



**JNCC Report**

**No. 452**

**The global land use impact of the United Kingdom's biomass consumption  
Part I: Biomass flows through the UK economy - an overview of biomass sources and  
overseas land requirements**

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## Summary

1. Under current production and consumption conditions the United Kingdom cannot produce sufficient biomass to meet the national demand for food, timber products or bioenergy. Analysis of the flow of biomass through the UK economy indicates that one third of the biomass material utilised by the UK is imported.
2. The UK economy has shown long term growth since 1990 with a corresponding increase in imports. UK economic growth is dependent on imported raw materials and the environmental impact of continued economic growth is likely to be felt overseas. The high volume of biomass imports for food, construction and bioenergy use makes it clear that we are drawing on significant amounts of primary production from overseas ecosystems. Forecasts for the future use of biomass for food, biofuels and the production of heat and power suggest this dependence will continue to increase.
3. National statistics permit the biomass input to the UK economy to be monitored in terms of the changing balance between domestic production, imports and exports. The Office for National Statistics reports domestic UK biomass extraction as approximately 102 million tonnes in 2008 with production fluctuating between 90 and 107 million tonnes over the last four decades. This domestic supply is complemented by imports of approximately 50 million tonnes per year. A detailed analysis of these import flows is possible using HM Revenue and Customs data. These data include information on commodity type, value, volume and country of origin.
4. Import profiling provides an insight into the key dependencies of the UK economy on overseas biomass production. It also forms the basis for quantifying and qualifying the pressures that are being exerted by the UK economy on overseas ecosystems through our biomass consumption, in particular through the use of overseas land.
5. Key conclusions from this biomass import analysis are:
  - food chain materials (for human or animal consumption) represent 60% of biomass imports. European Union partners supply 60% of UK biomass imports. A significant proportion (approximately 27%) are sourced from tropical and sub-tropical countries;
  - approximately 14 million hectares of overseas land was required to produce the 52 million tonnes of biomass imported in 2008. This complements the 20 million hectares of domestic land producing biomass. Approximately 90% of the overseas land use requirement arises from provision of agricultural products for food and from forest products. The remaining 10% is from bioenergy crops;
  - material flow analysis allows the pressure exerted by UK biomass consumption on overseas ecosystems to be estimated in terms of land use. These pressures are currently being felt primarily in the boreal forest and temperate forest biomes of Europe and the temperate grasslands and tropical moist forests of South America;
  - the UK, as a significant importer of biomass will continue to contribute to global pressures on these biomes through population and economic growth, and changing patterns of biomass consumption. Material flow analysis offers an opportunity to monitor these pressures and provides the evidence for the formulation of policies to avoid or mitigate potential impacts on the overseas ecosystems which provide the UK with essential biomass.

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# 1 Introduction

- 1.1 Under current production and consumption conditions the United Kingdom cannot produce sufficient biomass to meet the national demand for food, building materials or bioenergy. Analysis of the flow of biomass through the economy – including domestic production, imports and exports – indicates that one third of the biomass material consumed in the UK is imported. Currently the UK imports 40% of its food and 75% of its biofuels. These imported materials, which vary from highly processed commodities through to basic raw materials, are the product of overseas agricultural and forest systems upon which the UK is dependent.
- 1.2 Long term trends show that the UK economy (as measured by GDP) grew consistently between 1990 and 2008 but there was no overall increase in consumption of domestically produced natural resources - minerals, fossil fuels and biomass. Over the same period, however, imports have risen making it clear that UK economic growth is dependent on imported raw materials and that the environmental impact of continued economic growth is likely to be felt overseas. The high volume of biomass imports for food, construction and bioenergy use makes it clear that we are drawing on significant amounts of primary production from overseas ecosystems. Forecasts for the future use of biomass for food, biofuels and the production of heat and power suggest this dependence will continue to increase.
- 1.3 Our dependence on overseas ecosystems makes it imperative that we take steps to ensure the long term productivity of these systems. Routine monitoring and analysis of imports flows, identifying potential negative overseas impacts, and the formulation of policies to avoid or mitigate these, is therefore in the national interest. National statistics permit the biomass input to the UK economy to be monitored in terms of the changing balance between domestic production, imports and exports. Material flow analysis of biomass imports in particular forms the basis for quantifying and qualifying the pressures that are being exerted by the UK economy on overseas ecosystems through our biomass consumption.
- 1.4 Through this series of reports JNCC focuses attention on these imported biomass streams:
- reporting on the sources of biomass available to the UK economy using Material Flow Analysis techniques;
  - determining the nature, quantity and sources of imported biomass;
  - estimating the overseas land required to produce the biomass imported;
  - identifying the key global ecoregions (biomes) that are supplying the UK with biomass;
  - identifying trends in production and consumption that will influence the UK's future impact on overseas ecosystems and suggesting techniques to monitor these impacts.
- 1.5 The reports are presented in three parts:
- **Part I - Biomass flows through the UK economy:** an overview of biomass sources and overseas land requirements;
  - **Part II - UK biomass imports:** a detailed analysis of flows and overseas land use requirements;
  - **Part III - UK biomass consumption:** forecasting import flows, monitoring overseas impacts and recognising policy implications.

## 2 Material flows through the UK economy

### 2.1 Material flows in the UK economy

- 2.1.1 National economies use physical raw materials - minerals, fossil fuels and biomass – and measurements of these material flows through the economy can be used as indicators of progress towards sustainable use of natural resources. Material Flow Analysis (MFA) uses direct measures of such flows (as mass, monetary value, domestic production, import or export) to monitor flow changes in time and space (Eurostat, 2000, Bringezu *et al* 2003). The principal material flow indicators available are summarised in Table 1.
- 2.1.2 The UK government has collected these data on material flows since 1970, providing a long term database for trend analysis (UK Office for National Statistics, 2005). Material flow data can be combined with other national statistics, such as GDP or population data, to determine the drivers of material use and how these change through time (Gazley & Francis, 2010; JRC, 2010). Material flow data on biomass can be analysed at a strategic level to look at aggregated flows of materials through the economy as a whole – for example looking at all imported biomass - or used for detailed flow analysis of specific imported commodities such as soya, palm oil or forest products.
- 2.1.3 Over the last 200 years the UK economy has moved from a mixture of services, manufacturing and biomass based activities (farming, forestry, fisheries) to an economy based on the service sector (Figure 1). Material flows through the economy have therefore changed and the extent to which primary productivity (from agricultural and fisheries sectors) support the current service based economy are not always obvious (Millennium Ecosystem Assessment, 2005). The shift from an economy dominated by agricultural production, through a manufacturing phase and eventually to a service economy disguises the economic importance of biomass which has recently been re-emphasised (Rickard, 2010). The food price rises in 2008 and the increasing use of biomass to mitigate the climate change impacts of energy production have, however, caused a fundamental reappraisal of the role of biomass in developed economies (Svetlana & Vinterbäck 2009, Biomass Task Force, 2005).
- 2.1.4 Long term analysis shows 'Domestic Biomass Consumption'<sup>1</sup> in the UK to be virtually recession proof (Figure 2) in contrast with mineral and fossil fuel consumption patterns which reflect major recessions, typically reducing mineral consumption (due to contraction in the construction sector) and fuel use. Economic growth in the UK since 1990 has not been matched by an increase in consumption of domestic natural resources ('Domestic Material Consumption') but over the same period imports have risen. In the words of the Office for National Statistics this suggests *'that some of the environmental impacts associated with consumption are being transferred abroad'* (ONS 2010a). A third of the biomass input into the UK economy is imported (Figure 3) and the steady increase in biomass imports contrasts with relatively steady domestic biomass production (Figure 4) making it clear that the UK is drawing increasingly on the primary production of overseas ecosystems.
- 2.1.5 National statistics permit the biomass input to the UK economy to be monitored in terms of the changing balance between domestic production, imports and exports and the net consumption (Domestic Material Consumption) of this raw material

