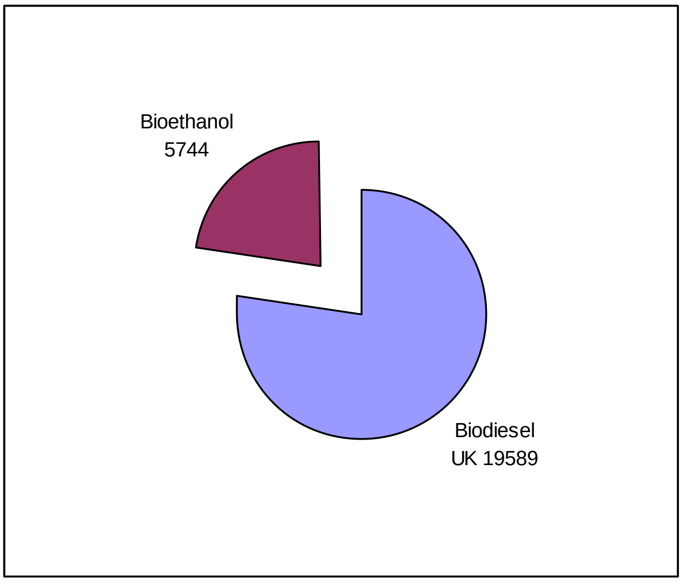

Figure 31: Calculated UK land requirement to supply
UK biofuels from domestic sources (year to March 2008).
Values in hectares

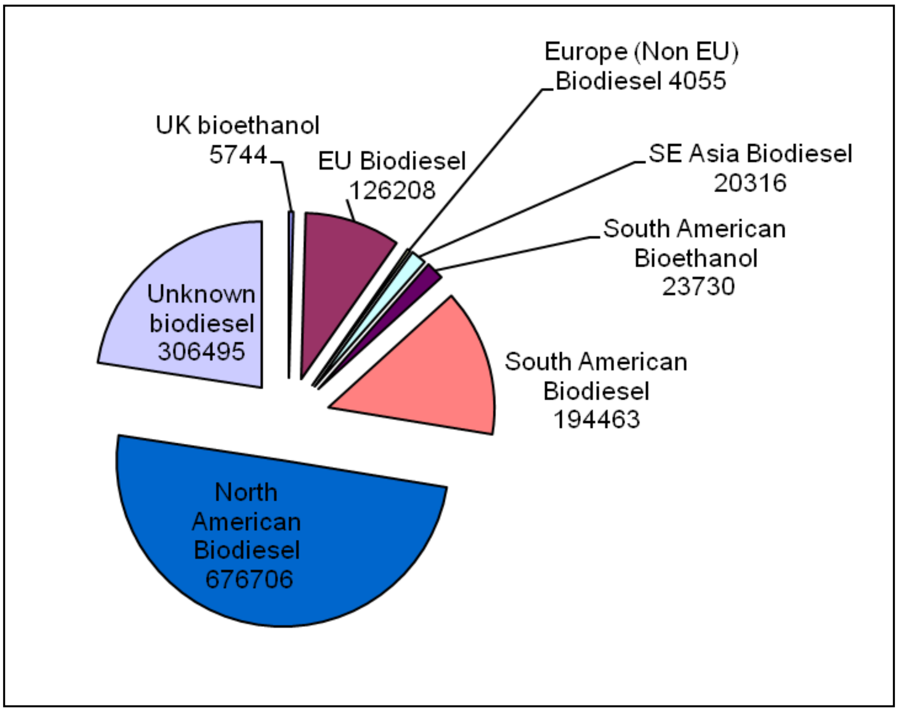

Figure 32: Calculated global land requirement to supply
UK biofuels (11 month period to March 2008).
Values in hectares

Note: during 2008 significant volumes of Argentinean biodiesel were exported to the USA and re-exported to the EU to take advantage of tax incentives. The North American biodiesel footprint is therefore overstated, the South American biodiesel footprint understated.

