The countryside charity
Cambridgeshire
and Peterborough

The Town Hall, Market Hill
St Ives, Cambridgeshire
PE27 5AL
[redacted]

The Planning Inspectorate
Temple Quay House
Temple Quay
Bristol
BS1 6PN

14 June 2023
Submitted via website.

Dear Sir/Madam

Ref: EN010127 Application by Mallard Pass Solar Farm Limited for an order granting development consent for the Mallard Pass Solar Farm

The Cambridgeshire and Peterborough branch of the Campaign to Protect Rural England (CPRE Cambs. & Peterborough) is an independent charity which works to maintain the thriving and beautiful countryside of Cambridgeshire and Peterborough, to encourage strong rural communities and to prevent urban sprawl into, and other damage to, the countryside.

Although outside our normal area of activity, we have been requested by some affected residents to review this application.

CPRE Cambs. & Peterborough objects strongly to this proposal for the reasons set out below.

In summary our objections include:

- Inconsistency with National Planning Policy
- Inconsistency with Local Planning Policy
- Threat to national food supply due to use of productive agricultural land at a time of increasing risk to food imports and flood risk to the Fens and other low-lying farmed areas of the UK
- Potential impact on local public transport and highways' improvements
- Damage to the historic and unspoiled landscapes
- Poor information regarding visual mitigation measures
- Damage to local communities and their surroundings
- No consideration of brownfield sites or installation on large commercial buildings & warehouses
- Lack of sustainability due to no current means of end-of-life recycling of materials

Background and Principle
CPRE locally and nationally is very conscious of the accelerating effects of climate change and the need for rapid change to a low carbon economy using suitable sources of renewable energy. All such projects must be considered in terms of their true, life-time, environmental impact just as any other item of new infrastructure.

In the case of solar installations on farm land, the cumulative effect on national food supply must also be a significant consideration. From our viewpoint, this issue requires even greater consideration due to the increased flood risk to the Fens caused by the increasing rate of rising sea levels due to ice melt.

This proposal is damaging to the countryside, to the landscape, to local heritage assets, and to local communities in many ways. There is little evidence that alternative methods of providing the same levels of renewable energy or alternative, more sustainable, locations have been looked at meaningfully by the applicant.

This proposal is damaging to rural communities. This is totally unacceptable when so little is being done locally and nationally to reduce energy usage.

CPRE supports the objections raised by all local councils and their Parliamentary representatives.

National Planning Policy
In summary, the National Planning Policy Framework (NPPF) considers that renewable energy projects should be part of the Local Plan process, should not cause cumulative landscape or visual effects, and that the only acceptable projects which are outside of Local Plan boundaries should be those supported by communities through the Neighbourhood Planning process.

Clearly this proposal satisfies none of these criteria.

The NPPF, para 148, states:

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.",

and in para 151:

"To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);"

and in para 152:

"Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning."

Local Planning Policy
We are concerned that this project is, and will remain inconsistent with, the Local Planning policies of South Kesteven District Council, SKDC.

SKDC, Local Plan 2011-2036, page 78, Renewable Energy Generation, para 2.152, states:

"….. The Government has also made it clear in its Solar PV Strategy that regarding renewable energy from Solar PV it sees the greatest potential being from roof-mounted panels on the estimated 250,000 hectares of south-facing industrial and commercial roofs in England. The Council recognises this approach as having the greatest potential, with significantly less adverse impacts (such as the loss of agricultural land) compared with large scale ground mounted panels and therefore wishes to encourage such provision."

CPRE Cambs. & Peterborough agrees strongly with this statement.

Para 2.155, states:

"A crucial context to consideration of renewable energy projects will be the importance of agriculture and food production in South Kesteven. This sector is not only key in the local economy but also the District, as part of Lincolnshire, provides a strategic role in national food production. This strength is rooted in the quality of the District's farmland. Renewable energy projects that displace, sterilise or conflict with this economic asset will be unlikely to be considered favourably."

CPRE Cambs. & Peterborough agrees strongly with this statement.

Based upon clearly formulated argument, SKDC has derived **Policy RE1: Renewable Energy Generation** which states:

"Proposals for renewable energy generation will be supported subject to meeting the detailed criteria as set out in the accompanying Renewable Energy Appendix 3 and provided that:

a. The proposal does not negatively impact the District's agricultural land asset;

b. The proposal can demonstrate the support of affected local communities;

c. The proposal includes details for the transmission of power produced;

d. The proposal details that all apparatus related to renewable energy production will be removed from the site when power production ceases; and

e. That the proposal complies with any other relevant Local Plan policies and national planning policy."

CPRE Cambs. & Peterborough believes the current application demonstrates clear non-compliance with SKDC Local Plan Policy RE1.

Furthermore, the document "Appendix 3 – Renewable Energy Appendix" of the SKDC Local Plan sets out the criteria which SKDC believes should be used to judge applications for solar installations. CPRE supports all of these criteria and we would draw particular attention to this extract from Criterion 9:

"The Council requires that any proposals in this District on agricultural land for solar farms will:

- *first be required to carry out an extensive search for derelict or brownfield sites – these could for example be former industrial sites, old quarries or former airfields. This test should not necessarily be confined to the District, in line with the Wherstead appeal decision;*
- *second be required to carry out a search for poorer agricultural sites i.e., of Grades 4 and 5. This test should also not necessarily be confined to the District;*
- *third be required to prove the MAFF agricultural grade classification for the proposed site and if it is Grade 3 whether or not it is Grade 3A or 3B. As there is no national mapping of these sub divisions, this will require a site survey using trail holes/augers produced by a qualified expert;"*

We do not believe this application complies with Criterion 9.

Use of Agricultural Land
Significant weight is given by the NPPF to protecting "best and most versatile" land from development. CPRE Cambs. & Peterborough considers this proposal to be inconsistent with the NPPF in its use of good agricultural land.

Examination of the Agricultural Land Classification Map East Midlands Region (ALC010), shows that the majority of the land to be affected by this proposal is Grade 3, with some Grade 2.

The land grading system is frequently mis-used by developers to denigrate highly productive farm land which is not necessarily classed as 'best and most versatile' (Grades 1, 2 and 3a). A favourite trick is to forget to mention that Grade 1 is reserved for exceptionally productive peatlands such as the Fens, and therefore Grades 2 and 3 are in fact the highest quality 'high' land.

In a country which imports over 60% of its food supply, taking such a large area of highly productive land out of use is not in the national interest or in the interest of the environment. It will probably cause more food miles and greenhouse gas generation than it will save.

CPRE Cambs. & Peterborough considers that there should be an urgent change of national policy in relation to solar parks and farmland. There are thousands of acres of space on the roofs of warehouses, factories, office blocks and other industrial buildings in this country. It should be mandated that these are fitted with solar panels where practicable and any further take-up of agricultural land should be halted in the interest of national food security

These views have been endorsed by the Secretary of State's recent statement in Parliament in response to questions about the current shortage of imported fresh foods in UK shops, that people should be looking to eat more seasonable fresh food such as root crops like carrots, parsnips and of course turnips.

It is well known that maintenance of solar panel installations on open land requires regular cleaning with chemical cleaners or distilled/de-ionised water, regular mechanised mowing and treatment of roadways and sub-panel areas with weedkiller, usually glyphosate. Companies which specialise in providing these solar panel maintenance services are now commonplace. Here are just a few examples of professional organisations with an online presence:

- Optisol Services Ltd
- MLR Solar-tech Solutions
- Tugwell Contracting
- Clean Solar Solutions Ltd
- CGM Group Ltd

The cumulative impact of damage to the soil over a period of 40 years from a combination of shielding from daylight, regular spraying with weedkiller and routine tracking of panel-cleaning and grass-cutting vehicles and equipment does not appear to have been properly considered.

Food Security
CPRE Cambs. & Peterborough considers this proposal to be inconsistent with current national food security policy.

In 2019, the Environmental Audit Committee, EAC, of Parliament in their document *"Our Planet, Our Health"*, warned the UK government that it must reduce dependence on imported foods because climate change will reduce their availability.

This warning was repeated in the "*UK Food Security Report 2021"* issued by DEFRA in May 2022, along with much other data.

Droughts, wildfires and floods across Europe during the past 18 months have demonstrated that the EAC was correct in its warning. Fresh-food growing areas in the Netherlands and Spain, which are the sources of 30% of UK fruit and vegetable imports, have suffered badly and food prices have risen accordingly.

Last summer's drought had a significant impact on UK food production and, coupled with climate-related issues in Spain, Portugal and Morocco, led to winter shortages of fresh foods in UK shops. With more droughts likely in future years, maintaining land in production is an increasing priority.

Furthermore, increasing flood risk to the Fens presents an additional threat to national food supply.

For example, due to the tidal nature of the river Great Ouse, any flooding brings with it nematodes from the saline water and these can cause crop damage for up to seven years.