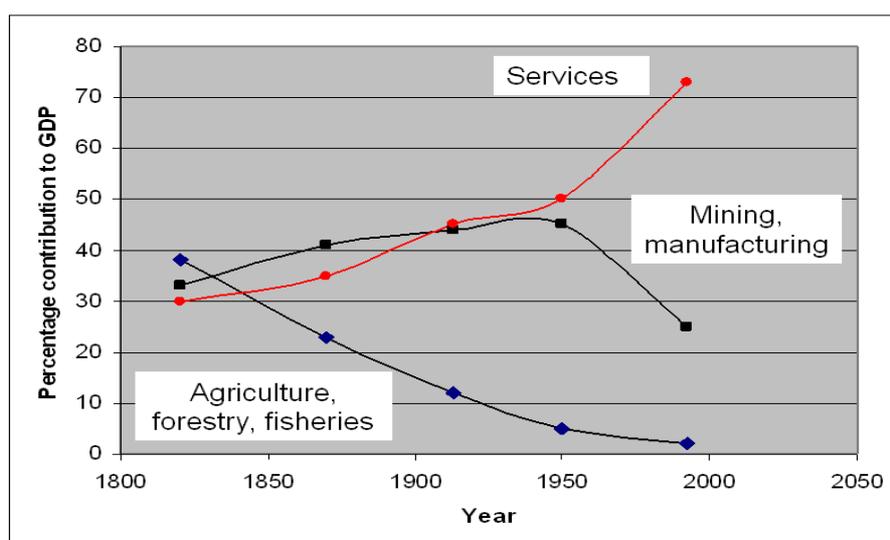
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<sup>1</sup> See Table 1 for definition

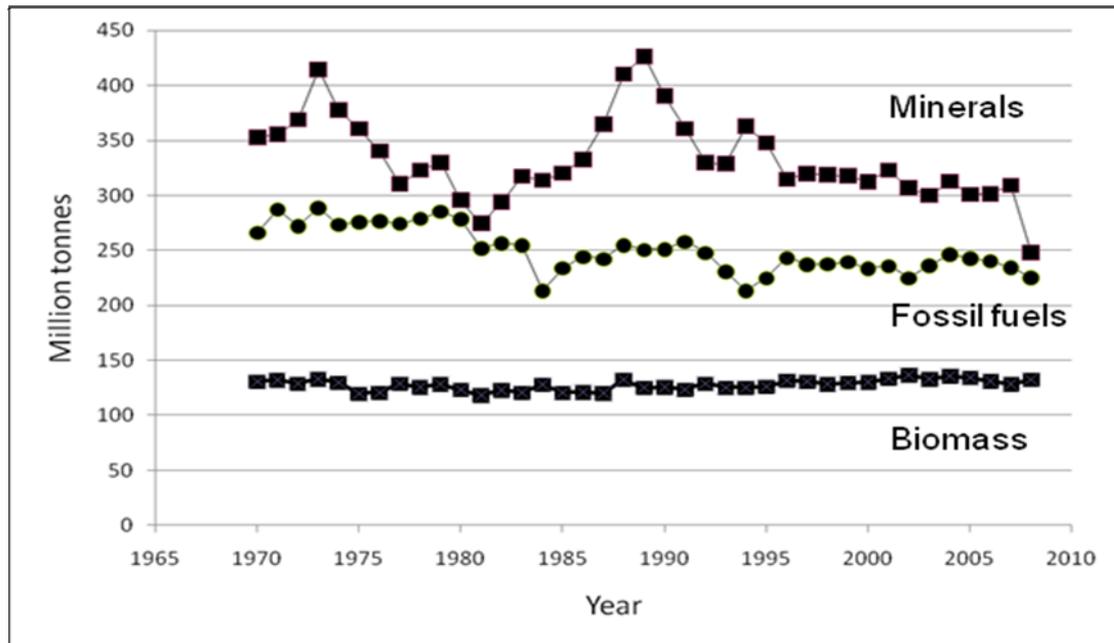
(Figure 3). This material flow analysis of biomass forms the basis for identifying the relative roles of domestic production and imports, and for the more detailed examination of import flows. Biomass Material Flow Analysis can also be used to identify pressures arising on overseas ecosystems and the actual impacts that may result (Bringezu *et al* 2003).

**Table 1.** Material and biomass flow terminology and available indicators. Data from Office for National Statistics (2010a).

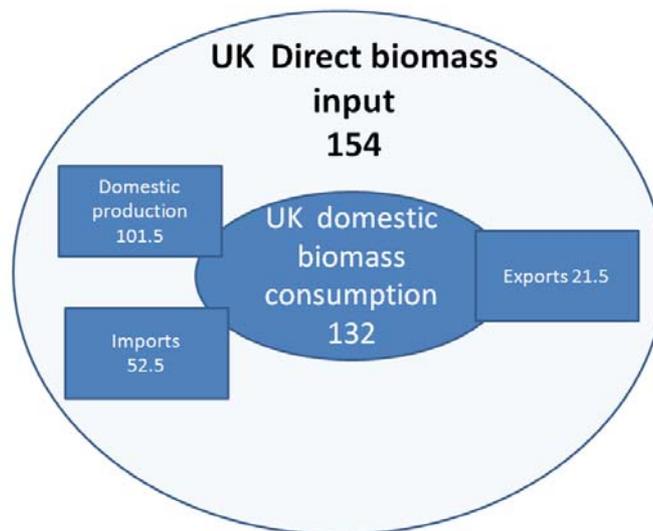
| <b>Total material flow indicator</b>   | <b>Equivalent biomass flow indicator</b>   |
|--|--|
| <b>Domestic Extraction</b> - the sum of materials (minerals, fossil fuels, biomass) taken from the UK environment.   | <b>Domestic Biomass Extraction</b> - the sum of primary biomass taken from the UK marine and terrestrial environment.  |
| <b>Direct Material Input</b> - primary resources extracted from the UK environment plus imports. DMI represents the <i>gross</i> use of raw materials by the UK economy. | <b>Domestic Biomass Input</b> – biomass extracted from the UK environment plus biomass imports.  |
| <b>Domestic Material Consumption</b> - Domestic Material Input less the mass of goods exported from the UK.  | <b>Domestic Biomass Consumption</b> – domestic biomass input less biomass exported.  |
| <b>Imported Material</b> – mass of primary resources (minerals, fossil fuels, biomass) imported into the UK.   | <b>Imported Biomass Input</b> – mass of biological material imported into the UK. Can be used at aggregated level (total imported biomass) or for specific commodity groups. |



**Figure 1.** Evolution of the UK economy 1800-2000. Data from Millennium Ecosystem Assessment (2005).



**Figure 2.** UK long term Domestic Material Consumption. Data from Office for National Statistics (2010a).



**Figure 3.** UK biomass balance for 2008. Figures in millions of tones. Data from Office for National Statistics (2010a).

