

Climate change and land

Opportunities and challenges for the UK

Introduction

The Intergovernmental Panel on Climate Change (IPCC) special report on *Climate Change and Land* concludes that land is a critical resource and that sustainable land management has a vital role to play in tackling climate change and adapting to its impacts. Multiple, integrated changes to the way land is used would avoid significant future greenhouse gas emissions, contribute to enhanced food security and provide other land-related benefits. However, sustainable land management is not a substitute for immediate and aggressive emission reduction across all other sectors if the goals of the Paris Agreement are to be met. This briefing provides an overview of the key IPCC findings, considers what these mean for the UK and highlights significant opportunities to improve land use and land management, in the UK and internationally.

FIGURE 1

Land cover of global ice-free land compared to land cover in the UK*



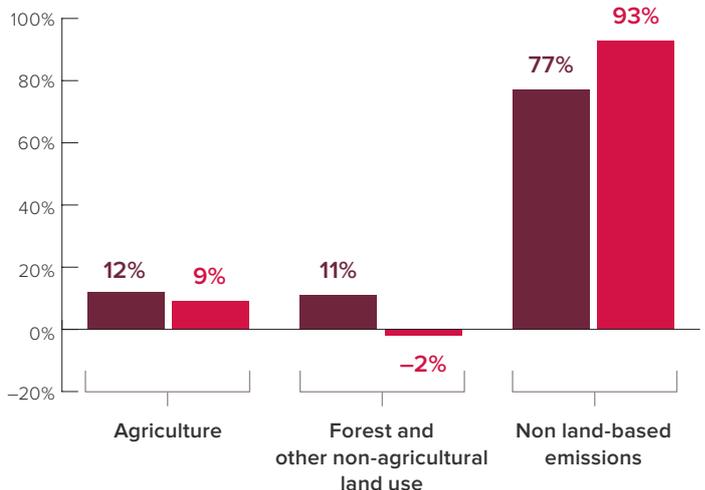
*Not shown is 12% global land cover that is barren or rock and 1% UK land that is freshwater.

KEY

- Infrastructure
- Cropland
- Managed forest
- Managed grassland, shrub, pasture or savannah
- Minimal use or other natural areas

FIGURE 2

Sources of greenhouse gas emissions comparing global and UK estimates for the time period around 2016



KEY

- % of total global emissions
- % of total UK emissions

Source: Global numbers are from the IPCC special report on *climate change and land*; UK numbers are from the Committee on Climate Change report *Land use: Reducing emissions and preparing for climate change*

The global perspective

Agriculture, forestry and other uses of land accounted for 23% of greenhouse gas emissions from human activity between 2007 and 2016. The role of land use and land management in climate processes and the importance of adapting land use practices to climate change impacts are often overlooked.

How land and climate change are interconnected

Land underpins the diversity of life on Earth and directly supports human survival and wellbeing. Globally, we use more than 70% of the ice-free land surface to provide us with essential resources including food, water, timber and energy.

Land stores carbon and exchanges it with the atmosphere, so that it can act either to emit carbon to the atmosphere or to remove it. Decisions about land use are therefore an essential element of any strategy to mitigate and adapt to climate change.

Appropriate and integrated decisions and policies are needed at national and global levels, both to reduce emissions and address the impacts of climate change.

Where we are – facts and figures

What have the effects of climate change on land been so far?

Between 1850 – 1900 and 2006 – 2015, the global mean surface air temperature over land has risen by around 1.5°C, and continues to rise. This is substantially more than the overall global (land and ocean) increase of around 0.9°C.

Climate change can, depending on the location, lead to more intense rainfall, greater flooding, more frequent and severe dry spells, increased wildfire, sea-level rise, and thawing of permafrost. So far, it has resulted in more frequent and more intense weather events, including heat-waves in Europe. Droughts have become more frequent and severe in regions including the Mediterranean, west and north-eastern Asia, many parts of South America and much of Africa. There has also been an increase in the intensity of heavy rain events leading to increased flood risk.

Arid zones have expanded and polar zones have contracted. Many plant and animal species have undergone changes in distribution and abundance, and in their seasonal behaviour patterns, for example emerging earlier from winter dormancy.

