

Submission to the UK Environmental Audit Committee's Inquiry on Environmental Change and Food Security

Elizabeth Robinson, Shouro Dasgupta and Lei Bian

March 2023

The Centre for Climate Change Economics and Policy (CCCEP) was established in 2008 to advance public and private action on climate change through rigorous, innovative research. The Centre is hosted jointly by the University of Leeds and the London School of Economics and Political Science. It is funded by the UK Economic and Social Research Council. www.cccep.ac.uk

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 this report

This report consists of written evidence submitted by the Grantham Research Institute on Climate Change and the Environment to the UK Parliament Environmental Audit Committee's **inquiry on environmental change and food security**. Launched on 10 November 2022, the inquiry set out to examine the UK's preparedness and resilience to future food supply stresses or shocks caused by climate change and other environmental change. The evidence submitted to the inquiry by the Grantham Research Institute was published on 26 January 2023 and is available at: <https://committees.parliament.uk/writtenevidence/114517/pdf/>.

The Grantham Research Institute's responses relate to our particular areas of expertise and on which we have published work.

This report represents a lightly edited version of the written submission, including minor revisions to the summary points.

Authors

Elizabeth Robinson, Director, Grantham Research Institute on Climate Change and the Environment.

Shouro Dasgupta, Environmental Economist, Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) and Visiting Senior Fellow, Grantham Research Institute.

Lei (Alice) Bian, Policy Fellow, Grantham Research Institute.

© The authors, 2023.

Permissions requests should be directed to the Grantham Research Institute.

Suggested citation: Robinson E, Dasgupta S and Bian L (2023) *Submission to the UK Environmental Audit Committee's Inquiry into Environmental Change and Food Security*. 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.

Summary points

- Climate change is a systemic risk that is already having a negative impact on food security in the UK, through its impacts on both domestic and overseas food production, and on the resilience of global food supply chains.
- To ensure food security in a climate-insecure world, it is increasingly important that domestic food production is resilient. The UK is a net food importer, and as such it is highly vulnerable to disruption to global food supply chains, whether caused by extreme weather shocks, geopolitical conflict, or crises such as the COVID-19 pandemic. These kinds of disruption can drive up food prices, affecting people's ability to access sufficient, healthy food.
- The increasing severity and frequency of heatwaves and extremes of precipitation due to climate change already threaten food security in the UK. If the Glasgow commitments are not met, moderate to severe food insecurity in the UK could be more than 4 percentage points higher by 2050.
- The UK's Food Strategy of 2022 does not sufficiently factor climate risks into building resilient domestic food supply chains. To inform effective policy, a better understanding of how climate change is increasingly affecting food security is needed, including through its impact on food production, labour supply and labour productivity, food prices and health.
- Air pollution also affects food supply through its impacts on crop growth. Tightening the UK's national air quality standard for nitrogen dioxide would both reduce the impact of ozone pollution on food, health and nature, and contribute to climate change mitigation.
- Accelerating a shift to low-carbon and more plant-based diets can contribute to improved food security and provide health and climate mitigation co-benefits. Whilst the emissions intensity of livestock in UK beef production is around half the global average, there is scope to lower livestock emissions by reducing both beef imports and domestic livestock production. Less land would be needed to grow grain for livestock that are not fully grass-fed, and there would be potential to enhance biodiversity and carbon sequestration through, for example, tree planting and rewilding.
- The UK Government could take a number of measures to encourage dietary shifts to lower-carbon, more plant-based diets, such as imposing a ban on advertising unhealthy foods, and making fruit and vegetables more affordable and accessible, such as through support to increase domestic production.

Introduction

Climate change is one of the biggest long-term threats to food security, globally and in the UK. Agriculture around the world is vulnerable to changes in temperature and rainfall, pests and diseases, and extreme weather events – all of which are exacerbated by climate change. In the UK, the prolonged heatwaves and drought of 2022 adversely affected harvests and UK agriculture may continue to suffer in the summer of 2023 if there is not consistent above-average rainfall over winter 2023 to replenish water levels. UK wheat yields fell by 40% in 2020, and continuing drought may further threaten domestic food production.