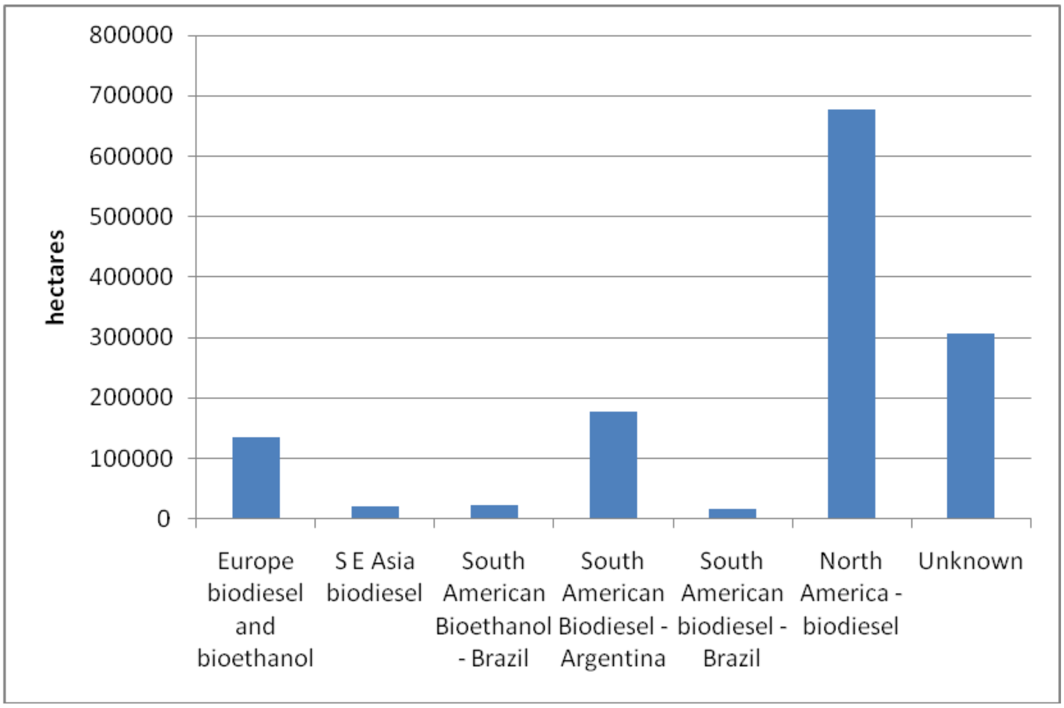

Figure 33: Estimated land requirement for currently imported UK biofuels

Note: during 2008 significant volumes of Argentinean biodiesel were exported to the USA and re-exported to the EU to take advantage of tax incentives. The North American biodiesel footprint is therefore overstated, the South American biodiesel footprint understated.

6.2 Land use requirements of current UK biofuels consumption – biomes

Crop and biofuels yield data have been used to estimate land required to produce the biofuels consumed in the UK. Map data pinpointing crop production areas in key countries can be combined with biome maps to identify within which biomes environment pressures are occurring as a result of UK biofuels use. The precise nature of these impacts, and the extent to which they are being managed, is not discussed in this report.

Figures 34 to 36 and Table 4 identify estimated land use to supply UK biofuels for key regions around the world and identify the biomes affected. Key points from this analysis are:

- The bias towards biodiesel use by the UK transport sector (Figure 16) skews land use impacts to those areas producing oilseed rape, palm oil and soya. Germany, Malaysia/Indonesia and the Americas are the respective identified sources for these plant oil based biofuels (Figure 22);
- Plant oil, and therefore biofuel yield, per hectare varies considerably across the three principal biodiesel source crops (Figure 37). Soya is the most important single biodiesel feedstock (Figure 19) but has the lowest yield per hectare;
- The high use of soya based biodiesel by the UK results in over 60% of the land use pressure arising from UK biofuels use occurring in

the 'Americas', specifically the USA[18], Argentina and Brazil . This 'American' soya/biodiesel footprint falls primarily within temperate grassland biomes (Table 4);

- The US sourced soya is from well developed agricultural systems where new land is not being taken into agricultural production and where the impact of UK biodiesel consumption on unconverted grasslands can be considered minimal[19]. In Argentina agricultural pressure for conversion of grassland to agricultural use is increasing. These pressures and their consequences need to be evaluated;
- The UK's use of biofuels based on palm oil and sugar cane has a modest land use impact because of the low volumes used by the UK and the high energy yields of these two crops (Figures 35, 37 & 38). The UK biofuels footprint (from use of these crops) on tropical/subtropical grasslands and tropical forest systems is modest at present (Table 4). In land use terms, pressure on tropical forest is less than one tenth that being exerted on temperate grassland.

