Net Zero and the UK Agri-Food System: Priorities for Research and Policy

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1. Introduction

Globally, the agri-food system accounts for a third of greenhouse gas (GHG) emissions. In the UK, the proportion is just under a quarter. The UK agri-food system emits around 135 MtCO$_2$e a year, around half of which comes from the production sector. The next largest sources are transport and retail accounting for 11-12 per cent each.[1] Agricultural emissions are principally from livestock, agricultural soils, fuels and heating. Methane makes up almost two-thirds of agricultural emissions, largely from livestock and their manure. Since 1990, emissions from UK agriculture have fallen by 12 per cent, but most of this fall was due to falling livestock numbers and fertiliser use up to 2010. Emissions from agriculture have flatlined over the past 15 years, and between 2020 and 2021 they were estimated to have increased by 3 per cent.

The Climate Change Committee's (CCC) Sixth Carbon Budget, published in 2020, suggests changes in the UK agri-food system to ensure sufficient reduction in net emissions to achieve a net zero UK by 2050.[2] The budget suggests net emissions from agriculture and land should fall from 67 MtCO$_2$e in 2018 to 40 MtCO$_2$e in 2035 and to 16 MtCO$_2$e by 2050. The CCC assumes that the UK's self-sufficiency in food remains the same. The key changes for the agri-food and land use system are as follows:

Food: A 20 per cent drop in meat and dairy consumption by 2035 and a further 15 per cent drop in meat consumption by 2050; a 50 per cent reduction in food waste by 2030, and 60 per cent by 2050.

Farming: Annual agricultural emissions fall from 54.6 MtCO$_2$e in 2018 to 39 MtCO$_2$e in 2035, and to 35 MtCO$_2$e in 2050; uptake of low emission farming practices reduces emissions by 4 MtCO$_2$e by 2035; productivity improvements reduce emissions by 1 MtCO$_2$e by 2035; fossil fuel use in agriculture halves from 4.6 MtCO$_2$e of emissions in 2018 to 2 MtCO$_2$e in 2035.

Land: Some 440,000 ha of additional woodland to be established by 2035 and 260,000 ha shifted to bioenergy production. Total woodland area should increase to around 18 per cent of the UK's land area and additional energy crops to 720,000 ha by 2050. This will require 30,000 ha of trees a year established by 2025, rising to 50,000 ha per year by 2035. To meet targets, the CCC anticipates around a third of agricultural land would need to be freed up from production by 2050; 25 per cent of UK land area would be covered by forestry and energy crops (compared to 15 per cent today) and 80 per cent of peatland would need to be restored by 2050.

This pattern of change remains the most authoritative statement by an independent statutory body focussed primarily on how the UK gets to net zero. However, alternative pathways have been set out by others including the National Farmers' Union[3], the National Food Strategy[4], the Sustainable Food Trust[5] and the Green Alliance[6].

The AFN Network+ was established in 2022 to help inform the work of the UK research councils. It is funded by UKRI, the research councils' umbrella body, including the Engineering and Physical Sciences Research Council (EPSRC), the Biotechnology and Biosciences Research Council (BBSRC), the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC). The Network's membership has grown to over 1,500 (as of February 2024) and it organises activities to support networking, knowledge exchange and research agenda-setting among researchers, practitioners, stakeholder organisations and policymaking bodies. It also supports the professional development of early career researchers and funds some research of its own. This report has been produced after the Network's first 18 months of activities. Thematic priorities were developed at the Network's first annual meeting in Leeds in spring 2023. Draft research priorities were initially produced at an expert workshop in November 2023 and consulted upon among the Network's membership with responses analysed and incorporated into this report.