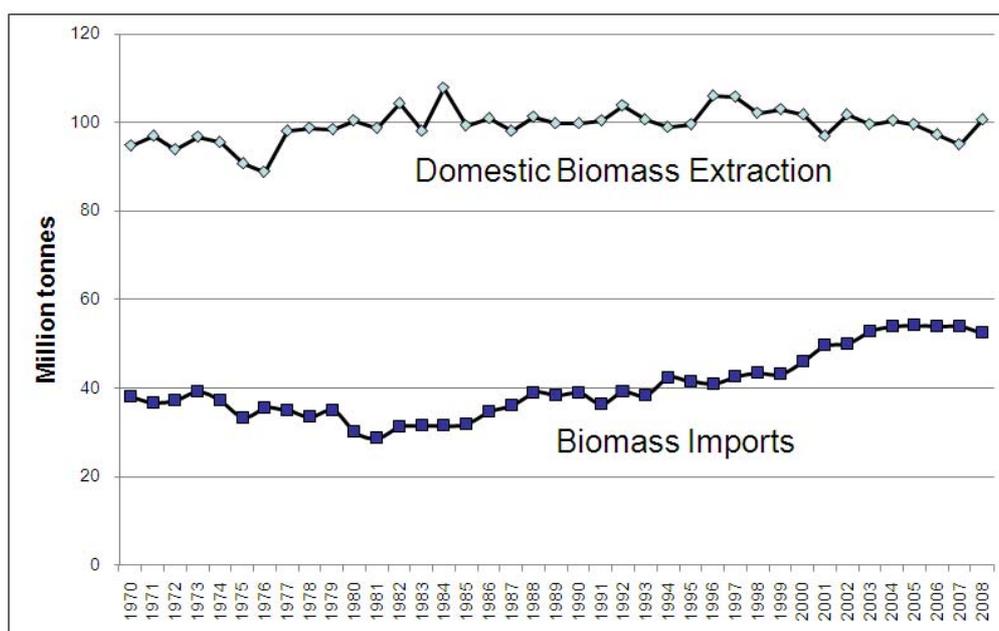
### 3 UK biomass production

#### 3.1 Usable UK biomass

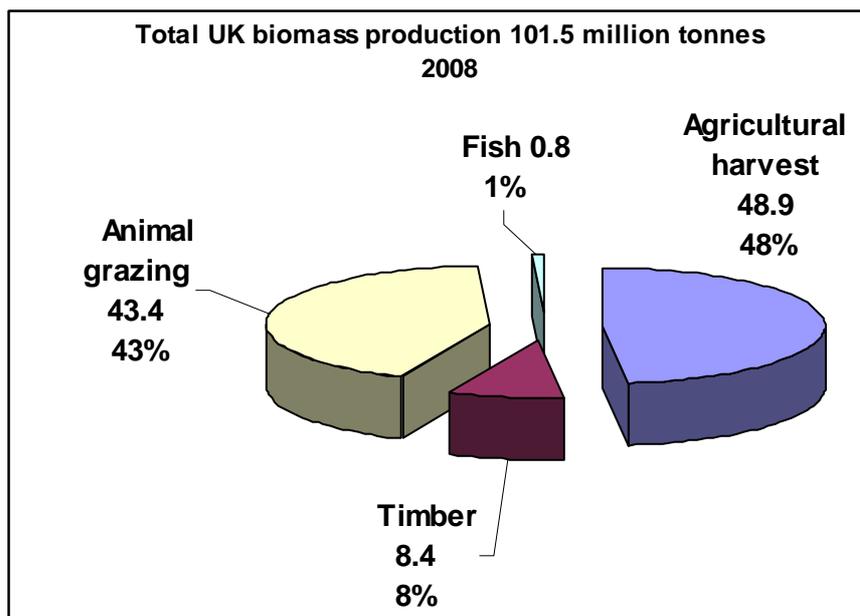
The strategic overview provided by the Office for National Statistics Environmental Accounts on the long term production and use of natural resources by the UK economy (UK ONS, 2010) identifies the principal sources of domestic biomass as animal grazing and silage (from grassland), agricultural harvest (cereals, root crops, fruit, vegetables), timber and domestic fisheries. This biomass is recorded as Domestic Biomass Extraction and represents the 'economically usable' output from the UK's terrestrial and marine ecosystems (Gazley & Francis, 2005).

Key aspects of the long term production of these domestic biomass streams in the UK are as follows:

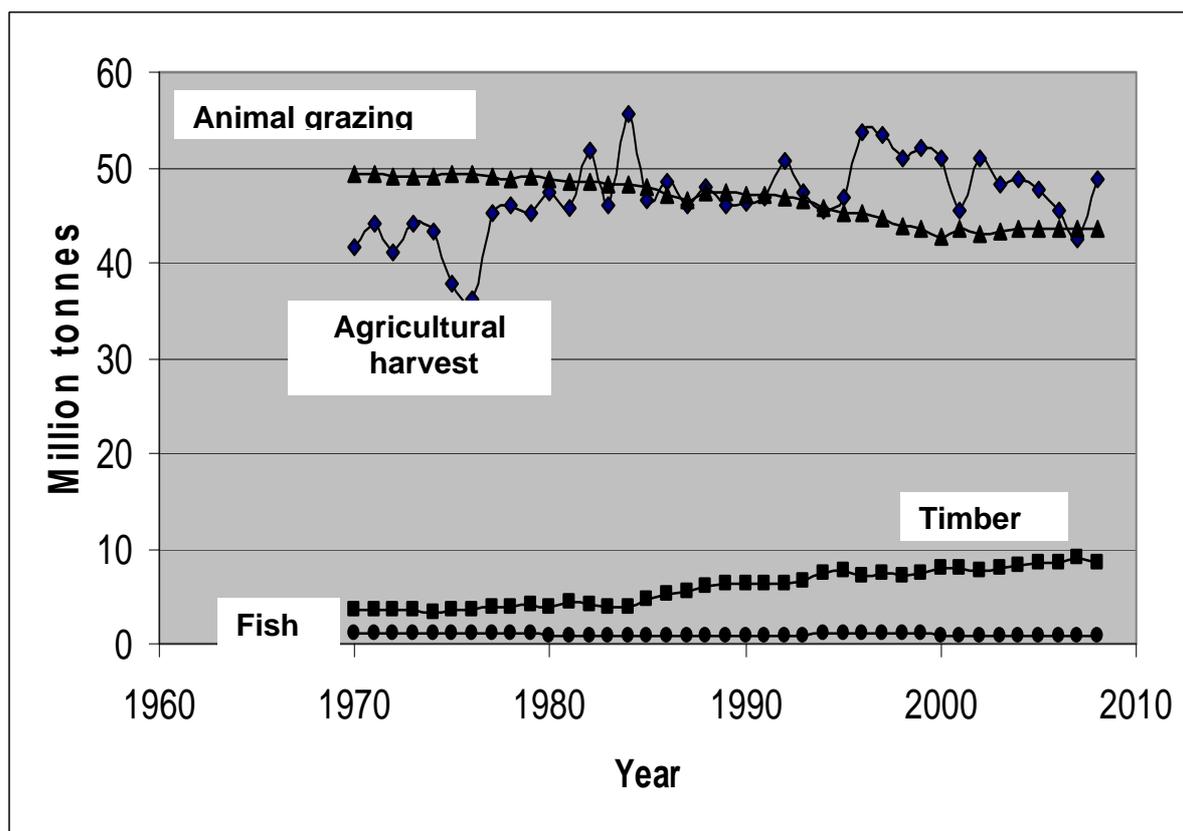
- the ONS reports domestic UK biomass extraction as approximately 102 million tonnes in 2008 with production fluctuating between 90 and 107 million tonnes over the last four decades (Figure 4);
- the ONS Environmental Accounts show that UK biomass production underpinning the economy comes predominantly from agricultural sources with fisheries and forestry contributions together less than 10% in 2008 (Figure 5);
- a steady decline in national biomass production since the mid 90's was abruptly reversed in 2008 as a result of the global increase in food prices and increased domestic agricultural harvest production (Figure 6 and 7);
- in contrast to fluctuating agricultural harvest production, grassland production (through animal grazing and silage production) has shown a long term decline with timber production showing a long term increase with both stabilising in recent years (Figure 6);
- the contribution from fisheries has shown a long term decline and represents less than 1% of the UK's domestically produced biomass (Figures 5 & 6).



**Figure 4.** UK domestic biomass production and imports 1970-2008. Data from Office for National Statistics (2010a).



**Figure 5.** Major sources of UK usable domestic biomass production, 2008. Hidden flows excluded. Numbers in million tonnes. Data from Office for National Statistics (2010a).



**Figure 6.** Major sources of usable domestic biomass production, 1970-2008. Data from Office for National Statistics (2010a).

## 3.2 Total primary production - accounting for hidden flows

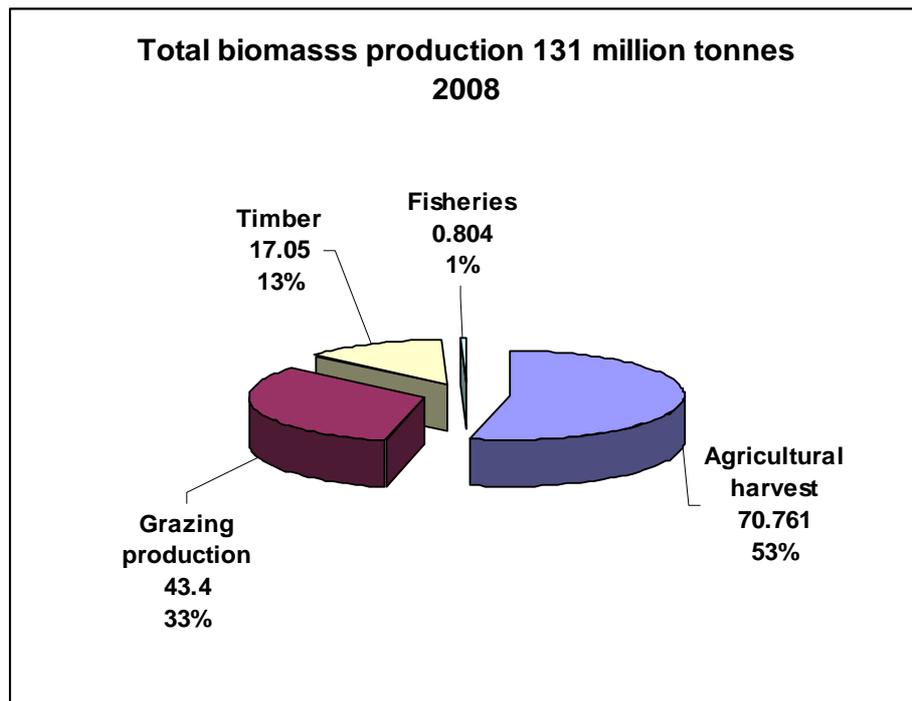
3.2.1 Material flow techniques record and trace the production and consumption of raw materials through an economy focusing on materials which have an economic value. In the case of biomass material flows, economically valuable materials include food and timber products. Material flow analysis recognises hidden flows associated with the agricultural and forestry systems which provide the economy with these materials and attempts to recognise these materials (Giljum *et al* 2007, Gazley & Francis, 2005). These hidden biomass flows within the UK economy are estimated at 30 million tonnes per year (ONS 2005, ADAS, 2010: Figures 7 through 11 and Table 2). Allowing for these residues total annual primary terrestrial biomass production from the UK is approximately 130 million tonnes per year.

