Annex 2: Government policies and technological changes affecting primary production

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Policy context

A key policy of the UK government is its Food Strategy (Defra, 2022) designed to deliver the following objectives:

- 'a prosperous agri-food and seafood sector that ensures a secure food supply in an unpredictable world and contributes to the levelling up agenda through good quality jobs around the country

- a sustainable, nature positive, affordable food system that provides choice and access to high quality products that support healthier and home-grown diets for all
- trade that provides export opportunities and consumer choice through imports, without compromising our regulatory standards for food, whether produced domestically or imported.'

It is proposed to achieve these objectives through multiple activities, among which is the reduction of GHG emissions in line with net zero commitments, namely:

1. 'Broadly maintain the current level of food produced domestically, including sustainably boosting production in sectors where there are post-Brexit opportunities including horticulture and seafood.
2. Ensure that by 2030, pay, employment and productivity, as well as completion of high-quality skills training will have risen in the agri-food industry in every area of the UK, to support our production and levelling up objectives.
3. Halve childhood obesity by 2030, reducing the healthy life expectancy (HLE) gap between local areas where it is highest and lowest by 2030, adding 5 years to HLE by 2035 and reducing the proportion of the population living with diet-related illnesses; and to support this, increasing the proportion of healthier food sold.
4. Reduce GHG emissions and the environmental impacts of the food system in line with our net zero commitments and biodiversity targets and preparing for the risks from a changing climate.
5. Contribute to our export strategy goal to reach £1 trillion of exports annually by 2030 and supporting more UK food and drink businesses, particularly small and medium sized enterprises (SMEs), to take advantage of new market access and free trade agreements (FTAs) post-Brexit.
6. Maintain high standards for food consumed in the UK, wherever it is produced.'

These objectives and associated activities demonstrate the multi-dimensional nature of the UK food system and its policy environment and the close alignment of climate change, GHG emission and net zero considerations.

The UK Committee for Climate Change examined the changes required to UK land use to achieve net zero (UKCCC, 2020). Their report starts from a premiss that '*the current approach to land use is unsustainable if the UK is to maintain a strong agriculture sector that also delivers climate mitigation, adaptation and wider*

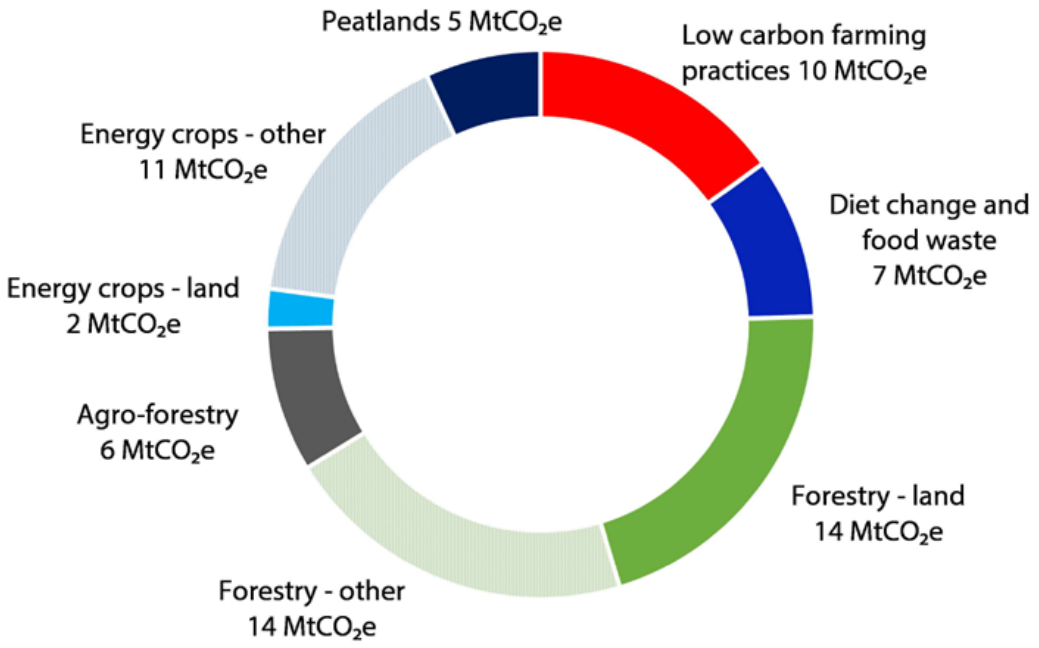
environmental objectives'. The current rate of decline of GHG emissions across the food system is insufficient to meet net zero by 2050, so the report makes the case for climate mitigation to be at the heart of a new land use strategy.

The report proposes that about 9% of agricultural land will be required for actions to reduce GHG emissions and sequester carbon by 2035 and 21% by 2050; this would reduce emissions by 67% from the LULUC (and forestry) sector by 2050. The corollary is that the UK's domestically produced food will have to come from about 25% less land by 2050.

A wide range of actions is proposed to deliver reduced emissions (Annex 2, figure 1) with about half of the reduction coming from afforestation with agroforestry and energy crops contributing a further third. The key actions envisaged are:

1. Low carbon farming practices to reduce GHG emissions from soil, livestock and manure – includes controlled release fertilisers, improved livestock health, slurry acidification.
2. Afforestation and agro-forestry – increase forest cover from 13% to 17% by 2050 at a rate of 30,000 ha per year.
3. Restoration of peatlands – restore at least 50% of upland peat and 25% of lowland peat.
4. Bioenergy crops – expand the growing of energy crops by 23,000 ha per year.
5. Reduce consumption of carbon-intensive foods – consumption of beef, lamb and dairy products reduced by at least 20% per person and food waste by 20%. This equates to a 10% reduction in sheep and cattle numbers by 2050 compared with 2017.