During 2023, the AFN Network+ produced four scenarios for 2050 to help broaden thinking about what the world could be like.[7] In each scenario, the UK gets

[1] https://edgar.jrc.ec.europa.eu/edgar_food#intro
[2] Climate Change Committee (2020) *The Sixth Carbon Budget: The UK's Path to Net Zero*. London: Climate Change Committee. https://www.theccc.org.uk/publication/sixth-carbon-budget/
[3] National Farmers' Union (2019) *Achieving Net Zero: Farming's 2040 Goal*. London: NFU. https://www.nfuonline.com/archive?treeid=138313
[4] National Food Strategy (2021) *National Food Strategy – Independent Review: The Plan*. London: National Food Strategy. https://www.nationalfoodstrategy.org/

[5] Sustainable Food Trust (2022) *Feeding Britain: From the Ground Up*. Bristol: Sustainable Food Trust https://sustainablefoodtrust.org/our-work/feeding-britain/
[6] Green Alliance (2023) *Shaping UK Land Use: Priorities for Food, Nature and Climate*. London: Green Alliance https://green-alliance.org.uk/publication/shaping-uk-land-use-priorities-for-food-nature-and-climate/
[7] Benton, T. *et al*. (2023) W*hat Could the UK Agri-Food System Look Like in 2050?* Bristol: University of West of England, AFN Network+ https://www.agrifood4netzero.net/news

to net zero by 2050, but along different pathways and in very different socio-economic and geopolitical circumstances.   The scenarios are not predictions of what will happen, but are tools to help us expand our thinking beyond simple assumptions that the future is an extrapolation of recent trends. They are designed to help us contemplate a wider range of research questions for the 2020s and beyond. The scenarios are:

- Scenario A: 'Build back fast again' – an unstable and globalised world, where economic growth is key (essentially business-as-usual);

- Scenario B: 'Circular worlds' – geopolitically stable and globalised, underpinned by circular sustainable systems and values;

- Scenario C: 'Self-sufficiency' – an unstable, regionalised world, where a circular economy is driven by the need to save resources; and

- Scenario D: 'The right to food' – a geopolitically stable world, with a globalised economy built on 'green growth'.

The scenarios were used to help stretch our thinking about plausible futures for the agri-food system, and the kinds of research priorities that emerge. In what follows, we set out the suggested priorities for research and policy that have emerged from our work under six themes. **The focus is on the emissions from UK agri-food system, and not the global environmental footprint of UK-based food consumers.** The themes are not easily separable and the proposals often straddle them. A seventh theme considers system-wide and cross-cutting issues.

Healthy and sustainable diets: How to develop a resilient UK food system that contributes to net zero while promoting healthy diets. This theme focuses on the need for dietary and food system change to contribute to a net zero UK, while promoting access to healthy and affordable diets. It covers the social, environmental and economic dimensions of animal and crop production, and of plant-based meat alternatives in the agri-food system, as well as the role of fruit, vegetables, and ultra-processed foods in diets.

Land productivity: What should we grow in the UK? This theme focuses on the productive utilisation of our finite land resource. It covers questions of how crop and animal breeding and husbandry can help ensure sufficient food is produced from less land, and how space can be created for ambitious targets for establishing trees and biomass crops to sequester carbon.

Food security and trade: Where should our food come from? This theme focuses on the geographical scales at which our agri-food system operates and the balance between food produced and traded locally, nationally and across national borders. It covers questions of food security, resilience and sustainability of markets and supply chains at different spatial scales.

Land use change and land management: How should we change land use and land management in the UK? This theme focuses on the mechanisms and incentive systems to drive required changes in land use and land management in the UK. It covers questions of agricultural support policies, new markets for carbon sequestration (through trees, biomass and soils), land use frameworks and reconciling demands of net zero, biodiversity and other environmental services.

Circular food systems: How can we develop a more circular UK food system, including the agricultural economy and ecology, other components of the system, and the infrastructure that underpins it? This theme focuses on the question of more sustainable agricultural production systems with a particular emphasis on the concepts of circularity and reducing waste. It covers questions of the need for smaller-scale, mixed farming systems and the relative merits of systems such as agroecology, agroforestry and regenerative agriculture, and the re-use of nutrients from along the supply chain.

Behaviour change: Individual and institutional behaviour change in the UK agri-food system. This theme focuses on the role of institutions and policies to encourage behaviour change in the agri-food system. It covers questions of the politics, economics, psychology and food nutrition science of effecting large-scale behavioural change and the individual and institutional dynamics of changes in food production practices.