Newly published research into the increasing likelihood of rapid sea-level rise due to uncontrolled melting of South Polar ice and Greenland ice leads to the conclusion that current official estimates of projected sea level rise and hence flood risk, are too low and that serious flooding of the Fens is almost inevitable sooner rather than later.

The current official estimates of sea level rise used in flood protection estimation and planning are based on either IPCC 2014, 1 metre by 2100, or IPCC 2019, 1.1 metre by 2100. For example, using IPCC 2014, the South Bank of the river Great Ouse is currently being raised to protect against 1 in 80-year events, a very low level of protection.

Due to timing, neither IPCC 2014 or IPCC 2019 takes into account the accelerated melt rate of the Greenland ice sheet leading to an estimated additional 10 inches of sea level rise, as recently announced by researchers, or the increasing risk of the collapse of the Thwaites glacier in the Antarctic, leading to an estimate of up to 10 feet of sea level rise, or an estimated potential 0.5 metre sea level rise from the Pine Island ice sheet as studied by the British Antarctic Survey.

Satellite measurements collated by the Copernicus Marine and Environment Monitoring Service (CMEMS) and published on its Aviso web site show that the rate of annual global sea level rise is increasing steadily and inexorably. In May 2023 it had reached 3.57mm per annum.

These projections indicate a significant increase of flood risk to the Fens and bring forward its timing, the Thwaites Glacier in particular. That is without taking into account the effects of high-tide and increased tidal surges due to more extreme weather events. Neither does it take into account the increased run-off being caused by unwise developments in upstream flood plains which can no longer be vetoed by the Environment Agency.

This increased risk likely compounds the food supply issue that climate change is already causing whereby countries to the south, which supply much of UK foodstuffs will no longer be able to supply the same quantities, which the EAC has drawn attention to.

In simplistic terms, it is CPRE Cambs. & Peterborough's view that the UK should look back at the actions it was forced to take during and after World War II in order to maintain food security and that it should be ready to implement similar actions again if forced to do so.

This issue is now recognised globally at the highest levels because it is not only a risk to food security. It is also a risk to population safety. The seriousness with which this issue is now being taken is witnessed by the recent address on global sea-level rise to the UN Security Council by the Secretary General, António Guterres.

Therefore, CPRE Cambs. and Peterborough maintains its view that it would be very unwise indeed – and irresponsible - to reduce the availability of productive 'high' land by covering large areas of it with solar panels.

Alternative Renewable Energy Installations

CPRE is concerned that this applicant seems to have focussed on a single approach to 'renewable' energy supply, apparently because it is a market leader rather than it being truly sustainable.

CPRE considers that alternative, less damaging and more sustainable installations and technologies must be considered and brought into use for energy generation because of the food security issues and the apparent lack of a proper carbon lifecycle analysis associated with current solar panel technology.

There are thousands of acres of space on the roofs of warehouses, factories, office blocks and other industrial buildings in this country. CPRE considers that these should be fitted with solar panels and any further take-up of agricultural land should be halted.

CPRE and the Building Research Establishment have published several articles making this point and advising how it can best be achieved.

CPRE Cambs. & Peterborough contend that there are large areas of commercial roof space, particularly in the Peterborough area, which could be fitted with solar panels and any further take-up of agricultural land should be halted.

In August 2022, we became aware that the UK Warehousing Association (UKWHA), has recommended to its members that they take advantage of the financial gains available to their members if they install solar generation on their properties.

The UKWHA has published a paper to this effect, *"Investment-Case-for-Rooftop-Solar-Power-in-Warehousing"*, and has started lobbying Parliament for support for this welcome approach to solar energy generation by holding a meeting with the House of Lords.

Cambridgeshire County Council is setting a national example by fitting solar panels to its Park & Ride sites in St Ives and Babraham. It is to be hoped that other authorities and organisations will follow their lead.

Cambridgeshire County Council has also implemented the first community ground-source heat pump in the UK in Swaffham Prior. This is another potential, less intrusive, source of energy generation.

There are now many technologies available for renewable energy generation, ranging from small wind turbines, to solar tiles and heat pumps. These should be considered as alternatives to the current application which will take a large area of productive farm land out of use and industrialise the countryside. The applicant does not appear to have considered alternatives.

Transport

CPRE Cambs. & Peterborough are concerned by the effect of this development on local roads, particularly during the construction phase.

The proposed sites lie on both sides of the East Coast main railway line, and we are very concerned that the risk of accidental issues will be increased by this development.

Landscape & Design

CPRE Cambs. & Peterborough have already expressed very real concerns for the local landscape in the context of the policies of the SKDC Local Plan. However, more than that, it must be recognised that this is a quiet and relatively unspoilt area of rolling agricultural countryside.

It is our opinion that the applicant has completely misunderstood, or deliberately ignored, the characteristics of the local landscapes. It has failed to comprehend their significance historically, visually or as the settings for the villages and farms.

The ranks of solar panels will turn the current vibrant landscape into a dead area, visibly industrial and totally unnatural.

There will be a range of large industrial box-like structures varying in height from 3 metres to 6 metres, 10 metres and 12 metres at several visible locations within the sites and accompanied in some places by unsightly office and control buildings.

The organised theft of solar panels and equipment has become a significant rural crime, leading to the use of pole-mounted security cameras around such sites.

We note that, to prevent cable and panel thefts, Cambridgeshire Police are requesting solar installers to take the following security measures:

- security rated weldmesh fencing/gating to meet LPS1175 SR2 is installed,
- installed CCTV is continuously monitored, and any recordings are stored should they be required for evidential purposes,
- a fully qualified lighting engineer is assigned as they will be able to design in the safety and security element as well as having the ecology and wildlife in mind.

We understand that other police forces are now taking a similar approach.

CPRE considers that the use of CCTV in the manner being recommended by the police will be visually intrusive in this rural landscape and completely out of character with the surrounding countryside. It also represents a significant privacy intrusion and any such use must be in accordance with the GDPR and registered with the Information Commissioner, in accordance with the Information Commissioner's Office (ICO) document *"In the picture: A Data Protection Code of Practice for Surveillance Cameras and Personal Information".*

CPRE fear that the combination of 2-metre-high security fencing, CCTV mounted on 2.5 metre poles plus security lighting will have a major adverse effect upon the landscape. We are particularly concerned by the security lighting which will negatively impact wildlife and residents.

No level of tree planting in mitigation will hide the visual harm. Trees will take time to grow and, as usual, the applicant seems to conveniently forget that trees lose their leaves in Autumn and are bare until Spring.

Public Rights of Way and Safety
The sites are criss-crossed by a network of Public Rights of Way (PRoWs). It is promised that these will be retained during the life of the sites except for some during construction. CPRE is concerned that there appears to have been limited analysis of the effects upon countryside views for those using the PRoW network.

We are also concerned at how safe the PRoW network will be, especially for children and horse riders. It is one thing to fall or be thrown from a galloping horse onto grass. It is quite another to hit a metal security fence, a metal and silicon solar panel, or to be tossed into high voltage electricity apparatus.

How will the fences be monitored and properly maintained so as to prevent incursions by curious children and teenagers? If an accident does occur, how will emergency services safely access any injured persons in remote areas of the sites? It will not be possible for MAGPAS to land an emergency helicopter on a sea of silicon and metal.

Decommissioning and Sustainability
CPRE are very concerned by the statements made by the applicant concerning the removal of facilities and reinstatement of the sites, should they cease to operate. This is a further example of lack of compliance with Policy RE1 of the SKDC Local Plan.

There are statements to the effect that panels and their frames will be removed and that the land can then be returned to agricultural use, but will a guaranteed decommissioning fund be lodged independently to ensure that there will be sufficient resources for this to happen in 40 years time?

A clear, fully-funded, plan for the decommissioning, removal and recycling of the materials from these sites must be in place before their development is allowed to proceed.

Formal carbon lifecycle analysis (CLA) should be used to prove that during their whole lifecycle - construction, operation, decommissioning and disposal/recycling - this installation will actually save more carbon emissions than it creates.

The standard evaluation used by the applicant is not a complete CLA. Without a robust carbon lifecycle analysis, the development cannot be said to be sustainable.

Conclusions
1. This proposal is not compliant with national planning policy.
2. This proposal is not compliant with local planning policy.
3. This proposal will take out of production a large area of good agricultural land currently used for growing valuable food crops.
4. This proposal is inconsistent with required responses to the national and international issue of dwindling food supply due to climate change and conflict.
5. This proposal is in direct opposition to the advice of the Environmental Audit Committee and DEFRA concerning national food security.
6. This proposal takes no account of the increasing risk of flooding of the Fens and other low-lying UK farm land due to sea level rise and the associated loss of agricultural production of around 24% of UK food crops.
7. There will be significant adverse impact on residential and visual amenity.
8. This proposal will have a further cumulative effect on some local roads which are already heavily used.
9. There will be unacceptable levels of harm to local landscapes and to views across the countryside as well as significant harm to the historic landscape pattern.