Climate change has already affected food production and the scale and magnitude of impact is projected to increase, largely due to lower water availability and higher extreme temperatures. Climate change is expected to reduce fruit and vegetable yields, especially in tropical and subtropical regions. The incidence of pests and diseases is likely to change and increase the risk to food production. While increased carbon dioxide may enhance crop productivity in some regions under lower levels of warming, risks arising from the greater

frequency of extreme events will rise. Increased atmospheric carbon dioxide can also reduce the nutritional quality of some crops.

Climate change generally causes greenhouse gas emissions from land-based ecosystems leading to further acceleration of climate change. Such effects include enhanced carbon dioxide and methane emissions when permafrost thaws and carbon dioxide emissions when peatlands degrade or forests burn.

How has the way humans use land contributed to climate change effects so far?

Land-related factors contributing to climate change include: carbon dioxide emissions from loss of tropical forest and from degradation of ecosystems and soil; nitrous oxide emissions from excess fertiliser applied in farming; methane emissions from ruminants, rice farming, biomass burning and landfills; and changes in the extent to which the land surface reflects sunlight.

25 – 30% of all food produced is estimated to be wasted and this accounted for 8 – 10% of global anthropogenic greenhouse gas emissions between 2010 and 2016.

Land degradation due to direct human activity affects at least a quarter of the Earth's ice-free land area. It is caused by activities such as some types of intensive farming and tree clearance that lead to soil erosion, which reduces agricultural productivity, increases carbon loss, and can be exacerbated by climate change.

The degradation of peatland ecosystems is particularly significant given their high carbon content. The major drivers of this degradation are drainage and burning for conversion to agriculture. Globally, peatlands cover 3 – 4% of the Earth's land area and store 26 – 44% of global soil organic carbon. Degradation of these carbon-dense ecosystems is responsible for about 5% of global carbon dioxide emissions.

Why is there now a need to change the way land is used?

The IPCC report shows that substantial changes in land use are vital to meeting the goals of the Paris Agreement.

In addition, land use practices need to evolve to improve resilience to unavoidable climate change impacts.

The following section presents opportunities for action in the UK.

The UK's role – risks, opportunities and priorities¹

The current land use context

Approximately 72% of the UK's land area is used for agriculture. Widespread losses of biodiversity, mostly attributable to past and ongoing agricultural practices, are likely to continue. Climate change poses new and serious land-related risks to people, infrastructure and wildlife. These risks include:

- Flooding and coastal change;
- Shortages of water affecting availability for people, agriculture, industry, and ecosystems;
- Further declines of species and habitats;
- New and emerging pests and diseases, including invasive non-native species; and
- Impacts on domestic and international food production and trade.

However, there are opportunities to improve land management which also reduce the risks from climate change. As well as supporting adaptation, action on land use and land management is critical to achieving the UK's 2050 net-zero emissions targets.

The Agriculture and Environment Bills coming before Parliament provide an important opportunity to take an integrated approach to land management, repurposing current means of supporting rural economies to incentivise farmers and other landowners to use methods that produce more public goods, including lower emissions.

Most land management related actions to mitigate and adapt to climate change have significant co-benefits, including improved air and water quality, enhanced biodiversity, improved recreational opportunities, and health benefits, to name but a few.

What the UK can do at national level

Solutions to sequester carbon and adapt to impacts of climate change

Peatlands, when well-managed, provide a long-term carbon store, while providing wildlife habitats, water filtration and flood risk reduction. The UK has over two million hectares of peatlands, covering 10% of its area, three quarters of which are in some stage of degradation.

Eliminating use of peat in garden and commercial composts would reduce the active degradation of peatlands, and a wider programme to preserve intact and restore degraded peatland would secure a significant carbon store. According to the Committee on Climate Change, restoring 55 – 70% of peatlands could reduce annual land emissions by about 10%.

Woodland protection, maintenance, restoration and expansion would provide substantial carbon storage. Tree planting in appropriate sites can provide co-benefits to health, and climate change adaptation, especially in urban areas. Restoring and expanding native woodlands, rather than creating monoculture plantations, is particularly important for biodiversity and climate adaptation. It can also connect habitats, which facilitates the dispersal and movement of plants and animals under a changing climate, as well as enhancing the land's leisure and amenity value.