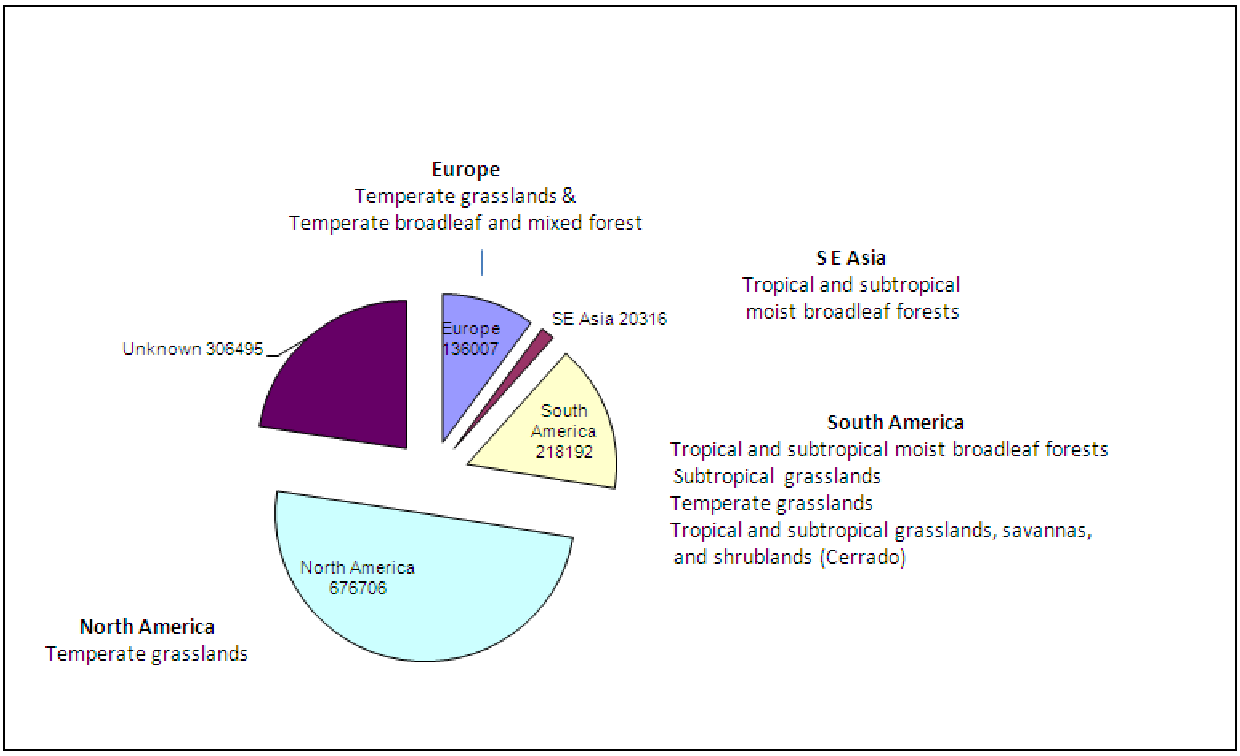

Figure 34: Global distribution of land currently supporting UK biofuels consumption and biomes potentially impacted. Figures in hectares.

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[18] Soya based biodiesel imported from the USA includes biodiesel originating in Argentina and re-exported to UK. Precisely defining the origin of UK soya based diesel is therefore not possible at This biodiesel pathway will change in 2009 after the EU action to prevent unfair competition through US subsidised biodiesel production including Argentinean sourced biodiesel. Direct exports of biodiesel from Argentina to the EU have already increased in the first half of 2009.

[19] There is some evidence of US 'conservation grassland' being converted to corn for ethanol – see http://www.newswise.com/articles/in-search-of-wildlife-friendly-biofuels-could-native-prairie-plants-be-the-answer

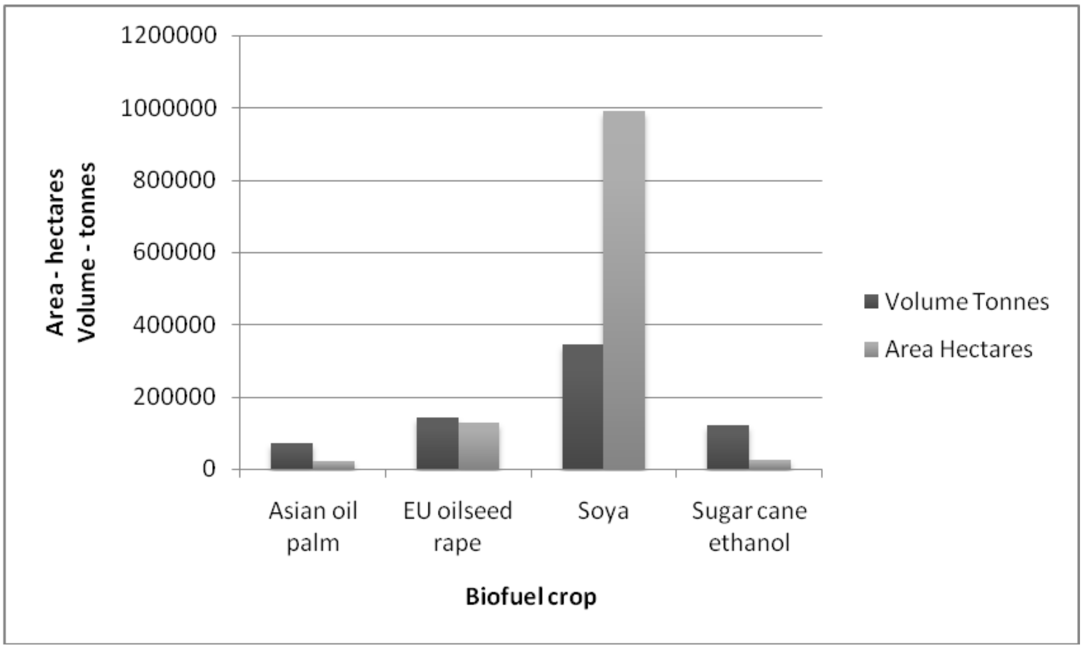

Figure 35: Biodiesel volumes and agricultural land requirement for UK biodiesel use (three main biodiesel crops and sugar cane).
Volumes in tonnes and area in hectares.