3.2.2 Although the hidden biomass materials, in particular cereal straw and forest 'wastes'<sup>2</sup>, have had little or no economic value in the past, some of this material is now potentially useful, particularly as feedstocks for the bioenergy industry. The UK's renewable energy targets will increase national demand for biomass and identifying these additional materials is becoming increasingly relevant when assessing the national capacity to produce biomass (Kilpatrick, 2008).

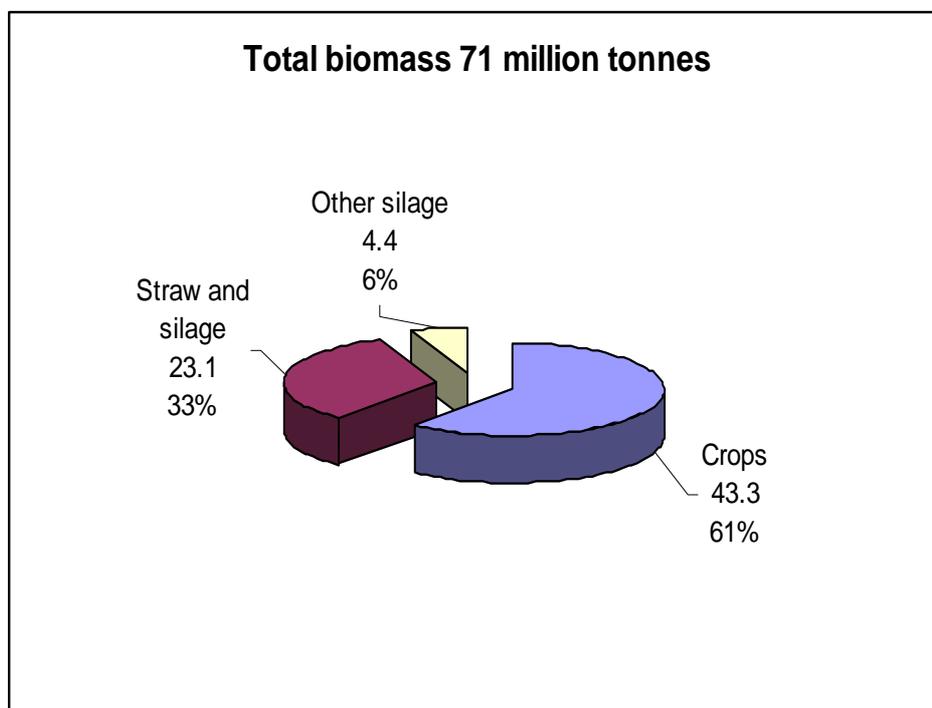
| Source                      | Million tonnes | Biomass category      | Million tonnes |
|-----------------------------|----------------|-----------------------|----------------|
| <b>Agricultural harvest</b> | 70.8           | Crops                 | 43.3           |
|                             |                | Straw and silage      | 23.1           |
|                             |                | Other silage          | 4.4            |
| <b>Grazing production</b>   | 43.4           | Grass for hay         | 2.1            |
|                             |                | Grass for silage      | 18.9           |
|                             |                | Grazing               | 22.4           |
| <b>Timber</b>               | 17.1           | Coniferous round wood | 3.5            |
|                             |                | Coniferous saw logs   | 5.8            |
|                             |                | Sawmill product       | 2.3            |
|                             |                | Recovered wood        | 4.5            |
|                             |                | Other wood fibre      | 1.0            |
| <b>Fisheries</b>            | 0.8            |                       |                |
| <b>Total</b>                | <b>131.2</b>   |                       | <b>131.2</b>   |

**Figure 7.** Usable and waste terrestrial biomass production, 1996-2008. Data from Office for National Statistics (2010a) and Sheerin (2002).

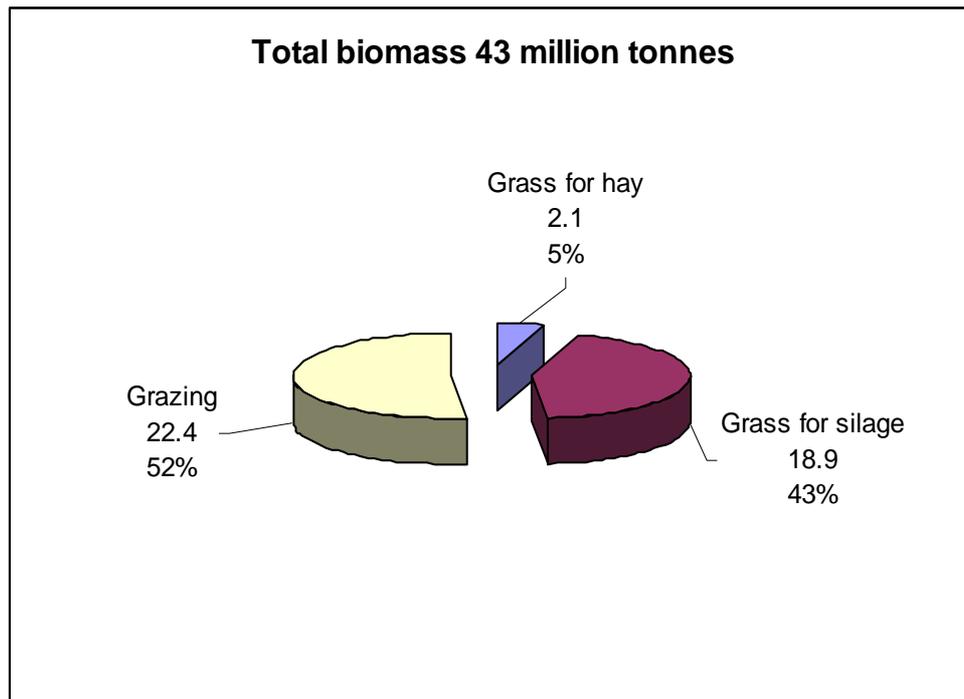
<sup>2</sup> Materials produced by the forestry and agricultural sector which in the past have had no economic value are typically described as waste ('unwanted or useless materials'). It is becoming harder to unequivocally define true wastes (something without any economic value) given the potential use of some of these materials for the bioenergy industry in particular. The term hidden flow is more appropriate and makes no assumption about the actual fate of these materials.