Wetlands, including flood plains and salt marshes, can be preserved and restored to support carbon storage and water purification. They help reduce risks from flooding and/or coastal erosion and have significant biodiversity benefits, for example for migrating birds.

Bioenergy is a means of producing renewable energy from plant growth. Bioenergy with carbon capture and storage (BECCS) can in principle provide a low or even negative emission energy source. Both play a significant role in strategies to achieve the emissions reductions required for compliance with the Paris Agreement. However, there are difficult practical and technical challenges and trade-offs with other land uses, so extreme care is needed in implementation and for devising policy and practice.

Potential trade-offs of bioenergy

A key issue in producing bioenergy is to ensure that production does not disrupt food supply, damage biodiversity, degrade land or affect water availability. Replacement of natural vegetation by monoculture crops results in the loss of biodiversity, and use of arable land threatens food and water security. The lifecycle emissions associated with growth, preparation and transport of biomass must be considered. Strong governance around bioenergy deployment is therefore extremely important.

1. This section draws extensively on findings from the Committee on Climate Change and other references which can be found on the Royal Society website royalsociety.org/climate-change-ipcc-briefings

Solutions to reduce emissions from food production and consumption and enhance food security in a changing climate

Sustainable diets with smaller land and climate footprints, including lower consumption of meat, dairy, and other animal products, would reduce emissions significantly and free up marginal lands for ecosystem restoration and expansion as well as for economic activities such as forestry.

Sustainable and low-carbon crop farming practices include increasing organic matter and limiting erosion in soil, using nitrogen and phosphorus fertiliser more efficiently, applying nitrogen fertiliser that has been produced in a low carbon way, and using perennial crops where possible as well as varieties with better heat and drought tolerance.

Solutions for more sustainable livestock farming include better storage and application of manure, and adjustment of cattle and sheep diet to reduce methane emissions.

Food loss and waste can be reduced through improved harvesting techniques, on-farm storage, infrastructure and transport, loss prevention in the retail and catering sector, and promotion of changes in consumer behaviour.

Recycling systems for bio-degradable waste enable food waste to be composted or used for bioenergy instead of going to landfill where it generates methane emissions.

What the UK can do at global level

The UK's domestic land-based carbon footprint is relatively small at global scale but there are opportunities to contribute to the global effort by developing new solutions for both mitigation and adaptation, sharing experience and expertise, and providing support and assistance to other countries.

Advancing low carbon and low polluting farming methods and restoring ecosystems with high carbon storage including peatlands, native forests and coastal habitats are all important activities.

Aid programmes can support land-based environmental solutions, which provide multiple benefits including climate mitigation and adaptation, and conservation and restoration of biodiversity, livelihoods and economic development.

The UK can also work to reduce land-related emissions from products created abroad but consumed domestically, particularly food and textiles, for example by supporting certification schemes and capacity building at the point of production, and developing consumer-awareness programs. As bioenergy and BECCS markets develop, the UK can lead on global sustainability standards for land products such as biomass pellets, considering the need for net-negative lifecycle emissions in BECCS, to meet its own net zero targets whilst also supporting global action.

PRIORITY ACTIONS

Priority actions to reduce land-related greenhouse gas emissions and prepare for climate change impacts include:

- **Keeping carbon locked in soils and vegetation** and sequestering additional carbon through land-based actions such as peatland and woodland restoration;
- **Reducing emissions from agriculture**, including methane and nitrous oxide, by encouraging and supporting investments in sustainable land management practices and technologies, and supporting land managers with training and information;
- **Reducing food waste** along the whole supply chain and encouraging consumers to adopt diets with less meat that is also produced using environmentally sustainable methods, and an increase in plant-based food;
- **Implementing land-based measures** such as enhanced tree cover and habitat connectivity to aid adaptation to the impacts of climate change such as flood risk and water stress; and
- **Reducing land use related emissions** from products we import and supporting low income countries to reduce land use-related emissions and to adapt to climate change impacts.

WORKING GROUP MEMBERS

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