System-wide and cross-cutting issues: How can we capture the system-wide features of the agri-food transition? This theme focuses on the need for systems-thinking and analysis in research and policy and a holistic approach to science and policy measures, including the functioning of the R&D and innovation system and the need to consider the social and political questions of fairness in system transformation.

Within each section, research and policy priorities are listed in order of the strength of endorsement of them by those who responded to our consultation exercise.

2. Healthy and Sustainable Diets

Research evidence suggests diets that are good for individual nutrition and health are also better for greenhouse gas emissions. Independent bodies such as the Climate Change Committee and National Food Strategy advocate a shift away from animal-based production towards more plant-based proteins. Providing healthy and sustainable diets for a growing population — by 2050 the UK population is projected to be 74 million — is at the heart of agri-food system transformation, which must take place while the UK's climate and international supply chains are also changing. The relationship between consumer preferences, producers' practices and the supply chains in-between are continually changing and need to be better understood. The power and freedoms of some exist alongside the squeeze and constraints upon others. The UK's transition to net zero will require more than just the development and adoption of new technologies in the agri-food system, including a more robust understanding of the powerful ways in which market and consumer influences operate.

Research Priorities

2.1   How could the economic framework governing UK food production better incentivise domestic production of healthy foods (*e.g.* fruit, vegetable and salad crops) and address the market failures that inhibit growth and investment in these crop categories? What are the retailing and supply chain management systems that shape sustainable and unsustainable production practices?

2.2   What social and demographic trends influence dietary choices? How do information and knowledge systems and their associated power relations shape behaviour? How might social trends be actively influenced to promote healthier and more sustainable behaviour? What is the relationship between cultures and habits around food consumption and healthy diets, and how can more people be more broadly engaged in changing food systems?

2.3   What changes may help ensure stronger promotion and co-ordination around healthy and sustainable food across Government Departments, including, but not limited to, the Department of Health, the Department for Environment, Food and Rural Affairs, the Department for Education, the Ministry of Justice, and the Department for Culture, Media and Sport? What steps can be taken to avoid the risk of party politicisation of food reforms and so avoid 'culture wars' and social division around this important set of issues?

2.4   How can action research develop new models of inclusive local systems of food provision, including innovation in business models and social and physical infrastructure development? How can we ensure existing inequalities and poverty are not made worse but also addressed through a food system transition? What framework could be used to design a socially just food system?

2.5   What are the scientific assumptions incorporated in our National Inventory compiling and reporting system around GHG emissions sources from the agri-food system (*e.g.* methane from manure management v enteric sources)? How can measures of sequestration be better incorporated alongside emissions? How can confidence in the evidence base be improved?

2.6   How can a whole systems-approach to the relationship between soils and nutrition be developed (bringing together specialists in the soil and gut microbiomes, for example), including studies of long-term changes in soil management, fertilizer and pesticide use and their implications? How will agricultural production practices need to adapt in response to climate change?

2.7   What social, economic, infrastructural and informational trends have shaped today's agri-food system, its structure and functions? How can international comparative work help better understand the distinctive characteristics of the UK's system? How does the cold chain affect the environmental performance of the UK agri-food system, for example?

2.8 How can research better embed the lived and living experience of household food insecurity? This is not only to provide real-life examples of the operation of the food system, fuel and social benefits at the household level, but also to ensure a commitment to a just transition to net zero is informed by voices of those who could otherwise be hardest hit.

Policy Priorities

2.9 The UK and Devolved Governments should collectively develop a clear strategy for the pathway to a sustainable agri-food system that actively enables the UK's net zero-by-2050 goal. The vision should be collaboratively produced with agri-food industry, environmental and consumer organisations in order to enjoy widespread stakeholder support. It should convey the seriousness and urgency of the net zero challenge, emphasising that action is required immediately and in line with agreed five-yearly milestones. It should take a whole-systems approach that includes sufficiently mitigating greenhouse gas emissions, enhancing public health, strengthening biodiversity, and supporting livelihoods.

