Grantham Research Institute on Climate Change and the Environment

Decarbonising food systems

A comparative analysis of UK and EU policies

Leo Mercer and Nina Valin

Policy report

September 2025

Grantham Foundation for the Protection of the Environment

The Grantham Research Institute on Climate Change and the Environment was established in 2008 at the London School of Economics and Political Science. The Institute brings together international expertise on economics, as well as finance, geography, the environment, international development and political economy to establish a world-leading centre for policy-relevant research, teaching and training in climate change and the environment. It is funded by the Grantham Foundation for the Protection of the Environment, which also funds the Grantham Institute – Climate Change and the Environment at Imperial College London. www.lse.ac.uk/granthaminstitute

About the authors

Leo Mercer is a policy fellow at the Grantham Research Institute on Climate Change and the Environment.

Nina Valin is a postdoctoral researcher at IFRO, University of Copenhagen.

Acknowledgements

During the preparation of this work the authors used ChatGPT to find and explore linkages between literature in addition to translation and term definition. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

The authors would like to thank Tom Lancaster (ECIU), Anke Brons (University of Wageningen), Wallis Greenslade and Cristóbal Budnevich Portales (Grantham Research Institute) for their detailed comments on pre-publication drafts of this report. Sarah King and Georgina Kyriacou edited the report.

This paper was first published in September 2025 by the Grantham Research Institute on Climate Change and the Environment.

Suggested citation: Mercer L, Valin N (2025) *Decarbonising food systems: a comparative analysis of UK and EU policies*. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science.

Contents

Summary

Food systems are at the heart of the global climate and ecological crisis, accounting for an estimated 34% of greenhouse gas emissions worldwide, with agriculture and land-use changes contributing over two-thirds of that share. Yet, despite the substantial and increasing emissions share, in addition to environmental burdens, food systems have remained peripheral to national and international decarbonisation strategies.

In comparing how the UK and selected EU member states (Denmark, France, Spain and Poland) are developing policy to decarbonise food systems, we find that while agricultural production policies are advancing in the UK, demand-side interventions remain limited and fragmented. Few jurisdictions — in the UK or EU — have developed integrated food systems policies that target emissions reductions, health, equity and climate resilience. Nonetheless, the EU examples show that more ambitious and joined-up approaches are possible and our insights into policy design, political feasibility and implementation strategies could inform UK food system reform.

High-level insights from EU case studies

- Policy coherence through food systems framing: The EU's Farm to Fork Strategy (now politically de-prioritised) and the Strategic Dialogue on the Future of Agriculture demonstrated how supply- and demand-side levers can be aligned under a shared food systems vision with considered co-design processes with relevant stakeholders.
- Denmark: Denmark is the first EU country to commit to a carbon tax on livestock, developed through extensive negotiation with farmers and civil society. This approach underscores the value of structured dialogue and political sequencing and a recognition that the emission profile of agriculture will only continue to rise as other sectors decarbonise.
- France: France's EGalim law has created a legal framework that attempts to rebalance commercial relationships between farmers and the supply chain while also mandating sustainable food procurement in schools and public institutions.
- Poland: With a fragmented smallholder farming structure, Poland has prioritised training, peer learning, and eco-scheme delivery through advisory services.
- Spain: Spain integrates adaptation into food and land-use policy, including legal frameworks on food waste and regional planning.

Implications for the UK

UK administrations have increasingly conditionalised subsidy payments to environmental improvements in post-Brexit agri-environment policy. The key sources of agricultural emissions, enteric fermentation, manure management and nitrification, remain poorly addressed. Scotland and Northern Ireland have developed innovative policies targeting production efficiencies through maximum slaughter ages and calving intervals. However, measures to target livestock emissions remain inconsistent across the UK administrations, and demand-side policies have not kept pace. There is little integration between climate, health and dietary policy — and limited political will to regulate consumption of high-carbon foods. While promising efforts are underway in procurement reform, education and protein innovation, these remain insufficiently supported or coordinated.

There is also a clear gap between production and consumption policies to support a food systems transformation. For example, while farm-level interventions are encouraged through subsidy reform, parallel measures to influence consumer demand (e.g. diet guidelines, procurement, labelling) are weak or voluntary. This disconnect risks undermining mitigation efforts and increasing reliance on food imports. Interviewees across the UK highlighted structural and political barriers — including legacy IT systems, lobbying pressure and administrative fragmentation — that

limit reform. Yet there are also signs of innovation, particularly in Northern Ireland's genetic efficiency schemes and Scotland's farm auditing model.

Recommendations for the UK

1. In the UK, the agencies responsible for agricultural, climate and environmental policy should continually facilitate dialogue between farming unions, environmental non-governmental organisations (NGOs), academia and other relevant stakeholders. The experience of Denmark shows agreement on contentious policies, like a carbon tax, can be reached when there is ongoing dialogue and trust between government, farming representatives and NGOs, despite seemingly divergent views.
2. The UK administrations need to articulate a policy roadmap for how they will sustainably decarbonise agricultural production in line with independent advice from the Climate Change Committee (CCC). Particular emphasis needs to be placed on addressing methane and nitrous oxide emissions from the livestock sector and must include incentives to integrate low-methane genetics into national herds, methane suppressants for intensive operations, and measures to improve efficiency by selecting for desirable heritable traits including live-weight-gain and resistance to parasites and infection.
3. There is a precedent in the cases examined to address consumption emissions through targeted regulations aimed at limiting consumption of carbon-intensive foodstuffs. The respective government departments responsible for health, farming, environment and economics/finance in the UK administrations should coordinate and pursue regulatory options to reduce consumption of high-carbon foodstuffs, particularly foodstuffs from ruminant livestock. Each department should identify levers within its remit (e.g. in England, health campaigns and reformulation initiatives at the Department of Health and Social Care [DHSC]; streamlined regulatory approval for new foodstuffs at the Department for Business and Trade) but determine their implementation through existing cross-government fora (e.g. the Carbon Budget Delivery Plan or the National Food Strategy) to align on outcomes.
4. Using agricultural subsidies as a fiscal instrument to redirect investments towards lower greenhouse gas emissions food production would enable a shift towards plant-based protein production over livestock. Because this recommendation addresses topics across health, environment, agriculture and treasury mandates, the repurposing of subsidies should be supported by joint action. This would involve the Department for Environment, Food & Rural Affairs (Defra) in restructuring subsidy frameworks within environmental land management schemes (ELMs), the DHSC ensuring health outcomes are accounted for as a set of criteria, HM Treasury reallocating funds, and each of the devolved administrations adapting their own subsidy schemes.
5. Farmers may be more receptive to policy measures that emphasise resilience and manage risks associated with climate change-driven extreme weather events. The UK administrations' agriculture and environment ministries should emphasise resilience and risk management in strategic communications and subsidy programmes given the overlap in actions between these two priorities. Lack of clarity was flagged by interviewees as a factor for the low uptake of post-Common Agricultural Policy (CAP) schemes, suggesting that clear step-by-step guidelines would increase the popularity of environmental incentives.
6. Data and evidence gaps (e.g. due to the fragmentation of public data) continue to limit understanding of farm-level emission profiles and the expected efficacy of mitigation measures. Agricultural and environmental agencies in the UK must continue to invest in high-quality programmes and farm auditing, targeting breakthroughs in methane suppressants, genetics and nitrification inhibitors.

1. Introduction and context

This report examines how the UK and selected EU member states are developing policy to decarbonise food systems. It focuses on the interplay between production- and consumption-side measures and draws out lessons for the UK through document analysis and interviews with policymakers and experts. Case studies from Denmark, France, Spain and Poland offer comparative insights on policy design, political feasibility and implementation strategies that could inform UK food system reform.

Why is action on food system emissions necessary?

Humanity is now operating far beyond the ecological limits that enable a stable and habitable Earth. In 2009, Rockström et al. outlined nine planetary boundaries that define a "safe operating space for humanity". By 2023, six of these had already been breached, largely due to unsustainable economic activity (Richardson et al., 2023). For most of these transgressions, agriculture has been identified as a significant driver, notably compromising biosphere integrity and biogeochemical flow, through land-use change and freshwater use and greenhouse gas emissions which contribute to the greenhouse effect and global climate change (Campbell et al., 2017).

The types of food we consume and the way we produce this food are thus a key driver of the climate and ecological crises. The 'food system' (see Box 1.1) contributes an estimated 34% of all greenhouse gas emissions, with agriculture and land use accounting for 71% of this total (Crippa et al., 2021). Agriculture is also one of the leading causes of biodiversity loss, deforestation, water pollution and soil degradation. Its contribution to environmental harm stems not only from the direct emissions from livestock and fertilisers, but also from demands placed on ecosystems from land-intensive, input-heavy production driven by high-output demands and globalised markets (Dasgupta, 2021).

While agricultural productivity has continued to improve, the cumulative impacts of climate change are increasingly being felt in agrifood systems through more frequent and severe storms, flooding, tidal surges, wildfires and incidences of pestilence. These losses and damages to nature and people are unequally distributed across systems, regions and sectors (IPCC, 2023). Feeding a population forecast to be 9.8 billion in 2050 (FAO et al., 2021) will lead to more emissions, more cumulative warming and more climate impacts unless reforms to the food system tackling supply- and demand-side emissions can be equitably enacted. Even with rapid and sustained cross-sectoral decarbonisation, business-as-usual emissions within the global food system would lead to overshoot of the 1.5°C target, and potentially the 2°C target (Clark et al., 2020). Any hope of limiting global warming to 1.5°C will require diet shifts aligned to the Mediterranean or EAT-*Lancet* planetary health diets, following guidelines for healthy daily calorific intake, closing crop yield gaps between farms and deploying modern genetics and agronomic practices, reducing food losses and waste by 50% and reducing greenhouse gas intensities of food production. Even if these actions are achieved, it leaves a 67% chance of hitting 1.5°C according to analysis from the IPCC's (2023) Sixth Assessment Report Third Working Group (AR6 WGIII). Such changes touch on numerous policy areas that are the various responsibilities of economic, health, innovation, environment and climate government departments. Deep reforms and intra-agency cooperation will be necessary to make a success of this necessary transition.

The goal of the Paris Agreement to limit the average global temperature increase above preindustrial levels to 'well below 2°C' while pursuing efforts to limit temperature increase to 1.5°C is increasingly out of reach, if not entirely (IPCC, 2023). Achieving either goal requires large and rapid reductions in greenhouse gas emissions in all Intergovernmental Panel on Climate Change (IPCC) pathways to limit warming to 1.5°C or 2°C.

Figure 1.1 details the proportion of emissions that are attributable to the sub-components of the food system. Livestock farming and aquaculture, crop production, and land-use change contribute the largest shares to overall food system emissions.

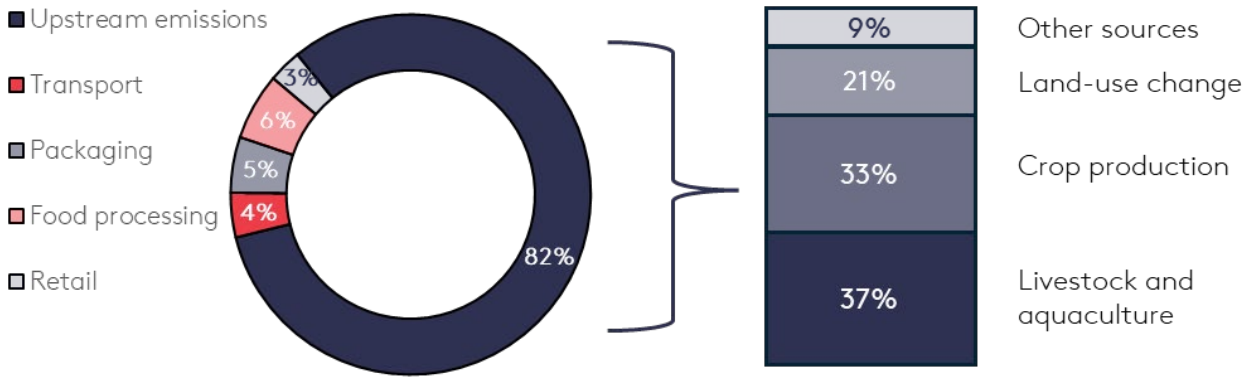
Box 1.1. Defining the 'food system' and 'food system approach'

The Food and Agriculture Organization of the United Nations (FAO, 2018) defines food systems as encompassing "the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded". The food system consists of the five interrelated components listed below. The functioning of these components is influenced in turn by socioeconomic drivers (markets, policies and innovation) and environmental and biophysical constraints (climate, soil quality and water availability) (Van Berkum et al., 2018).

- **Food supply system:** The value chain is central to the food supply system, where value is added at each step from production, storage, transport and processing to retail and consumption.
- **Enabling environment:** The food supply system operates within an enabling environment facilitating all components to support the continued operation of the food system. This includes transport, regulations, institutions and research infrastructure.
- **Business services:** Although peripheral, business services provide essential support to value chain actors. These services include training, agricultural inputs, technical support, and financial and professional services.
- **Food environment**: The food environment encapsulates product advertising, label information and quality seals.
- **Consumer characteristics:** Consumer trends and preferences, all of which are shaped by cultural norms and other elements of the food system, which shape consumer relationships with products.

Taking a 'food system approach' means accounting for the interconnections and potential trade-offs or synergies between these components, the people involved in the chain of activities that lead to the production and consumption of food, and the social, economic, environmental and health outcomes of these activities (Hawkes, 2022).

Figure 1.1. Global food system emissions by stage in the value chain (left) and breakdown of upstream emissions (right)



Source: Authors' analysis based on Crippa et al. (2021) and Ritchie and Roser (2019)

Competing demands on land use

In the UK, as is the case worldwide, land is under increasing pressure to deliver on multiple social demands. The urgency of responding to the twin climate and nature crises necessitates a fundamental rethink of how we incentivise and support farmers to deliver the goods that are required in this transition, from food to biomass, energy and landscape resilience. For centuries, farmers have been incentivised to maximise productivity and outputs. However, this approach to land management has contributed to the global proliferation of greenhouse gases in the atmosphere, which necessitates multilateral cooperation to mitigate. In the UK as in all jurisdictions, these processes have resulted in severe declines in indicators of ecosystem and biodiversity health.

The delicate balance between food production and the natural systems that sustain this process is under threat due to reliance on high levels of external inputs such as synthetic fertilisers, pesticides, herbicides and imported feed, which maintain profits and supply of goods while degrading the capacity of farming systems to resist external shocks — whether from geopolitical instability, tipping points, environmental degradation or commodity price fluctuations. As a result, a damaging feedback loop has been set in motion. The degradation of the ecosystem services underpinning agricultural systems necessitates ever more costly, environmentally damaging and toxic inputs to maintain productivity (Dasgupta, 2021).

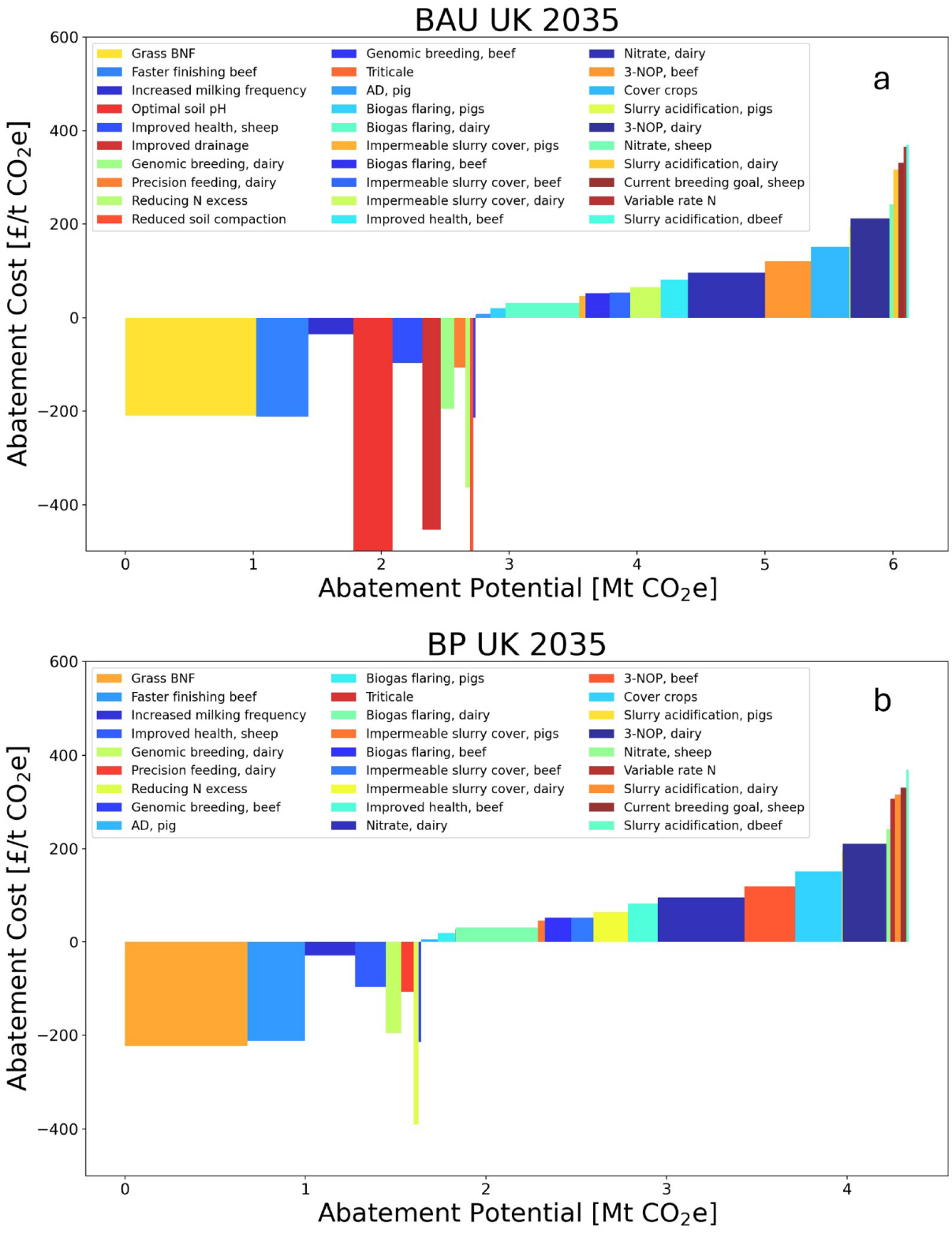
The urgent imperative to reduce emissions and avoid the worst impacts of climate change has to date focused almost exclusively on energy systems, industry and transport. In these sectors, there are comparatively 'easy wins' relative to the complexities and interrelationships of the food system. With investment and policy support, the UK has steadily phased out coal and natural gas from its energy supply and increasingly replaced these with renewable sources of energy generation that are powering, in ever increasing shares, our homes, factories and vehicles (CCC, 2025).

However, the food system is a much more challenging system to decarbonise. For farmers and other agricultural producers, this is largely because the abatement options available in other sectors are either too expensive (especially in the absence of a carbon price), do not exist (emissions from livestock farming are largely short-lived biogenic methane), are associated with difficult trade-offs (i.e. reducing livestock numbers can impact food supplies), or are too complex to integrate into farming systems.

These challenges are further complexified by broader economic and cultural conditions. Many farm businesses are heavily indebted or fully reliant on subsidies to remain viable (Franks, 2022), which does not allow them to take risks and invest in the low-carbon transition, innovation or restructuring. Farm revenues are often not sufficient to cover inheritance tax charges, such that farmers' children might have to sell the land (Food Farming and Countryside Commission, 2025).

Moreover, most abatement measures with high abatement potential in agriculture are more expensive than in other sectors, such as energy or industry, which means that the transition involves higher marginal costs or longer timelines for farmers. Figure 1.2, by Eory et al. (2025), illustrates the UK Marginal Abatement Cost Curve (MACC) for different agricultural greenhouse gas mitigation activities under Business as Usual (BAU) and Balanced Pathway (BP) scenarios aligned to Climate Change Committee (CCC) recommendations in 2035. The figure suggests that less than half of mitigation options result in net savings while the rest require positive investments. For instance, anaerobic digestion and feed additives such as 3NOP have high mitigation potential but come with substantial costs.

Figure 1.2. Marginal abatement cost curves (MACCs) for the entire UK in the (a) Business as Usual (BAU) and (b) Balanced Pathway (BP) land-use scenarios in 2035



Source: Eory et al. (2025: 20), reproduced with permission

Decades of investment in research and development (R&D) have begun to bear fruit and innovations in policy, land management, plant and animal genetics and other technologies have begun to diffuse into some farming models. However, these changes are not happening at the speed necessary, given the aforementioned risks and trade-offs, and there is a clear case for governments to play a more active role in supporting farmers to reduce their emissions while

maintaining food production. Public funding or risk-sharing mechanisms can help farmers overcome financial constraints and adopt higher-cost but highly effective mitigation measures. Making strong use of MACCs can help prioritise the most cost-effective solutions.

However, achieving the transition is not as simple as a government signposting the direction of travel and deploying policies to reduce production emissions. Farmers operate within a market and provide goods in response to demand signals from consumers and expectations of future trends. It is just as critical a policy challenge to support consumers to transition their diets away from the most carbon-intensive foodstuffs (i.e. red meat and dairy), or those produced on recently deforested land, and towards those foods with much lower embodied emissions. This transition entails an entirely different set of policy challenges and questions across behavioural psychology, supermarkets and food processors, advertising, cultural norms and so forth, but must also be tackled in order for any food system transformation policy to be fair and coherent. These dual challenges bridging both supply and demand of foodstuffs are explored in depth from a public policy and evidential perspective in Sections 3–5.

Risks to food producers from climate change

Climate extremes are materialising in all geographical regions. In the UK, as elsewhere, these risks are escalating. The *UK Food Security Report 2024* identifies climate change, biodiversity loss and environmental degradation as critical long-term threats to domestic and global food systems (HM Government, 2024c). These systemic risks are already materialising; for example, England experienced its second worst harvest on record in 2024, largely due to severe winter rainfall that reduced yields and disrupted sowing (HM Government, 2024a). Most cereal crops and oilseed rape saw lower yields than in 2023, with oats the only exception. Overall, yields fell below the five-year average.[1] The World Weather Attribution organisation has calculated that the persistent rain which inhibited sowing, growing and harvesting was made 20% heavier by human-caused climate change (WWA, 2024).

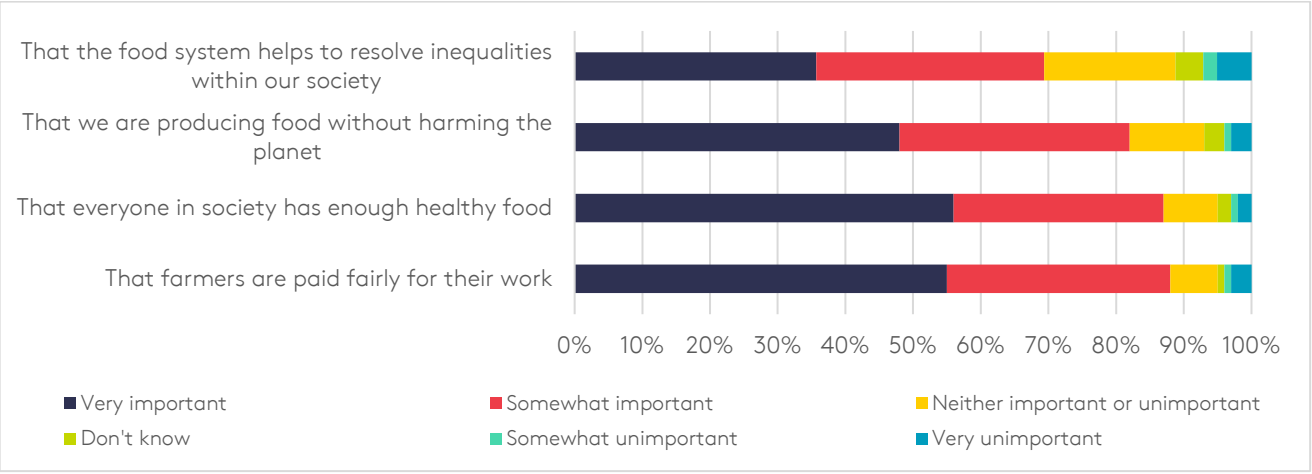
These climate disruptions thus affect agricultural production and are expected to intensify further. There will be an increased chance of warmer, wetter winters and hotter, drier summers alongside increased extreme weather events in the UK over the remaining part of the century (Met Office, 2022). This is already being evidenced by record high temperatures in July 2022 of over 40°C resulting in the Environment Agency declaring droughts in parts of the South West, Southern and Central England and the East of England (Met Office, 2022). Floods in London and the South East in August 2022 were exacerbated by dry, compact earth that did not absorb the deluge of rainwater that eventually arrived. Irrespective of the climate policy choices of the UK, climatic volatility will become more frequent and intense and undermine the productivity and resilience of UK food systems.