10. The mitigation proposed is minimal and inadequate. It will not reduce the negative impacts on the most sensitive receptors.
11. There will be increased risks to the safety of walkers and riders using the existing Public Rights of Way.
12. There is no detailed, resilient plan for the safe decommissioning of the site and the recycling or re-use of the materials removed.
13. A decommissioning fund must be available, sufficient and placed in escrow in advance of any construction commencing.
14. A full carbon lifecycle analysis has not been carried out for this installation, without which it cannot be claimed to be sustainable.

CPRE Cambs. and Peterborough urge the Planning Inspectorate **not to approve this application.**

Please note that our submission is in respect of the proposed development. While we have taken every effort to present accurate information for your consideration, as we are not a decision-maker or statutory consultee, we cannot accept any responsibility for unintentional errors or omissions and you should satisfy yourselves on any facts before making decisions arising from our submission.

Yours faithfully,

Alan James BSc.Tech., PhD, MBCS, CITP, MIMMM, CEnv
Chairman - CPRE Cambridgeshire and Peterborough

Enc.
Environmental Audit Committee document: "Our Planet, Our Health"
DEFRA document: "UK Food Security Report 2021"
Sea Level Rise Address to UN Security Council by Secretary General, António Guterres
UKWHA document: "Investment-Case-for-Rooftop-Solar-Power-in-Warehousing"

House of Commons

Environmental Audit Committee

Our Planet, Our Health

Twenty-First Report of Session 2017–19

Report, together with formal minutes relating to the report

Ordered by the House of Commons to be printed 3 September 2019

HC 1803
Published on 17 September 2019
by authority of the House of Commons

Environmental Audit Committee

The Environmental Audit Committee is appointed by the House of Commons to consider to what extent the policies and programmes of government departments and non-departmental public bodies contribute to environmental protection and sustainable development; to audit their performance against such targets as may be set for them by Her Majesty's Ministers; and to report thereon to the House.

Current membership

Mary Creagh MP (*Labour, Wakefield*) (Chair)

Dr Thérèse Coffey MP (*Conservative, Suffolk Coastal*)

Geraint Davies MP (*Labour (Co-op), Swansea West*)

Mr Philip Dunne MP (*Conservative, Ludlow*)

Zac Goldsmith MP (*Conservative, Richmond Park*)

Mr Robert Goodwill MP (*Conservative, Scarborough and Whitby*)

James Gray MP (*Conservative, North Wiltshire*)

Ruth Jones MP (*Labour, Newport West*)

Jeremy Lefroy MP *(Conservative, Stafford)*

Caroline Lucas MP (*Green Party, Brighton, Pavilion*)

Kerry McCarthy MP (*Labour, Bristol East*)

Anna McMorrin MP (*Labour, Cardiff North*)

John McNally MP (*Scottish National Party, Falkirk*)

Dr Matthew Offord MP (*Conservative, Hendon*)

Alex Sobel MP (*Labour (Co-op), Leeds North West*)

Derek Thomas MP (*Conservative, St Ives*)

Powers

The constitution and powers are set out in House of Commons Standing Orders, principally in SO No 152A. These are available on the internet via www.parliament.uk.

Publications

Committee reports are published on the Committee's website at www.parliament.uk/eacom and in print by Order of the House.

Evidence relating to this report is published on the inquiry publications page of the Committee's website.

Committee staff

The current staff of the Committee are Lloyd Owen (Clerk), Leoni Kurt (Second Clerk), Ruth Cahir (Committee Specialist), Laura Grant (Committee Specialist), Laura Scott (Committee Specialist), Jonathan Wright (Senior Committee Assistant), Katie Gibbs (Committee Assistant), Anne Peacock (Media Officer).

Contacts

All correspondence should be addressed to the Clerk of the Environmental Audit Committee, House of Commons, London SW1A 0AA. The telephone number for general enquiries is 020 7219 8890; the Committee's email address is eacom@parliament.uk.

You can follow the Committee on Twitter using @CommonsEAC.

Contents

Summary

Everything we do to the planet, we do to ourselves. Humans are living longer, healthier lives than ever as a result of advances in food production, public health and access to medicines.[1] But the systems that support human life rely on a healthy natural environment and "natural systems are being degraded to an extent unprecedented in human history".[2] We are concerned that the NHS and the pharmaceutical industry is not sufficiently resourced to deal with projected changes: non-communicable diseases (NCDs) kill 41 million people each year, equivalent to 71 per cent of all deaths globally.

Current rates of extinction are at 100–1000 times more than what is considered natural biodiversity loss, and the Government's progress towards meeting the Aichi targets by 2020 falls woefully short. The Environment Bill must include a framework for legal nature restoration and biodiversity targets, and the Government should set out the principles behind the design of the new environmental land management schemes.

Our food contributes up to 30 per cent of total greenhouse gas emissions in the UK and we waste 10 million tonnes of food every year. The EAT-Lancet Commission recommended a "Great Food Transformation": an "unprecedented range of actions taken by all food system sectors across all levels … to normalise healthy diets from sustainable food systems".[3] The Government has a responsibility to raise public awareness of its Eatwell Guide, identify ways to promote the consumption of healthy diets that are sustainably produced and ensure the public sector leads by example in reducing meat and dairy consumption. The Government has begun working on a National Food Strategy and should establish a National Council for Food Policy to advise on transforming our food system.

The World Bank estimates that 83 per cent of the UK's population lived in urban areas in 2017. Cities are responsible for 70 per cent of global emissions. City design and lifestyles contribute to poor outdoor and indoor air quality, with issues ranging from asthma to diabetes, and cause over 40,000 deaths a year. We look forward to the introduction of air quality legislation as soon as possible if we leave the EU.

Integrated urban planning is essential to ensure better planetary health outcomes. The transport sector relies heavily on unsustainable fossil fuel energy and is a contributor to sedentary lifestyles. Witnesses encouraged "active transport". Poor quality housing and city design has significant harmful impacts on public health, mental health and life expectancy. The Government's review of the building regulations must take an integrated approach to ensure that sustainability and public health are properly reflected in any new code. The National Planning Policy Framework needs to be updated to promote opportunities for active travel, ambitious green space targets, and access to healthy, sustainable food in planning authorities' local plans.

1 The Rockefeller Foundation Economic Council on Planetary Health, What is planetary health (Accessed 8 August 2019)

2 Sarah Whitmee et al., 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', The Lancet, Vol. 386 (2015), pp.1973–2028

3 Walter Willett. et al., Food in the Anthropocene: the EAT- Lancet Commission on healthy diets from sustainable food systems, The Lancet Commissions, Vol. 393 (2019), pp.447–492

Improving public health in the UK while improving the environment will require significantly better data sharing and cross-departmental working. There should be a single point of accountability for planetary health at both ministerial and senior civil service levels. The Government should also establish a joint unit to manage planetary health across Government. To support these meetings, health leaders and organisations must attend: the Chief Scientific Advisers, Public Health England and the Chief Medical Officer all have a major role to play. The UK Government should highlight planetary health at forthcoming international meetings.

1 Planetary health

1. Everything we do to the planet, we do to ourselves.[4] Humans are living longer, healthier lives than ever before as a result of advances in food production, public health and access to medicines.[5] But the systems that support human life rely on a healthy natural environment and "natural systems are being degraded to an extent unprecedented in human history".[6] Climate change and biodiversity loss are the biggest threats our planet faces and are already affecting the health of millions globally.[7]

2. The link between the health of humans and of the planet is captured by the term, planetary health, defined as:

> The achievement of the highest attainable standard of health, wellbeing, and equity worldwide through judicious attention to the human systems—political, economic, and social—that shape the future of humanity *and* the Earth's natural systems that define the safe environmental limits within which humanity can flourish. Put simply, planetary health is the health of human civilisation and the state of the natural systems on which it depends.[8]

3. The consequences of human activity on the climate have been studied for decades and are likely to be increasingly serious and wide-ranging. Direct effects on health include heat stress and heat-related mortality due to increasing temperatures;[9] indirect effects include the impact of environmental changes on agricultural production and on food and nutrition security.[10] Some researchers have proposed the concept of "planetary boundaries", which, as explained by Professor Howard Frumkin, Wellcome Trust, "when transgressed may trigger dangerous and even irreversible changes in earth systems".[11] The planetary boundaries framework "defines a safe operating space for humanity based on the intrinsic biophysical processes that regulate the stability of the Earth system",[12] and includes the following planetary boundaries:

i) climate change;

ii) novel entities (e.g. chemical and toxic pollutants);

iii) ozone depletion;

iv) atmospheric aerosol loading (e.g. particulate matter such as dust and smoke);