2.10 The National Food Strategy (2021) provides a sound analysis of the priorities for change and should form the basis for strategies to support the transition. It provides the best basis for setting a clear and constructive vision and policy framework for the development of the UK agri-food system. It also helpfully considers how the preferences of the next generation of food consumers can be positively influenced through the education system. It stops short of recommending climate food education be embedded in national curricula, but this would be an important step in helping raise awareness and giving agency to young people around climate change.

2.11 What is the UK farming sector for? The UK and Devolved Governments need to decide and make explicit the extent to which agricultural land in the UK is to be used for producing food for UK consumption, to supply export markets or to grow the agricultural economy. If optimising domestic self-sufficiency in food production were to be the goal (rather than optimising exports), then evidence-based minimum thresholds of self-sufficiency in the major food commodities (meats, cereals, fruit and vegetables) would need to be set.

2.12 The UK and Devolved Governments should each develop a contingency plan for a sudden drop in food availability in case of problems (*e.g.* due to extreme weather interacting with more volatile geopolitical environment). Local resilience forums and civil contingency arrangements should be reviewed from the perspective of food supply and distribution.

3. Land Productivity

Discussions about issues affecting future UK land use often seem to assume we have much more land than we do. There is a general commitment to at least maintain levels of domestic self-sufficiency (for which there is a weak evidential basis), but also a need for considerable additional land to be used for establishing trees and growing energy crops. A growing UK population may mean stronger demand for food, or changes in the composition of diets and thus agricultural production or supply chains. Environmental targets also require land for nature conservation and biodiversity, and land will be required to house a growing population. The net zero transition raises fundamental questions about how land is used optimally, and how UK consumers' demands for food can be met from less agricultural land while not increasing imports, and all while the climate is changing.

Research Priorities

3.1 How can we best improve yields and productivity in a sustainable way? Do current markets and policy frameworks sufficiently incentivise improved productivity on farms, and of the right products (*e.g.* grain vs biomass vs fruit and vegetables)? How can the competition for land between food for humans and animals be managed for optimum public benefit? How can technological advances in animal breeding and data science be harnessed to improve productivity and reduce emissions, including using individual animal data?

3.2 What are the best strategies for mixing trees, biomass crops and food production on farmland (in terms of food production and sequestration)? How can market failures be corrected through tax, subsidy and regulation? How can establishing trees and other above-ground sequestration measures be most effectively guided to ensure optimum co-benefits (sequestration, flood risk, biodiversity, recreation) and to manage the risk of future forest fires? How can the restoration of peatland for emission-reduction purposes be most effectively balanced with food production priorities?

3.3 How can we move from single-use food and energy to multi-purpose crops and animals, (including exploiting waste streams)? To what extent can agricultural land and buildings be utilised to generate solar power while maintaining and enhancing food production? How can calculations around emissions and sequestration be used to inform enterprise stacking?

3.4 Sustainable intensification and agroecological approaches have emerged as alternative, or perhaps complementary, strategies to address food production and environmental goals. How can the relationship between these two perspectives be managed, including at the landscape scale where some strategic co-ordination across groups of farm businesses may be required? How clear and robust is the definition of regenerative farming and is it sufficiently clear to become a desirable object of policy intervention? How can soils support enhanced productivity, reduce emissions and sequester carbon?

3.5 What policy measures, incentive systems and knowledge exchange arrangements are required to reduce pre-farm-gate food waste? How can models of circularity be developed to eliminate waste at source? Can new spaces of sustainable food production be created in urban areas?

3.6 What lessons can be drawn about the efficacy of the research, innovation and knowledge exchange system for British agriculture including through learning from other countries' experience?

Policy Priorities

3.7 The UK and Devolved Governments should develop clear agri-food industrial strategies to support the improvement of productivity across key food product types, in the light of the likely changed requirements in land use types by 2050. These strategies should include provision for the strengthening of the R&D and innovation system to support change more directly among agri-food firms of all kinds and this should be more strongly

focussed on supporting the net zero transition than is currently the case.

