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1. The impact of climate change on grass-based agricultural systems

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Take home messages:

- Climate change offers enormous challenges to UK livestock production systems.
- Increasing the application of on-farm adaptation and mitigation strategies to manage the impact of climate change is of critical importance.
- Inaction now is very likely to result in high costs later.

Climate change is expected to impact global food production systems and to potentially exacerbate food insecurity in many regions. The current scale of risk from unmanaged climate change to UK and European food security is immense. The Intergovernmental Panel on Climate Change (IPCC) [state that](#) 'if the capacity of Europe's food production systems to sustain climate shock events is exceeded, then the region will require exceptional food importation'. This is potentially of grave concern as the future costs of food importation, at a time when demand is likely to be high and supply potentially low, could be vast.

Warming of the climate system is now [unequivocal](#), with almost the entire globe experiencing some surface warming. In the last century (1880 to 2012), the Earth's average temperature has warmed by 0.85 °C, a figure which has risen significantly since 1951 at a rate of 0.12 °C per decade. Warming in the last 30 years has been



substantial, with the period between 1983 and 2012 recognised by the IPCC as ‘very likely’ to have been the warmest in the northern hemisphere in the last 800 years and ‘likely’ to have been the warmest in the last 1400 years.

Climate change and agriculture

Climate change is driven by the emission of greenhouse gases (GHGs), such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), as a consequence of man’s activities. Agriculture is a significant contributor to GHG emissions, with livestock production alone estimated to account for approximately [14.5% \(11.6% for ruminants specifically\)](#) of global emissions. In the UK, agricultural activities generated [49.1 million tonnes of CO₂](#) equivalent in 2014, which is roughly 9% of total GHG emissions. In Wales, this proportion is higher with agricultural activities [contributing around 13%](#) of total GHG emissions. Of these figures, approximately half is attributed to livestock production, primarily from enteric methane emissions or as a result of manure management practices.

Livestock farming systems, particularly ruminant systems, constitute a substantial proportion of global agricultural production, accounting for around a third of useable terrestrial land, with approximately 3.5 billion hectares under grazing. This is a similar statistic across Europe, where 34% of land is permanent grassland or meadow, however, this figure is much [larger for Wales](#), where grassland constitutes 75% of land use. Enhancing the resilience of these systems to manage significant environmental change is therefore essential to meet future demands of food production, as [European agricultural systems](#) are of global importance to future food security.

By 2050, consumption rates of meat and livestock products are predicted to double. [Of these increases](#), 31% will be ruminant meat consumption and 58% will be consumption of dairy and egg produce, due primarily to rising demand from developing countries such as China and India. This rise in consumption rates is predicted to equate to an increase in GHG emissions of 32% per capita. Livestock farming systems must therefore be built to cope with this increased demand for food production, whilst also able to reduce the environmental impact of current agricultural practice and the emission of GHGs, to reduce the further potential for future climate change.

The cost of climate change

The costs for production within Europe are predicted to increase significantly as a direct result of climate change. For ruminant agriculture, it is expected to drive sizeable increases in the cost of ruminant meat products, which for beef as an example, is estimated to equate [to a 60% rise](#) by 2050.



Total costs of climate change have been estimated to reach 4% of GDP by the end of the century. [The cost of flood events alone](#), which are expected to be one of the major impacts of climate change across Europe, currently cost the EU €5.5 billion per year, but this figure is projected to reach €98 billion per year by 2080. Predicting the costs associated with adaptation to climate change is particularly difficult due to gaps in existing evidence. Nonetheless, adaptation methods are essential and have been demonstrated, for certain impacts at least, to reduce future costs by over half.

The costs of mitigation are also expected to be substantial and are likely to increase with every year of inaction. [One recent study](#) demonstrated that if global mitigation strategies were implemented now, the cost of keeping global climate change under 1.5 °C would be US\$40 per tonne of CO₂ emitted. If action takes between 10 - 20 years to initiate, then the same cost would only prevent a temperature increase beyond 3 °C; which is a significantly greater increase than the 2 °C target of the Paris climate change agreement.

Conversely, the potential benefits associated with mitigation strategies are also substantial. For example, the value of benefits associated with reducing emissions of methane, which is a key mitigation strategy, are estimated to be [in the region of \\$700 to \\$5000 per metric ton](#). The mitigation potential of the livestock sector is also significant and represents approximately [50% of the mitigation potential](#) of agriculture, forestry and land-use combined, making the implementation of technical mitigation strategies within this sector a realistic

opportunity to reduce the influence of climate change. Currently however, due to low adoption rates, this opportunity has yet to be realised.

Summary

The impact of climate change on UK and European agricultural systems will be multifaceted and offers major challenges for livestock production systems. In addition to this, future demand for food production is predicted to [increase by around 60% by 2050](#), as a consequence of global population increase.

Agricultural activities in the UK are currently responsible for producing significant amounts of greenhouse gases. However, by altering management approaches it may be possible to reduce the contribution of livestock production to climate change and, potentially, to reduce the impact of climate change in general.

Therefore, increasing the application of effective agricultural practices, which are designed to be robust to the coming climatic changes, which reduce environmental impact and greenhouse gas (GHG) emissions, and which sustainably increase productivity to meet projected rising global demand for meat and dairy products is of critical importance.

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