4 Tara Ocean Foundation, Everything we do against nature, we do to ourselves, (Accessed 8 August 2019)
5 The Rockefeller Foundation Economic Council on Planetary Health, What is planetary health (Accessed 8 August 2019)
6 Sarah Whitmee et al., 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', The Lancet, Vol. 386 (2015), pp.1973–2028
7 UNEARTHED, We are losing the web of life': why the global nature crisis is as dangerous as climate change, (Accessed 8 August 2019); Sandra Diaz, et al., Summary for Policymakers of the Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES, (2019)
8 Richard Horton and Selina Lo, Planetary Health: A new science for exceptional action, The Lancet, Vol. 386 (2015), pp.1921–1922
9 London School of Hygiene and Tropical Medicine (PLA0022)
10 London School of Hygiene and Tropical Medicine (PLA0022)
11 LSHTM Planetary Health Alliance (PLA0020)
12 Will Steffen et al., Planetary boundaries: Guiding human development on a changing planet, Science, Vol. 347 (2015), p.736

v) ocean acidification;

vi) biochemical flows (including phosphorus and nitrogen);

vii) freshwater use;

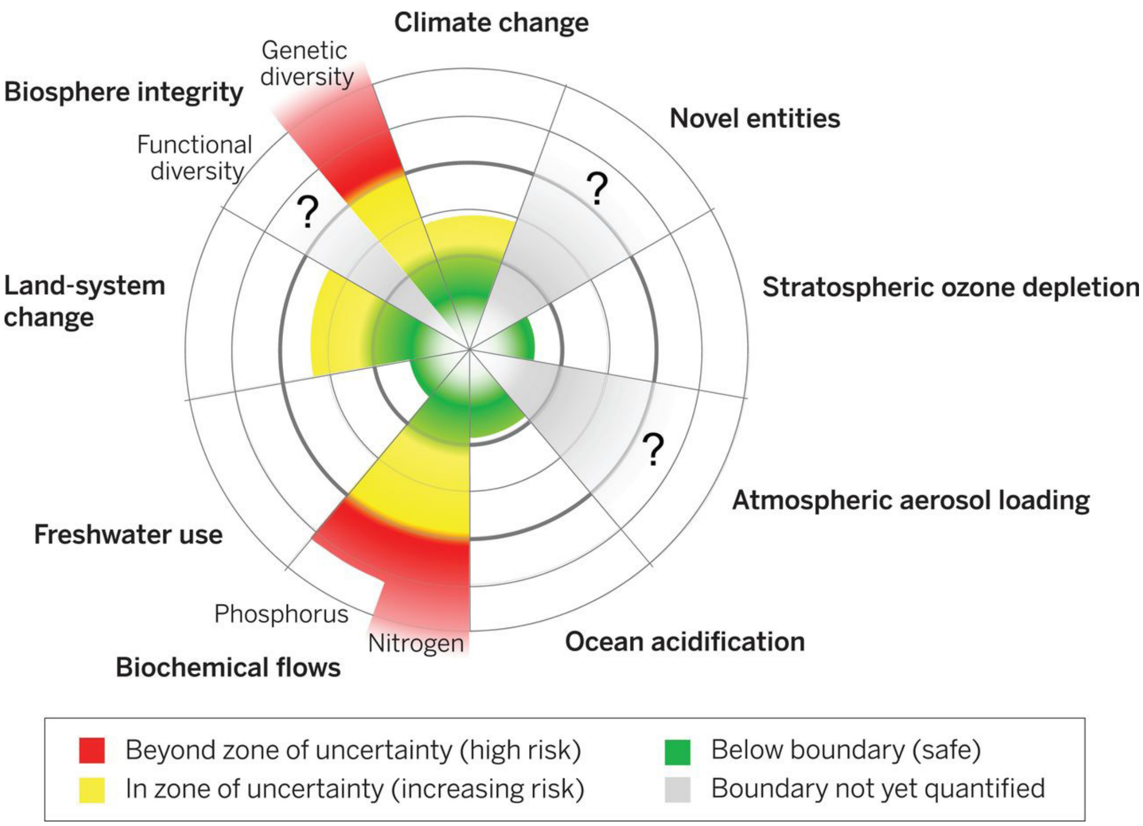
viii) land-system change; and

ix) biosphere integrity (including functional and genetic diversity).[13]

Latest assessments show that four of the nine planetary boundaries may have been crossed. As Figure 1 shows, we have breached the safe operating space for biochemical flows (the amount of nitrogen and phosphorous in our environment) and genetic diversity. In written evidence the Department for Environment, Food and Rural Affairs (DEFRA) noted that:

> remaining within these boundaries does not itself guarantee low levels of human health impacts from environmental factors. Shifting baselines,[14] involving our cognitive incapacity to conceptualise progressive and slow degradation of environmental quality and productivity, is a threat in itself. Rigorous and independent measurement of key environmental indicators and disciplined policy implementation to sustain objectives is needed to prevent slippage in environmental standards.[15]

Figure 1: Nine processes with thresholds that could generate unacceptable environmental change: planetary boundaries



Source: Will Steffen, Katherine Richardson, Johan Rockström, et al., Planetary boundaries: Guiding human development on a changing planet , Science, 347(6223), 1259855, 2015

13 Johan Rockström, et al., A safe operating space for humanity, Nature, Vol. 461 (2009), pp.472–475
14 Pauly, D. (1995) Anecdotes and the shifting baseline syndrome of fisheries. TREE 10(10): 430
15 DEFRA (PLA0028)

In 2015, the Potsdam Institute for Climate Impact Research reported that an international team of 18 researchers in the journal Science had found that: "Four of nine planetary boundaries have now been crossed as a result of human activity […] The four are: climate change, loss of biosphere integrity, land-system change, altered biogeochemical cycles".[16]

The inquiry

Previous Committee inquiries: climate change adaptation

4. In our adaptation to climate change series, we have looked at *Heatwaves: Adapting to Climate Change*;[17] *Flooding, Cooperation Across Government*;[18] and *Invasive non-native species*.[19] This inquiry on planetary health attempts to make clear the connection between human health and the health of our planet.

5. Our recent work has focused on the United Nations (UN) Sustainable Development Goals (SDGs) that "address the global challenges we face, including (…) poverty, inequality, climate, environmental degradation, prosperity, and peace and justice" in an interconnected way.[20] UK Research and Innovation noted that "concepts of planetary health are embedded in the approach taken to the (SDGs), which explicitly recognise the interconnected nature of health, environment and social systems".[21]

6. Public interest in climate change has increased sharply in the last year. Sixteen year old Swedish activist, Greta Thunberg's school strike for climate action has gone global and protests like Extinction Rebellion's action in London in April this year have been catalysts for concern over the climate. Landmark reports published recently have warned about the risks to both the environment and human health from global heating, including:

- *UN Intergovernmental Panel on Climate Change Special Report*: Global warming of 1.5°C , launched in October 2018, which found that the health risks of global heating of 1.5°C are large and these risks will increase with further warming beyond this and not in a linear fashion;[22]
- *Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2019 Global Assessment Report on Biodiversity and Ecosystem Services*, published in May 2019, which found that nature is declining globally at rates unprecedented in human history, with around one million animal and plant species threatened with extinction, many within decades;[23]

16 Potsdam Institute for Climate Impact Research, Four of nine planetary boundaries now crossed, [Accessed 09 September 2019]
17 Environmental Audit Committee, Ninth Report of Session 2017–19, Heatwaves: Adapting to Climate Change, HC 826
18 Environmental Audit Committee, Second Report of Session 2016–17, Flooding: Cooperation Across Government, HC 183
19 Environmental Audit Committee, Invasive Species Inquiry, [inquiry launched 04 April 2019]
20 United Nations, Sustainable Development Goals [Accessed 01 July 2019]
21 UK Research and Innovation (PLA0024)
22 IPCC, Summary for Policymakers of the Special Report: Global warming of 1.5°C, (2018)
23 Sandra Diaz, et al., Summary for Policymakers of the Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES, (2019)

- *Committee on Climate Change, Net Zero: the UK's contribution to stopping global warming*, also published in May 2019, which found that it is technically and economically feasible for the UK to achieve net zero emissions by 2050, ending the UK's contribution to global heating, by pursuing an ambitious policy agenda;[24] and
- *UN Intergovernmental Panel on Climate Change Special Report: Climate Change and Land*, published in August 2019, which found that land can play a role in tackling climate change, but is already under growing human pressure and must remain productive to maintain food security as the population increases and the negative impacts of climate change on vegetation increase.[25]

Development of the inquiry

7. We launched our inquiry on planetary health on 23 November 2018. We received 32 pieces of written evidence, and held five evidence sessions with nine panels. We would like to thank all contributors and witnesses for taking part. We would also like to thank Professor Alan Dangour, Director of the Centre on Climate Change and Planetary Health, London School of Hygiene & Tropical Medicine (LSHTM), for the expertise he provided as the Specialist Advisor to the inquiry.

8. In this report, we begin by outlining some of the risks to human health that arise from environmental damage and global heating. Chapters three to five concentrate on three major, inter-related topics: nature, wildlife, and the environment, food systems, and sustainable cities. The final chapter examines issues relating to governance for planetary health.