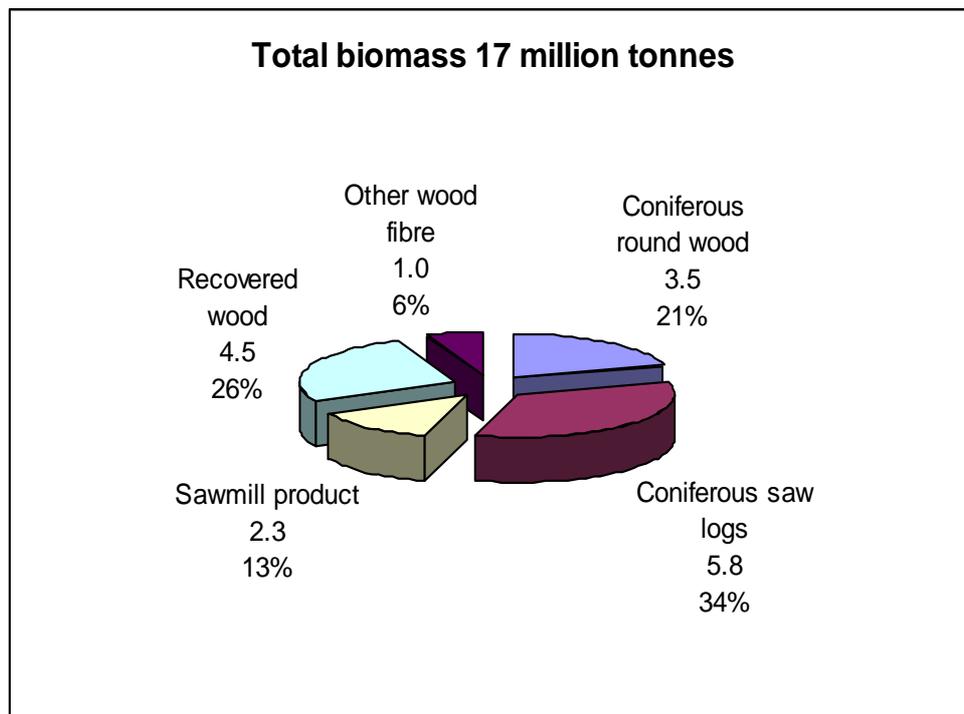
**Figure 8.** Major sources of UK domestic biomass production, 2008. Hidden flows included. Numbers in million tonnes. Data from Office for National Statistics (2010a) and Kilpatrick (2008). See Table 1 for details.



**Figure 9.** UK agricultural harvest production, 2008. Hidden flows included. Numbers in million tonnes. Data from Office for National Statistics (2010a) and Kilpatrick (2008).



**Figure 10.** UK grassland production, 2008. Numbers in million tonnes. Data from Office for National Statistics (2010a).



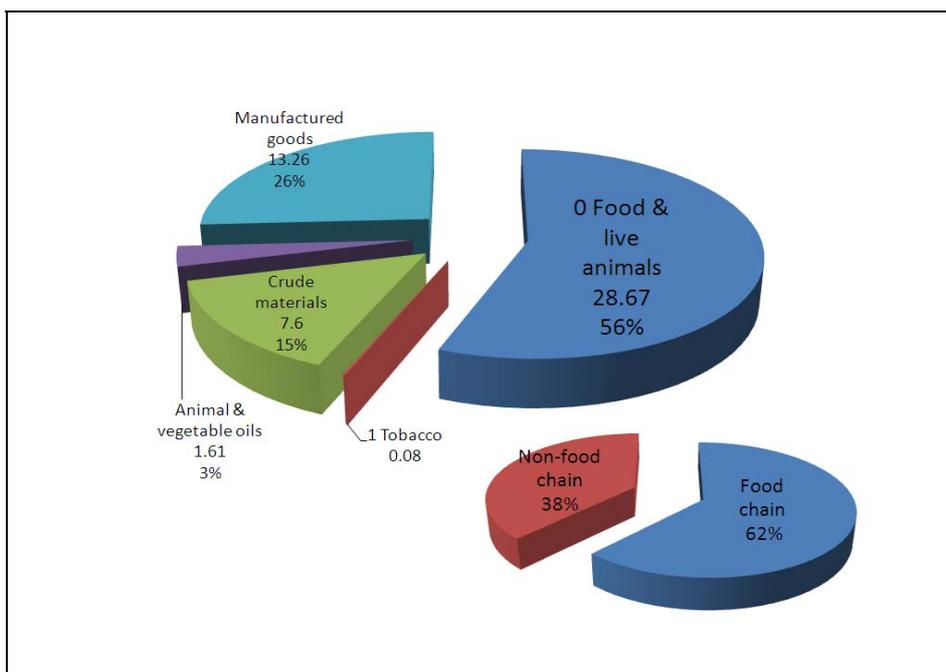
**Figure 11.** UK timber production, 2008. Hidden flows included. Numbers in million tonnes. Data from Office for National Statistics (2010a).

## 4 UK biomass imports

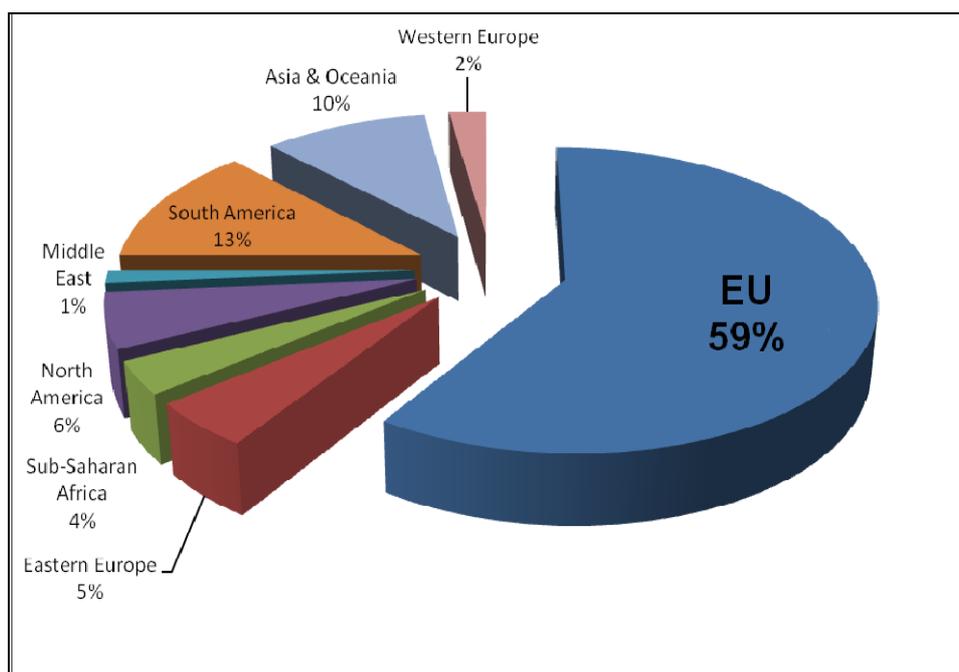
- 4.1 The Office for National Statistics Environmental Accounts provides an overview of biomass imports entering the UK (Figure 4: Office for National Statistics, 2010). A detailed analysis of import flows is possible using HM Revenue and Customs data (HM Revenue and Customs, 2010a, 2010b). This data includes information on commodity type, value, volume and country of origin. Biomass flows into the UK are summarised here but Part II of this report series presents a more detailed analysis of these imports.
- 4.2 The UK currently imports approximately 50 million tonnes of biomass per year (Figure 4). These imports cover the full range of biomass based commodities from unprocessed raw materials through to highly processed items. Over 60% of imported biomass is food chain material for direct human consumption or animal feed (Figure 12). Customs data (based on Standard International Trade Classification codes) permit recognition of the key biomass commodity groups imported by the UK - see Box 1 for a summary.
- 4.3 Customs and revenue data allows a national biomass import profile to be determined (Figure 13), describing the major biomass import groups and their significance in terms of volumes. This import profile provides an insight into the key dependencies of the UK economy on overseas biomass production the main aspects of which are:
- *food chain imports* – the UK is only 60% self sufficient in food with the major import groups being fruit and vegetables and animal feedstocks to support the national herd of cattle, pigs and poultry. Cereal imports are significant but the UK is also an exporter and has a net surplus of cereals;
  - *forest products* – the UK has a limited capacity to produce wood and other timber products and imports significant quantities of wood in unprocessed and processed forms, cork, rubber and (most significantly) paper products;
  - *bioenergy commodities*– biomass imports for bioenergy production (electricity or heat) and liquid biofuel imports<sup>3</sup> are currently very small but are likely to grow rapidly in the future due to new policies on the use of renewable energy.
- 4.4 Customs and Revenue import data (reference? HMRC 2010 a) & b) identify regions and countries supplying the UK. The UK's trade relationships are dominated by its links to the EU and in 2008 60% of UK biomass imports came from the UK's neighbours in the European Union (Figure 13). A significant proportion - approximately 27% of the UK's imported biomass - also comes from tropical and sub-tropical countries in South America (13%), Asia/Oceania (10%) and Sub-Saharan Africa (4%).

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<sup>3</sup> The main bioenergy imports are currently bioethanol and biodiesel which are monitored by the Renewable Fuels Agency.