In essence the proposals fall into two groups: first, delivery of reductions in land-based emissions and increased carbon sequestration; and second, reduced demand through dietary change and reductions in food waste. Given the extensive nature of changes proposed, the report acknowledges 'there is inevitable uncertainty around the precise levels of ambition that can be achieved in practice'. However, a critical component of the UKCCC report is that the emission reductions delivered should not be at the expense of food imports that result in 'carbon leakage' to other countries. A mix of regulation, financial incentives and enabling policies is required to deliver the actions envisaged.



Source: CCC analysis.
Notes: Based on the CCC 'Further Ambition' scenario in *Net Zero - The UK's contribution to stopping global warming*. These are savings compared with business as usual GHG emissions in 2050.
'Energy crops - other' and 'Forestry - other' refer to GHG savings from the use of harvested products in other sectors of the economy (e.g. with CCS).
Savings from diet change and waste reduction are from direct agricultural emissions reduction only.

Annex 2 Figure 1: GHG savings from measures proposed to reduce UK agriculture and land use emissions (UKCCC, 2020).

While there is strong consensus among organisations and institutions representing primary producers that an integrated approach to reducing GHG emissions is required that also embraces food production, biodiversity, water quality and other environmental factors, there is much less agreement on the actions to be taken (Ward, 2023).

Both the National Farmers Union (NFU, 2019) and the Food, Farming and Countryside Commission (FFCC, 2019) have developed alternative suggestions for how producers might contribute to net zero, with the NFU focussed on food production and modest carbon reductions and the FFCC on farmland biodiversity through agroecological interventions that promote both production and nature conservation, but very little about carbon. Together, these three reports highlight a set of emerging tensions that will require resolution including (Ward, 2023):

1. The relative balance of effort and potential between supply-side and demand-side measures to reduce emissions.
2. Contrasting visions of farming's role in food production and environmental management.
3. Different implicit models of behaviour change among farmers and landowners and of the relationship between the state and the individual.
4. The techniques and technologies for measuring and monitoring progress in emissions' reductions.

How these tensions are resolved in practice have several consequences for food safety considerations. For example, demand-side changes to diets (e.g. reduced ruminant meat and dairy and increased plant protein consumption) and reduced food waste have potential allergen and microbiological implications. Similarly, the juxtapositioning of wildlife and animal production to combine nature and production objectives risks harming farm animal health with knock-on consequences for meat composition and quality.

Technological innovation

Technological innovations are already underway in nearly all areas of primary production and throughout the food system. The FSA's Rapid Evidence Assessment of emerging technologies impacting the UK food system identified six important technology fields (FSA, 2021):

1. Food production and processing (indoor farming, 3D food printing, food side- and by-product use, novel non-thermal processing, novel pesticides).
2. Novel sources of protein (such as insects for human food and animal feed).
3. Synthetic biology (cultivated meat and proteins).
4. Genomic applications along the food chain (for food safety applications and personal 'nutrigenomics').
5. Novel packaging (active, smart, biodegradable, edible and reusable).
6. Digital technologies in the food sector (supporting analysis, decision making and traceability).

The Assessment examined some of the food safety risks (allergen, contamination/toxicity and fraud) associated with each of the technological innovations identified within each technology field. Annex 2 Table 1 details the level of various food safety risks associated with those technologies that affect primary production, although it is not clear from the report how the assessments of high, medium and low categories were derived. The report concluded that the widespread nature of change means that the FSA should 'adopt a complex

systems perspective to future food safety regulation’ (FSA, 2021).

Innovate UK provides funding to de-risk the translation of innovation from research to exploitation and is supporting work in three key areas of primary production:

1. Precision agriculture (including biosensors, drones, imagery, spectral cameras, calving interventions etc with smart phones often as the end point and agronomists and vets as the delivery points to farmers).
2. Alternative proteins (including non-traditional crops, insects (black soldier fly), microalgae and bacterial fermentation – aquaculture and monogastric animals are often the target markets for these products.
3. Controlled ‘farming’ (including vertical farming, growing cultivated meats, developing production systems as an optimised factory).

The development of alternative proteins is supported by private equity investment and is currently the fastest growing area globally because consumer demand makes it attractive from an investor perspective.

Annex 2 Table 1. Abbreviated table from the FSA Rapid Evidence Appraisal of Emerging Technologies that will impact the Food System

Emerging technology	**Food safety risk:** Allergens	**Food safety risk:** Con/Tox	**Food safety risk:** Fraud	**Enhanced food safety:** Allergens	**Enhanced food safety:** Con/Tox	**Enhanced food safety:** Fraud
Food production and processing						
Indoor farming	No	Medium	No	Medium	Medium	Low
Food side/by products	Medium	High	High	No	No	No
Novel pesticides	Low	Low	No	No	Medium	No

Novel proteins						
Alternative proteins	Medium	High	High	No	No	No
Novel feedstocks	Low	Medium	Medium	No	No	No
Synthetic biology						
GM/GE organisms	Medium	Medium	No	Medium	Medium	No
Lab-based products	Medium	High	High	No	Medium	Medium
Genomic applications						
Genomes for food safety	No	No	No	Low	High	High
Genomes for personalised medicine	No	No	No	High	High	No
Novel food packaging						
Active packs	Low	Low	No	Low	Medium	Medium
Nanotech/biodegradable	Medium	Medium	No	Low	Medium	No
Reusable	High	High	High	No	No	No

No = no anticipated impact