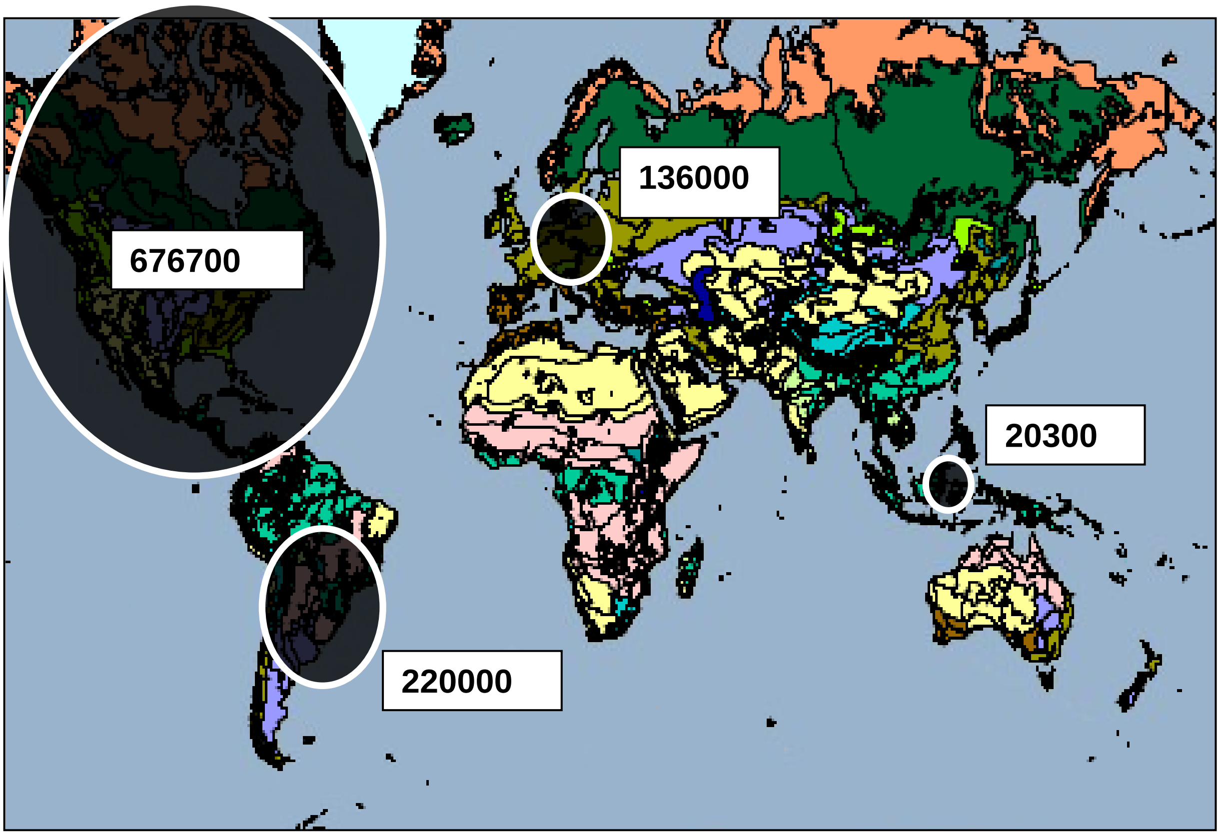

Figure 36: Global overview of known land required to meet current UK biofuels demand. Values in hectares. See table 4.

Region & fuel	Areas (hectares)	Biome
Europe biodiesel and bioethanol	136000	Temperate grasslands & Temperate broadleaf and mixed forest
S E Asia biodiesel	20300	Tropical and subtropical moist broadleaf forests
South American Bioethanol - Brazil	23700	Tropical and subtropical moist broadleaf forests & Subtropical grasslands
South American Biodiesel - Argentina	177900*	Temperate Grassland
South American biodiesel - Brazil	16500	Tropical and subtropical grasslands, savannas, and shrub lands (Cerrado)
North America biodiesel	676700*	Temperate grasslands
Unknown	306500	
Total	**1358000**	

Table 4: Summary of biomes currently supplying UK biofuels
*Note: during 2008 significant volumes of Argentinean biodiesel were exported to the USA and re-exported to the EU to take advantage of tax incentives. The North American biodiesel footprint is therefore overstated, the Argentinean biodiesel footprint understated.