Alongside the impacts of extreme weather events and heat stress, the impact of climate change on food prices is being increasingly felt by the public and increasing food prices are now the second most frequently cited impact of climate change experienced globally after extreme heat itself (Kotz et al., 2025). Unsurprisingly, in public opinion polling released by the Food, Farming and Countryside Commission, in which a representative sample of UK citizens were asked questions on elements of the UK's food system, a majority of participants thought it important the food system addressed societal inequalities and environmental harms and were supportive of the Government playing a more active role in mitigating the environmental impacts of agriculture and the food system (see Figure 1.3).

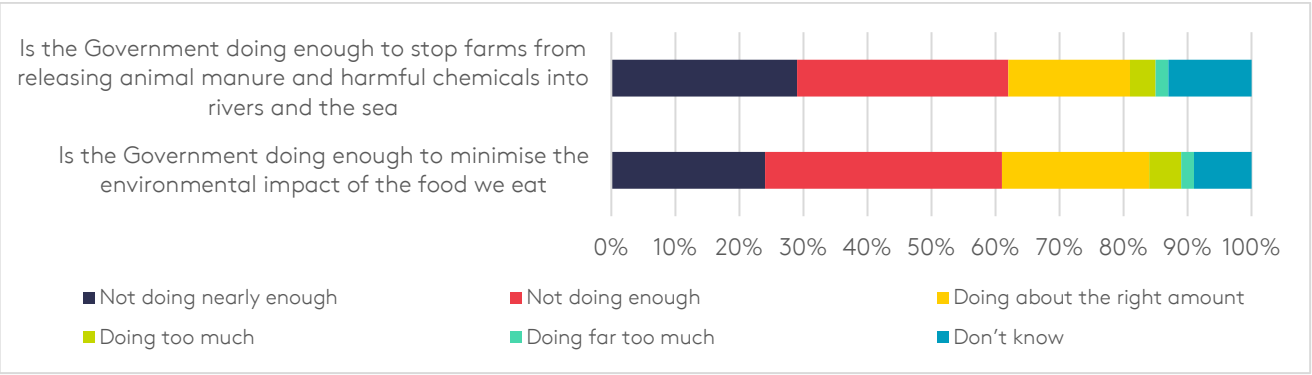
[1] Wheat production dropped 20% to 11.1 million tonnes, due to an 11% fall in planted area and a 10% drop in yield. Barley production rose slightly by 1.8% to 7.1 million tonnes, with a 24% fall in winter barley offset by a 24% rise in spring barley. Oat production increased by 19% to 986,000 tonnes, supported by gains in both area and yield. Oilseed rape fell 32% to 824,000 tonnes, with declines in both area and yield (HM Government, 2024c).

Figure 1.3. Food, Farming and Countryside Commission polling data on the UK's food system, 2023

Thinking about the UK's current food system, how important to you is it...



On the following topics, do you think the Government is doing too much or not enough?



Note: Polling commissioned by the Food, Farming and Countryside Commission for 'The Food Conversation'. Fieldwork conducted 1–4 September 2023. N=2041 adults aged 18+.
Source: Authors' analysis based on More in Common (2023)

For now, the UK's food system remains emissions-intensive and current trajectories are misaligned with the net zero target, as discussed in Section 2 (see Figure 2.1). Thus, the question becomes how to reduce emissions in line with the statutory net zero target. The Seventh Carbon Budget advice released by the independent Climate Change Committee (CCC, 2025) advises on cross-sectoral decarbonisation pathways for the UK to reach this target. The CCC's Balanced Pathway sees agricultural emissions fall by 39% (on 2022 levels) to 29.2 million tonnes of carbon dioxide equivalent ($MtCO_2e$) by 2040 and to 26.4 $MtCO_2e$ by 2050, which is a 45% decline on 2022 levels. The CCC further projects LULUCF (land-use, land-use change and forestry) to transition to a net sink, with emissions projected to fall from 0.8 $MtCO_2e$ in 2022 to –1.9 $MtCO_2e$ by 2040 and –29.9 $MtCO_2e$ by 2050. Importantly, under this pathway, while agricultural emissions are not projected to reach net zero by 2050 (and will represent 27% of the UK's total emissions) the increase in sequestration from new woodland, hedgerows and restored peatland ensures that residual agricultural emissions are counterbalanced by the land sink. The CCC's Balanced Pathway also sees a 35% reduction in the amount of meat consumption by 2050 (based on 2019 levels).

The economic costs of the food system

In the food system, as in most other economic sectors, the costs of production have been systematically externalised and profits internalised. Where costs are calculated, these largely fall on the public purse. The food system produces wide externalities (i.e. impacts from an activity that are not accounted for in its price) across sectors. To give an example, in the UK the hidden

costs of food production and consumption are estimated at £40–96 billion per annum[2] (Dimbleby, 2021). These costs are calculated on the basis of: health costs (both for consumers and food producers); environmental costs; natural capital degradation; food loss and waste; and greenhouse gas emissions. In relation to health, obesity is associated with costs of around 2.8% of the world's gross domestic product (GDP) (Candari et al., 2017). In the EU, chronic diseases linked to obesity represent around 7% of the EU's health budget (ibid.). In the UK, obesity costs around 1–2% of annual GDP (Metcalfe and Sasse, 2023).

The impact the food system has on human health and the environment raises questions of accountability and responsibility. Land managers who generate negative externalities — whether point source or diffuse pollution — have usually not been required to compensate society for these. In contrast to point sources of pollution (e.g. factory waste outflows), diffuse greenhouse gas emissions contribute to global warming processes that have a substantial time lag and the identity of the producer responsible for the externality is not always known (Bognar et al., 2023). Almeida et al. (2025) examine the relationship between nature loss and total factor productivity and find a clear negative relationship between the two variables which has cascading effects on GDP growth, disruptions to labour dynamics and population growth.

The social and environmental costs from the emission of greenhouses gases are consequently not incorporated into the cost structure of the agri-food value chain, thus burdening other market participants, future generations and the ecosystem (Bognar et al., 2023). As the Dasgupta Review (2021) into the economics of biodiversity articulates, environmental degradation and climate change place a material financial burden on taxpayers because the degradation is at once *silent, invisible and mobile*; it is not factored into any meaningful financial metrics that progress is benchmarked against. This is a function of poor regulatory oversight, evidence gaps for policymakers, uncomfortable trade-offs and information asymmetries between different food producers.

The EU and UK food systems are responsible for indirect externalities on food systems outside the EU too, via greenhouse gases and deforestation induced by the production of imported foods (Mann, 2022). For example, the EU27 import around 40% of oilseed meals used in agriculture within the bloc, and around 80% (38 million tonnes) of soybean meal for the same purpose (Mudriian, 2024). They primarily source soybean meal and oilseeds from Brazil, the US and Argentina (European Commission, 2025c), where their growth, for animal feed, is associated with the expansion of agricultural areas, to the detriment of the Amazon Rainforest in particular, generating a negative impact on biodiversity.

These elements together form a complex picture that requires finding compromises between sustainable agricultural production and healthy, nutritious and sufficient human food (Poux and Aubert, 2018).

Public health burdens created by the food system

Diets also have a strong impact on agricultural emissions and environmental degradation by providing demand signals which in turn influence production decisions and the choices farmers make regarding agronomic practices. The transition to healthier diets has been widely recognised as a necessary way forward to support the shift towards sustainable food production that is less emissions-intensive or environmentally harmful (Willett et al., 2019). To achieve a healthy and sustainable global food system transition, the EAT-*Lancet* Commission on Food, Planet, and Health recommends a 50% reduction in all consumption of unhealthy foods (including products high in sugar, salt, processed food and red meat), and to double the consumption of healthy foods (e.g. fruit, vegetables, nuts, whole grains, legumes) (ibid.). The role of the food environment (i.e. both the spaces in which food is available, such as supermarkets, and the products that are available in them) is crucial here to accompany these dietary shifts, as it

[2] The variations depend on the organisation making the estimation (e.g. the Ellen MacArthur Foundation found externalities of £53 billion whereas the Sustainable Food Trust calculates £94 billion).

determines what foods are made "available, accessible, affordable, and desirable" for the consumer (EPHA, 2019). These food environments are shaped by diverse food chain actors (retailers, suppliers, marketing, etc.), whose change in practices could help make healthy products a first choice for consumers.

In addition to impacting the climate and environmental health, the current food system is partly responsible for the fast-growing spread of non-communicable diseases such as obesity. Excessive consumption of unhealthy foods that are poor in nutrients but high in calories, and are linked to high levels of inequality (e.g. fast-food outlets being currently prominent in most deprived areas [Food Foundation, 2025]) have contributed to a doubling of obesity rates worldwide since 1980 (Candari et al., 2017). In the EU, half the adult population is overweight (ibid.), and the UK has the third highest rate of obesity in Europe (Metcalfe and Sasse, 2023).

Food insecurity concerns

These health and sustainability concerns come in a context of growing food insecurity. Brexit has brought about trade uncertainties with fluctuations in import–export market dynamics (Lang et al., 2025). More recently, the Russia–Ukraine war has revealed how strongly the availability and price of fertiliser in Europe are linked to access to Russian gas (ibid.). It also provoked a 2% increase in global wheat prices in 2022 by disrupting Ukrainian wheat production (Devadoss and Ridley, 2024), though this did not especially hurt the UK, which is 90% self-sufficient in wheat (Lang et al., 2025). In 2022, 58% of food consumed in the UK was produced domestically and 42% was imported (House of Commons Environmental Audit Committee, 2023). The country, however, only produces 50% of the vegetables the population consumes, and 16% of fruit, which raises concerns regarding the current recommendation to double fruit and vegetable consumption (Lang et al., 2025).

While fruit and vegetables is the food group most reliant on imports (HM Government, 2024c), UK livestock is also heavily dependent on feed imports, such as soy and cereals. Regarding fertilisers, 89% of UK farmers of tillage crops rely on nitrogen fertiliser, only 40% of which is produced in the UK by a single, US-owned company (CF Fertilisers); the rest is imported (HM Government, 2024c).

Approach, aims and research methods

Food system reform is too often approached in siloed ways, with climate, environmental and health goals treated separately and without giving due attention to the complex interdependencies that shape food supply, processing and consumption. By contrast, this report explicitly adopts a food system approach to explore how better-integrated policies can support a just, resilient and low-emissions transition. In doing so, it aims to deliver realistic and actionable insights for policymakers across the UK.

The report focuses on the UK food system and examines the design of agri-environmental policies across the administrations (England, Northern Ireland, Scotland and Wales) in the context of post-Brexit agricultural reform and the phaseout of the EU Common Agricultural Policy (CAP). It aims to explore both production- and demand-side measures, assessing the coherence and ambition of current policies through a food system lens. Using document analysis and key informant interviews, the report investigates how the UK's administrations are responding to the climate and environmental challenges embedded in food production and consumption.

Importantly, the report also draws on four EU case studies — Denmark, France, Poland and Spain — applying the same analytical approach to highlight evidence, strategies and policy options that may support the UK in decarbonising its food system. These case studies provide comparative insights into how other jurisdictions are addressing similar challenges and offer lessons for shaping UK policy in line with pathways set out by the CCC and other expert bodies.

The report seeks to synthesise evidence, policy interventions and innovations that reduce greenhouse gas emissions from both the production and consumption sides of the food system. It

places particular emphasis on the role of finance, governance and incentive structures in enabling UK producers to transition towards more regenerative practices while delivering nutritious food through fair and resilient supply chains.

To this end the report has used two research methods. Firstly, a literature review was conducted using material found in academic literature, government whitepapers and data and policy-oriented publications from the third sector. This review has helped to identify policy incentives, behaviour changes and innovations that can support these goals. Secondly, we interviewed stakeholders in each UK administration and EU case study country to better understand the unique attributes and challenges facing each country's agricultural sector and food policy mix while also exploring how food system greenhouse gas emissions are addressed in each jurisdiction. Interviews were semi-structured in nature and transcription was delivered by Microsoft Teams' inbuilt transcription features and this was cross-referenced with additional interview recordings where transcription was unclear. Coding of interviews was achieved using AtlasTI coding software and each interviewee was given an anonymous code, as detailed in the tables at the start of Sections 5 and 6, where the interview analysis is presented. Lessons learned, primarily from the UK, were drawn out during this process.

2. Relevant policies and targets for the EU and UK

UK and the devolved administrations' climate policies and targets

In the UK, the Government and devolved administrations have set binding targets for emissions reduction, with the country committed to achieving net zero by 2050 under the 2008 Climate Change Act. Within the UK, Wales and Northern Ireland have also set their net zero target year as 2050, and Scotland's target date is 2045. In 2022, agriculture contributed an estimated 12% of total UK greenhouse gas emissions (in $MtCO_2e$), a similar proportion to 2021 (HM Government, 2025b).

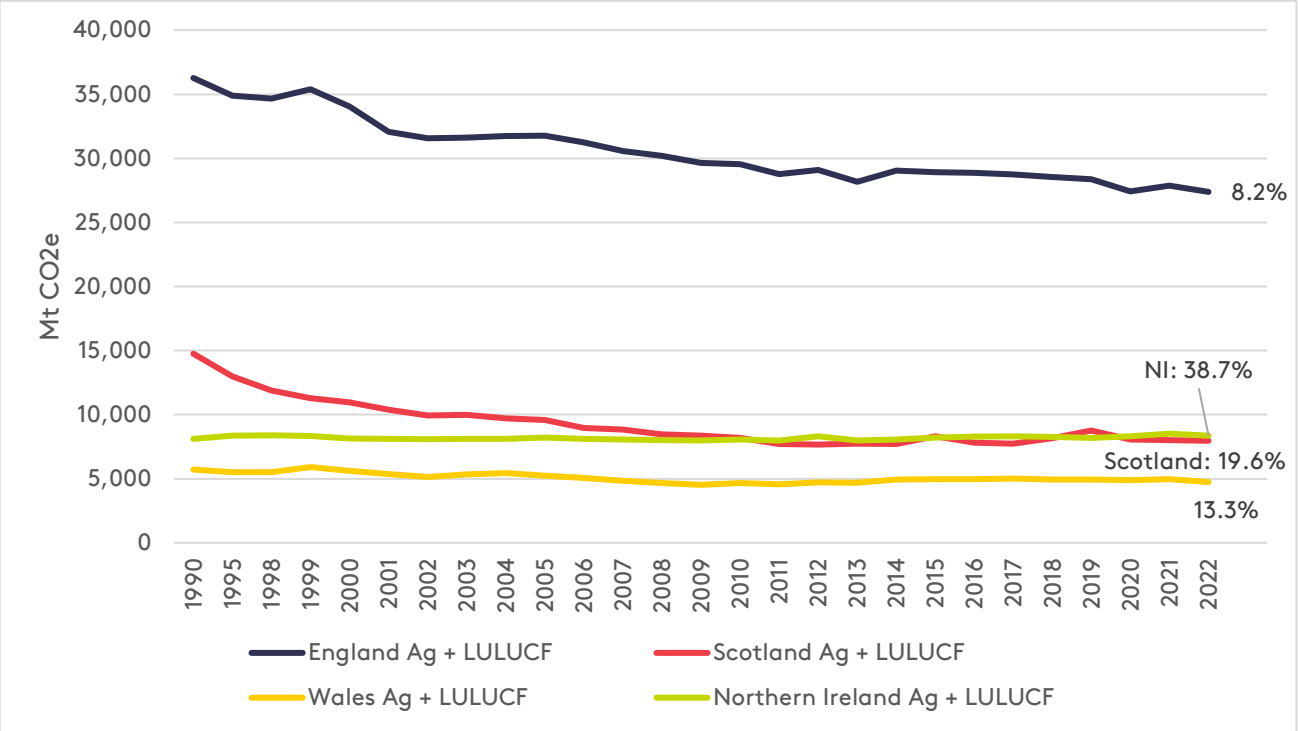
Breaking down emissions for each UK administration, Figure 2.1 presents the agricultural and LULUCF emissions for each administration between 1990 and 2022. While emitting substantially more from agriculture and LULUCF than the other UK administrations, in 2022, England's emissions from these sectors comprised only 8.2% of the total greenhouse gas profile. In Northern Ireland, this share was 38.7%, with agriculture comprising 29% of total emissions and the LULUCF sector being a net emitter with a 10% share of total emissions (largely from degraded peatland and mineral soils). This was substantially more than in Scotland (0.6%) and Wales (–2.40%). As such, Northern Ireland will need substantial investment and policy support to reduce emissions from ruminant livestock and manure management while concurrently enhancing the terrestrial carbon sink.

The UK was an early member of the EU, having acceded during the first expansion in 1973 (when named the European Economic Community). After the UK exited the EU, formulation and administration of agri-environmental policy were ceded back to the UK and the devolved administrations. The UK Government now advocates for the collective interests of its administrations through trade policy but devolves almost all aspects of agri-environmental policy to the devolved administrations (Jelliffe et al., 2023).

The UK administrations have charted different courses with post-CAP agri-environmental policy, with environmental land management schemes (ELMs) in England upending subsidy payments by targeting the delivery of environmental goods to receive subsidies. Scotland, Wales and Northern Ireland have, to varying degrees, elected to align policy with the CAP through continuation (in some guise) of the Basic Payment Scheme, while requiring delivery of environmental goods to receive this payment or top-ups therein. Agri-environmental policy in England closely resembles that of other wealthy EU countries with smaller agricultural sectors, while the other devolved administrations have chartered a course aligned with other large food producers such as France or Ireland through primacy of guaranteed payments to farmers rather than for delivery of public goods (Jelliffe et al., 2023). UK agricultural greenhouse gas policy is not wholly oriented to emissions abatement and instead uses subsidies, which are increasingly conditional on delivery of environmental improvements, and regulations to support food producers. Conditionality means that improvements across animal welfare, climate change mitigation and ecosystem indicators are conditions that must be achieved in order to receive agricultural support payments.

Table 2.1 introduces key policies, strategies and targets at the UK and devolved administration level that are of relevance to the food system across demand and supply dimensions related to decarbonisation. The section then introduces relevant policies, strategies and targets at the EU level before introducing the EU country case studies. These case studies include information from the literature review spliced with data from key informant interviews.

Figure 2.1. Greenhouse gas inventories and percentage of total emissions for the combined agriculture and LULUCF sectors for England, Scotland, Wales and Northern Ireland: 1990–2022



Source: Authors' analysis based on HM Government (2024b)

Table 1.1. Targets, policies and strategies in the UK and its devolved administrations concerning the food system and climate policy

Jurisdiction	Relevant instrument or strategy	Key details	Date introduced or period of applicability
United Kingdom	Climate Change Act 2008 (2050 Target Amendment) Order 2019	This Act established the UK's legally binding target of reaching net zero greenhouse gas emissions by 2050. It serves as the foundation for UK climate policy and drives action across all sectors. Originally entered into force in 2008, it has been amended to include a net zero emissions target in 2019.	2019
	Seventh Carbon Budget (CCC, 2025)	The Seventh Carbon Budget sets a legally binding goal to reduce UK emissions by 87% compared with 1990 levels between 2038 and 2042. For agriculture, by 2040, emissions fall by 39% in the Balanced Pathway, relative to 2022. It recommends a 20% reduction in meat and dairy consumption by 2030, increasing to a 35% reduction in meat consumption by 2050 (CCC, 2025).	2038–42
England	Environmental Land Management Schemes (ELMs)	ELMs replace aspects of the EU's CAP in England and pay farmers for delivering environmental public goods such as biodiversity, climate resilience and water quality. ELMs will fully phase out CAP Pillar I-type direct payments by 2027, with a reduction in this type of payment over a seven-year timeframe (Jelliffe et al., 2023). The scheme includes three components: the Sustainable Farming Incentive (2021), Local Nature Recovery (2024), and Landscape Recovery (2023). The **Sustainable Farming Incentive** is the most developed scheme, with a broad range of targeted outcomes applicable for most farms and including: producing a nutrient management report, maintaining a herbal ley, cover cropping, converting to organic farming, testing soil organic matter, grazing grassland with cattle, maintaining a riparian margin, removing cattle from grassland in autumn and winter, providing habitat for native birds, precision farming, managing grassland to reduce nitrogen leaching, and carrying out no-till cropping.	Phased from 2021

	Good Food Cycle — National Food Strategy whitepaper (HM Government, 2025a)	This recently published policy paper supersedes the Dimbleby Review (2021) and the National Food Strategy of 2022. It outlines a long-term plan to create a healthier and more sustainable food system that reduces diet-related ill health and improve food security at the national and household scale, provides a growth strategy for the agri-food processing sector and outlines the climate impacts of farming and risks to food producers. It contains 10 priority outcomes across accessibility to more healthy and affordable food, the sector growth plan, supporting resilient domestic food production with high animal welfare and environmental standards and support for UK regional food cultures.	2025
Scotland	The Agriculture (Retained EU Law and Data) (Scotland) Bill (2020)	The Scottish Government has proposed a four-tiered system of farm support with area-based income support and additional payments available for farm sustainability measures, nature-based projects and landscape or catchment scale work (Scottish Government, 2024a). **Tier 1:** 'Base Level Direct Payment' — a universal, entry-level payment for undertaking agricultural activity while meeting minimum standards regarding sustainable farming activities, environmental improvements, animal health and welfare and ensuring Fair Work. **Tier 2:** 'Enhanced Level Direct Payment' — a supplement to the Base payment that is designed for land managers undertaking *additional* activities that deliver outcomes for nature and climate improvement as well as collective landscape scale land management. **Tier 3:** 'Elective Payment' — a competitive payment scheme for targeted actions on priorities within the Vision for Agriculture such as works to protect specific habitats and species or other nature and climate outcomes. **Tier 4:** 'Complementary Support' — provision of support for continuing professional development, knowledge exchange and linkages to wider land management support from Scottish Government officials and/or public partners.	2024
	Preparing For Sustainable Farming Scheme (PSF)	The existing EU framework of support will continue until later in 2025 when the PSF enters into force. The basic payment scheme will be phased out between 2025 and 2029. Farmers looking to receive funding under this scheme must complete five separate audits under the Whole Farm Plan. These include a carbon audit, a biodiversity audit, an animal health and welfare plan, an integrated pest management plan and soil analysis. This model will remain in place in 2025 and 2026 but is set to be reviewed by 2027.	2022

	Agri-Environment Climate Scheme (AECS)	A legacy scheme that will be reviewed in 2027 which subsidises farmers for environmental improvements that have abatement potential, including: organic farming, irrigation infrastructure, slurry storage infrastructure, rotation cropping, pest control, riparian margins, hedgerows, wetland management, and establishing biodiversity habitats. Tier 3 of the new farm support system (see above) is based on the AECS.	2014
	Scottish Suckler Beef Support Scheme (SBSS) (Mainland and Islands)	A support scheme for specialist beef producers that has been amended so that Scottish beef farmers will only receive payments if the calving interval is under 410 days or the calf is the first born to the dam. This policy sets a maximum allowed period between births to increase the efficiency of beef breeding operations and reduce greenhouse gas emission intensity. Will likely fall under Tier 1 of the farm support scheme (see above).	2025
	Peatland and Wetland Cross-Compliance	From 2025, this regulation restricts damaging activities (ploughing, draining, applying fertilisers or otherwise damaging soils) on peatland and wetland landscapes. Will likely fall under Tier 1 of the farm support scheme (see above).	2025
	National Good Food Nation Plan	Enacted under a framework piece of legislation, the Good Food Nation (Scotland) Act 2022 takes a food system approach to transitioning Scotland towards being a 'Good Food Nation'. However, the outcomes are 'high-level aspirations' and new policy levers to enact changes are not proposed. The six key outcomes the plan seeks to achieve are (Scottish Government, 2024b): • **Outcome 1:** Everyone in Scotland has reliable access to safe, nutritious, affordable, sustainable and culturally appropriate food. • **Outcome 2:** The food system supports net zero goals, protects animal welfare and helps restore biodiversity. • **Outcome 3:** A healthy food system reduces diet-related conditions and supports physical and mental health. • **Outcome 4:** The food and drink sector boosts economic and social wellbeing, supports fair work and strengthens food security. • **Outcome 5:** Scotland fosters a strong food culture, with a population engaged in and informed about sustainable food. • **Outcome 6:** Scotland promotes its global reputation for high-quality food, contributes to international food systems change and shares best practices.	2024

Wales	Sustainable Farming Scheme (SFS)	The SFS will replace CAP direct payments, beginning 1 January 2026. Farmers must carry out specific 'universal actions' to be eligible to receive payments. A baseline obligation to have 10% tree cover on-farm and habitat created for nature was a flashpoint for farmer protests in summer 2024. The final scheme rules will be published in mid-2025. There were originally 17 universal actions, but this was whittled down to 12 after consultation in 2024. Universal actions largely relate to on-farm sustainability measures, but there are also obligations to restore semi-natural peatland. The SFS also has optional and collaborative actions that will be available from 2026 when the scheme begins. These are similar to ELMs in that farmers can opt in for higher-ambition on-farm actions or collaborate with neighbours on social, environmental or economic projects (Welsh Government, 2024).	2025
	Community food strategy	This strategy focuses on enhancing food-related policy and service delivery at the community level (Welsh Government, 2025). It builds on previously implemented Local Food Partnerships in place since 2022, which coordinate local food systems to tackle food poverty, improve public health and support green growth and education (ibid.). The Sustainable Food Places network financially supports such partnership initiatives across Wales via trusts and foundations (Reynolds, 2024).	2025
Northern Ireland	Sustainable Agriculture Programme (SAP)	This is a successor scheme to the CAP currently being developed to replace conditional and basic payments. Additionally, the Farm Sustainability Transition Payment (FSTP) will enter into force in 2026 after a transition period in 2025 and will be a basic income support scheme, but this is expected to phase down with payments increasingly provided through the SAP. To access this support, farmers will need to enrol in programmes such as the Soil Nutrient Health Scheme or the Beef Carbon Reduction Scheme (explained below). To reduce fertiliser-related emissions, the government will promote the use of treated urea fertilisers, optimising the timing of slurry and fertiliser applications, and the use of legume- and herb-rich grassland swards. Other land-based carbon sequestration options include funding for peatland rewetting and sustainable management as part of the Northern Ireland Peatland Strategy.	2026
	Soil Nutrient Health Scheme (SNHS)	This scheme runs from 2022 to 2026 and aims to test the vast majority of the 650,000 paddocks used for farming in Northern Ireland in order to help farmers manage their nutrient applications and better understand natural capital baselines.	2022

	Beef Carbon Reduction (BCR) Scheme	This scheme prescribes a maximum age of slaughter (30 months in 2024, tapering to 26 months in 2027) for farmers wishing to receive a subsidy. Additional measures in the dairy sector will involve lowering the age of first calving and optimising heifer replacement rates and will be co-designed with stakeholders (Northern Ireland Government, 2025).	2024
	Bovine Genetics Project	This project supports the breeding of more environmentally efficient and tuberculosis- (TB-) resistant cattle. 70% of dairy and beef cows will be included in the programme over the first five years (which began in January 2025) before it is also rolled out to the sheep sector (Northern Ireland Government, 2025).	2023
	Food Strategy Framework Action Plan	This plan focuses on improving dietary health outcomes, building a sustainable agri-food supply chain, and fostering a food-conscious society (Northern Ireland Government, 2024). The Food Standards Agency (FSA) in Northern Ireland is actively involved in supporting the framework's implementation, particularly through its Making Food Better Programme (Pettifer, 2025). This programme works with food businesses to reformulate products, aiming to reduce calories, saturated fat, sugar and salt, and to promote healthier portion sizes and responsible marketing practices.	2025

Note: Green shading refers to agri-environment/production policy and red shading refers to food/consumption policy.