**Figure 12.** UK biomass imports, 2008. Values in million tonnes. Source: Data from HM Revenue and Customs (2010b).



**Figure 13.** Overseas sources of UK biomass in 2008S. Data UK HM Revenue and Customs (2010b).

## 5 The overseas ecosystem impacts of UK biomass consumption

### 5.1 Ecosystem pressures

- 5.1.1 Pressures on global ecosystems are dominated by indirect anthropogenic causes, the most significant of which are demographic and economic changes. Population growth and urbanisation are significant factors along with changing consumption patterns associated with increasing *per capita* income. These indirect drivers have resulted in an absolute increase in global consumption of ecosystem services and goods, and also an increase in *per capita* consumption. The indirect drivers are linked to a set of direct drivers of ecosystem degradation (and biodiversity loss) which include habitat loss, climate change, invasive alien species, overexploitation and pollution.
- 5.1.2 The UK, as a significant importer of biomass, contributes to these global pressures through the following socio-economic drivers;
- *increasing population* – over the past 30 years, increased UK biomass consumption has been closely related to population growth (Figure 15);
  - *economic growth* – although UK material consumption appears detached from economic growth (as measured by GDP) the economy has grown through use of overseas resources which provide biomass for food and, increasingly, for energy (Office for National Statistics, 2010);
  - *changing patterns of biomass consumption* – over 60% of the biomass imported into the UK enters the food chain, either directly or through contributions to the animal food chain (Figures 12 & 14). However, the pattern of biomass consumption within the UK economy is also changing as a result of new policies on recycling and the use of renewable energy sources<sup>4</sup>.

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<sup>4</sup> Part III of this report takes a forward look at biomass use in the UK.

### Box 1: Imported biomass – data available, data codes and import profiling

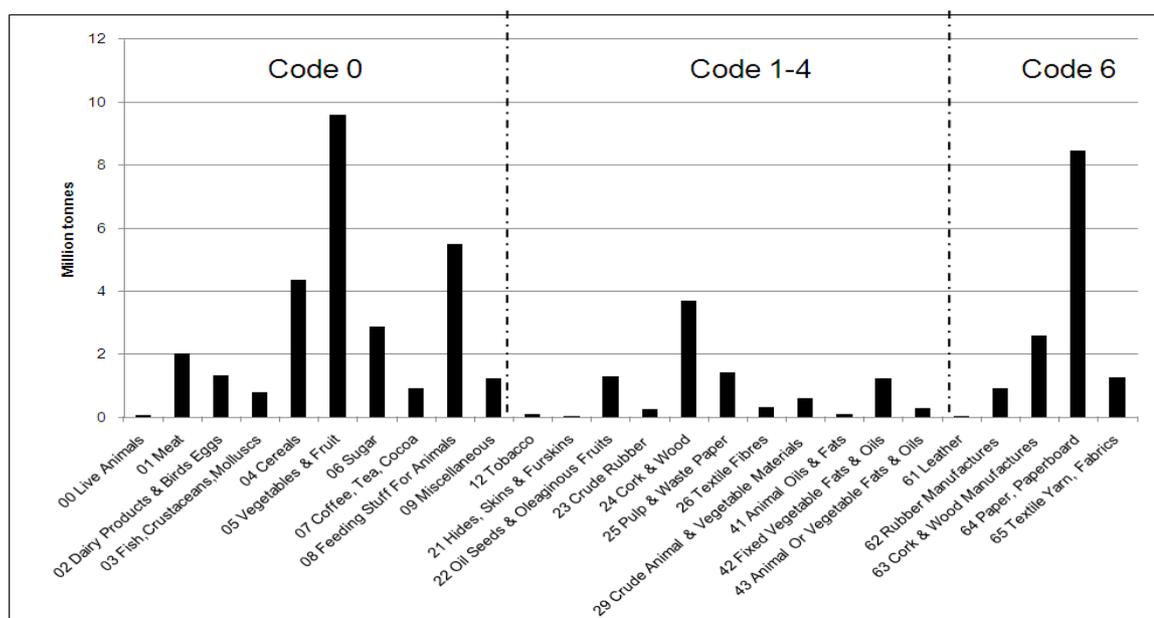
UK reporting on import flows follows international guidelines and employs a hierarchical coding system that allows biomass imports to be classified and recorded on the basis of a single through to eight digit coding system. Single digit codes provide a high level summary; eight digit coding provides very specific commodity data. For example code 15111010 represents the precisely defined '*Crude palm oil for technical or industrial uses (excluding for manufacture of foodstuffs)*'.

The UK Revenue and Customs database records commodity code, commodity type, volume (kilogrammes), value (Pounds Sterling) and country of dispatch for each import category. Detailed coding provides the ability to analyse import data for specific commodities of interest.

Five trade data groups defined by single digit codes and 26 associated (two digit) commodities can be used to provide a strategic overview of biomass imports. Two digit coding classifies biomass imports into the following groups:

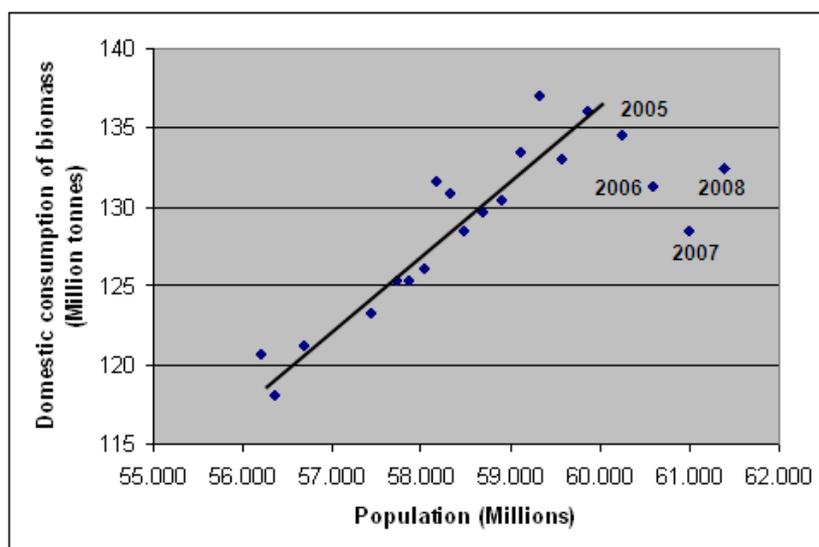
- **Food and live animals** (Code 0) – over 50% of UK biomass imports fall into this category which includes meat, cereal, animal feedstuffs and vegetable commodities;
- **Beverages and tobacco** (Code 1) – a minor commodity group within which only tobacco is classed as biomass for this analysis;
- **Crude materials** (Code 2) – includes the oilseeds, wood pulp and cork/wood commodities;
- **Animal and vegetable oils and fats** (Code 4) – includes palm oil, soya and rapeseed oils;
- **Manufactured goods** (Code 6) – a miscellaneous group of processed biomass commodities, paper products being most significant.

These groupings provide the basis for high level analysis of import flows including the graphical profiling of the UK's biomass imports in terms of volume and category (Figure 14).



**Figure 14.** Commodity profile of UK biomass imports, 2008. Data from UK HM Revenue and Customs (2010b).

- 5.1.3 The UK's use of imported biomass provides a key economic link to overseas ecosystems. Increased biomass production from those global ecosystems (biomes) that supply world markets with agricultural commodities and biofuels is usually achieved at the expense of other ecosystem functions which are impaired due to the effects of habitat loss, pollution, the impacts of invasive alien species or increased water demand. Increasing biomass extraction from forests (as hardwoods) or fisheries has a range of negative impacts on ecosystem functioning. In marine ecosystems, significant biomass extraction changes the ecological structure.
- 5.1.4 The original extent of many of the global terrestrial biomes is uncertain because of deforestation, agricultural expansion and urbanization. The original boundaries can be estimated by reference to soil and climate conditions suggesting that major changes have occurred in all of the major biomes with 20%-50% of nine out of the 14 key biomes converted to croplands (Millennium Ecosystem Assessment, 2005). This pressure for conversion is increasing as global demand for food and other biomass rises, emphasising the role of provisioning services at the expense of the other ecosystem services and biodiversity. The Millennium Ecosystem Assessment (2005) predicts habitat loss due to land use change will cause continued decline in local and global taxa. This decline is a cross border issue driven by both local and global pressures and the UK's use of global ecosystem services will add to these pressures.



**Figure 15.** Relationship between national biomass consumption and UK population size. Data from Office for National Statistics (2010a and b).