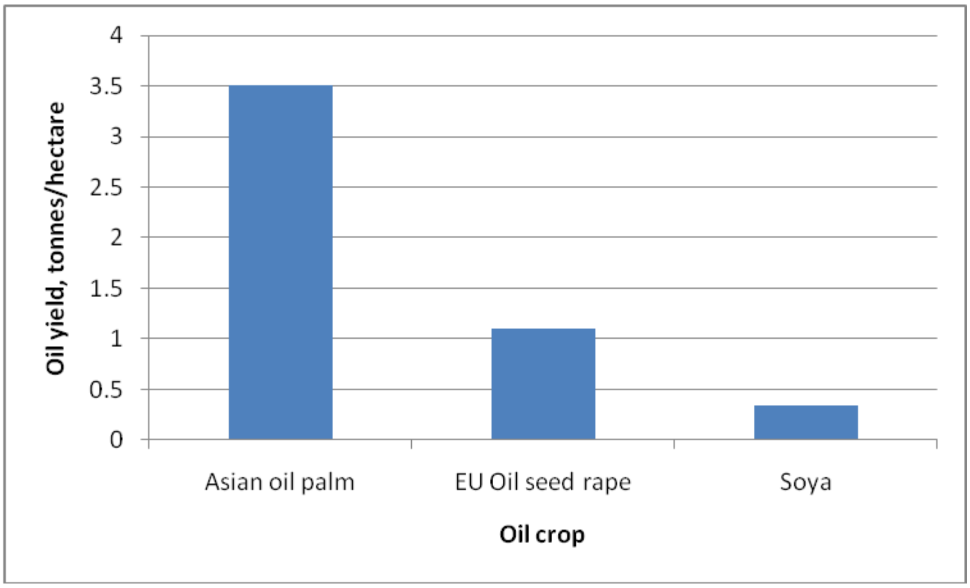

Figure 37: Oil yield per hectare for three main oil crops.

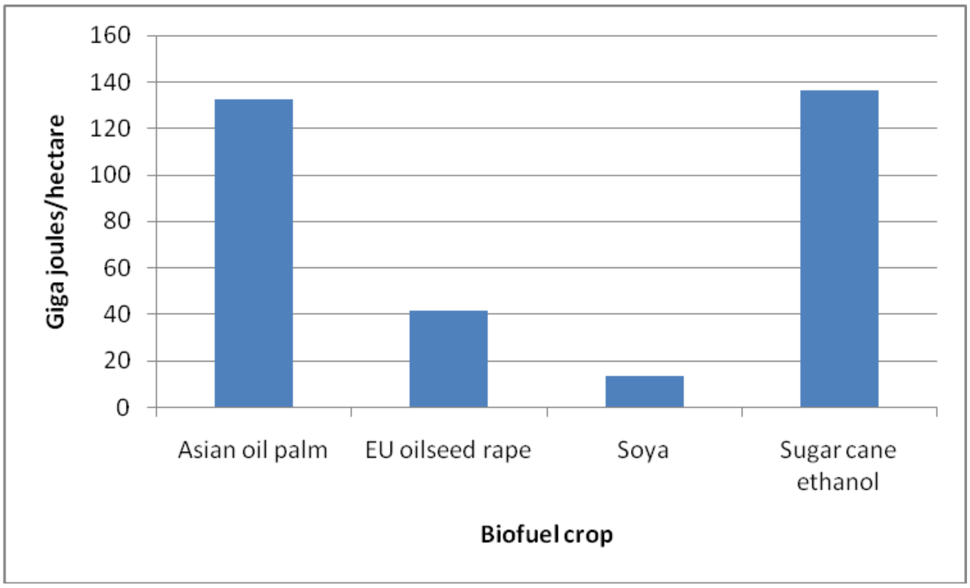

Figure 38: Energy yield per hectare for main biofuel crops supplying the UK.

7. Potential global biodiversity implications of UK biofuels consumption in 2020

7.1 Overview

UK consumption of transport biofuels could increase six-fold between 2010 and 2020, rising to 6 million tonnes a year if the EU targets are met (Section 4.4). The geographical footprint of current biofuels consumption reflects the high level of imports and the dominance of biodiesel as a biofuel. Although second generation biofuels will become more important over the coming decade, along with the increased use of recycled oils, it is highly probable that world and UK demand for biofuels will be met primarily from first generation fuels sourced from food crops (Figure 7). These fuels will therefore create a land use demand drawing on existing croplands or requiring virgin habitat conversion.