EU climate policies and targets

The Nationally Determined Contribution (NDC) for the EU27 is for a reduction in greenhouse gas emissions of at least 55% by 2030 compared with 1990 levels. A recent proposal to revise the European Climate Law settled on a net 90% reduction by 2040 relative to 1990, before reaching net zero emissions by 2050. In 2021, agricultural emissions constituted 12% of the EU's emissions profile (European Environment Agency, 2024). Within this profile, the largest sources of emissions were methane emissions from enteric fermentation and manure management, responsible for 49% and 17% respectively, while nitrous oxide emissions from soil constituted 30% (European Environment Agency, 2024). Modelling by the European Commission indicates a potential range of emissions reductions, depending on technological uptake and behaviour change among EU farmers, of between –5% and –27% on 2022 levels by 2040. This equates to a 33–76% share of agricultural emissions within the total EU emissions profile by 2040 (European Commission, 2024).

The EU climate policy architecture includes several relevant supply- and demand-side policies that support the net zero target (see Table 2.2). Agricultural climate policy in the EU focuses on meeting climate targets through subsidy, incentives and regulations. At present, there are no plans to price agricultural greenhouse gases at this stage although a report was commissioned to explore policy options for entering agriculture into the EU Emissions Trading System (ETS) (Bognar et al., 2023).

The CAP is the principal EU mechanism to safeguard the production of food, improve farm productivity and farmer livelihoods, maintain rural employment and deliver on various EU environmental policy objectives. The CAP was established in 1962 and remains one of the longest-running EU policies. Since its inception, the CAP has been reformed multiple times, but it has retained two core functions, termed 'pillars', from the Agenda 2000 reforms. Pillar I provides direct financial support to farmers, based in large part on the size of a landholding. Pillar II has a wider remit to boost competitiveness in farming and forestry, alongside environmental and rural economic development and diversification (Petetin and Dobbs, 2022). As such, Pillar II is the principal EU policy mechanism designed to deliver wider objectives not explicitly related to food production.

Examples of public goods incentivised under Pillar II include land set aside for riparian buffer zones or rare species habitat or the adoption of less intensive agricultural practices such as agroforestry and no-till cropping. Other beneficial practices it incentivises include reduced pesticide and herbicide usage and restoration of degraded peatland and wetlands. However, it has been estimated that since 2006 only 4% of total CAP funding delivered nature-friendly farming practices that restored soils and boosted biodiversity (Scown et al., 2020). Each EU member state implements the CAP differently through 'Strategic Plans'.

Reform of the CAP has supported farmers to adopt more nature-friendly practices which can have incidental benefits with respect to emissions. However, schemes within the broader CAP architecture, such as Voluntary Coupled Support payments which are given to farmers to maintain permanent grassland, may result in increasing emissions. For example, over the 2014–20 period, 74% of these payments supported livestock rearing (mainly cattle) (Bognar et al., 2023) to maintain permanent grassland. Matthews et al. (2018) found that greening measures introduced to the CAP during 2014–20 had minimal efficacy given that they were subservient goals to the CAP's core aim of improving the competitiveness of agriculture. Indeed, the European Court of Auditors found that the CAP did not significantly reduce emissions despite a quarter of EU agriculture spending — €100 billion — being earmarked for climate mitigation; it also found that its measures had not halted biodiversity decline and that water abstraction had increased rather than decreased (European Court of Auditors, 2021).

Despite the overarching policy architecture provided by the CAP, LULUCF regulation and various strategies, EU member states have broad latitude to pursue more ambitious policy goals in line with domestic priorities. Policy developments at the member state level are discussed in greater depth in Section 6.

Although EU policies around food and agriculture have largely focused on the production side, they have progressively started targeting consumer behaviour and dietary choices as well during the last decade (OECD, 2023). Notably, the European Green Deal comprises several initiatives aiming to influence behaviours towards healthier and more sustainable diets. One main limitation of these initiatives is that most are not yet legally binding. However, since the 2024 EU Parliament election there has been a shift in priorities for food system policy. This is evidenced by recent strategic discussions on how to support a transition of the EU food system and a notable divergence in priorities between the first Commission under the presidency of Ursula von der Leyen (2019–24) and the second, current, von der Leyen Commission.

In 2024, the Strategic Dialogue on the Future of EU Agriculture was launched by the European Commission, bringing together 29 key stakeholders — including farming unions, agri-food companies, NGOs, academics and financial institutions — to forge a shared vision for transforming EU food systems (Strohschneider, 2024). The Dialogue clearly situated EU agriculture within broader contexts of escalating climate risk, the biodiversity crisis and geopolitical challenges, and produced ambitious recommendations, notably including demand-side policies to shift diets away from livestock proteins and align production with healthy dietary goals. The Dialogue also advocated for increased agrobiodiversity, reduced reliance on mineral fertilisers and pesticides, improved nutrient management, and the decarbonisation of fertiliser production.

However, the von der Leyen Commission II, established in December 2024, appears to mark a shift in emphasis. Its early Communication, *A Vision for Agriculture and Food* (Strohschneider, 2024), while influenced by the Dialogue, adopts a narrower focus centred on competitiveness, economic growth, food security and supply chain resilience, diverging from the more transformative, systems-based approach underpinning the Dialogue and the earlier Farm to Fork Strategy (see below). The Vision sets the course for EU agri-food policy over the next five years, with long-term implications for farmer practices. It outlines four pillars for the sector: making it "attractive and predictable" to secure farmer incomes; "competitive and resilient" in the face of geopolitical instability; "future-proof" within planetary boundaries; and focused on valuing food and supporting fair, vibrant rural and coastal communities (Foote, 2025).

The Farm to Fork Strategy (F2F) (see Table 2.2) was an important element of the EU Green Deal and demonstrated a focus on how food is *consumed* as well as its production. But implementation was very limited, and the F2F was effectively abandoned in early 2024 following growing political backlash and pressure from several member states, farming lobbies and conservative groups in the European Parliament. In particular, a central component of the strategy, the Sustainable Use of Pesticides Regulation (SUR), which aimed to halve pesticide use by 2030, faced significant resistance. The European Parliament rejected the proposal for this regulation in November 2023, and the Council of the EU failed to reach consensus on its introduction (Halleux, 2023). After months of farmers' protests across Europe, on 6 February 2024, President von der Leyen announced the withdrawal of the SUR, arguing it had turned into a "symbol of polarisation" and citing the lack of progress in discussions (Henley et al., 2024). Although some individual actions under the F2F may yet proceed, its holistic, systemic vision has largely been dismantled, and it no longer serves as a central guiding framework for EU food policy.

Table 2.2. EU targets, policies and strategies concerning the food system and climate policy

Jurisdiction	Relevant instrument or strategy	Key details	Date introduced or period of applicability
European Union	EU Climate Law — Regulation (EU) 2021/1119	This law establishes a legislative framework to support the EU to reach net zero greenhouse gases by 2050. The NDC for the EU is for a 55% reduction on 1990 levels by 2030. A recently announced proposal to amend the Climate Law by the EU Commission has set a target of 90% reductions by 2040 from the same baseline year.	2021
	Effort Sharing Regulation (ESR)	This is a policy which sets binding national targets for reducing non-CO_2 greenhouse gases (methane and nitrous oxide) and CO_2 emissions from agricultural energy use for individual member states. The ESR reduction target is 40% by 2030 (on 2005 levels) for sectors not covered under the EU ETS, which include agriculture and transport, buildings and waste.	2018
	LULUCF regulation 2023/839	This regulation (of 19 April 2023, amending Regulation [EU] 2018/841) is designed to accurately account for the negative emissions generated by land-use activities within the EU's climate targets and is most relevant to decarbonising land use. Recent amendments have aligned the LULUCF regulation with the 2030 climate target and set an overarching objective for member states to generate 310 $MtCO_2e$ of net removals by 2030. The regulation further seeks to reverse the decline of terrestrial carbon stores in EU member states and ensure, at a minimum, a climate-neutral land sector by 2035 where agricultural emissions are netted off against LULUCF removals (Jensen, 2023).	2023
	Common Agricultural Policy (CAP)	This core EU agricultural subsidy framework has two pillars: direct farm support (Pillar I) and rural/environmental development (Pillar II). Post-2023 reforms include environmental conditionality and eco-schemes.	Current funding period 2023–27
	Food Labelling Regulation (EU 1169/2011)	This regulation has been legally binding since 2011. It mandates ingredient, allergen and origin information on food products. Front-of-pack nutrition labelling (e.g. Nutri-Score) exists in France but is not mandatory at the EU level.	2011
	EU Climate Law — Regulation (EU) 2021/1119	This law, now adopted, targets greenwashing and sets standards for label certification and sustainability claims (e.g. to challenge unclear or vague sustainability claims on products). A supporting directive, the 'Green Claims Directive', which would have required companies to provide evidence for sustainability claims on their products, has been withdrawn.	2024

	Farm to Fork Strategy (F2F)	Adopted in 2020, the F2F outlines the EU's vision for a fair, healthy and environmentally friendly food system. While not legally binding itself, it sets political priorities and proposes a series of legislative and non-legislative actions to reduce the environmental and climate footprint of the food system, ensure food security and public health, and promote sustainable consumption. Among its objectives are reducing pesticide and fertiliser use, improving animal welfare, promoting healthy diets and reducing food waste. The F2F called for the development of a Sustainable Food Systems Framework (SFSF) in 2019, which was to be a regulatory framework setting sustainability rules for the EU food system, such as food sustainability criteria, harmonised eco-labelling standards and criteria for 'Green Public Procurement'. The fate of the F2F, the SFSF and Green Public Procurement are uncertain at present.	2020
	Food Waste Targets (proposed under Waste Framework Directive revision)	The EU has proposed binding waste reduction targets of –10% in food processing and –30% per capita in retail and consumption by 2030 (Bowman and Herzog, 2024). However, as of mid-2025, this legislative proposal is still under discussion among member states and the European Parliament, with concerns being raised about feasibility, enforcement mechanisms and the uneven availability of reliable food waste data across member states (European Council, 2025).	N/A — at proposal stage
	Marketing and reformulation standards for unhealthy foods	The EU has recommended demand-side measures such as marketing restrictions and reformulation standards to reduce sugar, salt and saturated fat in foods. However, these remain non-binding. The European Commission has issued guidance and promoted voluntary action through frameworks such as the 2011 EU Framework for National Initiatives on Selected Nutrients. Some member states, such as Portugal, have adopted their own national policies, reflecting a divergence in public health approaches across the EU in the absence of binding legislation.	2011

Note: Green colouring refers to agri-environment/production policy and red colouring refers to food/consumption policy.

3. Policy options and innovations to decarbonise food production systems

In this section we review the relevant literature relating to the potential of different policy options and innovations to decarbonise aspects of food production; Section 4 follows with the same related to consumption. Evidence has been sourced largely from EU and UK contexts, however evidence from other jurisdictions has been interposed where relevant. We explore market and non-market options alongside nascent technologies or innovation that have demonstrable potential.

Lee and Ignaciuk (2025) systematically analyse the efficacy of policy measures to drive emissions reductions in the agriculture, forestry and other land use (AFOLU) sector. The review assesses the results of 190 studies within the 38 member countries of the Organisation for Economic Co-operation and Development (OECD) and classifies them according to whether they were an economic instrument, a regulatory instrument or 'other instrument'. Pertinent studies from this review are highlighted in this section. Evidently, there are a plethora of land management techniques to mitigate emissions from organic/regenerative farming, agroforestry and agroecological models. We focus on evidence about particular innovations, and specifically those addressing the key emission sources from livestock production and cropping, namely enteric fermentation, manure management and nitrification. At a macro level, the most effective policy measures are shown to be framework regulations, such as zoning laws, that conserve carbon-rich ecosystems from conversion to agricultural use. Technology standards and R&D investments promoting biofuel production also have substantial mitigation benefits. Agri-environmental subsidies and carbon taxes have smaller relative mitigation benefits within the sector.

A brief overview of the evidence from these studies, as summarised by Lee and Ignaciuk (2025), is provided below.

Subsidies

In general, subsidies that protect natural ecosystems and reward farmers for changes in land management more consistently showed positive mitigation results (when compared with framework regulations, product standards and zoning laws), with average reported abatement of 5.3 tonnes of carbon dioxide equivalent per hectare per year (tCO_2eq ha/year) (Lee and Ignaciuk, 2025). Farmer participation is a key determinant of the overall mitigation effectiveness of subsidy schemes and unsurprisingly, higher compensation rates significantly increase the adoption of agri-environmental practices (Gars et al., 2024). Beyond absolute payment levels, tailoring agri-environmental scheme design to account for farmer risk preferences, common practice in their locality, or their support for particular environmental issues is necessary, according to Dessart et al. (2019). Lankoski et al. (2015) find positive correlations between markets that reward farmers for nature and climate benefits, an ability to stack benefits from these markets, and reaching a threshold for farmers to participate in the scheme.

In terms of mitigation potential, evidence suggests that subsidies targeting efficient fertiliser use, soil carbon sequestration and afforestation are among the most effective (Lee and Ignaciuk, 2025). Among all interventions, payments to prevent land conversion — especially in tropical forests, mangroves and peatlands — show the highest abatement potential. However, such options are less applicable to the EU and UK contexts, where landscapes are already heavily modified and peatlands are often already degraded, with the release of carbon either long past or still ongoing. Therefore, measures to promote the adjustment of land management practices would seem to have most relevance. Payments supporting reductions in livestock methane emissions in Ireland through the Beef Environmental Efficiency Programme — Sucklers is an example. The scheme encourages the use of animal health and performance data to inform on-farm decision-making and steer breeding decisions towards selecting for efficient cattle (Banks and Cawley, 2021). Average payments of €1,587, made to 25,880 farmers to weigh suckler

cow/calf pairs and complete optional actions including meal feeding, vaccination and faecal egg testing, are forecast to deliver 14.9 $KtCO_2e$ savings by 2030 (0.5% of Ireland's 2020 emissions) (ibid.).

Payments to farmers for conserving land from conversion have potential when designed well, but the risk of emissions leakage (where a reduction in supply of agricultural commodities in one region/jurisdiction is replaced by increased production and supply from another) may negate the benefits of a policy, whether subsidy- or tax-based. Additionally, Henderson and Verma (2021) find that global emissions leakage declines as more countries implement taxes, and conversely, higher taxes stimulate greater global greenhouse gas reductions while inducing higher emissions leakage, especially when few jurisdictions have implemented such measures.

With respect to incentives promoting the uptake of organic farming, Seufert and Ramankutty (2017) find mixed evidence, dependent on the scope of the analysis, that organic farming can lead to sustained emissions abatement, but potentially find that this method produces lower yields than conventional farming systems. There is evidence that area-scaled nitrogen dioxide (NO_2) emissions (i.e. their distribution) are lower in organic farming plots than conventional plots (Skinner et al., 2014). But when comparing expected mitigation with yields from both production models, organic models have higher emissions per unit of dry matter than conventional models: an area of divergence that is explained by soil characteristics in organic systems and higher bioavailability of nitrogen in synthetic fertilisers in conventional systems (ibid.).

Taxes

At present, there are no carbon taxes identified in the review by Lee and Ignaciuk (2025) that cover methane or nitrous oxide. The studies that do exist concerning the effectiveness of taxes, specifically on agricultural emissions, are *ex ante* and provide only illustrative results (i.e. they are model based). Lee and Ignaciuk (2025) conclude that 95% of these *ex ante* studies show carbon taxes to be an efficient means of mitigating agricultural greenhouse gases. Henderson and Verma (2021) find that a global AFOLU tax is twice as effective as an emission abatement subsidy because it induces farmers to cease production or abate emissions, which a subsidy would not achieve. At present, only Denmark has forged an agreement to implement a carbon tax on its agricultural sector, under the Green Tripartite Agreement. Prior to the signing of this agreement, Mollgaard et al. (2023) model the effects of a carbon tax set at kr750/tCO_2e (£84/tCO_2e) using existing abatement technologies and practices, indicating it will lead to 45% greenhouse gas reductions by 2030 relative to 1990, with half of this abatement from increased land-based sequestration. However, this tax will not be implemented until 2030.

The experience of New Zealand's abortive levy-rebate scheme 'He Waka Eke Noa' highlights the challenge of reaching political consensus on agricultural greenhouse gas abatement measures.[3] It failed largely due to equity concerns between different subsectors (in this case sheep, beef and dairy), the proposed scheme governance (especially levy setting), measurement, reporting and verification (MRV) challenges, and emissions leakage concerns.

Regulations

Regulations offer another direct or indirect route to addressing agricultural production emissions. Of the literature reviewed in Lee and Iganciuk (2025) concerning regulatory measures (performance standards, technology standards and framework regulations), 73% of measures were identified as effective in reducing emissions. The EU Nitrates Directive is a nitrate trading scheme that sets binding limits on nitrate pollution from agriculture to protect water quality, while giving member states flexibility in how those limits are met. Modelling by Velthof et al. (2014) found that between 2000 and 2008, the Directive had contributed to 16% aggregate

[3] A five-year policy programme comprising representatives from farming unions, Māori and the Government sought to develop an on-farm agricultural emissions pricing system to tax methane and nitrous oxide emissions from farming (while giving a rebate for carbon sequestration occurring on-farm). Challenges setting levy rates and farmer distrust, in addition to a change of government (and loss of political consensus on emissions pricing), ultimately scuppered the partnership (Johnston, 2023).

nitrate leaching reductions within the EU27 and reductions in nitrous oxide emissions of 20% in the Netherlands, and 12% in Denmark and the UK. In New Zealand, the Lake Taupo Nitrogen Trading programme was the first ever non-point source nutrient cap-and-trade scheme to be piloted. Duhon et al. (2015) provided evidence that the scheme has worked as intended, with improvements in water quality to Lake Taupo despite the long lag times between nutrient release and appearance in the lake.

With respect to technical standards, a literature review finds that improving fertiliser use efficiency, cattle breeding and energy efficiency in mobile machinery are among the most cost-effective standards to apply to mitigate agricultural greenhouse gas mitigation (MacLeod et al., 2015). In order to maximise uptake of these measures, the authors suggest information dissemination, skills training and demonstrations for diffusing best practice. Incentives to stimulate the bioenergy market (from crop residues, manure-based biogas and lignocellulosic biomass) offer strong mitigation potential; however, adoption is still limited due to high capital costs, land-use competition, limited policy support and technology uncertainties, highlighting how open-market dynamics drive efficiency and also externalities (Lee and Ignaciuk, 2025).

Market regulations

Lee and Ignaciuk (2025) review literature on zoning policies to prevent the destruction of carbon-rich ecosystems. Evidence from the tropics highlights the substantial mitigation benefits delivered through zoning policies by protecting carbon-rich tropical rainforests, wetlands and mangroves from conversion to agricultural uses. However, these are arguably less relevant to the UK and EU context because of the lack of tropical rainforests and extant mangroves. Mixed evidence is presented on the impact of the EU dairy quota on absolute dairy cow numbers and emissions. Kotyza et al. (2022) find that dairy cattle numbers increased in seven countries between 2008 and 2018 but some countries also saw reductions due to increased competition and market rebalancing. In Ireland, removal of milk quotas from 2015 led to substantial expansion of dairy production for the export market; while decoupling output from farm-level emissions, gross emissions substantially increased (Läpple et al., 2022).

Other instruments

The synthesis by Lee and Ignaciuk (2025) shows that public investments in R&D yielded average mitigation of 28 tCO_2e per ha and they conclude that some high-risk and high-potential innovations such as methane vaccines and inhibitors or low-methane genetic markers would not be possible without public investment. Finally, information instruments to upskill farmers on low-carbon production methods and highlighting best practice will be critical for supporting widespread decarbonisation of conventional production methods.

Technological innovations

Management of waste and fertiliser use

Reducing emissions from livestock farming can be achieved through a range of on-farm technologies that manage waste and fertiliser use more effectively. These approaches typically aim to lower methane or nitrous oxide emissions by improving how nutrients are handled and used on farms. They include:

- Anaerobic digestion: This is a widely used technology, which processes livestock manure in sealed tanks without oxygen. This turns the waste into two useful products: biogas, which can replace fossil fuels on farms or in the energy grid, and digestate, a nutrient-rich fertiliser that can be spread on fields (Jebari et al., 2023).
- Nitrification inhibitors: These are chemical additives mixed with fertilisers to slow the conversion of nitrogen in soil, which helps reduce the release of nitrous oxide. Some, like sodium chlorate and dicyandiamide (DCD), have been shown to produce significant reductions in emissions (Fu et al., 2018; Hargreaves et al., 2021), but there are concerns

about potential damage to plants and contamination of water supplies. These risks have limited their uptake so far, despite the strong emission-reduction potential.

Feeding options and animal health

Adjusting livestock diets has untapped potential to moderate methane production by either improving live-weight gain of livestock (thus reaching finishing age sooner) or inhibiting methane production in the rumen (a ruminant's first stomach). Several feed-based strategies are being researched or trialled to reduce methane production while maintaining animal health and productivity, including:

- **Feed additives — chemical inhibitors**: One of the leading feed-based approaches is the use of methane-inhibiting additives such as Bovaer® (3-NOP). This supplement blocks certain microbial processes in the animal's digestive system, reducing methane by around 30% in dairy cows (Kebreab et al., 2023). However, it must be present in every meal to be effective, making it challenging to use with grazing animals. It is approved for use in the UK and many other countries (NFU, 2024).
- **Seaweed supplements**: Seaweed species such as *Asparagopsis armata* have shown even higher methane reductions — of up to 52% — in feedlot cattle when added to grain-based diets (George et al., 2024). However, concerns persist about bromoform residues in meat and milk, though studies suggest these are well below levels that would be unsafe (Alvarez-Hess et al., 2024).
- **Diet formulation and additives**: Various changes to livestock diets have been identified to cut methane emissions. These include feeding livestock younger, less mature grass, reducing the amount of fibre in the diet, and increasing the use of fats, oils or oilseeds (Arndt et al., 2022). Some natural compounds such as liquorice extract have shown positive early results. In sheep, small doses led to a 27% drop in methane and a 77% drop in nitrate concentrations (Ramos-Morales et al., 2018).
- **Pasture quality and feed waste reduction**: High-sugar grasses help balance nitrogen and carbohydrate levels in the rumen, improving digestion and reducing emissions (Soteriades et al., 2018). Using food industry by-products such as dried distillers' grain as animal feed can also reduce waste and efficiently uses waste streams (Wilkinson and Garnsworthy, 2017).
- **Animal welfare and productivity**: Healthier animals tend to grow faster and therefore emit less over their lifetime. Improving welfare by reducing environmental and health stressors through provision of better housing and shelter, animal health management, and more time on pasture improves overall productivity, resulting from better behavioural and physiological conditions (Mee and Boyle, 2020).