3.8 At the core of the dilemmas in the agri-food system transition is the use of land for domestic food production and other purposes (including for production for export). The UK Net Zero Vision and Strategies for the Agri-Food System need to be underpinned by a land use strategy, for each part of the UK, that reflects the need for significant land use changes to maintain, and even enhance, UK levels of self-sufficiency in food while making sufficient land available for other uses. The land use strategy must be robust enough to help drive the required change over the next three decades accompanied by effective regulation and financial incentives to landowners and managers, and not just be 'light-touch' pieces of analysis. It also needs to consider and plan for the implications for rural economies and local livelihoods from extensive land use changes.

4. Food Security and Trade

The UK's food security will continue to depend heavily on imports but there is uncertainty about how geopolitical and environmental change will affect future trading relationships and the security of international supply chains. Within the UK, food production is both for domestic consumption and for export. The balance between these two has important implications for how we think about optimising UK land use for food production and other purposes. Pressure on the land resource focuses attention on the land used to support livestock farming, including grazing land for farm animals, but also the arable cropland used to grow animal feeds and crops for digestate. Recommendations to reduce livestock numbers are about the release of land for other purposes as well as reducing direct emissions from the animals themselves.

Research Priorities

4.1   What novel crops and production systems might contribute to optimising the UK's land resource under conditions of climate change? How might changes in rotations and cropping patterns help improve diets, reduce food security risks and enhance the productivity of land? How might an understanding of key micronutrient needs inform measures to improve food security? What would be the implications of developing alternative proteins to replace processed meats for food security and land use?

4.2   What does a resilient and adaptive food supply and trade system look like? How can we build resilience into food supply chains which are able to adapt and withstand pressures from external political, environmental or economic instabilities? How can we ensure strengthening UK resilience does not undermine the resilience of other parts of the world? How can resilience be measured? What pathways, enablers, and support arrangements could help advance the transition? What is the relationship between building domestic resilience and strengthening export prospects? How can fairness in commercial practices in food supply chains be strengthened?

4.3   What would be the impacts on UK production and exports of large-scale dietary shift in UK consumption (*e.g.* away from meat and dairy)? Would changed UK consumption patterns prompt changes in land use, or simply increase food exports? Is UK-produced meat competitive enough to be exported if domestic consumption fell dramatically? What are the likely implications of large-scale

UK dietary change for UK emissions, agricultural livelihoods and animal welfare? How elastic are the relationships between changes in yields, land use, diets, and exports? How distinctive are recent patterns of UK dietary change compared to other European countries?

4.4   How can we ensure future trade deals take account of the broader issues around food production such as GHG emissions, biodiversity and animal welfare? To what extent has the Australia and New Zealand deal 'set the bar' in terms of future UK trade deals when it comes to food and agriculture?

4.5   How can the UK become more self-sufficient in animal feedstuffs while not compromising the ability to produce food crops for human consumption? How is the switch from beef to chicken consumption affecting UK greenhouse gas emissions and the pattern of feed-sourcing? What would be the business opportunities and emission-reduction benefits in the UK food system from a move away from such dependence upon chicken meat?

4.6   How can data management and analytics be developed to better inform decisions around food trade and sustainability? How can sustainability and net zero measures be incorporated into mandatory reporting to inform consumers and companies in supply chains? What are the co-dependencies between food trade and emissions from other sources (*e.g.* processing, transport etc)? How can system-wide data be supported by field measurements?

Policy Priorities

4.7   The UK and Devolved Governments should develop more explicit, evidence-based, minimum thresholds for the degree of provision of the main food commodities and products that should be produced within the UK. In particular, the degree of self-sufficiency in fruit and vegetables should be actively stimulated and supported.

4.8   A National Task Force on Resilience of Agri-Food Supply Chains should be established to carry out horizon-scanning work to foresee and plan for threats and disruptions to key supply chains. This should include consideration of water supply and infrastructure in adapting to extreme weather events due to climate change.

4.9   A 50 per cent target has been suggested for the proportion of temperate food products procured through the public sector in England that should be British in origin. It would also be helpful to include requirements that food procured by the public sector is sustainably produced. Given the changing weather at home and abroad, and the changing geopolitical environment, Governments need to become clearer on the appropriate level of self-sufficiency that supports our food security, a diverse farming sector, and which comes at an acceptable cost.