Over half the food currently consumed in the UK is imported, making the country highly exposed to integrated global food supply chains that are also increasingly affected by climate change-related extreme weather events. The Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) published in March 2022 warned that climate change will increasingly put pressure on food production and access to food, especially in vulnerable regions, undermining food security and nutrition (IPCC, 2022).

In December 2021 the UK Government published the first in a triennial series of UK food security reports, under the Agriculture Act 2020, which examines trends relevant to food security, including climate change and biodiversity loss (Department for Environment, Food and Rural Affairs [Defra], 2021a). In June 2022 the Government published its Food Strategy, following an independent review carried out by Henry Dimbleby, which included policies intended to boost health, sustainability and food security, while contributing to the 'levelling up' agenda (Defra, 2022). The strategy commits the Government to publishing a 'Land Use Framework' in 2023 with objectives for English agriculture, the environment and net zero. The Climate Change Committee described the Government's Food Strategy as a "missed opportunity" for the climate (CCC, 2022). It said that the strategy contained little mention of the adaptations needed in the food system to build resilience to the climate and weather extremes of the future.

Overarching inquiry questions¹

Climate change and food security: projected effect, risks and mitigation

Question 1: What are the main risks posed to future UK food security from projected climate change and biodiversity loss pathways? The call for evidence mentions the three following warming scenarios: (1) 1.5°C to 2°C; (2) 2°C or higher; and (3) 3°C or higher.

The IPCC findings reported in the call for evidence refer mainly to agricultural production, but food security also depends on the resilience of global food supply chains and people's ability to afford sufficient nutritious food. The UN Food and Agriculture Organization (FAO) states that food security "depends on both food availability and affordability". Currently, key drivers of food insecurity in the UK are poverty, inequality and rising food prices.

Climate change-induced heat stress affects food production through multiple pathways, including increasing heat and heatwaves, increasing extremes of precipitation, and changing the geographical spread of pests and diseases (Romanello et al., 2022). Increased CO₂ in the atmosphere has also been found to have a negative impact on the nutritional quality of C3 grains

¹ Note that we do not address biodiversity loss pathways in our responses.

(grains adapted to cool season establishment and growth), such as wheat, barley and oats (Ebi et al., 2021).

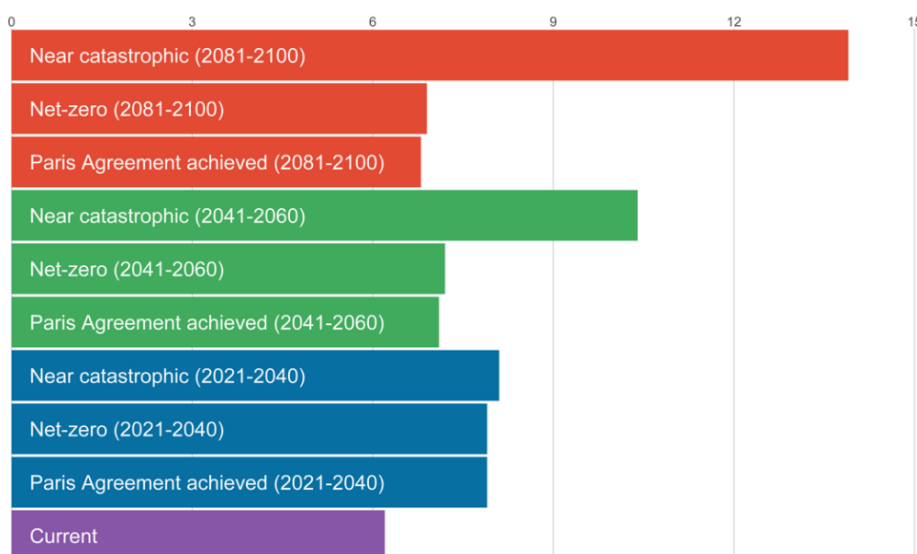
The UK depends on both domestically produced and imported foods. Physical access to food in the UK is affected by the impact of climate and weather shocks on both domestic and overseas production, and on the resilience of global food supply chains.