## 5.2 Quantifying pressures arising from biomass imports

- 5.2.1 Through its use of imported biomass the UK contributes to those global pressures likely to cause the widespread terrestrial habitat losses predicted by the Millennium Ecosystem Assessment (2005). A prime driver for such loss is through expansion of land areas used for food and bioenergy production. Material Flow Analysis techniques permit the scale and location of such land use pressures to be defined, and also permit identification of the likely resulting impacts.
- 5.2.2 A key objective of JNCC's review of the UK's use of imported biomass is to develop a methodology for measuring the potential impacts (pressures) of imported biomass flows on overseas ecosystems, where they occur and by what mechanisms. Material

Flow Analysis can be used to quantify biomass flows into the UK from specific regions and also to estimate the land required within these regions to supply the UK with these materials. This allows analysis of pressures exerted by the UK on specific overseas ecosystems and provides the basis for a set of indicators for measuring changes in these pressures in time and space. This report focuses on land use pressures but Material Flow Analysis also allows water use pressures to be analysed in a similar way (WWF 2008).

5.2.3 The land requirements estimates presented in this report are based on profiling of the UK's biomass imports in terms of volume, category and country of origin (Figure 14) and use of regional (or country) specific biomass yield data available from the UN Food and Agricultural Organisation (FAOSTAT, 2011). Land requirement estimates for agricultural commodities are relatively robust but estimates for other materials, particularly processed materials such as wood pulp, are more speculative. The calculation methodology is explained in more detail in Part II of this report series.

5.2.4 The nature of the data available on material flow of biomass imports into the UK (Box 1) allows the following 'primary' analyses:

- quantification (in tonnes) of material flows – this can be applied to total biomass imports or selected streams;
- characterisation of flows in terms of specific commodities;
- identification of source country and region;
- time series analysis or a single year snapshot.

5.2.5 Import trade data can be complemented by other regionally or nationally specific data to derive two numerical indicators using:

- crop yields to estimate land required to grow cultivated biomass (agricultural or forest products);
- crop specific requirements to estimate water demand.

5.2.6 Finally, knowledge of source country and agricultural zonations permits some of the biomass flows to be attributed to specific biomes with material flow, land use requirement and water demand being assigned accordingly.

5.2.7 Material flow data combined with other information therefore allows a variety of potential indicators to be identified and utilised to quantify, qualify and locate the pressures arising from UK use of imported biomass. These may be used to establish a global perspective or focus on links between the UK and specific global regions. The main biomes supplying the UK with biomass can be identified and the pressures exerted can be quantified.

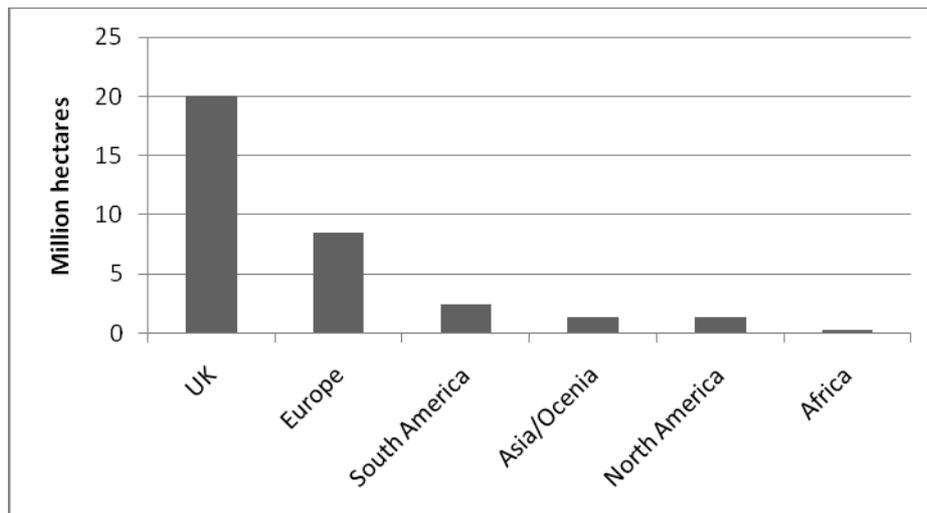
### **5.3 Measuring the impacts of imported biomass on overseas ecosystems - Realm and Biome overview**

5.3.1 Analysis of the UK's biomass imports – including bioethanol and biodiesel fuels – identifies approximately 52 million tonnes of imported materials for 2008 which, since this material originates from agricultural or forest systems – have a land use requirement for their production. Analysis of these biomass import flows into the UK (based on commodity, source country and biomass yields) suggests an overseas land requirement of approximately 14 million hectares to produce the 52 million tonnes of imported biomass in 2008, including food, forest products and biofuels.

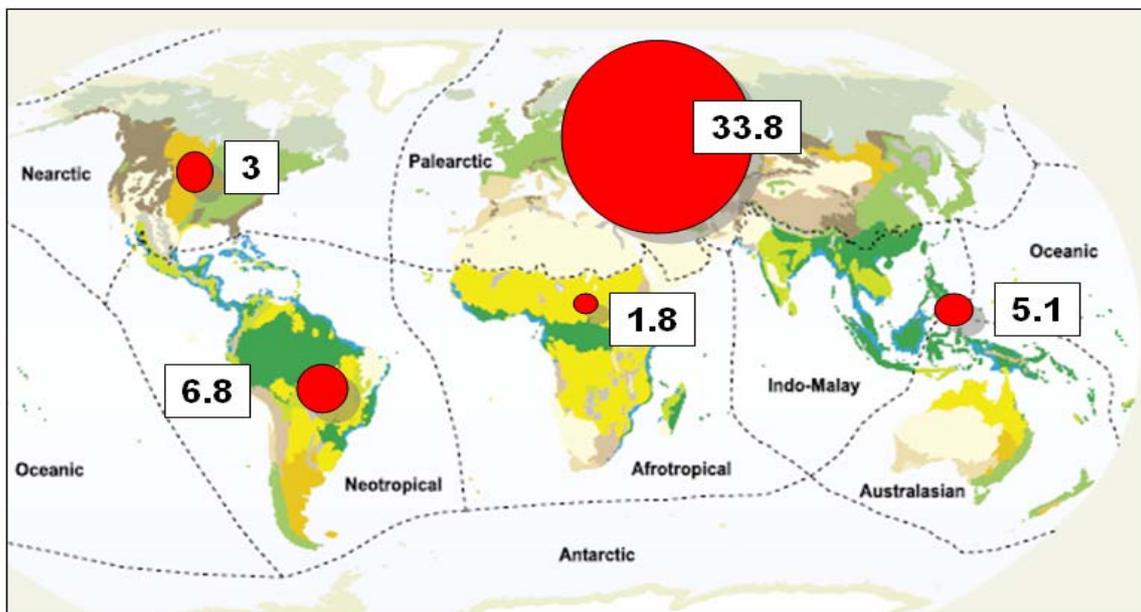
- 5.3.2 Approximately 90% of the overseas land use requirement arises from provision of agricultural products for food and from forest products. The remaining 10% is from bioenergy crops (JNCC, 2009). The total land requirement (domestic and foreign) required to supply the UK economy with biomass in 2008 is estimated at 34 million hectares (Figure 16) with Europe being the primary area providing 'additional' agricultural land to support the UK economy.
- 5.3.3 Over 98% of the UK biomass imports can be assigned to five Biogeographical Realms (Figures 17 & 18) as source. The majority of the footprint (8.5 million hectares) falls in the Palearctic. The Neotropical region of South America provides 2.4 million hectares of land to support UK biomass consumption, approximately equal to the total contribution from the Nearctic and Oceania realms put together.
- 5.3.4 Analysed at the global biome level, approximately 10 million hectares<sup>5</sup> of land use footprint can be assigned to five individual biomes (Figure 19). Boreal forest and temperate forest biomes are key providers, the former for timber products, the latter for food chain biomass. European sources are dominant. Outside these areas, the land use footprint is almost identical in temperate grasslands and tropical moist forests. Temperate grassland impacts are due to both food chain and biofuels provision but with soya-based products being the key impacting commodity in both cases and significant land use arising from biodiesel imports from North and South America.
- 5.3.5 Although much of the overseas land use footprint falls within the European Union the land requirement for biomass sourced from tropical countries is estimated to be four million hectares, equivalent to 20% of the land area used in the UK itself. A significant proportion of this currently falls within South America where an estimated 2.4 million hectares of land (primarily in Argentina and Brazil) are required to supply the UK with a range of commodities, including animal feeds, fruit and vegetables, sugar and oilseed. Soya products alone – oil, biodiesel and animal feeds – dominate these imports and account for much of this land requirement.
- 5.3.6 This form of analysis demonstrates not only the biomass trade relationships between the UK and the rest of the world, but also the specific dependencies between sectors of the UK economy and overseas suppliers. The UK agricultural and biofuels sectors have a strong link, not to say a strong dependence, on the agricultural systems within two South American states. This area and other tropical and sub-tropical zone countries are expected to be major suppliers of new biomass flows into the UK in the future.