With the limited use of second generation biofuels prior to 2020 the land-use impacts of UK biofuels consumption will continue to depend on the type and source of agricultural crops used as feedstocks. The food crops that currently provide biofuels feedstocks, and that will dominate for the next decade, are reviewed in this report. Numerical estimates of land required to supply the UK biofuels demand in 2020 have been made allowing quantification of the pressure that may be placed on specific global biomes. A large land use requirement in one country does not automatically imply a more significant biodiversity impact than in other countries where land requirement is smaller. However, quantifying land requirements to supply biofuels does allow an assessment of the potential scale for biodiversity impacts around the world to be made and the biomes likely to be affected can be highlighted.

7.2 UK Bioethanol 2020 footprint

The UK may require 3 million tonnes of ethanol in 2020 to meet EU substitution targets. The UK currently imports almost 80% of its bioethanol from Brazil, the balance coming from UK sugar beet. The UK's bioethanol production capacity is developing rapidly with an emphasis on the use of wheat[20]. The UK's 3 million tonnes of annual wheat surplus has been identified as providing sufficient feedstock to supply 1 million tonnes of ethanol, a year leaving an additional requirement for 2 million tonnes of ethanol.

Maximising domestic bioethanol production by use of surplus national wheat supply has been proposed as a means to minimise the overseas impact of UK biofuels use. Use of domestic wheat for ethanol production also produces animal feed[21] which can substitute for imported, soya based, animal feed. This co-product offset will reduce the UK's impact on Argentinean and Brazilian biomes in particular but, unless there is an overall increase in UK wheat production, impacts will be transferred elsewhere as the food industry looks for alternative sources. The UK wheat surplus was primarily exported to Spain in 2008 which would have to find a substitute supply; this is likely to be in the EU's near neighbours in the Ukraine or Russia. Use of UK surplus wheat to produce ethanol is therefore likely to reduce impacts on South American agricultural/ecosystems (lower sugar cane based ethanol and soya imports) but transfer some impacts to the eastern Europe through this 'diversion of domestic use'.

In 2020 the UK will certainly use ethanol from a variety of domestic and overseas sources. Figure 39 illustrates the relative land use impact of Brazilian sugar cane and UK or CIS wheat sourced ethanol based on a total UK requirement of 3 million tonnes. There is a six-fold difference between the land use impact of high yielding sugar cane and eastern European wheat using current yield factors. Minimal land use impact will result from high use of Brazilian ethanol but these impacts will be felt in the tropical and subtropical grasslands and forests of that country. Large scale use of eastern European cereals will maximise the land use requirement with impacts in temperate zone grassland biomes.

7.3 UK Biodiesel 2020 footprint

UK biodiesel is currently primarily manufactured from soya and German rapeseed (Figure 22). The 2020 UK demand for biodiesel could be as high as 3 million tonnes (Section 4.4) and the only domestic crop that could contribute significantly to biodiesel production is oilseed rape. UK rapeseed oil could contribute 1 million tonnes towards UK biodiesel demand if the entire national crop is dedicated to energy production in 2020 leaving an additional requirement for 2 million tonnes of biodiesel or plant oils.

The UK biodiesel demand in 2020 is likely to be met by a mix of domestic and imported biofuels and Figure 40 illustrates the relative land use impact associated with the production of 3 million tonnes of biodiesel from four oil crops. There is an eightfold difference between the land impacts arising from low yield crops compared with those of high yield. Minimal land use impact will result from high use of palm oil to produce biodiesel with impacts felt in the tropical forests of Asia, South America and Sub-Saharan Africa. Large scale use of soya will maximise the land use impact, affecting temperate grasslands in North and South America.

7.4 Overview of ecosystem impacts of UK biofuels consumption – 2010 to 2020

Biofuels derived from agricultural crops, rather than recycled materials, have a land use requirement. This requirement may be met by use of existing agricultural land, with diversion of crops into biofuels, or conversion of land to agricultural use for biofuel production. This report combines data from the UK's Renewable Fuels Agency with other information to make a quantitative assessment of the land required to produce the

[20] http://www.ensusgroup.com
[21] 3 tonnes of wheat yields 1 tonne ethanol and 1 tonne animal feed.