Genetics and efficiency

Advancements in animal genetics in recent years have allowed for selection of livestock with low-methane genetic markers. Heritable genetic improvements can be passed down over generations, making them a cost-effective and cumulative strategy for decarbonisation. Possible measures include:

- **Breeding for efficiency**: Selecting livestock for desirable genetic characteristics can mean that animals can convert feed into meat or milk more efficiently; further, it can enable farmers to shorten animal lifespans and reduce emissions per unit of product. Tools such as genetic performance recording, artificial insemination and using high-performing breeds have already delivered productivity – and thus climate benefits – in UK sheep systems (Morgan-Davies et al., 2021).
- **Low-emission livestock**: In New Zealand, breeding programmes have produced sheep that emit 16% less methane per kilogram of feed, without reducing wool production, sheep growth or fertility (Rowe et al., 2021). These low-emission traits are heritable and have led

to year-on-year reductions of 1–2% in methane emissions in commercial test herds (Rowe et al., 2022). This kind of breeding achieves its objectives because low-emission animals tend to have smaller rumens, feed more often, and have leaner muscle, helping them digest food in ways that reduce methane. So far, these changes have not adversely affected other desirable traits such as disease resistance or carcass quality (Hickey et al., 2022).

- Dairy breeding programmes: Similar programmes have been put in place for dairy cattle, with similar findings to sheep. A New Zealand study showed up to 20% variation in emissions among bulls, and low-emission traits have been passed to daughters (Starsmore et al., 2024). Irish trials also found cows selected for low methane emissions performed just as well in terms of milk yield and feed use.

4. Policy options and innovations to decarbonise the consumption of food

This section identifies the main challenges around food consumption that are specific to the UK, followed by a summary of the measures put in place in the different UK administrations to enable a sustainable transition of the agri-food system from the point of view of consumption.

Principle debates around food consumption in the UK

Four central debates in the UK relating to the food transition towards healthier and more sustainable diets concern accessibility, availability, price and affordability, and appeal, as echoed by the Food Foundation's *The Broken Plate 2025* report on the state of the UK's food system (Food Foundation, 2025). In the UK, these issues are particularly salient in so-called 'food deserts', areas where residents have limited access to affordable and nutritious food options.

Regarding accessibility, to give an example, on average, 26% of food retail spaces in England are fast-food establishments, a proportion that has remained stable during the past six years. But this average masks certain spatial inequalities linked to socioeconomic factors: in the most deprived fifth of neighbourhoods, fast-food outlets account for 31% of food retail locations, whereas in the least deprived fifth, the figure drops to 22% (ibid.).

An example regarding availability is the concern raised by several reports about the high availability of foods with high levels of sugar, including supposedly healthy products such as cereal bars and yogurts, the vast majority of which (95–97%) are high in sugar (Action on Sugar, 2024; Food Foundation, 2025).

Affordability or price also remains an obstacle for adopting more healthy and sustainable diets. The Food Foundation (2025: 6) estimates that "in order to afford the government recommended healthy diet, the most deprived fifth of the population would need to spend 45% of their disposable income on food, rising to 70% for those households with children". Certain plant-based products such as alternatives to cows' milk (e.g. almond, oat) remain on average twice as expensive as cows' milk (Food Foundation, 2025).

There is room to improve the appeal of plant-based alternatives and of more healthy and sustainable diets, which is currently undermined by the marketing landscape in the UK. Promotions and advertising currently favour unhealthy products, with 36% of total advertising spend on food and non-alcoholic drinks going to confectionery, snacks, desserts and soft drinks as opposed to 2% towards fruit and vegetables in 2024 (Food Foundation, 2025). Positively, plant-based alternatives and fruit and vegetables are gaining more visibility, via an increase of advertising and information in the media (Food Foundation, 2025; Pardoe, 2024). However, although plant-based alternatives are almost always lower in greenhouse gas content compared with animal-derived products, they are not necessarily healthier options. Further R&D and education are required to favour low-processed plant-based alternatives (as discussed further below under 'Innovations').

Market solutions

Market solutions are one approach to incentivise a shift in consumer diets towards healthier and more sustainable food choices.

Price regulation

A first possible market solution is to regulate prices, which requires consideration of food price elasticities. According to Andreyeva et al. (2010), who conducted a meta-analysis of over 160 studies, price responsiveness varies significantly across food types. They found high elasticities for products including soft drinks, juice, meats and fruit, suggesting that small price shifts could meaningfully alter consumption patterns. In contrast, products such as eggs, cheese and fats/oils

were found to be much more inelastic in price, making price-based interventions less effective for these items.

Other studies reinforce these findings. Gallet (2010) showed that beef and lamb consumption is more price-elastic than poultry, implying that fiscal measures could potentially be more effective at reducing consumption of high-emission meats. Similarly, Säll and Gren (2015) found that meat consumption is more sensitive to price and income changes than dairy, providing further evidence that price mechanisms could support dietary transitions.

These elasticity findings highlight the power of price signals in shaping consumer choices. However, current market prices often fail to account for the broader environmental and health impacts of food. An increasingly investigated method to internalise externalities in food prices is true cost accounting (TCA). TCA relies on the same logic as price-based interventions: adjusting market signals to better reflect true societal costs and influence consumer behaviour. By capturing the full range of environmental, health and social externalities associated with food production and consumption, TCA can help shift demand towards more sustainable and nutritious foods (FAO, 2023).

In the UK, interest in TCA has grown alongside broader efforts to reform agricultural policy, develop sustainability metrics and update dietary guidelines. The National Food Strategy (Dimbleby, 2021) endorsed the need for better metrics to assess the real costs of food, recommending the establishment of a national framework to measure and report externalities. Pilot initiatives in the UK have explored the practical implementation of TCA, such as calculating national external costs, and the soil, climate and water costs of different food categories (Sustainable Food Trust, 2019). If scaled up, TCA could influence market signals by acting on price structures, subsidies and investment flows (FAO, 2023), but it is currently undermined by methodological variation, data availability and the need for political consensus (Gemmill-Herren et al., 2021).

Fiscal tools

Fiscal tools, particularly environmental taxes, are other mechanisms available that can internalise the environmental costs of food production. In the UK, the idea of implementing a meat tax to accelerate the reduction in red meat consumption by incorporating the social cost of carbon into food prices (Springmann et al., 2018) has long been debated. The aforementioned National Food Strategy (Dimbleby, 2021) warns that such a tax would be highly regressive and politically volatile in the UK context. According to the Strategy, applying Treasury-assessed carbon prices to meat would raise the price of beef mince by 145% (from £4.80 to £11.76 per kilogram) while the price of rump steak would rise by 31%, exacerbating the burden on low-income households that rely on cheaper cuts (Dimbleby, 2021). Since emissions are measured by weight, not by product quality or processing, the least expensive products would see the steepest price increases. While such a tax may be effective in principle, the Strategy concludes it would provoke significant public opposition unless accompanied by compensatory measures, such as food subsidies or income transfers.

Instead of a tax, the National Food Strategy recommends a suite of interventions that collectively reduce meat consumption without disproportionately harming vulnerable groups. These include reformulating popular products, nudging choices through labelling and product placement, and increasing the uptake of plant-based meals in public sector catering (this is discussed later in Section 4).

Non-market solutions

Non-market solutions, including community initiatives, public procurement, regulations and education, are other, often softer or less coercive ways to incentivise a shift in consumer behaviour towards healthier and more sustainable diets. Some of these measures can be supported directly by the state, such as public procurement, school programmes or regulations, whereas others such as community or education initiatives (outside schools) are led by civil society.

Policy levers: regulations, subsidies and public procurement

Regulatory tools, such as bans, quotas or subsidies targeted at sustainable initiatives, are classically employed by governments to encourage consumption decarbonisation. An example of regulation is the restrictions on high fat, sugar and salt or 'HFSS' advertising and its placement in retail spaces, which were introduced in England from 2011 to reduce the overconsumption of unhealthy foods (HM Government, 2023).

As previously discussed, to help reduce greenhouse gas emissions subsidies can be redirected from supporting the meat industry towards the production of fruit and vegetables. Springmann and Freund (2022: 4) find that an optimal solution would be to only partially repurpose subsidies to "production of foods with beneficial health and environmental characteristics" as it would help reduce greenhouse gas emissions and improve public health while mitigating economic losses. Public authorities can also encourage the distribution of healthier and more sustainable products via regulations on public procurement. For example, Cambridge City Council decided that all civic events would have to showcase plant-based food options and it "will no longer procure and serve beef and lamb" as of 2023 (Cambridge City Council, 2023). The Department for Education in the UK also published national guidelines for school meals, which encourage at least one meat-free day a week and for children to be offered a variety of vegetarian options. Some of the UK's administrations have gone further by formally linking public procurement to sustainability objectives, as in the case of the Good Food Nation Bill in Scotland (Scottish Government, 2024b).

Community and education initiatives

Creating community through food partnerships can help reshape people's connection to food and their territory, notably by putting in touch various actors, such as farmers and citizens, businesses and public authorities. Initiatives such as the Sustainable Food Places network, which supports nearly 120 local partnerships across the UK, aim to establish such collaborations, thereby encouraging both education and joint action to transform local food systems. An example of a food community system is Incredible Edible Todmorden, located in the West Yorkshire town of Todmorden, which grows fruit, herbs and vegetables to share with the larger community. Food partnerships are even legally formalised in Scotland, where local areas are bound by law to develop a partnership plan, whereas in Wales, Northern Ireland, and England, this is encouraged but not legally binding (Reynolds, 2024).

These community initiatives connect in their aim with educational campaigns, which intend to inform citizens about their possible consumption choices. The citizen campaign Love Food Hate Waste, for example, is aimed at educating people about food waste, through activities such as sharing online recipes. Such initiatives often have a strong social equity component: for example, infrastructure investments in food redistribution, like those of the charitable food redistributors network FareShare, have redirected surplus food to vulnerable populations. Educational campaigns are usually not sufficient on their own to create a cultural shift, given that some populations have low agency in their consumption choices (Adams et al., 2016). Initiatives like Change4Life that aim to address rising obesity and poor diets recognise that dietary behaviours and health outcomes differ across socioeconomic, ethnic and geographical backgrounds. In place since 2009 with the support of Public Health England and the National Health Service (NHS), the Change4Life programme tailors messaging to address these differences when promoting healthy eating. For instance, community-based campaigns and conferences have targeted specific needs from Black and Minority Ethnic (BME) communities, with outreach through local radio, faith groups and community health workers.

The state, retailers and industry actors also get involved in influencing consumer choices towards healthier and more sustainable options via so-called 'nudges'. Labelling schemes, such as the traffic light front-of-pack nutritional label, which indicates levels of fat, saturated fat, sugar and salt using a colour-coded system, are designed to make healthier options easier to identify for buyers (Cecchini and Warin, 2016). Research has shown that these labels can "increase the amount of people selecting a healthier food product by about 17.95% (confidence interval:

+11.24% to +24.66%). Food labelling would also decrease calorie intake/choice by about 3.59% (confidence interval: –8.90% to +1.72%)" (ibid.: 201).

Several recent pilot projects have explored environmental labelling, including carbon footprint labels on food products, to nudge consumers towards lower-impact diets. For example, Foundation Earth launched a front-of-pack eco-score trial on selected products in UK supermarkets, aiming to simplify sustainability decisions for consumers (White, 2021).

Other possible nudge-based tools are menu design in public places like schools and hospitals, store layout (e.g. placing plant-based options at eye-level), or product placement: for instance, in 2015, NHS hospitals implemented a pilot trial for healthier snacks and drinks in their vending machines (Chadborn, 2018). At the end of the trial, consumers had shifted towards buying more water bottles (+54%) than sweetened beverages (–38%).

Food innovations

Another strategy to shift consumer behaviour is supporting the development and scale-up of alternative proteins, such as plant-based meat analogues, precision-fermented dairy and cultivated meat. These innovations have the advantage of providing similar culinary and nutritional profiles to traditional meat and dairy, often with a substantially lower environmental footprint (IPES-Food, 2022). For instance, the plant-based 'Impossible Burger' is estimated to use 96% less land, 87% less water and emit 89% less than a beefburger (Dimbleby, 2021). A shift in consumer diets towards more plant-based meals is deemed to have positive public health outcomes. The academic literature consistently recommends dietary transitions that reduce the intake of meat, dairy and fish while increasing fruit, vegetables and legumes (e.g. Burlingame and Dernini, 2012; Poux and Aubert, 2018).

Contrary to plant-based whole foods, some plant-based meat replacements that mimic the taste and texture of meat are not necessarily healthy options — the Impossible Burger mentioned above contains comparable levels of saturated fat and salt to a regular beefburger, for example — and are classified as ultra-processed foods (Gurung et al., 2024). Although these products have a smaller carbon footprint than meat, they often contain high levels of salt, artificial additives for flavour, colour, preservatives, and fewer nutrients (Lee et al., 2024). Similarly, alternative plant-based 'milks' often contain fewer nutrients and less protein (but less fat) than cows' milk, and can feature additives like thickeners, or even heavy metals in the case of poppy-seed milks (Zvěřina et al., 2025).

Because not all plant-based alternatives to meat and dairy are equally healthy or sustainable, the protein transition needs to ensure that consumers are well-educated on the different alternative products (e.g. whole foods versus ultra-processed foods) and that the food environment also reflects these differences via labelling regulations, reformulation incentives, and accessibility and affordability of minimally processed plant-based foods (e.g. legumes).

The UK accounts for approximately one-third of all plant-based product sales in the European region (Dimbleby, 2021). Retailers and food companies have responded to this demand, using innovation to trial and scale-up alternative products. Lidl UK, for instance, has piloted a 'Meat-Free Monday' campaign and trialled repositioning plant-based products alongside meat products to increase their visibility and uptake. These interventions aim to normalise alternative proteins within everyday purchasing patterns and make them more accessible to mainstream consumers. Similarly, Quorn, a UK-based pioneer in mycoprotein (made from fungus), has invested heavily in product diversification and carbon labelling, helping consumers link environmental information to their consumption decisions (Carbon Trust, 2023). In 2024, the UK-based biotech firm Multus claimed to be developing a production plant for an edible serum-free culture medium which could be commercialised for the cultivated meat industry (Vegconomist, 2024).

However, regulatory, economic and education barriers remain. In the UK, any novel food not consumed before May 1997 requires authorisation under the Novel Foods Regulation, a process that can take several years. As a result, cultivated and precision-fermented products have not yet

reached UK supermarket shelves, whereas such products are already approved in markets including Singapore and the US (Good Food Institute, 2024). To address this, the UK Government has launched a regulatory sandbox to accelerate the approval process for novel foods. The initiative aims to reduce authorisation timelines and foster innovation in the sustainable protein sector. However, without complementary public investment in R&D and infrastructure, these products may remain niche and unaffordable for most consumers.

5. Analysis of interviews: UK cases

This section presents insights from the key informant interviews with relevant policymakers and experts (see Table 5.1). We begin by introducing the UK case studies and relevant country-specific information, primarily on the production side. We then discuss pertinent information, gleaned from the interviews, for each case study and present key emerging themes.

Table 5.1. Codenames of interviewees, place of employment and date of interview — UK

Code	Interviewee organisation	Interview date
UA1	University of Oxford (UK)	14/4/25
UA2	University of Oxford (UK)	14/4/25
UA3	University of Oxford (UK)	14/4/25
UO1	Climate Change Committee (UK)	27/3/25
SC1	NatureScot (Scotland)	24/3/25
SC2	NatureScot (Scotland)	24/3/25
UO2	Department of Environment, Food and Rural Affairs (England)	25/3/25
ES1	Basque Centre for Climate Change (Spain)	28/5/25
WA1	Natural Resources Wales (Wales)	18/6/25
NI1	Department of Agriculture, Environment and Rural Affairs (Northern Ireland)	28/4/25

England — introduction

The agricultural system in England is large and diverse and predominantly shaped by geoclimatic variables such as soil type, rainfall and temperature, which vary greatly within England and between the devolved nations. According to [UO1], there are 52,000 farm businesses in England and 209,000 across the UK as a whole. As one interviewee put it, *"there's no other sector which has as much diversity … we do an awful lot of different things within agriculture, and we do a lot of the same things completely differently"* [UO1]. This applies acutely to dairy, where the UK operates *"about six different systems … ranging from more extensive to more intensive, with all year-round calving, spring calving and autumn calving"* [UO1]. This diversity also affects environmental outcomes. The carbon footprint of English beef ranges dramatically *"from about 5 kilos of CO_2 equivalent per kilo of meat to about 55 kilos"*, with an average of *"around 23 kilos … less than 50% of the global average"* [UO1].

A contrast was drawn with the Netherlands, which as a result of WWII, saw highly coordinated land-use planning which has not occurred in the UK. *"We didn't have the same opportunity [to plan land use] because … our landscape didn't suffer the same amount of damage"* [UO1]. Differences in ownership structure was also commented on: *"… who owns the land? Are we talking about tenants … landlords … estates?"* — these factors, alongside *"average herd size or arable farm size"*, vary significantly depending upon where you are in England. Interestingly, a point on entrepreneurialism in the sector was made, with a statement that this is limited compared with other sectors of the economy: *"We see a whole host of young people coming out of our colleges and elsewhere who want to get into the industry but can't because there isn't the land or there isn't access to the land for them that they can afford to … We want fresh blood. Just because you happen to [be born] on a farm … doesn't necessarily mean you're going to be the best farmer either, you know"* [UO1].

Northern Ireland — introduction

Compared with other nations in the UK, Northern Ireland is more heavily reliant on livestock than other UK administrations. Approximately 97% of the landmass is grassland, the majority of which is dedicated to beef and sheep farming. Livestock production is export-oriented, with the largest market being the UK. Horticulture and arable farming remain marginal, given the climatic conditions, and the country's limited diversification makes a transition to lower-emission food systems particularly complex. For instance, efforts to promote alternatives like plant-based proteins or lab-grown meat are hindered by their limited economic relevance and public acceptance.

Policy-wise, Northern Ireland is in the early stages of its transition, which relies on the recent Sustainable Agriculture Programme (Northern Ireland Government, 2025). This programme incorporates incentive-based schemes to promote environmental practices, including agroforestry, rewetting of peatlands, and resilient grassland systems using red clover. The SAP also includes a series of initiatives addressing emissions at the source with the Soil Nutrient Health Scheme, the carbon footprinting project, and what is likely to be "*the biggest [bovine genetics programme] in the world*" [NI1]. The bovine genetics programme will genetically profile every cow born in Northern Ireland to identify traits linked to lower methane emissions.

The Northern Ireland Food Strategy was also only approved recently, and signals a more integrated, cross-departmental approach. While "*ownership sits within DAERA [the Department of Agriculture, Environment and Rural Affairs]*" [NI1], implementation relies on coordination with other departments which must align on strategic priorities including climate targets, sustainability and economic development.

Scotland — introduction

Approximately 70% of Scotland's land is agricultural, with around two-thirds classified as semi-natural pasture supporting extensive sheep and cattle systems. "*Farming systems are dependent on the fodder that can be generated off that semi-natural habitat*" [SC2]. These land-use types rely heavily on public subsidy, while the remaining one-third comprises more intensive arable, dairy and beef production, where land-use decisions are driven by market signals. "*The most dominating supply chain on Scottish agriculture is whisky and barley production*" [SC2], which exerts significant influence over production choices and carbon management strategies. [SC1] warns of "*perverse*" outcomes from voluntary carbon markets (VCMs) and other policies encouraging carbon sequestration where *"most of the emphasis at the moment is on ways of maximising carbon productivity and yield in the short term … as opposed to thinking about the longer-term dynamics through soils in the carbon cycle"*.

The Scottish agricultural policy transition remains heavily shaped by its legacy under the EU Common Agricultural Policy. "*We are basically still delivering the same payments on the same basis and the same policy outcomes as … the previous CAP round*" [SC2], devised in 2011–2012. However, there are signs of change, with some farmers shifting to "*low-input, more sustainable farming systems — less nitrogen, less animal feed input*" [SC2]. This transition is happening at a slower pace than in England, where the CAP has already been removed.

The Scottish Government is developing 'whole farm plans' as a central mechanism for guiding support "*on what payments [farmers] claim and draw down for delivering the plan*" [SC2]. This approach is designed to improve farm-level environmental performance while integrating future subsidy eligibility into a coherent framework.

Wales — introduction

Welsh agriculture is predominantly pastoral, with a strong livestock sector and only a small area of cultivated land. While there are pockets of more diverse land use (the example was given of potato farming in Pembrokeshire), the broader structure of the sector is livestock dominant. *"The issues around livestock numbers are particularly challenging in a Welsh context because the vast*

majority of the agricultural sector is livestock … at least 50% of agricultural livestock product is exported" [WA1]. This reliance on export markets complicates efforts to align climate, trade and food system goals.

At the same time, Wales's small size offers advantages for policy design and stakeholder engagement. *"Wales is a relatively small country … and the development of the Sustainable Farming Scheme (SFS) has been helped by the relatively small stakeholder community"* [WA1]. The presence of a national roundtable helps to build *"relatively good links between the Senedd [Parliament], Welsh Government and the stakeholder community"*, making consensus-building, if not always in alignment, more feasible than in larger jurisdictions, according to [WA1].

Post-CAP objectives

In England, development of Environmental Land Management schemes (ELMs) has followed a public-money-for-public-goods philosophy whereby *"all payments in England are now conditionalised around … a broad and shallow set of mostly climate and nature-based objectives. So, farmers, in order to receive their money, have to at least demonstrate they're doing those"* [SC1]. Within ELMs, the Sustainable Farming Initiative (SFI) contains numerous measures that have been "*retrofitted to include net zero and climate related aspects"*, despite being *"originally designed and conceived to be much more about other environmental impacts"* [UO2]. Decisions to conditionalise payments within ELMs have built on pre-existing momentum within the CAP in the 2010s whereby *"CAP subsidies then became about the environmental stewardship of the land … we decoupled payments from production"* [UO2]. However, the trajectory of agricultural policy, as evidenced in the Treasury's 2025 Spending Review, has been to continue the phaseout of basic payments and for delinked ELMs payments to comprise £1.8 billion of the £2.7 billion annual Farming and Countryside programme budget. Interestingly, [UO2] states that *"[The UK Government should] focus on farm businesses that are economically viable and environmentally sustainable and nothing less, and that's [where] government policy is aiming … [and] the whole idea of subsidies at the moment is not to underpin failing businesses forever but lean industry towards being economically viable and environmentally sustainable"*.

As highlighted earlier in the report, the devolved administrations have taken different approaches to developing policies to support agricultural producers post-Brexit. In Scotland various policies are in the process of being implemented to maintain direct minimum payments and incentivise improved management practices under Good Agricultural and Environmental Condition regulations (which are being phased out and replaced with the PSF) and the Agri-Environment Climate Scheme. Current payments are delivered based on funding rates from the previous CAP round in 2011/2012 and will *"remain pretty much the same way for the next two to three years; but [new subsidies] … gradually, bit by bit, will be more and more conditionalised than they have been around … adaptation and nature/biodiversity outcomes"* [SC1], with emissions reduction an ancillary benefit.

In Scotland delivery of these schemes is guided by fears of *"the cliff edge and the just transition"* and acknowledged inequality in how *"[CAP] payments have [historically] been delivered, particularly around climate action … for those farmers and crofters who are able to deliver most for biodiversity, for climate"* [SC2]. Scottish farmers wishing to continue to access basic payments must satisfy requirements within the Whole Farm Plan and *"will have to declare they've undertaken two of five audits*[4] *on the farm with a view to 2027 having to do all five"* [SC2]. The Scottish Government has shown interest in Northern Ireland's Soil Nutrient Health Scheme (SNHS) and plans to invest in evidence gathering through *"a LIDAR*[5] *survey of Scotland"* [SC2]. A benefit of domestically developed agri-environment schemes is that by *"conditionalising*

[4] These audits are: a carbon audit, a biodiversity audit, an animal health and welfare plan, an integrated pest management plan, and soil analysis (Scottish govt.).

[5] Light Detection and Ranging (LIDAR) is a remote sensing method that uses laser light to measure distances and create detailed 3D representations of surfaces.

agriculture payments ... farmers start to concentrate on their costs and their inputs, and then on their productivity" [SC2].