24 Committee on Climate Change, Net Zero: The UK's Contribution to Stopping Global Warming, (2019)
25 IPCC, Climate Change and Land, (2018)

2 Environmental change and human health

9. The past 150 years have seen huge improvements in human health and wellbeing. We live longer, healthier lives as a result of advances in food production, public health and access to medicines.[26] But the systems that support human life rely on a healthy global natural environment. Human activity has caused unsustainable global pressures on natural resources and the life support systems which support us.[27]

10. Professor Sir Andy Haines, LSHTM, summarises the main concerns:

> Human health has advanced tremendously in recent decades… but that has all come at a considerable environmental cost.
>
> Global average temperature has increased by 1 °C since preindustrial times, and based on the commitments that were made in the run up to the COP21 Paris, the increase could amount to around 2.7 °C or more by the end of the century in absence of further actions. There are many other changes as well, including dramatic loss of tropical forests, one of the factors that is driving the loss of biodiversity that is occurring at rates 100-fold greater than [in] pre-human times.
>
> Freshwater resources are in decline in many parts of the world and about three billion people live in locations that are subject to varying degrees of water stress, partly because of depletion of aquifers, which cannot be replenished in human lifetimes. Carbon dioxide is dissolving in the ocean leading to increasing acidification with probable major impacts on marine ecosystems.
>
> A single species, Homo sapiens, is now dominating the global environment, which has led an increasing number of scientists to call our epoch the Anthropocene, in recognition of the dominant role played by humanity.[28]

11. The Rockefeller Foundation Economic Council on Planetary Health set out its concerns on planetary health:

> Improvements to health have come from advancements in public health and medicine as well as from agriculture and industry. However, this progress often comes at a cost. Human activities have caused global environmental change—not only do we pollute the air we breathe and the water we drink directly, but greenhouse gas emissions are changing the world's climate. This has knock-on effects for our health and society. The World Health Organization estimates that 25 per cent of death and disease globally, and nearly 35 per cent in regions such as sub-Saharan Africa, is linked to environmental hazards.[29]

26 The Rockefeller Foundation Economic Council on Planetary Health, What is planetary health (Accessed 8 August 2019)

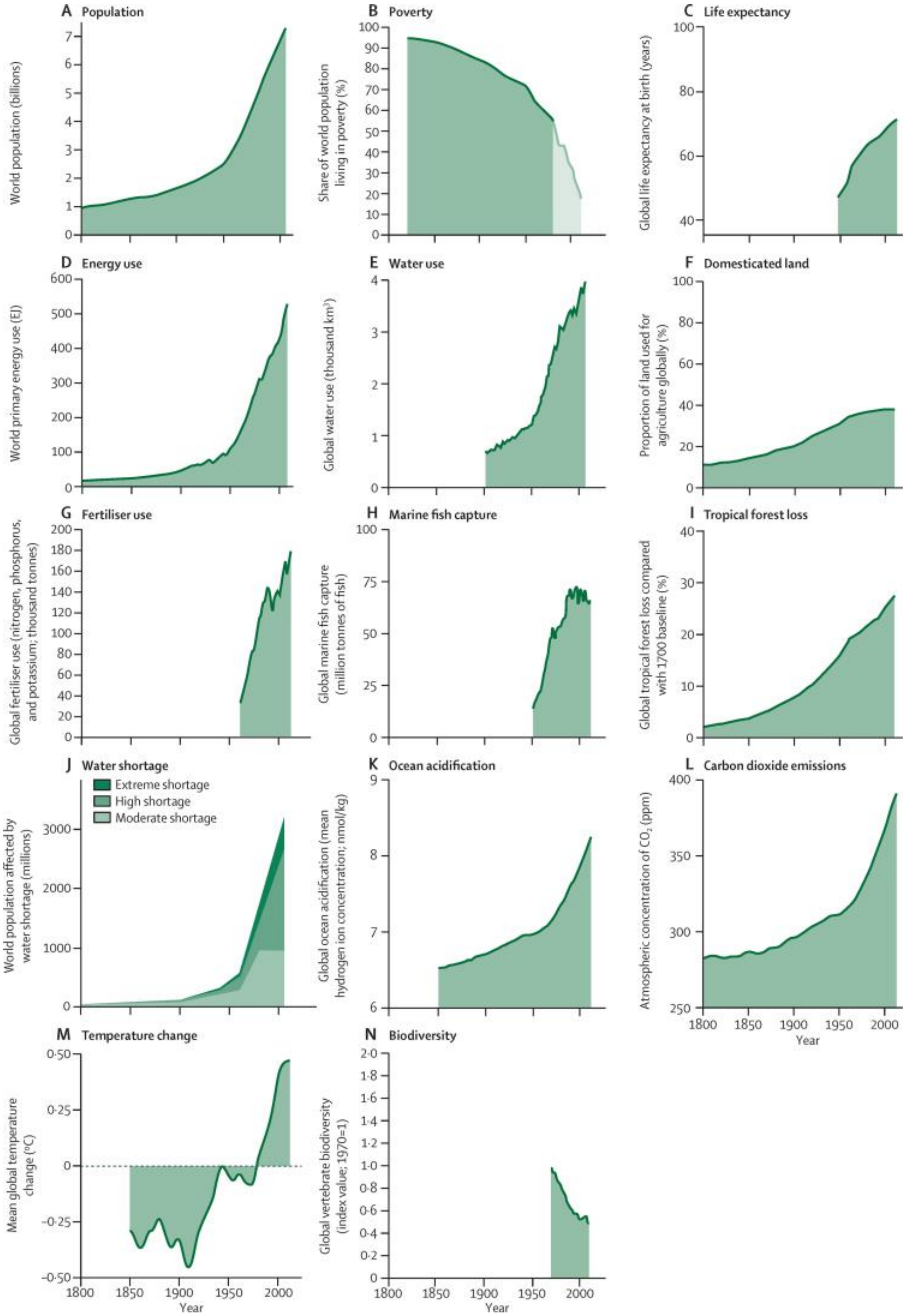
27 Will Steffen et al., The trajectory of the Anthropocene: The Great Acceleration, SAGE Journals, Vol. 2 (2015), pp.81–98

28 Andy Haines, Addressing challenges to human health in the Anthropocene epoch—an overview of the findings of the Rockefeller/Lancet Commission on Planetary Health, International Health, Vol. 9 (2017), p.269

29 The Rockefeller Foundation Economic Council on Planetary Health, What is planetary health (Accessed 8 August 2019)

12. The Rockefeller Foundation-Lancet Commission on planetary health, published a series of graphs comparing data on human progress and resource usage (including population increase, water consumption etc), with graphs showing the detrimental impacts to the environment (including tropical forest loss, and carbon dioxide emissions). Figure 2 shows that human progress has been accompanied by an increase in environmental damage.

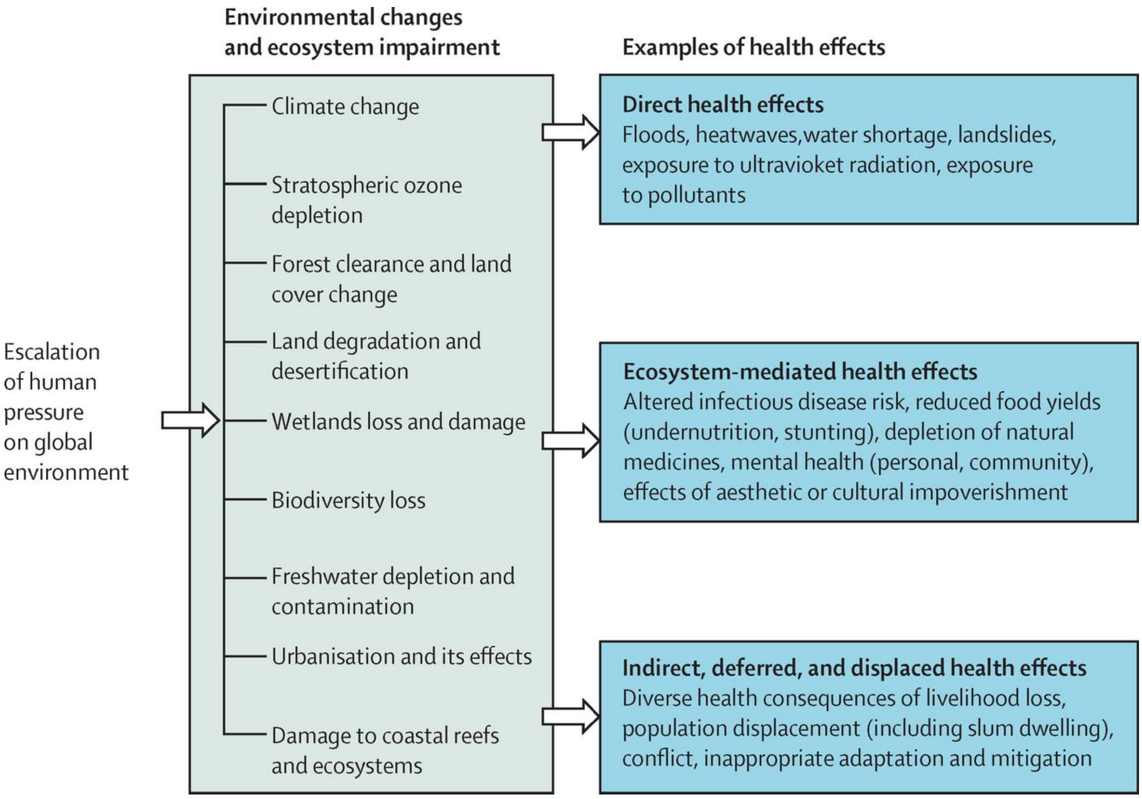
Figure 2: Characteristics of the Anthropocene epoch - global trends (Years 1800 to 2000) in population, consumption, health and the environment[30]



30 Source: Sarah Whitmee et al., 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', The Lancet, Vol. 386 (2015), pp.1973–2028

13. The Millennium Ecosystem Assessment, a major assessment of the human impact on the environment conducted by the UN, divided the threats to human health from environmental change into three categories, direct health effects, ecosystem-mediated health effects, and indirect, deferred and displaced health effects.