Past global food crises, including that in 2008, have demonstrated that some countries respond to harvest shocks in breadbasket countries (those that produce large amounts of wheat or other grains) by introducing export restrictions (CCC and China Expert Panel on Climate Change, 2018). This drives up the global cost of food. The UK imported 46% of the food that it consumed in 2020 (Defra, 2021a), making it vulnerable to systemic risk across the global food system. Regional and global commitments to not impose restrictions or bans on exports could reduce the cascading systemic risks of food insecurity that are triggered by harvest shocks in breadbasket countries and cause food prices to rapidly increase. However, some countries once again imposed grain export bans in response to the acute shock caused by the Russian invasion of Ukraine which has affected wheat exports and could also affect upcoming wheat harvests.

Resilient domestic production is important for ensuring food security in a climate-insecure world. In 2019 the UK produced 16.2 million tonnes of wheat. In 2020 this decreased by 40% to 9.7 million tonnes, the smallest wheat harvest since 1981, due to a series of adverse weather conditions. The harvest rebounded in 2021 but to only 14 million tonnes, thus remaining below the 2019 figure (Defra, 2021b; Defra, 2022b). This is an example of a domestic harvest shock compounding an overseas shock (in this case COVID-19 pandemic), which created impacts across the food supply chain.

Projections of UK food insecurity under different future climate change scenarios suggest that increasing frequency of heatwaves will result in higher levels of food insecurity in the UK (CVF and V20, 2022), as shown in Figure 1. Under both Paris and Glasgow commitments, both of which imply that the net zero target is met around 2050, moderate to severe food insecurity is projected to be 1.7 percentage points higher between 2021 and 2040, but only 0.6 to 0.7 percentage points higher between 2081 and 2100, compared with the reference period of 1995–2014. However, under a 3°C warming scenario, food insecurity in the UK is projected to be 1.9 percentage points higher between 2021 and 2040, and 7.7 percentage points higher between 2081 and 2100, compared to the same reference period (Table 1 below).

Figure 1. Projected levels of food insecurity (moderate or severe) in the UK as a percentage of the population under future climate change scenarios



Source: Climate Vulnerable Forum [CVF] (2022).

Table 1. Projected increase in food insecurity in the UK under various future climate change scenarios (percentage point change, compared with the 1995–2014 reference period)

Scenario	SSP1-RCP1.9 (1.5°C)			SSP1- RCP2.6 (2.0°C)			SSP3-RCP7.0 (3.6°C)		
	2021-2040	2041-2060	2081-2100	2021-2040	2041-2060	2081-2100	2021-2040	2041-2060	2081-2100
Moderate-severe food insecurity	+1.7	+0.9	+0.6	+1.7	+1.0	+0.7	+1.9	+4.2	+7.7

Source: Climate Vulnerable Forum [CVF] and V20 (2022)

UK preparedness: Government and markets

Question 2: How has the prolonged heatwave and drought in 2022 affected food growing in the UK?

Empirical analysis suggests that an increase in the number of heatwave days, compared to the 1981–2010 baseline, resulted in food insecurity in 2020 being 1.2 percentage points higher (2020 is the most recent year for which comparable time series data for food insecurity is available) (Dasgupta and Robinson, 2022; Romanello et al., 2022). Given the greater intensity of heatwaves and prolonged droughts seen in 2022 compared with 2020, the impacts on food insecurity are likely to have been even higher last year.

An increasing frequency of heatwave days can affect food insecurity through multiple channels, including through the impacts of heat stress on crop yields, agricultural and non-agricultural labour supply and productivity (therefore on crop production and income), health, food prices and food supply chains. A better understanding of these channels is needed to inform effective policy.

Question 3: What is the Government doing to prepare for disruption to the UK’s food supply resulting from climate change impacts or biodiversity loss?

The UK Food Strategy aims to ensure a sustainable, nature-positive and affordable food system, but more climate change mitigation and adaptation measures will likely need to be incorporated to address the projected impacts of the future climate on food insecurity in the UK. The Food Strategy highlights the importance of building the resilience of domestic supply chains to future crises and shocks, such as those caused by a changing climate, focusing for example on the increased use of organic-based fertilisers to reduce carbon dioxide emissions and critical input costs (Defra, 2022a). However, government actions have not sufficiently factored in the worsening impacts of climate-related extreme weather events such as heatwaves, droughts and floods on damaged food crops, livestock and fisheries, and on food price inflation.