In Wales, development of the Sustainable Farming Scheme (due to start in 2026) is considered to be *"a bit behind where things are in England"* [WA1]. The *Net Zero Wales* report (Welsh Government, 2021) *"sets out the key building blocks in relation to decarbonisation within the land use and agricultural sector"* [WA1]. As with ELMs, farmers must undertake universal actions — which have been whittled down from 17 to 12 after *"farmer activism"* [WA1] in 2024 — or more ambitious optional and collaborative elements of the SFS. Universal actions within the SFS relate primarily to carbon audits, habitat/woodland/peatland maintenance, animal health and pest management. Earlier proposals for farmers to set aside 10% of their land, as a universal action, for woodland and habitat creation have been substantially curtailed after widespread protests. Instead, a Carbon Sequestration Panel (Welsh Government, 2025) elicited expert and stakeholder opinion on options to increase sequestration through other methods such as biochar application and enhanced rock weathering, to assuage farmer concerns over the earlier proposals. The Welsh Government is currently considering this feedback.

Northern Ireland has established the Sustainable Agriculture Programme to replace the CAP. Challenges within the Northern Ireland Executive have meant policy development has been disrupted, however. *"The policy landscape in Northern Ireland is just so changeable within the last year even and a lot of that boils down to the fact that there was no functioning executive for three years"* [NI1]. The *"sustainable agriculture programme [will] incentivise agroforestry or rewetting of peat lands and there's a lot of research going on at the minute about cover-cropping and resilient grasslands"* [NI1]. According to interviewees, Northern Ireland has made a concerted effort, that is *"quite radical"*, to tackle livestock emissions through a *"mandated age of slaughter for beef cattle that starts at 36 months and drops a month every year until it comes down to 24 months"* [UO1]. Northern Ireland is also conditionalising payments on farmers participating in a *"bovine genetics programme, which is where every single cow born in Northern Ireland is going to be genetically profiled"* [NI1] alongside the Soil Nutrient Health Scheme, while also exploring how methane inhibiters can be deployed on farms. These measures *"are tied in together in order to chase efficiency improvements"* [UO1].

Farmer perceptions

According to interviewees, UK farmers show a consistent openness to more sustainable practices, provided incentives are clear, fair and constructive. As [UA1] argues, *"many farmers and land workers in the UK would like to farm in ways that are more sustainable, more environmentally friendly, [with] lower emissions"*. However, despite a "*positive incentive structure"* in post-CAP schemes, uptake is not as strong as it could be. Some interviewees argue that the lack of clarity is a major factor of this slow uptake. In Scotland, for instance, *"an increasing body of farmers is crying out for some clarity on what the change is expected so they can start planning for it"* [SC2].

A recurring theme across interviews is the deep emotional and cultural connection farmers feel to their work and land. As [UO2] explains, *"it is a job that literally connects you to the land and the landscape, people's place of business is often their home as well"*. This deep connection to place renders the ability to make changes, particularly those needed to lower emissions, or to exit farming altogether, very challenging. *"We need to find a way to not dismiss the emotion. Absolutely account for it, but have a separate conversation about emotion and a separate conversation about the economics of the situation"*, [UO2] adds.

This is particularly salient for livestock farmers, who often feel blamed for environmental harm: *"we often put blame ... on the shoulders of livestock farmers, who are often desperately trying to stop their business from failing, and they feel this extra burden that they're also sending the planet into, you know, burning"* [UO2]. The emotional connection farmers feel to the land may also arise because of their day-to-day work with livestock: *"there's much more emotion tied up with livestock than there is with cropping"* [UO2].

Structural and information/skill constraints have limited the ability of certain sectors of Scottish agriculture to participate in new agri-environment scheme requirements, particularly for those previously highly reliant on CAP subsidies, who have *"no farm auditing or new farm planning at all to speak of"* [SC2]. Introducing whole farm plans is seen as a foundational move (within the Agri-Environment Climate Scheme), helping *"[farmers to] understand what their baseline is and how their land is performing"* [SC2]. But pockets of discontent exist, with [SC2] identifying farmers north of the River Tay, who argue practices such as minimum tillage are incompatible with local conditions because *"they can't yield anything like the systems they have now"*.

In Wales, farmer resistance to the SFS was catalysed by miscommunication and media misreporting according to [WA1]. The proposal for a 10% woodland requirement within the prescribed universal actions was mischaracterised by the media as a demand to plant trees on 10% of all farmland, which ignored existing woodland/habitat cover that contributed to the 10% requirement. Additionally, Welsh farmers assert their comparative advantage in livestock production, challenging the assumption that reducing herd size is the only climate-friendly path: *"Wales is a good place to produce livestock ... if we are more efficient than other producers then why should we be required to reduce our numbers?"* [WA1].

Training and education

Another recurring theme across the interviews was the need for education, both among the farming community and the general public, in the UK's transition towards environmental sustainability.

At the national level, a key gap remains in the general public's understanding of the connection between food consumption choices, farming and climate change. While the school curriculum incorporates climate and sustainability in subjects like geography and science, there is scope to deepen people's understanding: *"The national curriculum could be changed ... to bring forms of healthy eating more into it ... as a lived experience that's built into school life. There are examples, I'm thinking about Japan, where that's been done very successfully"* [UA1]. There is also emerging evidence that public education can indirectly influence farm decision-making, especially via children. As [UO2] explains: *"there has been impact on farm decision-making by directing information at primary-aged children"*, who then relay these messages to their parents who are in farm management/ownership positions.

A cross-cutting challenge is understanding why certain climate- and cost-beneficial practices are not widely adopted, even when they are clearly aligned with farm business interests. [UO2] suggests that *"what is good for the climate and what is good for the environment is also good for the individual farm business pockets"*, and yet, despite *"quite a lot of measures [being] in the farm business self-interest"*, most farmers do not implement them. This raises a number of questions: "*Do they lack the knowledge, do they lack the education? Do they lack the incentive, do they lack access to means and tools and materials?*" [UO2].

In Scotland, the Government has moved to empowering farmers with tools for self-assessment and cost control, especially given the *"sheer cost of specialist advisors"* [SC2] and limited public capacity to deliver tailored support.

Wales is taking structured steps to embed continuous professional development into agricultural policy. Within the SFS, farmers are required *"as part of the universal actions for SFS to undertake some [learning] modules"* and "*it is down to the farmers to pick and choose what modules they feel ... [are] most appropriate to them*" [WA1].

Incentives demand and supply

Incentivising emissions reductions from agricultural production can be achieved through numerous approaches and this is represented in the diversity of views expressed by interviewees. Beyond the moves to conditionalise payments in the UK administrations, interviewees offered other suggestions as to how farmers might take up on-farm mitigations. One interviewee [UO1]

argues for incentives to support *"farm businesses to understand the economics of their own business"* because of the overlap between incentives to reduce input costs by improving live weight gain efficiency and reductions in methane emissions; *"if you take a beef cow in particular ... you feed the animal; you know [its] daily live weight gain goes up. But at some point, that chart starts to plateau and where it plateaus is both the economic and the environmental optimum for the age of slaughter"* [UO1]. This sentiment is affirmed by [SC2] who articulates a need for incentives to sharpen the focus on the *"marginal gain from additional inputs ... [to] become more profitable without subsidy, [leading] to low input ... more sustainable farming systems, less nitrogen, less animal feed input. And you manage your animals with forage that you can generate off the land"*. In Scotland, [SC2] highlights the role of VCMs in incentivising farmers to participate in reforestation or peatland restoration activities while also referencing risks associated with this engagement by *"maximising carbon productivity and yield in the short term, through what can be readily counted [through VCMs], as opposed to thinking about the longer-term dynamics through soils in the carbon cycle"*.

Within the suite of post-CAP agri-environment schemes in the UK administrations, and the conditionalised actions therein, there was no mention of support schemes to incentivise deployment of feed additives or nitrification inhibitors. Once additives such as Bovear clear food safety hurdles there will need to be a subsidy or tax incentive to apply feed additives: *"financial incentive [or] some sort of tax benefit ... or make it a legal requirement that farmers include them and use them. Or you mandate it such that feed compounds ... those people who are making up the feed that the ruminants are going to be consuming are legally obliged to include it"* [UO2]. Instead, supply chain incentives are increasingly important in shifting on-farm production practices; the *"relationship between markets, incentives and payments and regulation and so on matters to a degree but, but actually an awful lot of what goes on farms is determined by, you know, what the buyers are prepared to pay for over the gate. And a lot of that comes down to concentrations of power and wealth within supply chains"* [SC2]. Others spoke of the challenges for domestic policies on the demand side to influence export-oriented domestic food production. In Scotland, *"intensive beef, arable, dairy ... they're increasingly, but not quite ... yet ... driven by market demand... [with a] disparate group of supply chains [and] very much ... interested to export rather than [supply] domestic demand"* [SC1].

Food policy challenges

Across interviewees, demand-side measures mentioned included diet messaging and education, the development of protein alternatives, public procurement approaches and the need for greater accessibility of healthier and sustainable products, in particular for lower-income populations.

Northern Ireland is in the early stages of exploring how dietary goals and protein shifts align with farming strategy. Northern Ireland's broader food strategy relies on four priorities, namely, diet education and accessibility, sustainable supply chains, a prosperous food economy, and food culture, in the sense of developing a *"food conscious society"* [NI1]. These agenda items are coordinated across multiple departments, but in practice incentives are still in their infancy. The Protein Crop Scheme was recently launched to *"[encourage] farmers to get paid basically to grow protein crops rather than something else"* [NI1]. Yet, the scheme's current focus is on production only, not on consumption behaviour or shifting diets towards alternative proteins. Discussions are underway on lab-grown meat regulation, but Northern Ireland currently has no access to or regulatory pathway on these emerging technologies. Questions also remain about cultural acceptance and sustainability trade-offs in energy use.

In Wales, [WA1] reports that while the Welsh Government is considering alternative proteins and food system reforms, there is no concrete policy or imminent action: *"It's something that Welsh Government I think is considering, but I'm not aware that there's any specific policy or imminent kind of action around it"*. As with other nations, structural coordination across health, agriculture, and environmental departments remains a barrier. Scotland is advancing its food policy under the 'Good Food Nation' agenda, signalling a step towards integrating consumption concerns into

broader food systems policy. However, direct links with agricultural reform remain under development.

In the UK, a persistent challenge is *"the massive cost to the health sector associated with poor quality diets"* [SC1]. [SC1] further emphasises the *"false economy of big food"*, pointing to the burden on the health system of poor diets and noting that *"for every £1 of food consumed in the UK [there] is £2 of external costs. It's one of the worst ratios in the world"*. A polarised food environment limits healthier choices: ultra-processed, unhealthy food is cheap and widely available, while nutritious, low-carbon alternatives remain inaccessible, especially in lower-income neighbourhoods. [UA1] shares their own experience as an example, explaining that *"I can get to three food shops within a three-minute walk, and all of them basically only sell chocolate and sweets ... I'd have to walk a lot further to get to a shop that sells fresh food"*. [UO1] confirms that the food environments of low-income families often exclude healthier or plant-based alternatives: *"your corner shop is less likely to have a variety of food"*. Moreover, the relative price of food remains a central barrier. Interviewees consistently rejected punitive measures like taxing meat, instead favouring relative pricing reforms that support healthier and more sustainable options.

Regarding alternative proteins, [UO1] reports that *"before 2022 there was a bit of an explosion in the brands and stuff around alternative proteins, which also means that ... the options around cheaper ones improved"*. However, [UO1] warns that poor taste or texture in cheaper products risks deterring first-time buyers: *"There's some studies that show people fall out of trying it again for another year or two ... you don't want someone to have a negative experience with their first product"*. Moreover, novel food assessments and applications are slow and unpredictable, such that full commercial availability remains years away: *"It's a learning-by-doing process which takes years ... it takes five years or so to go through a portfolio assessment"* [UO1].

In terms of public messaging, interviewees noted that overcomplicated dietary advice is unhelpful. Clear and simple messages (e.g. reduce red meat consumption) should be prioritised, but cultural and political sensitivities continue to constrain open discussion about dietary change: *"it's a long-standing political culture thing that you don't talk about diet change if you can avoid it"* [UO1]. There is also an equity challenge: most demand-side interventions, such as public awareness campaigns, *"tend not to reach low-income families as much"* [UO1] as wealthier households.

Some policymakers are exploring more systemic levers such as public sector procurement to normalise dietary change (e.g. blended protein meals in schools and hospitals) but evidence of scale or effect remains limited.

Integrating agriculture and food policy

Another consistent theme emerging across the UK is the need for a more integrated approach to food policy, accounting for interdependencies between agriculture, health, climate, economics and social welfare. Northern Ireland appears to be taking initial steps towards food systems thinking, as indicated by [NI1]: *"This is the first piece of kind of one umbrella food strategy in Northern Ireland"*. Despite this milestone, the lack of a cohesive approach remains a major obstacle. Notably, food-related responsibilities are spread across multiple government departments (e.g. health, economy, the environment, etc.), leading to inefficiencies.

In contrast, Scotland faces a different set of challenges. While there is awareness of food system dynamics, the lack of a clear agenda on food at the national level leads to ambiguity which in turn constrains progress: *"Even the small tweaks and changes to agriculture, the existing schemes and basis for agriculture payments that the Ministers are prepared to introduce ... are still not very clear about how that works for food"* [SC2].

At the UK-wide level, interviewees emphasised the complexity of food system interactions, which implies that *"any one single measure is not gonna be enough ... they all interact and you don't really know what the consequences will be"* [UA2]. In practice, objectives are often handled in silos, when *"all ... those things [production, food security, nutritional requirements, carbon requirements, soil degradation] need to not just be separately taken into account, but taken into*

account together'" [UA3]. Moreover, UK-wide consumption trends, such as the gradual rise of flexitarianism, have complex feedback loops with supply chains, trade and environmental outcomes, which also need accounting for. Two interviewees also highlight that without aligning supply-side and demand-side measures, policy interventions risk leading to counterproductive effects in the global market:

If you convince your farmers through supply-side measures to reduce their livestock numbers, but you don't reduce demand ... all you do is hand over their share of the market to imports [UO1].

What happens in the first instance is that production stays exactly the same but exports increase ... diet change with regard to production is almost a flawed argument [UO2].

Data and evidence

As mentioned previously, there have been increasing efforts made by jurisdictions to understand baseline emissions and nutrient balances on farms. This has been pioneered by Northern Ireland with the Soil Nutrient Health Scheme (SNHS) and national LIDAR surveys to give the Northern Ireland Government valuable information on field-level nutrient balances while also giving farmers a baseline upon which to better manage fertiliser application and runoff [NI1]. The Scottish Government sees that there is a benefit in emulating the approach taken in Northern Ireland: *"[the] Scottish government is trying to [sic] follow the Northern Irish government's approach because it's very similar in terms of very intensive beef dominated industry and where the government there has chosen to, first of all, provide complete LIDAR survey of all of Northern Irish Farms to understand water conditions and to some extent, vegetation as well grassland condition, but also to couple that with soil sampling every field"* [SC2]. New monitoring techniques and the creation of large datasets must also be coupled with investments *"in machine learning, artificial intelligence for interrogating large data sets ... [to allow] real time monitoring and management adjustments"* according to [SC1], in order to best target interventions to reduce emissions and increase carbon sequestration. However, uncertainties abound with respect to land-use change decisions to increase carbon sequestration.

[SC2] highlights evidence that with *"natural regeneration on organic soils ... even where these trees are becoming established, naturally, the amount of soil disturbance associated in their establishment means that there's no net carbon benefit to 2040, but there is benefit after that"*. Such issues exemplify the challenges of policymaking with a limited evidence base. Similarly, one challenge identified with ELMs has been the difficulty of linking a given action within the SFI and the resultant abatement. Policy decisions have been made to incentivise actions without clearly linking this to abatement outcomes, for example cover cropping even though there are substantial uncertainties as to the accumulation rate of soil organic carbon: *"... are we talking about a cover crop mix that includes deep rooting crops? [Or] just, you know, shallow rooting crops; are there legumes in that mix? ... [What] is the soil type and clay composition of that soil? ... then you have to take into account [whether SOC accumulation is from] the cover crops per se, or is it the cover crops plus other cultural activities, i.e. those people who do cover crops often do minimum tillage as well?"* [UO2].

Finally, the ever-increasing requirements for farmers to provide scope 1–3 emissions data to downstream businesses is seen as an area ripe for reform: *"Personally, I'd love to see more interoperability of data, i.e. the farmers only provide it once and it's made available to whomever they choose it to go to, you know, because. So often there are ... more people benefiting from the [farmer's] data than the farmer themselves"* [UO2].

On-farm mitigations

Efforts to reduce agricultural emissions across the UK administrations increasingly centre on three strategies: enhancing sequestration, improving production efficiency, and adopting targeted mitigations such as feed additives.

In relation to sequestration, the administrations are trialling different approaches. In Scotland NatureScot has piloted a low-cost method of auditing on-farm biodiversity and above-ground carbon storage. This relies on farmers and crofters using a specially designed, farmer-friendly app to conduct their own audits, thereby reducing dependence on expert consultants and integrating biodiversity considerations into everyday farm decisions [SC1]. In Wales, the approach to woodland-based sequestration appears more cautious given the backlash to the earlier proposals. However, despite this, change may be happening, with *"farming unions happy to...agree a target for the Welsh agricultural sector to deliver in terms of woodland creation"* [WA1].

Across all the administrations, improving agricultural efficiency is increasingly seen not only as a pathway to profitability but as a route to emissions reductions. Technological advancements (such as integrating yield monitors into modern harvesters on arable farms) allow farmers to scrutinise in-field productivity and tailor land use accordingly. *"If you simply stop growing on those bits which are costing you money, you will be more profitable — not as productive, but more profitable"* [UO2].

In Wales, although no explicit policy currently seeks to reduce livestock numbers to reduce emissions, [WA1] emphasises the future role of feed additives, is cognisant of the emissions benefit of reduced slaughter age, and suggests enhanced productivity per animal as key levers to address emissions. A similar emphasis is found in Northern Ireland, where methane inhibitors, genetics programmes and improved grassland management are among the tools being explored. Although still at an early stage, such interventions form part of a wider mitigation landscape that also includes crop diversification schemes and circular economy pilots [NI1].

Nonetheless, interviewees recognise that these measures may not be sufficient on their own. The broader direction of travel, shaped by the CCC, implies a structural shift in land use and stocking density. The CCC *"set out the idea that there should be a reduction in productive agricultural area"*, partially offset by efficiency gains, but also *"by a genuine reduction in livestock numbers"* [WA1].

Yet deployment of these measures in the UK is hampered by several factors. A central challenge is the lack of clear long-term policy direction. One interviewee observed, *"an increasing body of farmers is crying out for some clarity on what ... change is expected so they can start planning for it — despite the fact that government are not prepared to actually make the changes yet"* [SC1]. This policy ambiguity, while intended to allow time for consultation and voluntary uptake, risks driving disengagement.

Structural barriers are particularly acute for tenant farmers, who may occupy land with high sequestration potential but lack the authority to participate in carbon markets or land-use schemes. In Scotland, *"most of the farming businesses are actually tenants and don't have control over the peatland or the woodland. So therefore can't take part ... in those carbon codes"*. Meanwhile, *"their owners [are] desperate to [participate in VCMs], but beholden to the tenancy agreements they have on their land"* [SC2]. This disconnect between land ownership and management control generates what was described as *"a real kind of inertia"* — a misalignment in incentives that undermines delivery of woodland creation and peatland restoration goals [SC1].

Policymakers also confront the complexity of the land-use puzzle itself. One interviewee referenced decision support exercises that conceptualised options as interchangeable "Lego blocks" of mitigation: *"each Lego block ... being a mitigation measure ... and the overall conclusion was that you can't ... not reduce livestock numbers, you can't not have woodland creation, you cannot not have peatland restoration or livestock production efficiency"* [WA1]. The implication is that no single strategy is sufficient and policy must support a variety of land-use changes and land management tweaks to effectively decarbonise agricultural production while balancing the trade-offs. Despite agriculture's adaptability, one interviewee cautioned that this responsiveness operates on long timescales: *"agriculture is ... one of the most responsive and changing industries — it just does it slowly, but it always responds to what the market wants"* [UO2].

6. Analysis of interviews: EU case studies

This report adopts a comparative lens using case studies from the EU context to showcase different approaches to tackling the agri-food transition that could inspire the UK to choose the most efficient and relevant policy levers. These cases vary in their socioeconomic and agricultural contexts, and the experiences they reflect can therefore not be directly applied to the UK. They represent, however, the diversity of agri-food models and offer context-sensitive perspectives on the transition from different regions of Europe: Northwestern — Denmark and France, Southwestern — Spain, and Central/Eastern — Poland. This section presents insights from the key informant interviews with relevant policymakers and experts from those countries (see Table 6.1).

Table 6.1. Codenames of interviewees, place of employment and date of interview

Code	Interviewee organisation	Interview date
PO1	Institute of Agricultural and Food Economics — National Research Institute (Poland)	28/5/25
DK1	Danish Council on Climate Change (Denmark)	23/5/25
ES1	Basque Centre for Climate Change (Spain)	28/5/25
FR1	Direction régionale de l'alimentation, de l'agriculture et de la forêt (DRAAF) (France)	18/6/25

The section first introduces the specificities of the agricultural sector and major food and agricultural policies in place in each country case. The analysis of interviews then elaborates on specific recurring challenges and themes of interest across the case studies.

Denmark — introduction

Denmark's agricultural sector plays a central role in its economy and landscape, marked by high livestock densities and an export-oriented domestic industry (Brocard, 2024; Jones, 2024). The Danish agricultural system is characterised by a *"large stock of cattle"* [DK1] and intensive cropping on peat soils. Of the cultured land, 60–70% is dedicated to feedstuff for the animal sector, while *"only 30% is used for producing foodstuff for people"* [DK1].

Denmark's agricultural sector is a major contributor of national greenhouse gas emissions (around 28%), which are dominated by methane from ruminants and nitrous oxide from fertilised soils (Albrektsen, 2025). Denmark has adopted a comprehensive climate strategy for agriculture, anchored in the 2021 agreement on a green transition of the agricultural sector, which sets a binding target of reducing agricultural emissions by 55–65% by 2030 compared to 1990 levels (Brocard, 2024; Jones, 2024). Historically, Denmark relied on voluntary, subsidy-based schemes to reduce agricultural impacts, but these have proven ineffective according to [DK1]: *"We have a long history of experiences trying to drive down agricultural environmental impact through voluntary schemes and they don't work … farmers don't opt into the schemes at a sufficient rate".'* Most interventions used Pillar II of the CAP to fund agri-environmental schemes such as reducing greenhouse gases from peat soils, establishing catch crops, or temporarily removing land from production.

As [DK1] notes, *"the focus on agriculture and climate has not been very pronounced from a policy perspective until the agreement last summer"*. That turning point came with the Tripartite Agreement (2024), a cross-sectoral deal between government, industry and civil society which set a decarbonisation pathway for agriculture and forestry until 2050. The agreement introduced a phased carbon tax on livestock emissions starting in 2030, alongside substantial subsidies for

peatland rewetting, afforestation, nitrogen reduction on crop land and the development of plant-based food systems (European Environment Bureau, 2025; Jones, 2024).

While the agreement is projected to reduce agricultural non-energy greenhouse gas emissions by up to 2.6 $MtCO_2e$ by 2030, the European Environment Bureau (EEB) notes that Denmark continues to rely heavily on technological solutions (e.g. feed additives, manure management and biogas) without addressing the structural impacts of intensive livestock production (European Environment Bureau, 2025). On the demand side, although "there is no comprehensive food strategy" (Brocard, 2024: 6), Denmark has introduced climate-informed dietary guidelines recommending a maximum of 350 grams of meat per week and has invested over €170 million in plant-based food innovation as part of the 2021 agreement on a green transition of the agricultural sector (Brocard, 2024). These investments focus notably on a "strategy for green proteins for food and feed as well as support for a far-level eco-scheme" (ibid.: 6). A 'Plant-Based food grant' has also been created to support projects relating to organic plant-based foods, sustainable production, education, and so on (Ministeriet for Grønt Trepart, n.d.). Despite these advances, and being considered an ambitious model in the EU (European Environment Bureau, 2025), the EEB believes that the current strategy prioritises competitiveness over systemic transformation (ibid.).

France — introduction

In metropolitan France, 54% of the land is cultivated. This cultivated surface area has only slightly decreased over time, from 34.4 million hectare in 1950 down to 29.0 million hectare in 2016 (Sharma, 2020). France's agricultural system is both economically significant and politically sensitive, shaped by a long-standing emphasis on food sovereignty, rural livelihoods and gastronomic heritage. In recent decades, changes in land use have been partly shaped by the EU CAP, which introduced, for instance, enhanced crop rotation (Sharma, 2020; Therond et al., 2017). In terms of cattle breeding, France stands out among other EU countries which tend to specialise in a single type of livestock. Indeed, in France's 'Great West', several livestock sectors coexist (dairy, meat (pork and beef), and poultry) each with a high level of production per unit of area and work, and a significant use of inputs (Dumont et al., 2016). This diversity allows great adaptability in terms of agricultural production. As [FR1] comments, *"it's easier to do grass-fed cattle with all the mountainous areas we have"*. This suggests that geographical advantages have facilitated France's alignment with the spirit of the CAP.