Figure 3: Mechanisms by which the harmful effects of ecosystem change can affect human health[31]



Indirect health effects

14. Our witnesses emphasised indirect health effects of a degraded environment and the importance of ecosystem-mediated health effects including:

a) **Non-communicable diseases (NCDs), such as obesity and cardiovascular disease**: Much of the food system is focused on agricultural yields and not directly on healthy and sustainable food. Witnesses emphasised how current agricultural practices, marketing and consumer behaviours are leading to an increased burden of non-communicable diseases such as obesity and diabetes. Professor Tim Benton, University of Leeds, told us that a: "few crops are produced in enormous quantities and are associated with increasing global dietary convergence, over-consumption of calories and production of food waste (partly driven by reduced food prices)".[32] In a recent review article the importance of

31 Source: Millennium Ecosystem Assessment, reproduced in: Sarah Whitmee et al., 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', The Lancet, Vol. 386 (2015), pp.1973–2028

32 Professor Tim Benton (PLA0026)

non-staple crops was also emphasised, "climate and other environmental changes also reduce the yield of vegetables and legumes overall, which has important implications for the prevention of noncommunicable diseases".[33]

b) **Mental health impacts:** Professor Lora Fleming, University of Exeter Medical School outlined the impacts that environmental change might have on mental health:

> "Both climate and other environmental changes… have been shown to directly impact on mental health potentially negatively, things like wars, poverty, extreme weather and so on. […] In the UK, we have data that shows that the more you interact with natural environments, particularly coastal and blue environments, the better for your physical and mental health".[34]

> Eco-anxiety, has emerged as a psychological disorder afflicting an increasing number of people concerned about the environmental crisis and suffering a sense of grief or loss. Eco-anxiety has been described by the American Psychological Association as "chronic fear of environmental doom".[35]

c) **Infectious diseases**: Professor Sir Andy Haines, LSHTM, told us about the role of environmental and climate change on infectious diseases:

> "There are also the effects on infectious diseases through natural systems; for example, vector-borne diseases like malaria and dengue. The distribution of those is changing as a result of climate and other environmental changes. Water-related diseases, of course, increase risks of diarrhoeal and other diseases related to water. Cholera as well can be influenced by climatic factors".[36]

NHS and planetary health

15. The NHS is one of the largest employers in the world, with up to 1.5 million employees, and is the largest public sector carbon emitter in the UK. Its annual budget, £110 billion in 2017/18, is roughly the same size as the GDP of Croatia and Sri Lanka combined.[37]

Adapting to change

16. Witnesses expressed concern that the NHS is not ready for a rise in health problems as a result of environmental damage. Dr Richard Horton, the Lancet, expressed his frustration at the lack of NHS preparedness for emerging health problems:

> We do not have enough doctors in the NHS to address liver mortality. We do not have enough liver specialists. We do not have a public health strategy

33 Andy Haines and Kristie Ebi, The Imperative for Climate Action to Protect Health, The New England Journal of Health. Vol. 380 (2019), pp.263–273

34 Q7

35 Susan Clayton Whitmore-Williams, et al., Mental Health and Our Changing Climate: Impacts, Implications, and Guidance. American Psychological Association (2017), p.68

36 Q3

37 Employee data from Lucina Rolewicz and Billy Palmer, The NHS workforce in numbers [date accessed 06/08/2019], Nuffield Trust (2018); annual budget data from NHS England, Annual Report and Accounts 2017/18, (2018); and GDP data for Croatia and Sri Lanka from World Bank, GDP (current US$), (2018)

> that is working on obesity. We do not have a public health strategy that is working on alcohol. Unless we address the health system components and the public health components together then many of these environmental-determined or influenced diseases we will not be able to contain or control.[38]

17. Dr Horton was particularly critical of Public Health England's (PHE) failure to see the big picture, noting that during a discussion with a senior official at PHE, "their vision" was limited to just two targets: incentives for smoking cessation and for reducing alcohol consumption. He explained that this narrow focus was driven by funding cuts, which were leading to a "struggle to deliver services in the NHS".[39] He went on to say:

> … We are talking about planetary health, we are talking about the environment and we are talking about these broader determinants. They [Public Health England] are nowhere, and they will admit they are nowhere when you ask them about that. That limited vision is a huge constraint on the future of public health in our country. Until they lift their gaze and embrace that broader vision, we are nowhere.[40]

18. That Public Health England "does not own these broader determinants of health", Dr Horton stated, "is a catastrophic failure in our health system".[41]

19. We note that the Government recently published a 10-year plan for the NHS.[42] Professor Chris Whitty, Chief Scientific Adviser at the Department of Health and Social Care (DHSC), told us that it had been "developed with multiple different people feeding in, including me and scientists from Public Health England and other areas".[43] He noted that parts of the 10-year plan "explicitly" took account of climate change.[44] Jonathan Marron, Director General of Community and Social Care at the Department of Health and Social Care, also emphasised that the 10-year plan had "a much broader focus than previous NHS documents in tackling environment sustainability as well as basic healthcare".[45]

20. However, there was also a recognition that tough decisions would need to be made, to ensure that the NHS was contributing sufficiently to climate change mitigation actions, reducing its own emissions and adapting to the future impacts of a changing climate. Professor Whitty reflected that there would need to be a "political decision as to where you trade off the different speeds and the costs".[46]

21. **Without rapid action to curb greenhouse gas emissions and efforts to safeguard the environment we risk causing irreversible damage to the planet. This is already having a significant and growing impact on human health, with impacts set to become more severe.**

---

38 Q234
39 Q226
40 Q226
41 Q207
42 NHS England, NHS Long Term Plan, (2019)
43 Q332
44 Ibid.
45 Q379
46 Q332

22. **We are concerned that the NHS and the pharmaceutical industry is not sufficiently resourced to deal with these projected changes. Non-communicable diseases (NCDs) kill 41 million people each year, equivalent to 71 per cent of all deaths globally. We note that more people now die from non-communicable diseases than communicable diseases.[47] We also note the recent stalling in life expectancy in the UK as a result of lifestyle changes with increased pressure for NHS resources.[48] Public Health England should broaden its key performance indicators to include climate resilience and adaptation measures to tackle emerging diseases. These should include guidance to general practitioners and the pharmaceutical industry on Lyme disease, malaria, the zika virus and other emerging tropical diseases. We repeat our recommendation from our toxic chemicals report that Public Health England should introduce a comprehensive UK wide human and wildlife bio-monitoring scheme to measure the effects of toxic chemicals.[49] A focus on lifestyle change means that it does not prioritise the impacts that wider economic and ecological changes will have on human health. Secondly, Public Health England must work across Government to advise local Government on the impacts of heat stress and protecting vulnerable communities, particularly the elderly, people living in care homes and those with kidney failure.**

Climate change mitigation by the NHS

23. The NHS is on the frontline of dealing with the impacts of environmental change on human health. However, as an organisation, it too has a responsibility for stewardship of the environment. The NHS employs 1.5 million people and is one of the largest consumers of water, energy and raw materials in the U.K. It has an annual water usage of 2.32bn m^3 (similar to that of Estonia), generates almost 600,000 tonnes in waste and accounts for 6.3 per cent of all carbon emissions in England.[50]

24. The NHS Sustainable Development Unit, established in April 2008 supports the NHS in England, public health and social care, to embed sustainable development into their operating practices.[51] The Unit is jointly funded by, and accountable to, NHS England and Public Health England.