Air pollution also affects food supply due to its impacts on crop growth. Integrated policy solutions can help to address the combined effects of extreme heat and air pollution on food supply. For example, the *United Kingdom food security report 2021* highlights the impacts of climate change on economic losses linked to food production, particularly wheat yields, due to higher temperatures and ground-level ozone pollution (Defra, 2021a). On ozone pollution, Defra could consider tightening the UK’s air quality objective for nitrogen dioxide from an annual mean concentration of 40 micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$) to $10 \mu\text{g}/\text{m}^3$, bringing it in line with the air quality value recommended by the World Health Organization (Defra, 2010; WHO, 2021). This will enhance the protection of human health, and vegetation and ecosystems.

Question 4: What role should the Government take in ensuring that land is available to secure the UK's food supply in the context of a changing climate?

Meat and dairy consumption accounted for over 70% of agricultural emissions in the UK in 2019, mostly caused by nitrogen fertiliser and methane emitted from livestock production (Romanello et al., 2022). Livestock emissions per kilogram of meat produced in the UK tend to be considerably lower than the global average, and animal welfare higher. However, the UK is a net importer of meat and dairy products. Therefore, reducing UK consumption of imported meat and dairy products would have a positive impact across multiple dimensions, including the climate, at the global scale. Further mitigation measures in the UK's livestock sector are crucial for reducing nitrous oxide, methane emissions and ammonia pollution, which harm soil health, biodiversity, food quantity and quality, human health and animal welfare.

Reducing livestock production in the UK is likely to be essential if the country is to reduce its methane emissions by 30% before 2030, in line with the Global Methane Pledge. This will also have the co-benefit of directly freeing up land that could be used to support biodiversity and carbon sequestration, such as through tree planting or rewilding, and some land could also be suitable for the production of crops for human consumption. Importantly, a WWF report suggests that 40% of the most productive agricultural land in the UK is being used to grow food for farm animals such as cattle, pigs and chickens (WWF, 2022). If this land were used to grow food directly for people instead, food security and thus health could be improved.

There is also some evidence that growing crops beneath solar panels ('agrivoltaics') can increase both food security (through increases in food production) and energy security (Hall, 2022). More research is likely needed to determine the role of agrivoltaics in a UK context.

Securing a sustainable food supply

Question 5: What role could a reduction in meat and dairy consumption play in improving food security and what measures could the Government take to capitalise on the trend to plant-based diets?

Changes to the food system resulting from a shift to lower-carbon and plant-based diets could contribute to climate change mitigation while also providing health benefits. Red meat is an important source of protein, iron, zinc and B vitamins. However, excess red meat consumption has been linked to increased risks of diseases including cardiovascular disease, stroke, coronary heart disease and diabetes. In the UK there is already a downward trend in meat consumption. The emissions intensity of livestock in UK beef production is around half the global average (NFU, 2020). Continued reductions in consumption of animal-based food products could improve food security and health. However, potential health benefits may be lessened if people substitute meat with highly processed plant-based alternatives.

The Government may consider taking several measures to promote balanced diets that are lower in meat and dairy and higher in plant-based foods, including the following:

- The adoption of a whole-of-government approach could help to accelerate a shift to healthy, low-carbon diets. This requires the definition of a healthy diet to be consistent across government agencies. For example, the 2021 food security report prepared by Defra specified that dairy and beef products are part of a healthy diet, which is different from the healthy eating recommendations given by Public Health England (Public Health England, 2018).
- The highest increase in the prevalence of obesity among primary school children since the National Child Measurement Programme was launched in 2006 was recorded between 2019/20 and 2020/21 (NHS, 2021). To tackle childhood obesity, the Government could explore imposing an advertising ban on food products that are high in fat, salt and sugar.

The current government's decision to delay the ban on TV and online junk food advertising until 2025 will put child health at risk (Obesity Health Alliance, 2022).

- An introduction of fiscal incentives could help improve the affordability of plant-based diets. For example, redirecting agricultural subsidies towards sustainable farming practices may incentivise British farmers to boost home-grown fruit and vegetable production, which would reduce dependency on imported foods, thereby increasing resilience to global shocks along the food supply chain. Similarly, consumption subsidies for fruit and vegetables could be rolled out to increase the intake of healthy and nutritious food.