Two recent national programmes have supported the sustainable transition of the French agricultural system. 'France Relance' (the post-COVID recovery plan) injected large amounts of public funds into the agricultural sector with a focus on sustainability and decarbonisation. A flagship measure was *"the support for carbon diagnostics ... and that worked very well"* [FR1]. These diagnostics are meant to help farmers identify emission reduction opportunities. Then 'France 2030' targeted cutting-edge innovation, funding selective projects for high-tech, low-carbon agri-equipment. The recently (2025) adopted Loi d'Orientation Agricole (Agricultural Orientation Law) aims to unify the various existing regulations around hedgerow governance, which is currently regulated by many different legal sources. The Climate & Resilience law (2021) also mandates an 'eco-nitrogen plan' to cut nitrogen fertiliser use by 15% and ammonia emissions by 13% by 2030 (on 2005 levels), including tax provisions if targets are missed (INRAE, 2023b). Lastly, the Planification Écologique (Ecological Planning framework) aimed to consolidate and deepen these efforts, but its future is uncertain due to recent government budget constraints. It notably introduced a national hedgerow support scheme to *"contribute to decarbonisation since [hedgerows] support carbon storage in soils"* [FR1].

On the demand side, two main programmes are in place to implement food policy in France: the Health and Nutrition Plan (PNNS, since 2001) and the French Food Plan (PNA, since 2010). Recent efforts have aimed to integrate climate, health and social equity objectives into a more coherent framework: in 2025 the government published a National Strategy for Food, Climate, and Nutrition (SNANC), intended to provide overarching direction to existing plans while fostering cross-sectoral coordination (Brocard, 2024). France has also introduced a series of regulatory

measures to improve the sustainability of public food procurement. Since the 2021 Climate & Resilience law, these include a mandatory weekly vegetarian meals experiment in schools, minimum thresholds for organic and 'quality' foods extended in private public procurement, and restrictions on single-use plastics in catering services (Brocard, 2024: 28) . INRAE and ANSES established the Oqali food observatory in 2018 to monitor nutritional reformulation across processed food products to track levels of salt, sugar, fats and packaging quality (INRAE, 2023a), complementing the Ministry of Agriculture's 10-year Plant Protein Strategy, launched in 2020 to double the cultivation of local protein crops by 2030 (INRAE, 2025). France has also begun to reframe its social food policy by greening food aid and piloting alternatives to the traditional food bank model. Initiatives such as the 'Mieux Manger pour Tous' programme and citizen-led experiments in 'social security for food' reflect a growing recognition of the need to ensure dignified, sustainable access to food for all (Brocard, 2024: 30). However, implementation remains uneven due to limited stakeholder engagement, lack of binding mechanisms and lack of funding at the municipal level (ibid.).

Poland — introduction

Agriculture occupies about half of Poland's land area, with arable farmland covering over a third — among the largest areas in the EU. The sector comprises ~1.3 million mostly small-scale farms averaging 11 hectares, often dispersed across multiple plots. These small-scale operations are typically *"not so effectively organised ... generally [being] focused on crop production"* [PO1], which limits their capacity to adjust land management strategies as knowledge changes or new innovations come to market. Mixed farming has seen a noticeable decline *"crop and livestock production is less and less popular in Poland. So we observe strong decreases of mixed farms"* with a bifurcation between, on the one hand, *"very well organised crop farms ... [and] on the other hand ... very intensive farms focused on specialised animal production"* [PO1]. This dual structure presents challenges, particularly for *"some average farms that could combine smaller scale livestock and crop production"*, which struggle to compete or adapt.

Within the EU, Poland is consistently one of the largest agricultural producers, typically being the third largest wheat, rapeseed and corn producer, the second largest rye producer and a substantial producer of silage corn, barley, oats, potatoes, sugar beets and beans (Purcell, 2024). The predominant livestock sectors are dairy, pigs and poultry. The Polish agricultural budget is €25.2 billion, comprising €22.1 billion in EU funds and the rest domestic. Funds support 200,000 farms, with 30% of their value conditional on environmental and climate friendly practices (European Commission, 2025b). The CAP Strategic Plan outlines strategies to deliver Pillar II payments through 'Eco-Schemes' focusing on solar photovoltaic developments and biogas projects, funding for beekeeping, soil health measures, pesticide reductions and incentives to leave land fallow (European Commission, 2025a). [PO1] identifies a willingness on the part of farmers to engage with domestic 'eco-schemes' beyond the CAP, but budgetary pressures limit the available payment per hectare.

The environmental efforts from farmers are also mixed: *"We see some very well organised farms when we think about environment and climate, but on the other hand, we have some percentage of farms that are only focused on the volume of production"* [PO1], especially in the poultry and pig sectors. Specific emphasis is placed upon skills development for farmers given the small scale of many farms which limits economies of scale, hinders data collection and contributes to low productivity. Challenges include limited technical equipment, a shortage of entrepreneurs and difficulty attracting a well-educated workforce due to poor rural infrastructure and services. With agriculture responsible for 9.7% of Poland's greenhouse gas emissions in 2022 (Ministry of Climate and Environment Republic of Poland, 2024), there is a growing need for practical tools to support farmers in reducing emissions from intensive crop and livestock systems.

Poland lacks a coordinated national food policy; responsibility for policy delivery across the food system is split between the agricultural and health promotion ministries (Wrona, 2024). The 2021–2025 National Health Plan is the key framework through which food and health policy is delivered, with a primary goal of increasing the number of healthy years lived, reducing the numbers of

people overweight or obese, and reducing social inequalities in health (including smoking cessation and mental health improvements) (ibid.). No connection between consumption and climate change is identified in the plan. Interestingly, a sugar tax that targets beverage producers has been introduced which encourages reformulation of sugary beverages and supports consumers to shift their choices. Revenue is earmarked to a National Health Fund (ibid.). An additional measure of note is a 2015 regulation to limit the sale of 'junk food' in schools. The law prohibits the sale, advertisement or serving of unhealthy or highly processed foods such as chips and fast food. Instead, it mandates that school shops and canteens offer a balanced range of food groups, focusing on vegetables, fruit and fish, and limiting fried foods. According to Wrona (2024), evidence on the efficacy of these programmes is limited because enforcement mechanisms are scant — however, the existence of these measures indicates a willingness to use policy to deliver on health goals and could be expanded to include emissions relating to foodstuffs as a criterion.

Spain — introduction

Spain's agricultural sector comprises crop production, livestock and a substantial fisheries industry. There are three main agro-ecological environments which dictate agricultural practice (Ministerio de Medio Ambiente y Medio Rural y Marino, n.d.). In the west, there are wet Atlantic systems, with a positive annual humidity balance; in the southern and eastern areas there is a dry Mediterranean system, with a three to five-month dry summer and annual humidity deficit; and in southern and inland areas throughout Spain there is a semiarid system where the number of dry months can exceed the number of wet months (ibid.). Crop production is the dominant segment by value, accounting for over 60% of agricultural output in 2015 (La Moncloa, 2015). Within this sector, fruit and vegetable cultivation is valued at €13.24 billion, with over 80 products grown and roughly half of production exported, particularly to other EU countries. Olive oil and table olives are also globally significant, with Spain producing 44% of the world's olive oil and leading in exports. Cereals are widely cultivated but for domestic markets.

Spanish agriculture comprises intensive and extensive elements and substantial areas devoted to maintaining more traditional and extensive livestock systems. Industrialised production, particularly in pork and poultry, is increasingly prevalent, especially in the north and northeast. The public perception of the Spanish agricultural system is, however, *"not a vision [of] a very industrial livestock system … because most of the system in Spain [is] quite linked to territories and rural areas"* [ES1]. The livestock sector, however, contributes 40% of agricultural output and this share has remained stable since 1970 (Ministerio de Medio Ambiente y Medio Rural y Marino, n.d.). With a herd of over 6.1 million, Spain ranks third in the EU by cattle population. Beef and dairy together account for 13.6% of total agricultural output (7.1% from beef, 6.5% from dairy) (ibid.). Sheep and goats are also widely farmed, with Spain hosting the largest sheep population in the EU25. Pig and poultry farming are the most specialised and industrialised livestock systems within the country, with pork farming dispersed throughout the entire country (La Moncloa, 2015). However, accounting for emissions within the pork sector presents challenges given the embodied emissions in imported feed, *"they eat a lot of soy … produced very far from Spain. So, most of these emissions are not reported in the Spain inventory"* [ES1]. Fisheries are another important segment with per capita consumption on average 39 kilograms per year. However, substantial imports are required to satisfy demand (ibid.). Agriculture comprised 11.5% of Spain's total emissions in 2023, with a 3.7% reduction since 2005 (Morgado Simões and Erbach, 2024).

Spain's exposure to climate impacts, especially water scarcity and extreme heat, means it is essential that mitigation and adaptation are integrated in agricultural policy. *"Spain is a very vulnerable country in terms of exposure to climate change impacts. So it's important that mitigation and adaptation policies … go together"* [ES1]. *"We need to cope in terms of water availability, temperatures … and at the end … the ones who need to implement the policies are the farmers"* [ES1].

On the demand side, contemporary Spanish diets are increasingly shaped by convenience and processed food trends. *"We are not cooking, so we are buying and consuming outside home, but also ultra-processed food and ready-to-eat food"*, leading to a nutritional shift away from traditional staples. *"We eat less vegetables and much less legumes from the recommendations in general"* [ES1]. The Spanish National Food Strategy was published in February 2025 and focuses on a number of areas which include: food supply stability; sustainability; regional and coastal strengthening; encouraging shifts to healthy diets; fostering innovation; promoting transparency and accessibility of food information for consumers. Relatedly, since early 2025, Spain has introduced a legal framework to tackle food waste. The legislation seeks to address wastage throughout the supply chain by mandating that all actors in the food chain — including industry, retailers, restaurants, caterers and canteens — develop food waste prevention plans. The law also introduces a legally binding food waste management hierarchy, prioritising: (1) donation or redistribution for human consumption, (2) transformation into edible products, (3) use as animal feed, (4) conversion into industrial by-products, and (5) composting or biofuel production (Batalla and Martínez, 2024).

Political will for climate action

Most of the EU cases studied face challenges in aligning sustainability goals with social equity and economic growth. They do not show the political will to make the agricultural transition a priority in their political agendas. Denmark seemed to show the highest level of ambition across the four case studies. The aim is not only to optimise national carbon accounting but to inspire policy diffusion internationally, even if some domestic actions lead to issues like carbon leakage: *"Our policymakers are more concerned about showing how to do it and then hoping that this will transform into policy actions in other countries and getting a global impact this way rather than focusing on more technical issues like CO_2 leakage"* [DK1].

France still struggles in *"finding a balance between more sustainable food and purchasing power"* [FR1]. This goal is explicitly reflected in government strategy documents. France's response during the COVID-19 crisis also illustrates a shift in political thinking. The traditional approach to public finance that prioritises balanced budgets, controlled public spending and low deficits was temporarily set aside in favour of massive public investment. This was justified by the urgency to preserve economic activity, which was done while aligning many of those investments with long-term sustainability goals: *"We decided it was better to use this aid for investment and to invest in more sustainable technologies"* [FR1]. This mindset led to the launch of the France Relance programme mentioned previously, which initially focused on sustainability investments (e.g. carbon diagnostics, agro-equipment).

In Spain, the political commitment to transforming the country's agri-food system appears to be limited and scattered across ministries. The fact that the agricultural sector currently represents only 12% of national emissions is used as an argument for supressing the issue on the political agenda. It is therefore not yet considered a high-priority sector in climate policy. There is also a gap between symbolic plans and actual ambitions. For example, the Ministry of Agriculture was 'proud' to develop a national food strategy, *"but it does not have any ambition in terms of changing diets"* [ES1].

Finally, Poland's accession to the EU marked a significant turning point as the Government aimed to align with EU standards and support the transition of its agricultural sector. Measures implemented nationally under the Green Deal were, for instance, diversification of crop production, improvement of soil health, and rational use of inputs such as fertilisers and pesticides. However, [PO1] emphasises that the system is polarised between well-organised farms that apply environmental and climate-friendly practices and large-scale intensive farms (e.g. poultry, pig production) focused on volume that have higher emissions. In this regard, *"policy should reflect the real structure of agriculture ... Different measures should be directed to different types of farming"* [PO1]. The current national CAP strategic plan attempts to include different types of measures, *"so everyone can find something for himself if he is interested in limiting his influence on climate"* [PO1]. However, [PO1] notes that there is a disconnect between policy

language and farmer understanding, due to a use of *"expressions that are not understandable for farmers"*. [PO1] also highlights a need for stronger government support for applied research, especially in tools like emissions calculators, to assist farmers in making informed decisions.

Farmer perception

Farmer perceptions of agri-environment schemes in the EU member states studied were generally negative according to interviewees; however, some differences are observed between the case studies. In Poland (as found in other EU countries), CAP payment levels remain contentious for farmers: *"the attitude to the level of payments is still too low in the opinion of agriculture producers"* [PO1]. Nevertheless, well-targeted schemes in marginal farming areas have received interest and have seen increasing uptake, *"... afforestation at the farm levels ... is observed and farmers ... were interested in such kind of measures, but they were included in the Rural Development programme directed to farmers"* [PO1]. Additionally, linking subsidies to environmental measures was seen as important for farmer engagement: *"farmers are not willing to implement more basic requirements at the farm level, they prefer some additional measures ... they are more open minded to understand that environmental measures are important because it is connected with subsidies"* [PO1].

Controversies surrounding the roll out of the EU Green Deal and the measures farmers were required to deploy were keenly felt in Poland. *"Farmers had many, many doubts ... they say that they don't want to implement European Green Deal, but practices that were underlined in the European Green Deal they knew very well ... I think that the core issue is some explanation"* [PO1]. Of course, such opposition is driven by the media and political environment within which farming operates. In Denmark, for example, resistance to green measures is fuelled by segments of politics opposed to the net zero agenda *"if you follow various political debates, you will see that some of the more nationalist or ... right wing politicians; they are very keen on saying that the Danes should still be able to eat their pork meat and ... their milk and eat their cheese"* [DK1]. This sentiment was echoed in all jurisdictions.

In Spain, by contrast, farmers are seen to respond better to measures supporting adaptation rather than mitigation. *"Little by little ... the farmers realise that if they implement some actions ... they maintain groundwater ... when you talk about mitigation, you are pointing at the farmers ... but you go through adaptation because you need to"* [ES1].

In Denmark, farming unions were brought onside by the communication of narratives of fairness and equity regarding the lack of a carbon price in agriculture unlike other high-emitting sectors. *"It was difficult to make the argument given that all other sectors had driven their greenhouse gas emissions so much down ... it was kind of difficult for the agricultural NGOs to say no, we won't contribute"* [DK1]. The success of Denmark's Tripartite Agreement is attributed in part to inclusive negotiation: *"it was actually negotiated between the government and the green NGOs and the agricultural NGOs ... there's a common understanding ... that this is the right thing to do"* [DK1].

Data governance

In Denmark, many emissions reductions are estimated using standard emission coefficients rather than direct measurements. Some initiatives, like the dairy company Arla's private 'climate account' scheme, provide financial incentives for farmers to document their greenhouse gas-reducing practices, such as using specific feed additives like Bovaer. However, actual farmer uptake and behaviour remain uncertain: *"We don't have one-to-one evidence that the farmers, although they buy Bovaer, they also feed it to the cows"* [DK1].

A very similar remark was made in the French case, where [FR1] explains that *"just because we help with the acquisition of equipment doesn't mean there's really a change in practices"*. To help these measures be implemented in favour of the sustainable transition, [FR1] believes the lever of education and training for farmers is essential. In France, 'Conseillers agricoles' (agricultural advisors) are responsible for *"transmitting this knowledge [on subsidies and investments and how to use them] to the producers"* [FR1].

Similarly, in Poland, *"advisors ... are the main chain between researchers, policy makers and farmers, because they can give them advice and do some business plans or some simulations"* [PO1]. A central issue raised by [PO1] is the lack of detailed information at farm level on practices and their environmental impacts, *"so we can't calculate [greenhouse gas emissions] as well as we wish"*. To address this issue, [PO1] suggests that a *"more advanced system should be created to deliver more information from the farm level to the system ... to give support to administration on how to improve some kinds of measures"*. Similarly, easily accessible tools should be made available to farmers to *"help them to organise [their] farm in a more environmentally friendly way"* [PO1]. Some progress has already been made through collaboration between researchers and advisors, particularly in the development of mobile applications for fertilisation planning.

Consumption themes

Moving onto discussion of demand-side measures and issues in the EU cases studied, four key sub themes emerge: cultural practices, affordability, public procurement, and public health policies. In Denmark, [DK1] illustrates the differences that are arising in consumption habits between generations and between urban and rural areas. *"The younger generation is much more on this agenda [lower meat diets] than the older generation. And the other thing is ... there's quite a big geographical difference ... between those living in the big cities and those living in the countryside"* [DK1].

In Spain, although meat remains widely consumed, it is partly driven by broader trends towards convenience *"... we are not cooking, so we are buying and consuming outside home, but also ultra-processed food and ready-to-eat food"* [ES1]. In France, in terms of dietary trends, there is a clear shift towards reduced meat consumption, though it is unclear whether this will reach the scale imagined in national scenarios. At the same time, the protein transition is facing major bottlenecks. While plant-based proteins and alternatives (such as legumes or insect-based foods) have received attention, the sector struggles with limited investment and market stability.

Public narratives around reducing meat consumption remain contentious in all jurisdictions, and there has been limited appetite, on the part of policymakers, to encourage dietary change. In Spain, resistance is both political and cultural *"... there are still a lot of resistance ... towards shifting towards less meat heavy diets ... it's a very polarised debate ... it's not possible now to start working [and] talking about that"* [ES1]. As such, policy lags behind the messaging from public health agencies. In Denmark, for example, *"the government is not really pushing for less meat heavy diets ... maybe you should see it in relation to that we have this very intensive livestock sector"* [DK1].

Across all interviews, public procurement of meat-free or low-carbon food for serving in schools, hospitals, government agencies, and so on, is seen as an effective policy lever to influence public diets, which needs to be developed further. Yet, this is also a fraught area *"... if you just say from next month, we will not serve meat in our daycare, then it's no go. But if you gradually shift ... then it's more acceptable"* [DK1].

France has developed a structured model to link various levers at the local level under the Territorial Food Project, which is a legal and policy framework introduced in 2014 that encourages local authorities to organise sustainable food initiatives in their regions. The EGalim law supports these efforts by requiring a minimum quota of sustainable and organic products in public canteens. However, its effectiveness is limited by enforcement gaps: *"it's a provision without any penalties ... it essentially relies on goodwill"* [FR1].

National food policies and dietary guidelines reflect varying levels of ambition. In France, the Programme National pour l'Alimentation (PNA) brings together multiple ministries to create a coherent approach to food, covering *"local food, food education, food safety standards ... reducing sugar, fat, salt, etc."* [FR1]. In Denmark, however, official dietary advice remains grounded in health rather than climate: *"The Ministry of Health ... have some recommendations ... but it is less based on climate ... and more on basic health"* [DK1]. In Spain, more of a middle ground has been trialled *"... in 2022, the Ministry of Health published new recommendations ... it*

was the first time ... they said we need to eat healthy but also in a sustainable way ... the recommendations were very ambitious in terms of meat consumption" [ES1].

Production themes

Regarding supply-side debates in the EU cases studied, five main sub-themes emerged from interviews: decarbonisation of agricultural production via taxes, regulatory frameworks, infrastructure, certification, and technology.

In Denmark, the two highest emitting sectors are agricultural production and person transport. Since other sectors have already significantly reduced their emissions (e.g. the energy sector), and emissions from person transport are expected to decrease thanks to current efforts from the Danish government, [DK1] expects that *"the agricultural sector in 2050 would represent 50% of total greenhouse gas emissions in Denmark"*. The intensive livestock system is therefore under increasing scrutiny for reducing emissions. A key policy response has been the planned implementation of a CO_2 tax on agricultural emissions, scheduled to begin in 2030, with gradual increases until 2035. The tax only applies to the top 40% of emissions, meaning, in practice, it targets roughly 30% of total agricultural emissions, largely from livestock. This *"base deduction"* [DK1] design helps make the policy more acceptable to farmers while leaving room to strengthen the tax if other measures underperform.

Public and political support for stronger measures have grown in part due to cross-sectoral equity (i.e. all other industries being taxed) and past collaboration between agricultural and environmental NGOs, which laid the groundwork for compromise. While the tax removes revenue from the sector, it is part of a net positive transfer, as farmers also receive substantial subsidies for implementing solutions. For example, afforestation on agricultural land is subsidised and was referred to as being *"cost-efficient"* for farmers [DK1]. However, a major gap remains: the CO_2 tax targets mainly livestock emissions, meaning that emissions from cropping are not taxed. The government has attempted to compensate through an *"extensive afforestation effort"* [DK1], including plans to reforest 250,000 hectares by 2050.

In France, infrastructure gaps undermine the scaling up of plant-based production. French farmers are often unable to shift to crops like lentils or fava beans due to missing links in the supply chain — from collection to processing and retail. As [FR1] illustrates: *"The farmer will say: 'It's great for the environment, but who do I sell to and at what price?'"*

Without viable markets, sustainable crops remain economically uncompetitive, *"it's a one-to-five income ratio ... it's quickly decided"* [FR1]. For [FR1], to help provide clear signals to producers and investors, regulatory frameworks supporting the agri-food transition should be aligned and driven at the European level as much as possible.

A national debate continues over prioritising organic farming versus other environmental certifications, particularly around Haute Valeur Environnementale[6] (HVE), which some actors argue is less ambitious than organic certification. While organic is often seen as the gold standard, many argue it is not realistic at scale due to lower productivity: *"A fully organic system is unrealistic because there are still large productivity differences"* [FR1]. However, some regions are pushing forward. In Auvergne-Rhône-Alpes, for example, organic farming represents around 23% of agricultural activity, supported by a strong network of technical institutions and federations.

Similarly to Denmark, in Spain the energy and transport sectors are decarbonising more rapidly than the agricultural sector, which means that agriculture's relative share of national emissions will increase. Because of this, [ES1] expects that *"maybe in 10 years time ... there will be much more focus on [agriculture]"*.

[6] Certification for farms and agricultural operations, particularly vineyards, recognising a high level of environmental commitment.

While agriculture is not currently perceived as a major emitter in Spain, its indirect emissions and future mitigation burden raise significant policy considerations. Imported feed, especially soy, generates substantial emissions linked to deforestation and land-use change, yet these emissions *"are not reported in the Spain inventory ... especially in livestock, most of the emissions are produced very far from the European Union"* [ES1].

In terms of emission reduction efforts, although technological solutions to reduce methane emissions exist, such as feed additives or inhibitors for enteric fermentation, their implementation raises equity concerns: *"The farmers cannot afford sometimes these technologies ... Intensive livestock systems could afford this kind of technologies compared with more vulnerable livestock producers"* [ES1].

Spanish pork production has been under particular scrutiny in public debates in recent years, as it is one of the main sources of ammonia emissions, which contribute to air and water quality problems and acidification of soils and ecosystems. [ES1] suggests that these impacts justify a more regulatory or punitive approach (such as taxation), rather than continued subsidies for this type of production: *"If I'm thinking on pork ... I would go through taxes for sure"*.

Over the last two decades, Polish agriculture has undergone significant structural transformation marked by increasing specialisation, a decline in mixed farming and reduced popularity of livestock farming. Notably, *"we observe a strong decrease of mixed farms in Poland ... On the one hand we have very well organised crop farms with crop rotation with quite good rules for soil conditions creation, but on the other hand we have very intensive farms focused on specialised animal production"* [PO1]. This polarisation has left a gap in mid-sized, diversified farms, which could otherwise support more balanced and sustainable systems. As explained by [PO1], *"we have a problem with some average farms that could combine smaller scale of livestock production and crop production. So I think that it is the core issue"*. Despite these limitations, there is notable progress in organic and integrated farming systems, and rural development programmes have played an essential role in increasing the focus on environmental compliance and sustainability standards. The conversion of low-quality farmland into forested areas is also progressing, especially when supported through rural development programmes.

However, a major concern for Polish farmers remains the perceived insufficiency of direct payments: *"The attitude to the level of payments is still too low in the opinion of agriculture producers"* [PO1]. While farmers show interest in environmental measures, they are more accepted if connected with subsidies. As [PO1] explains, *"when we describe that environmental measures can be profitable for them ... in the longer perspective, they understand it"*.

Social equity

In Denmark, although the notion of social justice is not formally included in most legal environmental acts, social fairness is very present in the political discussions around the agricultural transition. According to [DK1], *"[our politicians] are very much aware of kind of striking the right balance on this issue"*. Indirectly, social equity is also taken into account in the implementation of some agricultural policies such as the CO_2 tax, which is designed with gradual implementation and financial compensation to ensure economic and social acceptability, especially for farmers.