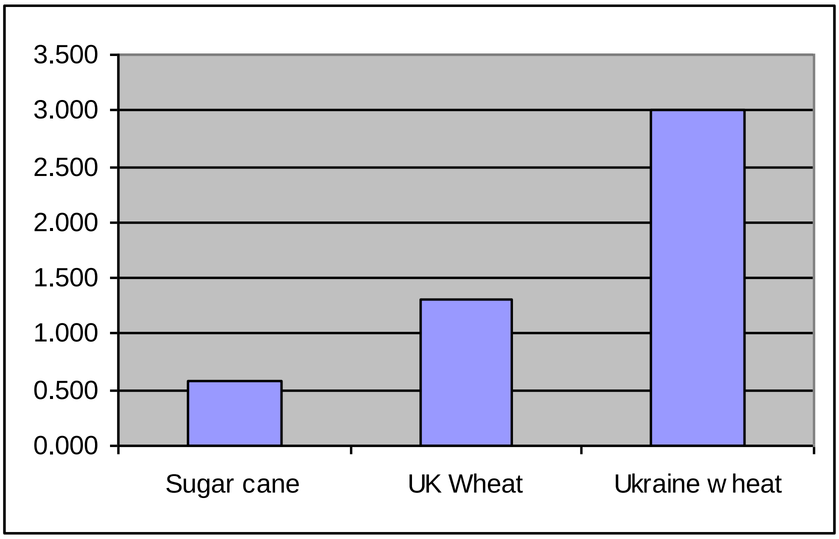

Figure 39: Land area required to source 3 million tonnes of bioethanol based on two possible crops.
Values in million hectares

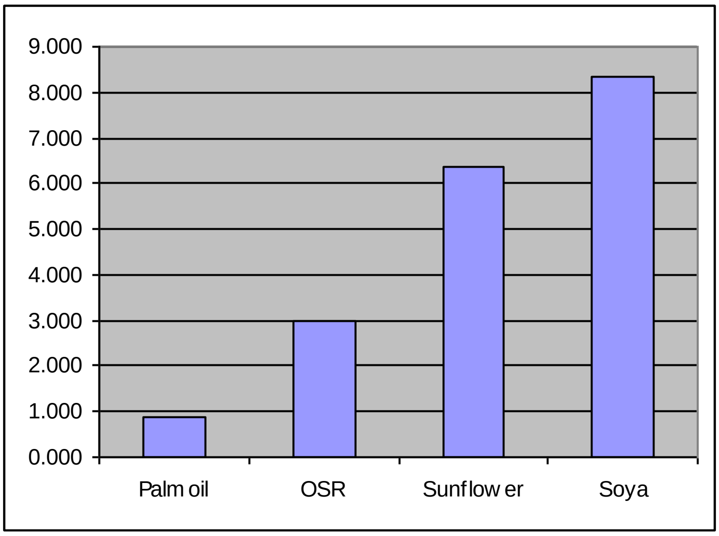

Figure 40: Land area required to source 3 million tonnes of biodiesel based on four possible oil crops.
Values in million hectares

biofuels consumed in the UK. This land use 'footprint' for current UK biofuels consumption has been calculated as approximately 1.4 million hectares of land. Estimating a biofuels land use footprint provides a 'first order' assessment of potential impacts arising from UK consumption of these fuels, indicating where impacts may occur and their possible magnitude. For example, in land use terms, pressure on tropical forest is currently less than one tenth that being exerted on temperate grassland.

Biofuels production can have an adverse affect on biodiversity through a range of mechanisms including land use change, pollution, impairment of soil function, use of invasive/GMO species and water use. The purpose of the footprinting exercise undertaken in this report is to determine where in the world these pressures might arise and, by quantifying the land use footprint, indicate where the pressures may be greatest. The analysis, highlighting the ecosystems that are being exploited, does not in itself imply negative impacts are occurring but serves to highlight areas that may be currently at risk or may come under pressure in the future. The report therefore provides a strategic overview, emphasising the links between specific biomes in specific countries and the UK biofuels economy.

Biomes impacted in the future by UK use of biofuels will depend on the biofuel crops which come to dominate the world market and the choices made by the UK and EU on how to supply their needs. Increased future use of cereals for bioethanol and rapeseed for biodiesel will come primarily from existing agricultural areas. The main biome impact of increased sugar cane use will be on grasslands, with soya increasing pressure on grasslands, forests and existing crop lands. The main impact of increased use of palm oil will be on tropical forest systems. The scale of the impacts, in terms of land use requirements, will also vary according to crop yields. Palm oil and sugar cane have high energy yields per hectare compared with soya and cereals and lower land use demand.

The future impact of UK biofuels use will therefore depend on how the national biofuel preferences evolve. Currently the UK has a strong preference for soya based biodiesel with the land use impact falling in the USA and Argentina. The latter source is likely to become more important in the next few years increasing pressure for land use change within the grasslands of that country. In the longer term a shift towards greater ethanol consumption by the UK is possible and, in land use terms and potential for greenhouse gas emissions reductions, desirable (Table 3).