4.10   Complementing the Nationally Determined Contribution calculations of the climate impacts of UK food production, the UK should additionally calculate and publish an annual consumption-based emissions account, which will enable monitoring and consideration of potential off-shoring of emissions.

5. Land Use Change and Land Management

Soil and land management can help sequester carbon. There is therefore increasing interest in how land management practices might be encouraged to contribute to reducing net emissions while still farming the land. This is partly about establishing trees and hedgerows, but carbon can also be sequestered through better soil management. There are questions about how such sequestration may be made more durable and how it might be monitored, audited and financially rewarded. There is also increasing interest in the technologies and instrumentation for authenticating and governing sequestration through land and soil management, as well as concern about farmland being taken out of food production for trees in a non-strategic way.

Research Priorities

5.1   How can net zero policies work to reduce emissions from land management, while also improving biodiversity and supporting livelihoods? How can the post-CAP support schemes across the UK be developed to ensure net zero UK by 2050 goals are sufficiently met?

5.2   How can the R&D, knowledge exchange and advisory system be developed to support the scale and systemic nature of change required of UK land use and land management practices for the net zero transition?

5.3   How do we create robust measures of appropriate land management practices for the net zero transition? What are the most effective business models to ensure sufficient natural capital from land? What are the most effective means of measuring and improving soil health? How can their adoption be most effectively supported? How can the opportunity costs of alternative land use options be best calculated, visualised and understood?

5.4   How does the regulatory baseline need to evolve over the coming decades to ensure net emissions are sufficiently reduced? What are the social and political obstacles to strengthening the regulatory baseline and how might they be overcome?

5.5   What is the relationship between patterns of land ownership, occupancy change and land management for the net zero transition? How do land ownership and land occupancy arrangements affect the prospects for establishing trees and sequestering carbon?

5.6   How can fruit and vegetable production and farmland trees and orchards be integrated back into commercial farming systems in the UK? How can fruit and vegetable production be incorporated into public and private spaces beyond agricultural land?

5.7   How can farmers be encouraged to proactively manage land holistically, for multiple benefits, rather than just for productivity? How can sustainable land management practices be more effectively 'locked in' to protect environmental benefits over the longer term?

5.8   How can the requirement for 'net zero' supply chains together with carbon pricing and carbon markets be most effectively developed to support the net zero transition and incentivise desirable land use and land management practices? How can GHG emissions reduction be handled alongside improving biodiversity, water resource management and water pollution risks? How might the tax system be developed to support net zero objectives around land use and land management?

5.9   What are the barriers to achieving the Climate Change Committee's suggested targets for upland and lowland peat restoration and how might they best be overcome?

Policy Priorities

5.10   Sustainable whole-system transformation will require a greater emphasis on, and resourcing of, training, skills and human capital development among land managers and within the main land-based education and training institutions.

5.11 The UK and Devolved Governments should ensure that post-CAP agricultural support schemes sufficiently incentivise greenhouse gas emissions reduction, especially in the key emitting areas such as ruminant livestock and peatland management, alongside other environmental and social objectives.

5.12 The UK and Devolved Governments should develop national plans for establishing a greater area of hedgerows to meet the Climate Change Committee's recommended targets by 2030 and 2050.

5.13 The UK and Devolved Governments should develop stretching targets for expansion of agroforestry which combines trees on farmland with agricultural production. In Wales and other upland areas, there is a particular need to better integrate establishing trees with support for the social and economic sustainability of the farming industry in the most agriculturally dependent regions.

5.14 A plan for the sustainable development of bioenergy for carbon capture and storage needs to be developed hand-in-hand with a land use framework which considers food production, biodiversity and other requirements from land use (with perennial bioenergy crops utilising the most marginal agricultural land, for example).

6. Circular Food Systems

Circular food systems can mean mixed crop and high nature value farming, but other strategies for circularity may be easier to scale (such as the use of agricultural side-streams and waste as feedstocks for cellular agriculture, or processing into plant-based foods, or greater incentives for mixed rather than specialist farming landscapes). Research into processing and side-stream utilisation on-farm could improve the economics of growing certain crops. There is also growing interest in the potential benefits of more mixed farming systems as a means of reducing reliance on manufactured inputs such as fertilisers, while also reducing agricultural pressures on the soil and water environment. It is less clear what this might mean for overall levels of production and productivity.