25. NHS England published its Long-Term Plan in January 2019.[52] The Plan restated its commitment to the carbon targets in the UK *Climate Change Act* (2008): reducing carbon emissions (from a 1990 baseline), by 34 per cent by 2020 and by 51 per cent by 2025.[53]

26. As of 2018 the NHS[54] has achieved an 18.5 per cent reduction on carbon emissions against a 2007 baseline. Whilst this is progress, the NHS Sustainable Development Unit note that "this is still behind the trajectory needed to achieve the *Climate Change Act* 2020 target of 34 per cent, highlighting the need to redouble and accelerate efforts going forward".[55]

47 World Health Organization, Noncommunicable diseases (June 2018)
48 Raleigh, British Medical Journal, Stalling life expectancy in the UK 2018; 362:k4050
49 Environmental Audit Committee, Twentieth Report of Session 2017–19,Toxic Chemicals in Everyday Life, HC 1805, paragraph 36
50 NHS Sustainable Development Unit Reducing the use of natural resources in health and social care, (2018), p.3
51 NHS Sustainable Development Unit, Who We Are [Accessed 01 July 2019]
52 NHS (2019) NHS Long Term Plan, (2019), p.120
53 Ibid.
54 Referring to Health and social care
55 NHS Sustainable Development Unit Reducing the use of natural resources in health and social care, (2018), p.8

27. The Sustainable Development Unit's actions to reduce emissions include improving energy efficiency through widespread use of LED lighting and smart energy management, and by modernising the ambulance fleet to reduce emissions and improve air quality.[56]

28. Professor Sir Andy Haines, LSHTM, noted that the Long-Term Plan:

> Does not capitalise sufficiently, in my view, on the potential for the NHS to be involved in thinking about these broader issues around how we sustain and promote health. I would like to see that given a much higher priority in future plans.[57]

29. In a letter to our Committee in May 2019, Sonia Roschnik, Director of the NHS Sustainable Development Unit, told us that 35 per cent of double crewed ambulances have low emission engines (Euro VI diesel engines) against a target of 66 per cent by 2028.[58] She also stated that of 1,458 rapid response vehicles, in operation in England, just 0.3 per cent of these (44 vehicles) are ultra-low emission.[59] She also stated that the NHS [in England] has committed to "phasing out primary heating from coal (by 2023/24) and oil (by 2028/29) in NHS sites".[60]

30. Our report in 2018, *UK Progress on reducing F-gas Emissions*, highlighted that fluorinated gases, used in refrigerators, foams and inhalers, are a major contribution to global heating.[61] We note that the Sustainable Development Unit has removed nearly 1 million tonnes of CO_2e per year from Metered Dose Inhaler (MDI) use. However, the use of MDIs continues to produce over 3 per cent of the health and social care sector's annual carbon emissions, greater than its emissions from the sector's construction and only slightly less than the sector's freight transport emissions.[62]

31. ***The NHS has shown some progress in reducing carbon emissions by 18.5 per cent since 2007. It is deeply disappointing that it will miss its Climate Change Act target of a reduction in emissions of 34 per cent by 2020. As the largest employer, and one of the largest consumers of goods and services in the UK, the NHS should bring forward its targets to end the use of coal (2023/24) and oil (2028/29) for primary heating on NHS sites. This target should now be revised to reflect the Government's commitment to achieve net zero greenhouse gas emissions by 2050 at the very latest. A new pathway for carbon reduction should be developed by April 2020 and communicated to all stakeholders. The NHS' carbon footprint should be clearly communicated to staff, patients and suppliers, with messages on how they can contribute.***

32. ***Fluorinated gases remain a major problem, with inhalers contributing to over 3 per cent of total annual emissions from the NHS. We reiterate our recommendation that Government should work with medical professionals, pharmacists, the pharmaceutical industry and patients to significantly improve the recycling of Metered Dose Inhalers (MDIs); this makes both environmental and economic sense. We encourage the Government to investigate all the means of removing the barriers to the safe re-use of***

56 NHS Sustainable Development Unit, Key sustainability actions in NHS Long Term Plan [Accessed 01 July 2019]
57 Q31
58 Sonia Roschnik, Letter from NHS England to the EAC Chair on Planetary Health, (03 May 2019)
59 Ibid.
60 Ibid.
61 Environmental Audit Committee, Fifth Report of Session 2017–19, UK Progress on reducing F-gas Emissions, HC 469, paragraph 1
62 NHS Sustainable Development Unit, Reducing the use of natural resources in health and social care, (2018), p.11

those valuable quota-restricted gases. The Government should also ensure that by 2020, at least 50 per cent of MDIs are recycled. It should also set out how it will reduce medical waste, such as MDIs, in its waste strategy.

Net Zero in the NHS

33. The Committee on Climate Change's (CCC) report, "*Net Zero: The UK's contribution to stopping global warming*", set out actions that should be taken by the Government to contribute to the UK's net zero goal. The CCC recommended that: "Ideally, ultra-low emission vehicles would reach 100 per cent of sales of cars, vans and motorbikes by 2030 or soon after, but must certainly do so by 2035".[63] The CCC also recommended that:

> If possible, an earlier end to sales of petrol and diesel vehicles would be preferable (e.g. by 2030 if feasible), as this will have lower financial costs, lower cumulative CO_2 emissions and lead to better air quality. This means a rapid ramping up of the market share of [Electronic Vehicles] EVs, from around 2 per cent today, during the 2020s.[64]

34. **We are concerned that, at current rates of progress, the NHS will fall far short of the Committee on Climate Change's recommendation of 100 per cent of low emission vehicles by 2035 at the latest. The current target of 66 per cent of vehicles being low emission by 2028 is not ambitious enough. The NHS should be taking the lead in the mitigation of climate change, given its size, budget and workforce, particularly when a major impact of climate change is likely to be a deterioration of several measures of population health. The Committee on Climate Change is clear that early uptake of electronic vehicles (EVs) brings co-benefits from reductions in air pollution. NHS direct fleet procurement and "Grey fleet" purchased through tax schemes should prioritise EVs.** ***We recommend that the NHS aligns its plans with the Committee on Climate Change's cost-efficient path for electric vehicle uptake to benefit from the financial savings and co-benefits (e.g. reduction in air pollution) of earlier EV uptake.***

63 Committee on Climate Change, Net Zero: The UK's Contribution to Stopping Global Warming, (2019), p.198
64 Committee on Climate Change, Net Zero: The UK's Contribution to Stopping Global Warming, (2019), p.178

3 Nature, wildlife and the environment

Environmental damage

35. The use and exploitation of natural resources by humans means that the Anthropocene, a new geological era, marked by human induced global heating, has begun.[65] Professor Sir Andy Haines, LSHTM, warned that "We have overexploited our land and our seas. We are dramatically changing the climate".[66]

36. Professor Peter Cox, University of Exeter, outlined that the UK is projected to experience significantly warmer temperatures over the next 50 years:

> Given the rate of warming we have globally, which is about 0.2°C a decade, and taking the slightly pessimistic view that that does not change, we are looking at probably 3-degree warming here in the UK, relative to pre-industrial. That is quite a big change.[67]

37. Dr Mark Mulligan, King's College London, summarised the impacts of higher temperatures on water availability in the UK:

> A warmer climate should generate a more rapid recycling of rainfall between the land and the atmosphere, and so there will be an overall increase in rainfall… If we look at the UK in terms of our water resources, of course our key issues are to do with seasonality of those resources, but also with water quality. We will see, under climate change, impacts both on the supply side of water and also, of course, in demand for water.[68]

38. A major concern has been the impact of human action and environmental change on global plant and animal biodiversity.[69] The Planetary Health Network at the LSHTM told us that:

> Current prediction rates of extinction are at 100–1000 times more than what is considered natural biodiversity loss. While biodiversity loss occurs at local—regional level, it has greater impact on the biosphere and how the Earth systems function.[70]

39. The landmark Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) global assessment report on biodiversity and ecosystem services, published in May 2019, found that, globally, the biomass of wild mammals has collapsed by 82 per cent. There has been a rapid decline in ecosystem functions and 25 per cent of animal and plant species are threatened, with around one million species at

65 Sarah Whitmee et al., 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', The Lancet, Vol. 386 (2015), pp.1973–2028
66 Q2
67 Q135
68 Q138
69 Aelys Humphreys et al., Global dataset shows geography and life from predict Modern pant extinction and rediscovery, Nature Ecology and evolution, Vol. 3 (2019), pp.1043–1047
70 LSHTM Planetary Health Alliance (PLA0020)

risk of extinction, and grave impacts on people around the world now likely. This loss is a direct result of human activity and constitutes a direct threat to human well-being in all countries.[71]

40. Professor Georgina Mace, University College London, criticised the Government's fragmented approach to nature conservation with DEFRA divided into animal health, plant health and the environment. Climate mitigation sits with the Department for Business, Energy and Industrial Strategy (BEIS), but responsibility for delivery lies with the Ministry of Housing, Communities and Local Government (MHCLG) and the Department for Transport (DfT).[72]