Key points from this analysis of potential ecosystem impacts of UK biofuel consumption are:

- Current patterns of UK biofuels consumption (in terms of fuel type and source) are focussing land use impacts on the USA and Argentina. Impacts in the far East are less important;
- Based on land use footprint analysis, current UK consumption of biofuels is exerting significantly more pressure on temperate grassland ecosystems than tropical forests (a tenfold difference);
- By 2020 the global land use footprint arising from biofuels use could increase from the current 1.4 million hectares to between 4 and 8 million hectares depending principally upon the fuels and feedstock used;
- By 2020 ecosystem impacts will be spread over a wider global area than at present with eastern European and western Russia affected by UK use of biofuels. Temperate grasslands in the northern and southern hemispheres are likely to come under greater pressure;
- Current tropical forest impacts are small in land use terms. Future tropical forest impacts will depend on the relative use

of palm oil for biodiesel compared with soya and rapeseed. These impacts are likely to be spread across South East Asia (Malaysia, Indonesia, PNG) and South America (Ecuador, Colombia) and in newly emerging sub-Saharan African palm oil producers.

Reviews of biofuels demand and supply suggest that 75% of global demand will be met from 1st generation fuels until at least 2020. These fuels have a land use requirement (footprint) which will grow as production increases until 1st generation production peaks and levels out in the next 10 to 15 years. After 2020 2nd generation fuels will become more important, increasing global biofuel production without significantly increasing the land requirement. If this analysis is correct, the period 2010 to 2020 (which will be dominated by food crop derived fuels), will be critical in respect of understanding, monitoring and managing land use change arising through use of biofuels.

Increasing domestic production of biofuels has been suggested as a way to reduce the overseas impact of UK biofuel use. The close link between food production and biofuels through 1st generation fuels suggests that such reduction will only happen if there is an overall increase in UK production of key crops such as wheat and oilseed rape. In the absence of such an increase, the domestic use of such crops for biofuels will require the food industry to increase imports creating a land use footprint overseas. Imported food commodities are not subjected to the same reporting requirements (source, greenhouse gas emissions, land use change) as biofuels. The UK currently imports approximately 50 million tonnes of biomass per year, 50% of which is food for human or animal consumption[22]. Biofuel imports could increase to 4 or 5 million tonnes by 2020.

Use of biofuel feedstock will be determined by commercial criteria and environmental restrictions imposed by the UK or EU. However, maximising the use of imported palm oil based biodiesel and sugar cane based bioethanol would minimise the land use requirement to supply the UK. As little as 1.5 million hectares would be needed to supply the 2020 6 million tonnes requirement but this land use impact would fall in the tropical regions of South America, Asia and Africa affecting tropical forests and savannah. Maximising use of wheat and soya as feedstocks would significantly increase the land use impacts, requiring as much as 11 million hectares to supply the 2020 demand but this impact would be felt outside the tropics in temperate grasslands. In practice the UK demand will be met from a variety of domestic and overseas sources and a variety of crops, and the impacts will be shared across a range of countries and ecosystems.

The global biodiversity impacts of the UK's biofuel use cannot be judged by land use requirement alone. A large land use requirement in one country does not automatically imply a more significant biodiversity impact than in other countries where land requirement is smaller. However, quantifying land requirements to supply biofuels (and determining within which countries and which biomes these are likely to fall) does allow an assessment of the potential scale for biodiversity impacts around the world to be made and the biomes likely to be affected highlighted. Detailed comparison of the nature of the impacts within highlighted areas will be necessary to determine the precise nature of the biodiversity impacts arising from biofuels production. This report identifies where such studies should be undertaken. Future JNCC reports will track changes in the UK use of biofuels and the changing pattern of global biodiversity impacts that may arise.

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[22] The Global Biodiversity Footprint of the UK use of imported biomass. JNCC. In preparation.

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JOINT NATURE CONSERVATION COMMITTEE

The Joint Nature Conservation Committee (JNCC) is the statutory adviser to Government on UK and international nature conservation. Its work contributes to maintaining and enriching biological diversity, conserving geological features and sustaining natural systems.

JNCC delivers the UK and international responsibilities of the Council for Nature Conservation and the Countryside (CNCC), the Countryside Council for Wales (CCW), Natural England, and Scottish Natural Heritage (SNH). The functions that arise from these responsibilities are principally to:

- advise Government on the development and implementation of policies for, or affecting, nature conservation in the UK and internationally;
- provide advice and disseminate knowledge on nature conservation issues affecting the UK and internationally;
- establish common standards throughout the UK for nature conservation, including monitoring, research, and the analysis of results;
- commission or support research which it deems relevant to these functions.

The Committee comprises 14 members: a Chairman and five independent members appointed by the Secretary of State; the Chairman of CNCC; the Chairmen or deputy Chairmen of CCW, Natural England and SNH; and one other member from each of these bodies.

JNCC, originally established under the Environmental Protection Act 1990, was reconstituted by the Natural Environment and Rural Communities Act 2006. Support is provided to the JNCC by a company limited by guarantee (JNCC Support Co) that the Committee established in 2005.

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