References

- Climate Change Committee [CCC] (2022) Government's Food Strategy 'a missed opportunity' for the climate. Press release, 13 June. <https://www.theccc.org.uk/2022/06/13/governments-food-strategy-a-missed-opportunity-for-the-climate/>.
- Climate Vulnerable Forum [CVF] and V20 (2022) *Climate Vulnerability Monitor, 3rd Edition: A Planet on Fire* [Eds. M McKinnon T, Lissner M, Romanello F, Baarsch M, Schaeffer S, Rosas A (eds.)]. *Dasgupta and Robinson are authors of indicator 1.4 – Food Insecurity and undernutrition*.
- Committee on Climate Change [CCC] and China Expert Panel on Climate Change (2018) *UK-China Co-operation on Climate Change Risk Assessment: Developing Indicators of Climate Risk*. www.theccc.org.uk/publication/indicators-of-climate-risk-china-uk. *Robinson is co-lead author of Chapter 4: Systemic risk in the context of climate change*.
- Dasgupta S and Robinson E (2022) Attributing changes in food insecurity to a changing climate. *Scientific Reports*, 12, 4709. <https://doi.org/10.1038/s41598-022-08696-x>.
- Department for Environment, Food and Rural Affairs [Defra] (2010) UK air quality limits. <https://uk-air.defra.gov.uk/air-pollution/uk-eu-limits>.
- Defra (2021a) *United Kingdom food security report 2021*. <https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2021>.
- Defra (2021b) *Agriculture in the United Kingdom 2020*. <https://www.gov.uk/government/statistics/agriculture-in-the-united-kingdom-2020>
- Defra (2022a) *Government food strategy*. <https://www.gov.uk/government/publications/government-food-strategy/government-food-strategy>.
- Defra (2022b) *Agriculture in the United Kingdom 2021*. <https://www.gov.uk/government/statistics/agriculture-in-the-united-kingdom-2021>
- Ebi K et al. (2021) Nutritional quality of crops in a high CO₂ world: an agenda for research and technology development. *Environmental Research Letters* 16(6), 064045. <https://doi.org/10.1088/1748-9326/abfcfa>.
- UN Food and Agriculture Organization [FAO] (1996) *Rome Declaration on World Food Security and World Food Summit Plan of Action*. <http://www.fao.org/docrep/003/w3613e/w3613e00.HTM>.
- Hall S (2022) Can crops grow better under solar panels? Here's all you need to know about 'agrivoltaic farming'. Blog post, 26 July. World Economic Forum. <https://www.weforum.org/agenda/2022/07/agrivoltaic-farming-solar-energy/>
- Intergovernmental Panel on Climate Change [IPCC] (2022) *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, USA: Cambridge University Press. <https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/>
- National Farmers' Union of England and Wales [NFU] (2020) The facts about British red meat and milk. <https://www.nfuonline.com/archive?treeid=141504>
- National Health Service [NHS] (2021) Significant increase in obesity rates among primary-aged children, latest statistics. Press release, 16 November.

<https://digital.nhs.uk/news/2021/significant-increase-in-obesity-rates-among-primary-aged-children-latest-statistics-show>.

Obesity Health Alliance (2022) An 'attack on health': Alliance responds to delay of advertising restrictions to 2025. Press release, 9 December.

<https://obesityhealthalliance.org.uk/2022/12/09/attack-on-health/>.

Public Health England (2018) *A quick guide to the Government's healthy eating recommendations*.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/742746/A_quick_guide_to_govt_healthy_eating_update.pdf.

Romanello M, ... Dasgupta S, ... Robinson E, et al. (2022) The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. *The Lancet* 400(10363). [https://doi.org/10.1016/S0140-6736\(22\)01540-9](https://doi.org/10.1016/S0140-6736(22)01540-9).

World Health Organisation [WHO] (2021) *WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide*.

<https://apps.who.int/iris/handle/10665/345329>.

World Wide Fund for Nature [WWF] (2022) *The future of feed: how low opportunity cost livestock feed could support a more regenerative UK food system*.

https://www.wwf.org.uk/sites/default/files/2022-06/future_of_feed_full_report.pdf.