Research Priorities

6.1   How can the true cost of food be included in the financial operation of the agri-food system, so that environmental and public health externalities are properly incorporated? How do food waste cycles operate and how can their environmental efficiency be improved?

6.2   In developing healthy soils, how can effective baselines be established, and how can networks of farmers best demonstrate and share good practice? How can better use be made of nutrients within the farming system to reduce emissions?

6.3   For companies who do not currently have science-based environmental, social and governance reporting, how can they be supported to shift focus from Scope 1 to Scope 3 GHG emissions?

6.4   Are we sufficiently equipped with the industrial base and skills needed to create the infrastructure for a more circular food system? Where would this capability come from otherwise? How vulnerable does this make us?

Policy Priorities

6.5   The Climate Change Committee's suggested targets on food waste reduction will require concerted emphasis on promoting waste-reduction systems and behaviours along the food chain (from on-farms, though processing, distribution and retailing, and to end use in catering and in households).

6.6   Defra and its Scottish, Welsh and Northern Irish equivalents should review the enforcement of water pollution laws that affect agriculture and better integrate greenhouse gas emissions reduction measures with those protecting water and clean air.

6.7   The UK and Devolved Governments should work with the agricultural industry to reduce manure management emissions from all dairy farms, indoor pig units and intensive beef enterprises with slurry-based systems, and from the intensive poultry sector.

7. Behaviour Change

Science and technology have a vital role to play in supporting the transformation of the UK agri-food system. However, an over-reliance on technological solutions risks diverting attention from the crucial role of the practices of individuals and institutions. The last Climate Change Committee Chair, Lord Deben, pointed to institutions as the biggest challenge in reforming the agri-food and land use system. The model for transforming electricity generation cannot be transplanted into the agri-food system, because of the greater diversity and cultural heritage of products, processes and organisations. Changing mind-sets and everyday practice will prove more challenging for individuals and institutions alike. Important questions arise over how social values may be influenced to align with net zero objectives and how basic human values and motivations might also be effectively harnessed.

Research Priorities

7.1   How might fiscal measures be developed to disincentivise harmful practices and incentivise good practices (among farmers and food companies), including measures modelled on the success of the Soft Drinks Industry Levy in stimulating beneficial substitutions by manufacturers?

7.2   How are farming culture, identity and values evolving over recent decades and how are net zero concerns influencing how farmers are valued by others? How do we identify and address the non-financial barriers which are preventing the required changes in farming and land management practices? How will the removal of the Basic Payments Scheme affect the viability of farming businesses and the social structure of the farming community in marginal areas, and with what implications for land management for net zero?

7.3   How could the insights from the Behavioural Insights Team report published (and then quickly unpublished) in October 2021 on behaviour change for net zero best be operationalised for the agri-food system?

7.4   What are the material and financial flows and interdependencies between key production systems and markets (*e.g.* between beef and dairy systems and markets)? What are the social and family dynamics influencing the age structure and skills profile of the livestock sector and what social, economic and technological trends will shape the sector's ability to adapt?

7.5   What is the place of regulation, taxes and standards in shaping behaviour change, and how can regulation be introduced in ways that reduce the risk of sharp social conflict?

Policy Priorities

7.6   Agriculture and food policy could be better aligned with public health objectives. The successful experience with the Soft Drinks Industry Levy could be extended to discourage the use of unhealthy and more highly emitting ingredients in processed foods so that manufacturers and processors reduce net greenhouse gas emissions. Ideally, it should be easier and cheaper to get a nutritious meal or a piece of fruit in a school, hospital or public place than a chocolate bar or bottle of pop.

7.7   The UK and Devolved Governments should develop a system of measurable targets for reducing food waste at key points along the food chain and for reducing consumption of the unhealthiest and most highly emitting foodstuffs and develop educational and public awareness programmes and other interventions to support desirable change.