In France, a core concern around social equity is that healthy and sustainable foods remain unaffordable to many. Cheaper products are often unhealthy, as [FR1] explains: *"if it's cheap, it's not healthy, it's not hard to understand"*. This reflects the structural reality that much of the food system is artificially low-cost due to subsidies, and once those supports are removed or not applied evenly, vulnerable populations are left behind. Another equity issue lies in public procurement (e.g. supplying healthy local food in schools), but *"in some areas, children hardly go to the school canteens"* [FR1]. This reveals territorial disparities in who actually benefits from public food programmes.

In Spain, certain groups, such as migrant populations, *"[are] in a more food insecurity context than the rest"* [ES1]. On the production side, equity gaps also exist among farmers. Intensive systems are more likely to access emissions-reducing technologies, while smaller or extensive producers risk being left behind.

The same central challenge around accessibility and affordability of sustainable products was evoked in the case of Poland, where organic and high-quality animal products, such as eggs and milk, are generally more expensive due to the higher labour intensity involved in their production. A tension remains between promoting sustainable production methods and ensuring equal access to their benefits across all income groups. Moreover, similarly to France and Spain, data governance gaps may contribute to inequity in policy targeting, as current systems do not sufficiently capture the diversity of farming practices or their emissions profiles. This limits the ability of policymakers to tailor support effectively, especially for smaller or mixed farms that may be more vulnerable during the transition.

7. Discussion: comparing UK and EU insights

This report has set out how the UK and selected EU member states are approaching the challenge of decarbonising food systems, by looking at policy mechanisms, innovations and behavioural changes to limit the impact that production and consumption of food is having on climate change, ecological functioning, and human health and wellbeing. We have drawn out policy implications for the UK to support this transition through document analysis and key informant interviews. We acknowledge the small sample size of interviewees, and do not attempt to infer definitive conclusions from the forthcoming discussion, but rather seek to highlight the continuing risks, from a human health, climate and nature perspective, of not enacting reforms of the UK and EU food systems.

By explicitly applying a food system lens to this research, we have sought to highlight those pieces of evidence and policy that are relevant to the UK context and may potentially be prioritised and trialled in the UK. We have found numerous examples of policy measures trialled to address the climate impact of agricultural production, limited evidence on the demand side, but a total dearth of policy to address both elements of the food system in tandem.

Reflections on the EU case studies

Some key learning points and examples of best practice from the analysis are presented below.

- The EU, under the Green Deal has (until recently) developed a coherent policy framework, most clearly embodied in the Farm to Fork Strategy (F2F) and other co-developed strategies such as the Strategic Dialogue on the Future of EU Agriculture. Although the F2F and the Strategic Dialogue have been subsumed/reformed, these exercises provided a clear vision of how supply- and demand-side measures might work together within a food system approach. Such coherence is missing at the UK or devolved administration levels and should serve as an exemplar for how UK administrations could establish the framework of a food system transition policy, by focusing on consensus building and co-design across farmers, food processors, NGOs, regulators and citizens.
- The case of Denmark stands out for its political realism and ambition. Having recognised the limits of voluntary subsidy schemes, Denmark moved towards pricing emissions — becoming the first EU country to commit to a carbon tax on livestock. Equity between all economic sectors was paramount in the decision to proceed with pricing agricultural emissions. A structured approach to negotiation that drew in farming unions, NGOs and other stakeholders in a multi-year co-design process was a necessary prerequisite to reaching a durable agreement. The phased introduction of the methane tax, set to begin in 2030, will then recycle revenues into peatland restoration, and incentivise reduced nitrogen application. The UK has no equivalent mechanism to price agricultural emissions and has experienced very limited public debate on the issue. Denmark's approach suggests that political feasibility depends less on the policy instrument itself and more on how it is designed and negotiated.
- France's Territorial Food Project and EGalim law emphasise local procurement and dietary shifts in public institutions. The legislation mandates weekly vegetarian meals in schools, sets thresholds for organic and local produce in public catering, and supports a plant protein strategy. These measures send signals through the market and provide a consistent reference point for upstream suppliers. In the UK, demand-side measures remain underdeveloped. While the National Food Strategy recognises the need to shift diets, this has not yet translated into law or binding targets. France's example shows that dietary transition does not need to rely solely on behaviour change campaigns — it can be steered through procurement rules, labelling and food environment reforms. The UK's fragmented public procurement policies could benefit from similar legally backed targets

for sustainable food in schools and hospitals, building on emerging efforts to offer healthier and more sustainable snacks and drinks in hospitals (Chadborn, 2018).

- Several case studies highlighted the importance of skills development and technical assistance, supported through eco-schemes and EU funding. Poland is an illustrative example here, with an agricultural sector dominated by small and medium-sized farms, many of which face capacity constraints in adapting to low-emission practices. Within existing agricultural extension services, Poland has prioritised technical advice, training and peer learning networks, emphasising nutrient management and nature recovery for smallholders. While the UK does not share this structural profile, it does have pockets of low-productivity and under-resourced farming businesses. Given the scale of land management changes that will need to occur in the future, it is critical that UK administrations invest in outreach and upskilling programmes to maximise the uptake and effectiveness of supply-side policy.
- In both France and Denmark, the strength of the approach lies not only in the individual policies, but in the way they are embedded within broader political settlements that include producers and civil society. Denmark's Tripartite Agreement and the EU's Strategic Dialogue on the Future of Agriculture both point to the value of creating formal spaces for negotiation and trust-building. In the UK, consultation exercises have taken place after controversy arose over policy proposals — particularly in Wales — but there is no permanent structure that brings together the different interests in the food system to co-develop policy. Without such fora, attempts to introduce more ambitious reforms may continue to fall victim to industry lobbying.
- Spain brings a sharper focus on adaptation. Faced with extreme heat and water scarcity, Spain has begun to treat food system policy as a means of building resilience. This includes a legal framework to reduce food waste, and an effort to integrate adaptation and mitigation across farming and land use. Although the UK is not yet exposed to the same degree of climatic stress, drought-like conditions in 2022 and the failure of the 2024 winter harvest in England (attributed in part to extreme rainfall) show how vulnerability is increasing. As the impacts of climate change accelerate, adaptation will have to play a larger role in UK food and land-use policy.
- Linkages on the demand side, between consumption of carbon-intensive food and climate change, are limited in the EU case studies, with food policies, when enacted, imposing standards on sugar or fat content in foodstuffs, restricting advertising, producing education campaigns, or limiting where 'unhealthy' foods are sold. Denmark's dietary guidelines remain health-focused rather than climate-oriented and are emblematic of a lack of political will to regulate diets and confront cultural practices. Spain's recent inclusion of 'sustainability' in national dietary recommendations is positive, but interviews highlighted cultural resistance to reducing meat consumption remaining high. Limited lessons can be learned for the UK as a result, but these measures, although politically unpalatable, offer a template for how climate-aligned dietary changes can be pursued.

Reflections on the UK case studies

Although pockets of good practice and policy innovation are highlighted in this report, interviews recognised a lack of political will in all jurisdictions to propose policies which meaningfully tackle emissions from livestock farming. Lobbying by agricultural unions can limit the scope of a policy as seen in Wales with the 10% woodland requirement in the SFS, or in Denmark, where lobbying delayed the creation of a political pact to set an agricultural emissions reduction target. Such efforts and exemptions can be rationalised given the paramount importance of food production in any economy, the squeezed margins faced by farmers, and the real risks of emissions leakage where there is incomplete carbon pricing around the world. However, the ever-present risk of cascading climate extremes and damage to domestic food production, as well as the economic benefits of the transition in terms of reduced hidden costs of the food system (Laderchi et al.,

2024), should deflect any extreme policy position which pushes back against attempts to lower production emissions.

Policy ambition and implementation

A recurring theme across all jurisdictions is the lack of cohesive, integrated policy in food systems. In the UK, post-Brexit agricultural policies such as ELMs in England and the SFS in Wales have aimed to conditionalise subsidy payment to environmental outcomes. However, across the UK, implementation remains uneven, with England more advanced in delinking payments from production, while Scotland and Northern Ireland remain closely tied to the CAP. Northern Ireland has made substantial investments in LIDAR surveying in tandem with the SNHS and a bovine genetics programme to improve efficiencies in livestock farming. This close focus on abatement within the livestock sector, given this is the largest emission source, through implementation of specific policies such as the Beef Carbon Reduction Scheme which sets a maximum (and declining) slaughter age, is innovative and should be closely examined by other UK administrations. A shift in focus to prioritise on-farm audits and increased conditionalisation under the four-tiered PFS scheme was praised in Scotland, but changes to subsidy schemes are hampered by legacy IT systems which significantly curtail the speed and scope of changes under the PFS. This is an obvious area for investment.

Staying on the supply side, there were no specific government schemes identified in the case studies to incentivise or require feed-out of methane-suppressing feed additives to livestock. Where this has occurred in a limited sense in the cases covered, such as in the UK and Denmark, this has been driven by suppliers (such as Arla) rather than government policy. Similarly, centralised programmes to select livestock based on whether they have low-methane genetic markers have also not been rolled out in any meaningful way in any jurisdiction, barring a national genetic profiling exercise in Northern Ireland. Conditionalising subsidies for farmers by meeting minimum calving intervals as in Scotland is also a blunt but effective policy to improve emissions efficiency. These measures are technically feasible, and have substantial mitigation potential, thus there is limited public policy justification for not piloting or consulting on such measures in England and Wales.

Disconnection between supply- and demand-side policies

On the demand side, policy progress to date has focused largely on extolling the importance of diet shifts for health rather than for explicit emissions abatement reasons and public procurement. For instance, regulatory tools deployed on the demand side align with the wider focus on health and diets by levying taxes on goods with high sugar or saturated fat content rather than embodied emissions. Each administration has released or intends to release 'National Food Strategies' which provide a roadmap for how health and dietary change goals can be achieved. These documents do not focus significantly on the climate impact of diet choices, but the measures targeted invariably support wider food system transition goals. In the absence of political will to emphasise reductions in the most carbon-intensive foods, emerging efforts in education, sustainable public procurement and protein innovation could indirectly contribute to decarbonising consumption in the UK. The scalability of these efforts is still limited by the lack of affordability of alternative proteins and by regulatory delays for novel foods.

A critical gap in both the UK and the EU is the disconnect between agricultural production policies and demand-side interventions, such as dietary guidelines and public procurement. In England, while ELMs incentivise on-farm environmental actions, there is little parallel effort to shift consumer behaviour towards lower-carbon diets. Multiple interviewees linked this directly to a lack of political will, despite the publication of the 2021 Dimbleby Review. This misalignment risks undermining supply-side measures, notably by leading to an increase of imports to the global market.

There is a precedent in the case studies examined to address consumption emissions through targeted policies aimed at limiting consumption of carbon-intensive foodstuffs. This could include incentives for supermarkets to reformulate ready meals with plant-based proteins, ease the

regulatory burden on startups attempting to bring novel proteins to market or more directly regulate advertising of some high-carbon foodstuffs. These steps must be taken in addition to widespread education campaigns focusing on the health benefits of reducing, but not curtailing entirely, red and ultra-processed meat and dairy consumption. Governments must use all of the tools available to reduce consumption emissions and give clear signals to agricultural producers so that farmers have the confidence to make investments in low-emissions genetics or anaerobic digestors and land management changes, for instance producing more legumes or scaling back livestock stocking densities.

8. Conclusion and recommendations

The comparison with EU countries brings into focus several areas in which the UK could strengthen its approach to food system reform. While there is no single model to follow, certain elements stand out. The EU has, until recently, developed a more coherent food system policy through the Farm to Fork strategy and the Strategic Dialogue on the Future of EU Agriculture. Although these initiatives are promising in terms of human and environmental health and should be pursued, changing political priorities have currently sidelined these measures. Denmark has shown that pricing emissions is politically possible if done gradually and in dialogue with affected sectors, including food and farming. France demonstrates how procurement, marketing nudges and regulation can be used to shift diets and steer markets. Poland highlights the importance of building the capacity of farmers, and Spain makes a strong case for integrating climate adaptation into food system planning.

For the UK, this points to six areas of action. First, there is a need for greater policy coherence. A food systems strategy *backed by legislation or regulation and clear enforcement mechanisms* — whether UK-wide or developed by devolved administrations — would help align existing goals across climate change mitigation/adaptation, agriculture and health. Second, demand-side policy must be made more robust. This means embedding sustainability criteria into public procurement, improving food labelling, and supporting the dietary shift already observed in UK data. Third, the government should begin a serious conversation about how to tackle livestock emissions. Discussions must consider the relative merits of pricing emissions versus incentivising or regulating use of the emissions abatement measures discussed within this report. While immediate introduction may not be politically feasible, national discussions and permanent fora that bring together stakeholders to discuss and plan for the agricultural transition, as seen at the EU level, offer a template for how to build consensus. Fourth, greater support is needed for farmers — not only through conditionalised subsidies, but through training, advice and infrastructure investment. Fifth, connecting on-farm changes to climate risk and the need to adapt to climate change may be an effective strategy. As climate impacts become more frequent and severe, food system resilience should be treated as a national priority. Finally, data and evidence gaps are pervasive across the food system. For example, farmers need to understand the abatement potential of different mitigation options and how efficacy changes across different farming systems and climatic factors while central government needs to invest in monitoring systems to understand uptake of mitigations and consequent contribution to national emission reductions.

Recommendations

1. In the UK, the agencies responsible for agricultural, climate and environmental policy should continually facilitate dialogue between farming unions, environmental non-governmental organisations (NGOs), academia and other relevant stakeholders. The experience of Denmark shows agreement on contentious policies, like a carbon tax, can be reached when there is ongoing dialogue and trust between government, farming representatives and NGOs, despite seemingly divergent views.
2. The UK administrations need to articulate a policy roadmap for how they will sustainably decarbonise agricultural production in line with independent advice from the Climate Change Committee (CCC). Particular emphasis needs to be placed on addressing methane and nitrous oxide emissions from the livestock sector and must include incentives to integrate low-methane genetics into national herds, methane suppressants for intensive operations, and measures to improve efficiency by selecting for desirable heritable traits including live-weight-gain and resistance to parasites and infection.
3. There is a precedent in the cases examined to address consumption emissions through targeted regulations aimed at limiting consumption of carbon-intensive foodstuffs. The respective government departments responsible for health, farming, environment and

economics/finance in the UK administrations should coordinate and pursue regulatory options to reduce consumption of high-carbon foodstuffs, particularly foodstuffs from ruminant livestock. Each department should identify levers within its remit (e.g. in England, health campaigns and reformulation initiatives at the Department of Health and Social Care [DHSC]; streamlined regulatory approval for new foodstuffs at the Department for Business and Trade) but determine their implementation through existing cross-government fora (e.g. the Carbon Budget Delivery Plan or the National Food Strategy) to align on outcomes.

4. Using agricultural subsidies as a fiscal instrument to redirect investments towards lower greenhouse gas emissions food production would enable a shift towards plant-based protein production over livestock. Because this recommendation addresses topics across health, environment, agriculture and treasury mandates, the repurposing of subsidies should be supported by joint action. This would involve the Department for Environment, Food & Rural Affairs (Defra) in restructuring subsidy frameworks within environmental land management schemes (ELMs), the DHSC ensuring health outcomes are accounted for as a set of criteria, HM Treasury reallocating funds, and each of the devolved administrations adapting their own subsidy schemes.
5. Farmers may be more receptive to policy measures that emphasise resilience and manage risks associated with climate change-driven extreme weather events. The UK administrations' agriculture and environment ministries should emphasise resilience and risk management in strategic communications and subsidy programmes given the overlap in actions between these two priorities. Lack of clarity was flagged by interviewees as a factor for the low uptake of post-Common Agricultural Policy (CAP) schemes, suggesting that clear step-by-step guidelines would increase the popularity of environmental incentives.
6. Data and evidence gaps (e.g. due to the fragmentation of public data) continue to limit understanding of farm-level emission profiles and the expected efficacy of mitigation measures. Agricultural and environmental agencies in the UK must continue to invest in high-quality programmes and farm auditing, targeting breakthroughs in methane suppressants, genetics and nitrification inhibitors.

References

Action on Sugar (2024) *Survey on sugar levels in children's cereals and yoghurts*. https://www.actiononsugar.org/surveys/2025/

Adams J, Mytton O, White M, et al. (2016) Why are some population interventions for diet and obesity more equitable and effective than others? The role of individual agency. *PLoS Medicine* 13(4): e1001990. https://journals.plos.org/plosmedicine/article/file?id=10.1371/journal.pmed.1001990&type=printable

Albrektsen R (2025) *Agriculture*. https://envs.au.dk/en/research-areas/air-pollution-emissions-and-effects/air-emissions/reporting-sectors/agriculture (accessed 14 July 2025).

Almeida E, Senni CC and Rastoka J (2025) *Exploring the interactions between nature loss drivers, vulnerabilities and economic impacts*. London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science. https://cetex.org/publications/exploring-the-interactions-between-nature-loss-drivers-vulnerabilities-and-economic-impacts/

Alvarez-Hess PS, Jacobs JL, Kinley RD, et al. (2024) Effects of a range of effective inclusion levels of *Asparagopsis armata* steeped in oil on enteric methane emissions of dairy cows. *Animal Feed Science and Technology* 310: 115932.

Andreyeva T, Long MW and Brownell KD (2010) The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food. *American Journal of Public Health* 100(2): 216–222.

Arndt C, Hristov AN, Price WJ, et al. (2022) Full adoption of the most effective strategies to mitigate methane emissions by ruminants can help meet the 1.5 C target by 2030 but not 2050. *Proceedings of the National Academy of Sciences* 119(20): e2111294119.

Banks C and Cawley A (2021) *Spending review 2021: Beef Environmental Efficiency Programme — Sucklers (BEEP-S)*. Dublin: Irish Government Economic and Evaluation Service. https://assets.gov.ie/203585/8a14d3b1-ba2d-4ae1-8b79-94cae284d4fd.pdf

Batalla I and Martínez V (2024) Case study Spain. In: *Towards food policies that support healthy and sustainable consumption. Case studies from 11 European countries highlighting good practices for demand-side policies*. Agora Agriculture and IDDRI. https://www.agora-agriculture.org/publications/towards-food-policies-that-support-healthy-and-sustainable-consumption

Bognar J, Lam L, Forestier O, Finesso A, Bolscher H, Springer K, et al. (2023) *Pricing agricultural emissions and rewarding climate action in the agri-food value chain*. EU: European Union. Epub ahead of print 2023.

Bowman M and Herzog M (2024) *Policy briefing: EU food waste recommendations for trilogues*. Brussels: Prevent Waste Coalition. https://eeb.org/wp-content/uploads/2024/05/Prevent-Waste-Coalition-Policy-Briefing-EU-food-waste-targets.pdf

Brocard C (2024) Case study France. In: *Towards food policies that support healthy and sustainable consumption. Case studies from 11 European countries highlighting good practices for demand-side policies*. Berlin: Agora Agriculture. https://www.agora-agriculture.org/publications/towards-food-policies-that-support-healthy-and-sustainable-consumption

Burlingame B and Dernini S (2012) *Sustainable diets and biodiversity: directions and solutions for policy, research and action*. https://www.fao.org/4/i3004e/i3004e.pdf

Cambridge City Council (2023) *Issue — items at meetings — plant-based catering options for civic events*. https://democracy.cambridge.gov.uk/ielssueDetails.aspx?Iid=29776&Opt=3 (accessed 14 July 2025).

Campbell B, Beare D, Bennett E, Hall-Spencer JM, Ingram JSI, Jaramillio F, et al. (2017) Agriculture production as a major driver of the Earth system exceeding planetary boundaries. *Ecology and Society* 22(4).

Candari CJ, Cylus J and Nolte E (2017) *Assessing the economic costs of unhealthy diets and low physical activity: an evidence review and proposed framework*. World Health Organization Regional Office for Europe. https://pubmed.ncbi.nlm.nih.gov/28787114/

Carbon Trust (2023) *Quorn footprint comparison report*. London: Carbon Trust. https://www.quorn.co.uk/assets/files/content/Carbon-Trust-Comparison-Report-2023.pdf

Cecchini M and Warin L (2016) Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. *Obesity Reviews* 17(3): 201–210.

Chadborn T (2018) *Hospital vending machines: helping people make healthier choices*. 20 July. UK Health Security Agency. https://ukhsa.blog.gov.uk/2018/07/20/hospital-vending-machines-helping-people-make-healthier-choices/ (accessed 14 July 2025).

Clark MA, Domingo NG, Colgan K, Thakrar SK, Tilman D, Lynch D, et al. (2020) Global food system emissions could preclude achieving the 1.5 and 2 C climate change targets. *Science* 370(6517): 705–708.

Climate Change Committee [CCC] (2025) *The seventh carbon budget: advice for the UK Government*. London: CCC. https://www.theccc.org.uk/publication/the-seventh-carbon-budget/

Crippa M, Solazzo E, Guizzardi D, Monforti-Ferrario F, Tubiello FM and Leip A (2021) Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food* 2(3): 198–209.

Dasgupta P (2021) *The economics of biodiversity: the Dasgupta review*. HM Treasury. https://assets.publishing.service.gov.uk/media/602e92b2e90e07660f807b47/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf

Department for Environment, Food & Rural Affairs [Defra] (2024) *UK food security index 2024*. https://www.gov.uk/government/publications/uk-food-security-index-2024/uk-food-security-index-2024?

Dessart FJ, Barreiro-Hurlé J and van Bavel R (2019) Behavioural factors affecting the adoption of sustainable farming practices: a policy-oriented review. *European Review of Agricultural Economics* 46(3): 417–471.

Devadoss S and Ridley W (2024) Impacts of the Russian invasion of Ukraine on the global wheat market. *World Development* 173: 106396.

Dimbleby H (2021) *National food strategy: part one*. National Food Strategy. London: HM Government. https://www.nationalfoodstrategy.org/part-one/

Duhon M, McDonald H and Kerr S (2015) *Nitrogen trading in Lake Taupo: an analysis and evaluation of an innovative water management policy*. Motu Working Paper 15-07. Wellington: Motu Economic and Public Policy Research. https://motu-www.motu.org.nz/wpapers/15_07.pdf

Dumont B, Dupraz P, Aubin J, et al. (2016) *Rôles, impacts et services issus des élevages en Europe. Synthèse du rapport d'expertise scientifique collective*. Clermont-Ferrand: INRA. https://www.inrae.fr/sites/default/files/pdf/esco-elevage-eu-rapport-complet-en-francais.doc.pdf

Eory V, Fletcher DM, MacLeod M, Duthie C-A, Rees R and Topp K (2025) *Greenhouse gas abatement in UK agriculture 2024–2050: report submitted to support the 7th carbon budget in the UK*. Scotlands Rural College. https://www.parallelparliament.co.uk/files/appg_documents/science-and-technology-in-agriculture/f77b24_9b3fd5950a0e4d219b54fff694937651.pdf

European Commission (2024) *Impact Assessment Report, Accompanying the document Communication from the Commission to the EU. Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society*. SWD 2024 (63), Impact Assessment Report. Brussels: European Commission. https://climate.ec.europa.eu/document/download/768bc81f-5f48-48e3-b4d4-

e02ba09faca1_en?filename=2040%20Climate%20Target%20Impact%20Assessment_en_0.pdf (accessed 24 March 2025).

European Commission (2025a) *At a glance: Poland's CAP strategic plan*. Brussels: European Commission. https://agriculture.ec.europa.eu/document/download/7716493a-28a0-4a7c-a66d-e54803e42bdd_en?filename=csp-at-a-glance-poland_en.pdf

European Commission (2025b) *Factsheet on 2014–2022 Rural Development Programme for Poland*. Brussels. https://agriculture.ec.europa.eu/system/files/2019-11/rdp-factsheet-poland_en_0.pdf

European Commission (2025c) *Oilseeds and protein crops market situation*. Brussels. https://circabc.europa.eu/rest/download/d5db7f03-9cfb-4c3e-a206-33073dfa1101

European Council (2025) *Council and Parliament agree to reduce food waste and set new rules on waste textile*. https://www.consilium.europa.eu/en/press/press-releases/2025/02/19/council-and-parliament-agree-to-reduce-food-waste-and-set-new-rules-on-waste-textile/ (accessed 14 July 2025).

European Court of Auditors (2021) *Common Agricultural Policy and climate: half of EU climate spending but farm emissions are not decreasing*. European Court of Auditors. https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=58913

European Environment Agency (2024) *Greenhouse gas emissions from agriculture in Europe*. https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-agriculture (accessed 14 March 2025).