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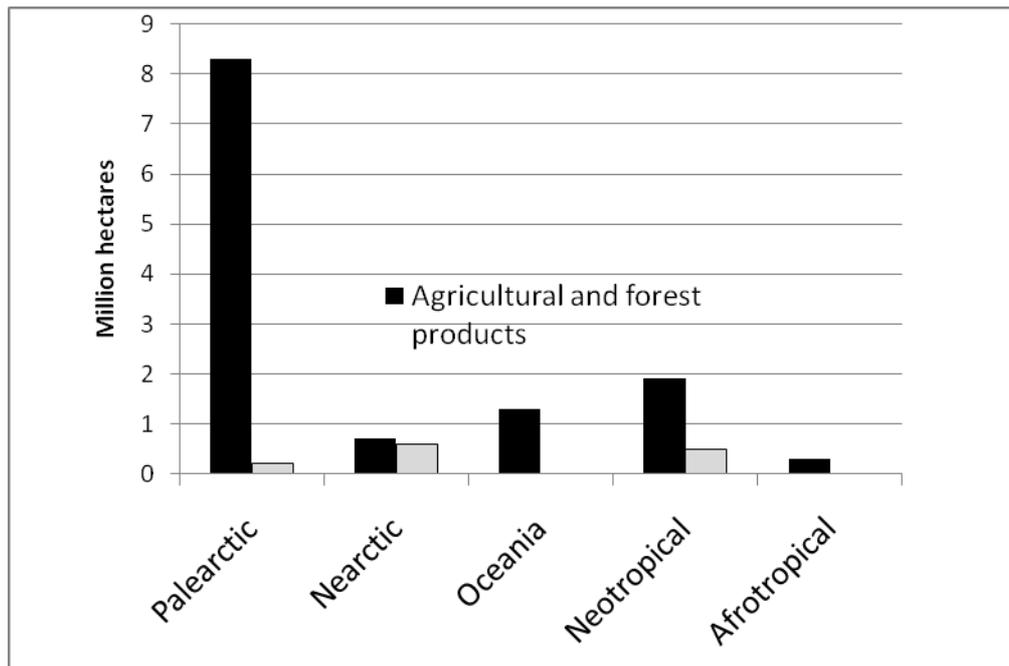
<sup>5</sup> The processed nature of some of the biomass imported into the UK prevents ready analysis of source biome.



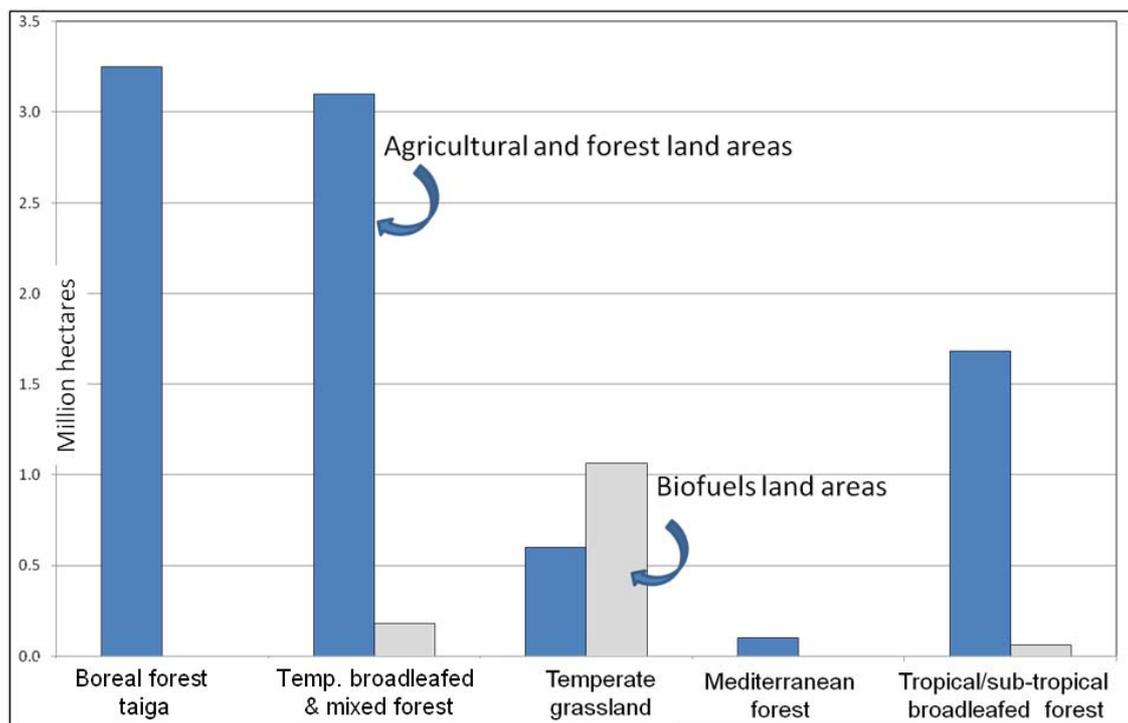
**Figure 16.** Estimated land requirements to supply UK economy with biomass in 2008 (includes domestic supply).



**Figure 17.** Source of UK imported biomass by Biogeographical Realm, 2008. Numbers in millions of tonnes. Data from H M Revenue and Customs (2010a). Map from Millennium Ecosystem Assessment (2005).



**Figure 18.** Estimated land requirement within Biogeographical Realms to supply UK biomass imports in 2008.



**Figure 19.** Estimated land requirement within global biomes to supply UK biomass imports in 2008.

## 6 Conclusions

- 6.1 The UK economy is dependent on imported biomass. Over a third of the total biomass utilised by the economy is imported, including 40% of our food and 75% of our biofuels. The national demand for biomass will continue to increase with population growth and the increased use of this material for energy production both in the transport and power sectors.
- 6.2 Almost 90% of the UK landscape is given over to productive agricultural and forest land and there is little scope for future expansion. UK agricultural yields are high by global standards and these can only be increased by the use of new technologies. There is some potential to increase domestic biomass production, and waste from agricultural and forest systems will be increasingly utilised for bioenergy production, but the national biomass deficit will certainly continue and probably increase over the coming decade.
- 6.3 This report highlights the national demand for imported biomass, which is currently approximately 50 million tonnes per year, and describes the nature and source of these materials. The use of official UK data, from the Office for National Statistics and HM Revenue and Customs, combined with information on crop yields allows the overseas land areas required to produce these materials to be estimated at 14 million hectares in total. Identifying where this land is, in terms of country and ecological unit, provides a measure of the pressure the UK is exerting overseas, which biomes are affected and in which countries.
- 6.4 The UK's major trade partners for biomass are in the EU and wider Europe and approximately eight million hectares of European land supports the UK economy through the supply of food and forest products. The UK, through its membership of the EU, is already engaged in managing the impacts of food and bioenergy production on the landscapes and ecosystems of Europe. This is not the case with the impacts that may arise elsewhere in the world, particularly in South America, Asia and Africa where major land use may be expected to occur in future. This report estimates that currently 2.4 million hectares of land in South America are required to produce biomass for the UK with pressure exerted on temperate grasslands in Argentina and the tropical/sub-tropical forests of Brazil. The key commodities coming out of these areas are soya-based food and animal fodder, and biodiesel upon which the UK food, farming and bioenergy sectors are dependent.
- 6.5 The UK, as a significant importer of biomass will continue to contribute to global pressures on overseas biomes through population and economic growth, and changing patterns of biomass consumption. Material flow analysis (as presented in this report and developed further in the subsequent sections) offers an opportunity to identify where these pressures are being exerted and monitor them through time and in space. This form of analysis also provides the evidence for the formulation of policies to avoid or mitigate potential impacts of UK biomass consumption on the overseas ecosystems which provide the UK with essential biomass.

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