7.8   The UK and Devolved Governments with UKRI should develop a sustained, long-term programme of research into the drivers of behaviour change among landowners and land managers, which draws on economics, socio-cultural and psychological perspectives from across the social sciences, to underpin measures to ensure net emissions reduction and a socially just transition.

7.9   Governments should periodically reconsider how to guide point-of-sale choices through, for example, labelling or in-store provision of data, to inform consumers' decisions.

8. System-wide and Cross-Cutting Issues

The economic pressures of the past 15 years have focussed attention on the affordability of, and access to, healthy food among different social groups, as well as the resilience of supply chains to international events.   Managed structural change to green the UK agri-food system is also an opportunity to address the serious problems of health inequalities which are increasingly influenced by poor diet. At the same time, there is the question of the 'winners' and 'losers' from what might be significant changes in land use and livelihoods in the agri-food system. Dietary-related poor health is a major driver of financial pressure on the NHS and is also affecting the overall performance of the UK economy through illness and absence from work. A just transition ought to ensure the social issues around food, diet and health are addressed for both social and economic benefit, and that measures are put in place to support any structural change that might significantly affect particular occupational communities.

Research Priorities

8.1   What are the institutional barriers to a systems approach to agri-food sector transformation and how might they be overcome?

8.2   How effective and reliable are the protocols for GHG emissions reduction and life-cycle analysis for food products being used by British food companies (such as ISO14067)? How can initiatives such as the Food Data Transparency Partnership be strengthened to improve the transparency, ownership, and public trust in emission-reduction measures?

8.3   How best do we build an engineering and bioscience skills base for the 'Green Food Bioeconomy'?

8.4   How does the research and innovation system incorporate lived and living experience into processes of research agenda-setting, prioritisation, programming and project funding?

8.5   Technological changes, including genetic engineering and gene editing, are a potentially disruptive force in the agri-food system. How might public and private interests most effectively work together to develop technological solutions in the agri-food system?

Policy Priorities

8.6   Governing and opposition parties should develop plans to promote transitional support for workers and businesses in sectors affected by structural adjustment to a net zero UK.

(For example, this could include support for livestock businesses under a scheme akin to Labour's proposed British Jobs Bonus scheme aimed at the oil and gas sector).

8.7   Strategic research and innovation funding questions relating to the UK agri-food system span the remits of several research councils. Within UKRI, these Councils should establish a cross-Council prioritisation body and consider the proportion of funding that goes to research focused specifically on the UK agri-food system as compared to research based in other parts of the world.

8.8   The net zero dimensions to the work of Defra and its devolved counterparts relating to the UK agri-food system should be considered holistically by an independent National Agri-Food for Net Zero Advisory Committee reporting jointly to the Cabinet Office, Defra and the Devolved Administrations. The Committee should work closely with the Climate Change Committee, monitor progress on emissions reduction, make recommendations for setting targets, and include within its remit questions of institutional change and the machinery of government and the interactions between net zero, other environmental goals, and those around trade, and access and affordability of healthy food.

8.9   Governing and opposition parties should take steps to ensure young people (aged under 35) and disadvantaged groups are able to inform policy-making for the agri-food system's net zero transition. (This could include measures such as the Climate and Economic Justice Screening Tool used in the US to understand

the distributional consequences of support for the net zero transition).

8.10   The UK Government should work with the Devolved Governments to produce a breakdown of 5-yearly emission-reduction targets by sub-sector, by devolved nation and English region starting in 2025.

Credits

About the AFN Network+

The AFN Network+ is a unique network of over 1,500 academics, researchers, third sector organisations, policymakers, and agri-food industry professionals from farmers to retailers. Together, we are working to identify key research gaps that may be holding the UK food system back from transitioning towards a net zero UK by 2050, while also enhancing biodiversity, nurturing livelihoods, supporting public health, and minimising the environmental impacts of overseas trade. Our findings will inform the next decade of research investments in this area by UKRI (our funder and the UK research councils' umbrella organisation). Alongside our core research, we run in-person and online events, produce topical resources, and commission research projects.

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Acknowledgements