European Environment Bureau (2025) *A check on 6 final updated NECPs: EEB assessment on agriculture in the EU National Energy and Climate Plans (NECPs)*. Brussels: European Environment Bureau. https://eeb.org/wp-content/uploads/2025/04/EEB-assesment-of-agri-in-NECPs-2025.pdf

FAO (2018) *Sustainable food systems: concept and framework*. Rome: Food and Agriculture Organization of the United Nations. https://openknowledge.fao.org/server/api/core/bitstreams/b620989c-407b-4caf-a152-f790f55fec71/content

FAO (2023) *True cost accounting applications for agrifood systems policymakers*. FAO Working Paper 23-11. http://www.fao.org/documents/card/en/c/cc8341en (accessed 14 July 2025).

FAO, IFAD, UNICEF, WFP, WHO (2021) *The state of food security and nutrition in the world 2021*. Rome: FAO. https://openknowledge.fao.org/server/api/core/bitstreams/191ee56e-2d4f-46cb-9710-0ca167ca314d/content/cb4474en.html

Food Farming and Countryside Commission (2025) *Paying the price: cheap food, big business and the cost to farming and food security*. https://ffcc-uk.files.svdcdn.com/production/assets/downloads/FFCC_False-Economy_report_part2_v5-1.pdf?dm=1741863510

Food Foundation (2025) *The broken plate 2025*. https://foodfoundation.org.uk/publication/broken-plate-2025

Foote N (2025) Q&A: What is on the menu of the EU's new Vision for Agriculture and Food? In: *Clean Energy Wire*. https://www.cleanenergywire.org/factsheets/qa-what-will-be-menu-eus-vision-agriculture-and-food (accessed 14 July 2025).

Franks JR (2022) UK agriculture at a crossroads. *Outlook on Agriculture* 51(4): 448–459.

Fu Q, Clark IM, Zhu J, et al. (2018) The short-term effects of nitrification inhibitors on the abundance and expression of ammonia and nitrite oxidizers in a long-term field experiment comparing land management. *Biology and Fertility of Soils* 54(1): 163–172.

Gallet CA (2010) Meat meets meta: a quantitative review of the price elasticity of meat. *American Journal of Agricultural Economics* 92(1): 258–272.

Gars J, Guerrero S, Kuhfuss L, et al. (2024) Do farmers prefer result-based, hybrid or practice-based agri-environmental schemes? *European Review of Agricultural Economics* 51(3): 644–689.

Gemmill-Herren B, Baker LE and Daniels PA (2021) *True cost accounting for food: balancing the scale*. Taylor & Francis. https://www.taylorfrancis.com/books/oa-edit/10.4324/9781003050803/true-cost-accounting-food-barbara-gemmill-herren-lauren-baker-paula-daniels?context=ubx&refId=bf89e52d-3202-446f-9e9e-ace41be8fb84

George MM, Platts SV, Berry BA, et al. (2024) Effect of SeaFeed, a canola oil infused with Asparagopsis armata, on methane emissions, animal health, performance, and carcass characteristics of Angus feedlot cattle. *Translational Animal Science* 8: txae116.

Good Food Institute (2024) *State of the industry: cultivated meat, seafood, and ingredients*. https://gfi.org/wp-content/uploads/2025/04/2024-State-of-the-Industry-Cultivated-meat-seafood-and-ingredients-GFI.pdf?_gl=1%2A3lelou%2A_up%2AMQ..%2A_ga%2AMTAwMDAwNjI1NS4xNzUyNDAyMDU3%2A_ga_TT1WCK8ETL%2AczE3NTI0MDIwNTUkbzEkZzEkdDE3NTI0MDIwNTUkajYwJGwwJGgw

Gurung I, Tobi R, Leigh-Taylor K, Buszard S, Mackean C and English A (2024) *Rethinking plant-based meat alternatives*. The Food Foundation. https://foodfoundation.org.uk/sites/default/files/2024-08/Rethinking%20Plant-Based%20Meat%20Alternatives.pdf

Halleux V (2023) *Proposal for a regulation on the sustainable use of plant protection products*. Legislative Train Schedule. https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-sustainable-use-of-pesticides-%E2%80%93-revision-of-the-eu-rules (accessed 14 July 2025).

Hargreaves PR, Baker KL, Graceson A, et al. (2021) Use of a nitrification inhibitor reduces nitrous oxide (N2O) emissions from compacted grassland with different soil textures and climatic conditions. *Agriculture, Ecosystems & Environment* 310: 107307.

Hawkes C (2022) *Taking a food systems approach to policymaking: what, how, and why*. London: Centre for Food Policy at City, University of London. https://r4d.org/wp-content/uploads/R4D-CITY-Food-Systems-Approach-Brief-1.pdf

Henderson B and Verma M (2021) *Global assessment of the carbon leakage implications of carbon taxes on agricultural emissions*. OECD. https://www.oecd.org/en/publications/global-assessment-of-the-carbon-leakage-implications-of-carbon-taxes-on-agricultural-emissions_fc304fad-en.html

Henley J, Jones S and Tondo L (2024) 'Symbol of polarisation': EU scraps plans to halve use of pesticides. *The Guardian*, 6 February. https://www.theguardian.com/environment/2024/feb/06/symbol-of-polarisation-eu-scraps-plans-to-halve-use-of-pesticides (accessed 14 July 2025).

Hickey SM, Bain WE, Bilton TP, et al. (2022) Impact of breeding for reduced methane emissions in New Zealand sheep on maternal and health traits. *Frontiers in Genetics* 13.

HM Government (2022) *Environment Agency chairs National Drought Group as parts of country move into drought*. https://www.gov.uk/government/news/environment-agency-chairs-national-drought-group-as-parts-of-country-move-into-drought (accessed 14 July 2025).

HM Government (2023) *Restricting promotions of products high in fat, sugar or salt by location and by volume price: implementation guidance*. London: Department of Health and Social Care. https://www.gov.uk/government/publications/restricting-promotions-of-products-high-in-fat-sugar-or-salt-by-location-and-by-volume-price/restricting-promotions-of-products-high-in-fat-sugar-or-salt-by-location-and-by-volume-price-implementation-guidance (accessed 14 July 2025).

HM Government (2024a) *Cereal and oilseed production in the United Kingdom 2024*. Department of Food, Environment and Rural Affairs. https://www.gov.uk/government/statistics/cereal-and-oilseed-rape-production/cereal-and-oilseed-production-in-the-united-kingdom-2024#:~:text=The%20final%20estimate%20of%20the,increase%20of%201.8%25%20on%202023 (accessed 17 April 2025).

HM Government (2024b) *Greenhouse gas inventories for England, Scotland, Wales & Northern Ireland: 1990–2022*. London: National Atmospheric Emissions Inventory. http://naei.energysecurity.gov.uk/reports/greenhouse-gas-inventories-england-scotland-wales-northern-ireland-1990-2022 (accessed 17 April 2025).

HM Government (2024c) *United Kingdom food security report 2021: theme 2: UK food supply sources*. London: Department of Food, Environment and Rural Affairs. https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2021/united-kingdom-food-security-report-2021-theme-2-uk-food-supply-sources (accessed 8 April 2024).

HM Government (2025a) *A UK government food strategy for England, considering the wider UK food system*. London: Department of Food, Environment and Rural Affairs. https://www.gov.uk/government/publications/a-uk-government-food-strategy-for-england/a-uk-government-food-strategy-for-england-considering-the-wider-uk-food-system#introduction (accessed 24 July 2025).

HM Government (2025b) *Agri-climate report 2024*. London: Department of Food, Environment and Rural Affairs. https://www.gov.uk/government/statistics/agri-climate-report-2024/agri-climate-report-2024 (accessed 14 July 2025).

House of Commons Environmental Audit Committee (2023) *Environmental change and food security: second report of session 2023–24*. London: UK Parliament. https://committees.parliament.uk/publications/42481/documents/211176/default/

INRAE (2023a) *Accelerating the transitions*. https://www.inrae.fr/en/reports/towards-healthy-and-sustainable-food/accelerating-transitions (accessed 14 July 2025).

INRAE (2023b) *Towards healthy and sustainable food?* Paris: INRAE. https://www.inrae.fr/en/reports/towards-healthy-and-sustainable-food

INRAE (2025) *INRAE for healthy, sustainable school meals*. https://app.inrae.fr/app/uploads/2025/03/Dossier-School_meals_EN.pdf

Intergovernmental Panel on Climate Change [IPCC] (2023) *AR6 synthesis report: climate change 2023*. Geneva: IPCC. https://www.ipcc.ch/report/ar6/syr/ (accessed 14 July 2025).

IPES-Food (2022) *The politics of protein: examining claims about livestock, fish, 'alternative proteins' and sustainability*. International Panel of Experts on Sustainable Food Systems. https://www.ipes-food.org/_img/upload/files/PoliticsOfProtein.pdf

Jebari A, Pereyra-Goday F, Kumar A, et al. (2023) Feasibility of mitigation measures for agricultural greenhouse gas emissions in the UK. A systematic review. *Agronomy for Sustainable Development* 44(1): 2.

Jelliffe J, Gerval A, Husby M, Jarrell P and Williams B (2023) *United Kingdom agricultural production and trade policy post-Brexit*. Washington, DC: U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/publications/pub-details/?pubid=105871

Jensen L (2023) *Revision of the LULUCF Regulation*. Briefing: EU Legislation in Progress. Brussels: European Commission. https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/698843/EPRS_BRI(2021)698843_EN.pdf

Johnston K (2023) Crown vs cow, part two: how agriculture and government fell out, and the climate lost. *RNZ*. https://www.rnz.co.nz/programmes/in-depth-special-projects/story/2018902908/crown-vs-cow-part-two-how-agriculture-and-government-fell-out-and-the-climate-lost (accessed 6 August 2025).

Jones M (2024) *Comparing agricultural emissions reduction targets, strategies and policies internationally: a snapshot comparison of 16 international jurisdictions*. Wellington: Beef + Lamb New Zealand. https://beeflambnz.com/knowledge-hub/PDF/comparing-agricultural-emissions-reduction-targets.pdf

Kebreab E, Bannink A, Pressman EM, et al. (2023) A meta-analysis of effects of 3-nitrooxypropanol on methane production, yield, and intensity in dairy cattle. *Journal of Dairy Science* 106(2): 927–936.

Kotyza P, Náglová Z, Slaboch J, et al. (2022) Dairy processing industry in the European Union: country-group clustering in pre and post-milk quota abolishment periods. *Journal of Central European Agriculture* 23(3): 679–691.

Kotz M, Donat MG, Lancaster T, Parker M, Smith P, Taylor A, et al. (2025) Climate extremes, food price spikes, and their wider societal risks. *Environmental Research Letters* 20(8).

La Moncloa (2015) *Agriculture*. https://www.lamoncloa.gob.es/lang/en/espana/stpv/spaintoday2015/agriculture/paginas/index.aspx (accessed 14 July 2025).

Laderchi CR, Lotze-Campen H, DeClerck F, et al. (2024) *Global policy report: the economics of the food system transformation*. FSEC: Food System Economics Commission.

Lang T, Neumann N and So A (2025) *Just in case: narrowing the UK civil food resilience gap*. London: National Preparedness Commission. https://nationalpreparednesscommission.uk/wp-content/uploads/2025/02/NPC-Just-in-Case-Main-Report_PDF-Download.pdf

Lankoski J, Ollikainen M, Marshall E, et al. (2015) *Environmental co-benefits and stacking in environmental markets*. Paris: OECD Publishing. https://www.oecd.org/en/publications/environmental-co-benefits-and-stacking-in-environmental-markets_5js6g5khdvhj-en.html

Läpple D, Carter CA and Buckley C (2022) EU milk quota abolition, dairy expansion, and greenhouse gas emissions. *Agricultural Economics* 53(1): 125–142.

Lee L and Ignaciuk A (2025) *Mitigating climate change in the agriculture, forestry and other land use (AFOLU) sectors: a literature review on policy effectiveness*. OECD Food, Agriculture and Fisheries Papers No. 221. Paris: OECD. https://www.oecd.org/en/publications/mitigating-climate-change-in-the-agriculture-forestry-and-other-land-use-afolu-sectors_166b6c31-en.html

Lee SY, Lee DY and Hur SJ (2024) Future perspectives: current trends and controversies of meat alternatives classified as ultra-processed foods. *Journal of Food Science* 89(11): 7022–7033.

MacLeod M, Eory V, Gruère G and Lankoski J (2015) *Cost-effectiveness of greenhouse gas mitigation measures for agriculture: a literature review*. Paris: OECD. https://www.oecd.org/en/publications/cost-effectiveness-of-greenhouse-gas-mitigation-measures-for-agriculture_5jrvvkq900vj-en.html

Mann S (2022) Why governments should tax animal production: a system approach to internalise the externalities of agriculture. *International Journal of Sustainable Economy* 14(3): 294–308. https://boris-portal.unibe.ch/server/api/core/bitstreams/64316cf4-753e-46c7-b25e-f006083db799/content

Matthews K, Blackstock K, Waylen K, et al. (2018) *Report on the quality check of the robustness of the narrative behind the Common Agricultural Policy (CAP)*. MAGIC (H2020–GA 689669) Project Deliverable 5.5. https://magic-nexus.eu/sites/default/files/files_documents_repository/magic_deliverable_5.5_cap_report.pdf

Mee J and Boyle L (2020) Assessing whether dairy cow welfare is 'better' in pasture-based than in confinement-based management systems. *New Zealand Veterinary Journal* 68(3): 168–177.

Met Office (2022) *UK climate projections: headline findings*. Hadley Centre: Met Office. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18_headline_findings_v4_aug22.pdf (accessed 8 April 2024).

Metcalfe S and Sasse T (2023) *Tackling obesity: improving policy making on food and health*. London: Institute for Government. https://www.instituteforgovernment.org.uk/sites/default/files/2023-04/tackling-obesity.pdf

Ministeriet for Grønt Trepart (n.d.) *A greener Denmark*. https://mgtp.dk/groent-danmark/english-a-greener-denmark (accessed 14 July 2025).

Ministerio de Medio Ambiente y Medio Rural y Marino (n.d.) *Autochthonous livestock in Spain*. Taravilla: Ministerio de Medio Ambiente y Medio Rural y Marino. https://www.mapa.gob.es/dam/mapa/contenido/ganaderia/temas/zootecnia/arca/razas/publicaciones-de-interes/libros/0autochthonous-livestock-in-spain.pdf

Ministry of Climate and Environment Republic of Poland (2024) *Poland's national inventory document 2024 greenhouse gas inventory 1988–2022: submission under the United Nations Framework Convention on Climate Change*. Warsaw: Ministry of Climate and Environment Republic of Poland. https://unfccc.int/sites/default/files/resource/NID%202024%20POL%20v.2.pdf

Mollgaard P, Jacobsen J, Kristensen N, Elmsekov J, Halkier B, Heiselberg P, et al. (2023) *Adaptation of the Danish farm sector to a tax on greenhouse gas emissions: effects of a carbon tax on Danish farms and their greenhouse gas emissions: English policy brief*. Copenhagen: Danish Council on Climate Change. https://klimaraadet.dk/sites/default/files/node/field_files/Adaptation%20of%20the%20Danish%20Farm%20Sector%20-%20English%20Policy%20Brief.pdf

More in Common (2023) More in Common polling for FFCC. Polling Data. More in Common polling tables. **https://www.moreincommon.org.uk/our-work/polling-tables/** (accessed 17 April 2024).

Morgado Simões H and Erbach G (2024) *Spain's climate action strategy*. Climate Action Research and Tracking Service, Members' Research Service. Brussels: European Parliament. https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767171/EPRS_BRI(2024)767171_EN.pdf

Morgan-Davies C, Kyle J, Boman IA, et al. (2021) A comparison of farm labour, profitability, and carbon footprint of different management strategies in Northern European grassland sheep systems. *Agricultural Systems* 191: 103155.

Mudriian K (2024) *EU oilseed meal market: repercussions off duty imposed on Russia — milling and grain*. https://millingandgrain.com/eu-oilseed-meal-market-repercussions-off-duty-imposed-on-russia/ (accessed 14 July 2025).

NFU (2024) Bovaer trials — what you need to know. NFUonline. https://www.nfuonline.com/updates-and-information/nfu-responds-to-bovaer-trial/ (accessed 14 July 2025).

Northern Ireland Government (2024) *Northern Ireland food strategy framework*. Belfast: DAERA. https://www.daera-ni.gov.uk/publications/northern-ireland-food-strategy-framework (accessed 14 July 2025).

Northern Ireland Government (2025) *Questions and answers: Sustainable Agriculture Programme for Northern Ireland*. Belfast: DAERA. https://www.daera-ni.gov.uk/sites/default/files/2025-06/Master%20Version%204.0%20Sustainable%20Agriculture%20Programme%20Q%26A%20June%202025.PDF

Organisation for Economic Co-operation Development [OECD] (2023) *Policies for the future of farming and food in the European Union*. OECD Agriculture and Food Policy Reviews. Paris: OECD Publishing. https://www.oecd.org/en/publications/policies-for-the-future-of-farming-and-food-in-the-european-union_32810cf6-en.html

Pardoe L (2024) *Plant-based meat and milk are now mainstream choices for British consumers*. GFI Europe. https://gfieurope.org/blog/plant-based-meat-and-milk-are-now-mainstream-choices-for-british-consumers/ (accessed 14 July 2025).

Petetin L and Dobbs M (2022) *Brexit and agriculture*. Routledge.

Pettifer K (2025) FSA Chief Executive's speech to the Northern Ireland Food and Drink Conference 2025. Belfast: Food Standards Agency. https://www.food.gov.uk/about-us/fsa-chief-executives-speech-to-the-northern-ireland-food-and-drink-conference-2025 (accessed 14 July 2025).

Poux X and Aubert P-M (2018) An agroecological Europe in 2050: multifunctional agriculture for healthy eating. *Findings from the Ten Years For Agroecology (TYFA) modelling exercise, Iddri-AScA, Study* 9: 18.

Purcell B (2024) *Poland 2024: agricultural conditions summary*. U.S. Department of Agriculture, Foreign Agricultural Service. https://ipad.fas.usda.gov/highlights/2024/09/Poland/index.pdf

Ramos-Morales E, Rossi G, Cattin M, et al. (2018) The effect of an isoflavonid-rich liquorice extract on fermentation, methanogenesis and the microbiome in the rumen simulation technique. *FEMS Microbiology Ecology* 94(3): fiy009.

Reynolds B (2024) Case study Denmark. In: *Towards food policies that support healthy and sustainable consumption. Case studies from 11 European countries highlighting good practices for demand-side policies*. Berlin: Agora Agriculture. https://www.agora-agriculture.org/publications/towards-food-policies-that-support-healthy-and-sustainable-consumption

Richardson K, Steffen W, Lucht W, et al. (2023) Earth beyond six of nine planetary boundaries. *Science Advances* 9(37).

Ritchie H and Roser M (2019) *Land use: how is humanity using the Earth's land? And how can we decrease our land use so that more land is left for wildlife?* https://ourworldindata.org/land-use (accessed 5 April 2024).

Rockström J, Steffen W, Noone K, Persson A, Stuart Chapin III F, Lambin EF, et al. (2009) A safe operating space for humanity. *Nature* 261: 472–475. https://www.nature.com/articles/461472a

Rowe S, Hickey S, Johnson P, et al. (2021) The contribution animal breeding can make to industry carbon neutrality goals. *Association for the Advancement of Animal Breeding and Genetics*. Epub ahead of print 2021.

Rowe SJ, Hickey SM, Bain WE, et al. (2022) Can we have our steak and eat it: the impact of breeding for lowered environmental impact on yield and meat quality in sheep. *Frontiers in Genetics* 13.

Säll S and Gren I-M (2015) Effects of an environmental tax on meat and dairy consumption in Sweden. *Food Policy* 55: 41–53.

Scottish Government (2024a) *Agricultural reform route map*. https://www.ruralpayments.org/topics/agricultural-reform-programme/arp-route-map/ (accessed 7 April 2024).

Scottish Government (2024b) *National good food nation plan*. Edinburgh: Scottish Government. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2024/01/national-good-food-nation-plan/documents/national-good-food-nation-plan/national-good-food-nation-plan/govscot%3Adocument/national-good-food-nation-plan.pdf (accessed 14 July 2025).

Scown MW, Brady MV and Nicholas KA (2020) Billions in misspent EU agricultural subsidies could support the sustainable development goals. *One Earth* 3(2): 237–250.

Seufert V and Ramankutty N (2017) Many shades of gray — the context-dependent performance of organic agriculture. *Science Advances* 3(3): e1602638.

Sharma H (2020) *Main challenges and drivers of biodiversity loss in France: a literature review*. Futureearth. https://futureearth.org/wp-content/uploads/2020/12/The-Post-2020-Biodiversity-Targets-and-the-SDGs-in-France-What-Pathways-to-Achieve-Them.pdf?

Skinner C, Gattinger A, Muller A, Mäder P, Fliessbach A, Stolze M et al. (2014) Greenhouse gas fluxes from agricultural soils under organic and non-organic management — a global meta-analysis. *Science of the Total Environment* 468: 553–563.

Soteriades AD, Gonzalez-Mejia AM, Styles D, et al. (2018) Effects of high-sugar grasses and improved manure management on the environmental footprint of milk production at the farm level. *Journal of Cleaner Production* 202: 1241–1252.

Springmann M, Clark M, Mason-D'Croz D, Wiebe K, Bodirsky BL, Lassaletta L, et al. (2018) Options for keeping the food system within environmental limits. *Nature* 562(7728): 519–525.

Springmann M and Freund F (2022) Options for reforming agricultural subsidies from health, climate, and economic perspectives. *Nature Communications* 13(1): 82.

Starsmore K, Lahart B, Villalobos-Lopez N, et al. (2024) Residual methane emissions in grazing lactating dairy cows. *New Zealand Journal of Agricultural Research* 67(3): 285–295.

Strohschneider P (2024) *Strategic dialogue on the future of EU agriculture — a shared prospect for farming and food in Europe*. Brussels: European Commission. https://agriculture.ec.europa.eu/document/download/171329ff-0f50-4fa5-946f-aea11032172e_en?filename=strategic-dialogue-report-2024_en.pdf

Sustainable Food Trust (2019) *The hidden cost of UK food: revised edition 2019*. Sustainable Food Trust. https://sustainablefoodtrust.org/wp-content/uploads/2022/01/Website-Version-The-Hidden-Cost-of-UK-Food_compressed.pdf

Therond O, Tichit M, Tibi A, et al. (2017) *Volet 'écosystèmes agricoles' de l'Evaluation Française des Ecosystèmes et des Services Ecosystémiques*. Clermont-Ferrand: INRAE. https://www.inrae.fr/sites/default/files/pdf/efese-services-ecosystemiques-rendus-par-les-ecosystemes-agricoles-rapport-complet-4.pdf

Van Berkum S, Dengerink J and Ruben R (2018) *The food systems approach: sustainable solutions for a sufficient supply of healthy food*. Wageningen Economic Research.

Vegconomist (2024) UK biotech Multus unveils world's first commercial-scale serum-free growth media facility. https://vegconomist.com/cultivated-cell-cultured-biotechnology/cultivated-meat/uks-biotech-multus-worlds-first-commercial-scale-serum-free-growth-media-facility/ (accessed 14 July 2025).

Velthof G, Lesschen J, Webb J, Pietrzak S, Miatkowski Z, Pinto M, et al. (2014) The impact of the Nitrates Directive on nitrogen emissions from agriculture in the EU-27 during 2000–2008. *Science of the Total Environment* 468: 1225–1233.

Welsh Government (2024) *Sustainable farming scheme: proposed scheme outline*. Cardiff. https://www.gov.wales/sustainable-farming-scheme-proposed-scheme-outline-2024-html (accessed 14 July 2025).

White K (2021) Foundation Earth: food companies and retailers create eco-labelling scheme. *The Grocer*. https://www.thegrocer.co.uk/news/foundation-earth-food-companies-and-retailers-create-eco-labelling-scheme/657445.article (accessed 14 July 2025).

Wilkinson JM and Garnsworthy PC (2017) Dietary options to reduce the environmental impact of milk production. *The Journal of Agricultural Science* 155(2): 334–347.

Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al. (2019) Food in the Anthropocene: the EAT–*Lancet* Commission on healthy diets from sustainable food systems. *The Lancet* 393(10170): 447–492.

World Weather Attribution [WWA] (2024) *Autumn and winter storm rainfall in the UK and Ireland was made about 20% heavier by human-caused climate change*. https://www.worldweatherattribution.org/autumn-and-winter-storms-over-uk-and-ireland-are-becoming-wetter-due-to-climate-change/ (accessed 11 April 2025).

Wrona A (2024) Case study Poland. In: *Towards food policies that support healthy and sustainable consumption. Case studies from 11 European countries highlighting good practices for demand-side policies*. Agora Agriculture and IDDRI. https://www.agora-agriculture.org/publications/towards-food-policies-that-support-healthy-and-sustainable-consumption

Zvěřina O, Kosečková P, Coufalík P, Michaličková D and Duborská E (2025) Essential and toxic elements in plant-based dairy alternatives: implications for vegan diets. *European Food Research and Technology*. Epub ahead of print 2025. DOI: 10.1007/s00217-025-04775-1.