41. She warned that insect species variety was a key insurance measure against climate change:

> The loss of invertebrates and the loss of species generally means that we do not have a lot of other kinds of services, natural pest control, natural decomposition of pollutants, natural nutrient cycling, and without those, we are increasingly going to have to intervene in ecosystems to provide those services… If you project these trends forward, we end up solving problems caused by the loss of natural systems one by one, which is a much less efficient way to solve those problems than treating the root cause of the problem, which is the depletion and degradation of the natural environment.[73]

Drivers of wildlife loss

42. UK Research and Innovation (UKRI) told us that "there are multiple stressors affecting biodiversity including changing land use and climate change".[74] Particular stressors identified include:

- **Land use change**: Dr Mulligan, King's College London, identified that biodiversity declines were mostly a result of "land-use change for agriculture, intensification of agriculture, and the application of pesticides, and herbicides, and novel chemicals".[75] Medact, a global health charity, told us that: "Change in land use, largely as a result of natural habitat being converted to agricultural use, has occurred in all continents, and continues, particularly in tropical and subtropical areas. This leads to loss of native species (both plant and animal) and loss of biodiversity, increased phosphorous and nitrogen pollution of watercourse[s] through agricultural run-off, air pollution (and CO_2 emissions) from burning forests, and increased soil erosion. This in turn has led to substantial areas of agricultural land (1–2.9 million hectares annually) becoming unusable, often turning to desert. This contributes to global food insecurity".[76] Matt Shardlow, Buglife, explained that what was important was "the health of

71 Sandra Diaz, et al., Summary for Policymakers of the Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES, (2019); IPBES, Media Release: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating', (2019)

72 Q157

73 Q134

74 UK Research and Innovation (PLA0024)

75 Q132

76 Medact (PLA0027)

the wider countryside and the fact that we have fragmented their habitats, where there is flower-rich grassland left, into small blocks so [species] are not able to move”.[77]

- **Climate Change**: Professor Cox, University of Exeter, told us that “Recent studies for the IPCC 1.5 report suggest that the ranges of insects are surprisingly sensitive to climate”.[78]

- **Ocean acidification**: (because of increased absorption of carbon dioxide) ocean acidification is “predicted to reduce survival of many marine animals, destroy coral reefs, and render crustaceans less able to form and maintain shells. These changes are likely to have impacts on the food chain, putting strain on the availability of fish for human consumption”.[79]

Insect populations

43. Dramatic decreases in insect populations have been widely reported. There have been press reports of “an insect Armageddon” with the Guardian reporting that UK farmland butterflies have declined by more than half since the year 2000 and Germany has lost three-quarters of its aerial insects since 1989.[80]

44. A meta-study of insect populations published in April 2019 concluded that “habitat loss by conversion to intensive agriculture is the main driver of the declines” and that “agro-chemical pollutants, invasive species and climate change are additional causes”.[81] According to the research, 41 per cent of insect species are at risk over the next few decades, and there has been a 2.5 per cent decline in insect biomass every year.[82] Commenting on the review, Georgina Mace, University College London, said that:

> I do not think they are correct that extinctions will necessarily follow, the idea that—I think it was said to be by the end of the century—most insect populations will be extinct, I do not think is true. What tends to happen is that these persistent threats deplete populations, so you lose a lot of the biomass and abundance. There are some extinctions, there are some local extinctions, but insects are pretty good at going somewhere else and becoming pests somewhere else.[83]

45. Matt Shardlow, Buglife, told us that insects were the “canaries in the coalmine” as they were “on the frontline of the extinction crisis”.[84] He told us that climate change represented a serious risk for smaller species such as birds, butterflies and dragonflies.[85] He commented that: “extinction approaches with silent wings for little things”, and gave the example of the bumblebee:

77 Q199
78 Q145
79 Medact (PLA0027)
80 ‘Warning of “ecological Armageddon” after dramatic plunge in insect numbers’, The Guardian, (18 October 2018)
81 Francisco Sanchez-Bayo and Kris A. G. Wyckhuys, Worldwide decline of the entomofauna: A review of its drivers, Biological Conservation, Vol. 232 (2019), pp.8–27
82 Francisco Sanchez-Bayo and Kris A. G. Wyckhuys, Worldwide decline of the entomofauna: A review of its drivers, Biological Conservation, Vol. 232 (2019), pp.8–27
83 Q145
84 Q199
85 Q199

> In the northern hemisphere there is clear evidence of the southern parts of the ranges of the bumblebee shifting north but the northern edges of their ranges are not moving. They are getting compressed, and of course if thousands of species are all doing that, what you end up with is species going extinct over large parts of their range.[86]

Pollinators

46. Climate change and other stressors have led to a significant reduction in pollinating insects. Insects provide pollinator services to a wide range of crops including many fruits and vegetables that are vital for a healthy human diet. Pollination by insects is an important form of reproduction for at least 87 types of common global food crops, which account for more than 35 per cent of annual global food production by volume.[87]

47. Neonicotinoid pesticides have been partly blamed for declines in bee populations, although this is contested. Neonicotinoids are the "world's most popular insecticides" and recent evidence suggests that they "affect the insects' abilities to navigate and communicate".[88]

48. Others have suggested that climate change may also play a key role. The Committee on Climate Change Adaptation Sub-Committee told us that "some pollinator species may have high susceptibility to changes in climate, space and seasonality, with the possibility of future mismatches with flowering dates".[89] It stated that there is a need for research "to better understand the potential for mismatches due to changes in climate space and seasonality and the extent to which pollination disruption may occur, as well as how climate and non-climate pressures (including use of neonicotinoids) may interact".[90]

Health risks from biodiversity loss

49. The loss of biodiversity poses a number of risks to human health. The *IPBES global assessment report on biodiversity and ecosystem services*, found that:

> The deterioration of biodiversity and ecosystem functions, and the consequent disruption of benefits to people, has both direct and indirect implications for public health. Emerging infectious diseases in wildlife, domestic animals, plants or people can be exacerbated by human activities such as land clearing and habitat fragmentation (established but incomplete) or the overuse of antibiotics driving rapid evolution of antibiotic resistance in many bacterial pathogens (well established). The deterioration of nature and consequent disruption of benefits to people has both direct and indirect implications for public health (well established) and can exacerbate existing inequalities in access to health care or healthy diets (established but incomplete). Shifting diets towards a diversity of foods, including fish, fruit,

86 Q197
87 Sarah Whitmee et al., 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', The Lancet, Vol. 386 (2015), pp.1973–2028
88 Gretchen Vogel, 'Where have all the insects gone?', Science, (10 May 2017)
89 Committee on Climate Change (PLA0016)
90 Committee on Climate Change (PLA0016)

> nuts and vegetables, significantly reduces the risk of certain preventable non–communicable diseases, which are currently responsible for 20 per cent of premature mortality globally”.[91]

A 2015 joint review by the World Health Organisation and the Secretariat for the Convention on Biological Diversity,[92] identified a number of ways in which “anthropogenic drivers of biodiversity loss are hindering the capacity of ecosystems to provide essential services”, including:[93]

- the loss of agrobiodiversity, which supports the production, pollination, and pest control services needed for food and nutrition security;
- increased risk of transfer of pathogens from wildlife to human populations; and
- the possibility that biodiversity loss might lead to reduced diversity in human microbiota, contributing to immune dysfunction and disease.[94]

Government progress on biodiversity

Aichi Targets

50. The UN Convention on Biological Diversity (CBD) is the framework for international action to support biodiversity. The Aichi Targets, which sit under the CBD, are a set of 20 goals to safeguard biodiversity which are to be achieved by all member states by 2020. The Joint Nature Conservation Committee, (JNCC - the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation), reported on UK progress towards achieving the Aichi biodiversity targets in 2019.[95] It found 14 out of 19 targets were progressing at an “insufficient rate”, including:

- **Aichi Target 1**: “By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably”.[96] The assessment made by the JNCC found that, 52 per cent of the UK population “report no awareness of the threats to biodiversity”.[97] Thus, there was still significant action required by the Government to raise awareness of biodiversity threats.
- **Aichi Target 3**: “By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions”.[98]

91 Sandra Diaz, et al., Summary for Policymakers of the Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES, (2019)
92 World Health Organization and the Secretariat for the Convention on Biological Diversity, Connecting Global Priorities: Biodiversity and Human Health, (2015)
93 Medact (PLA0027)
94 Medact (PLA0027)
95 JNCC, Sixth National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland: Overview of the UK Assessments of Progress for the Aichi Targets, (2019)
96 JNCC, Sixth National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland: Overview of the UK Assessments of Progress for the Aichi Targets, (2019)
97 Ibid.
98 Ibid.

51. During our final evidence session, Dr Thérèse Coffey, Parliamentary Under Secretary of State for the Environment, DEFRA, defended the Government's record on biodiversity, stating that the JNCC reported the UK was "absolutely on track to achieve five of [the Aichi targets] and on 14 there is progress to be made".[99] She described some of the targets as "somewhat nebulous".[100] As an example she said that:

> Even on target 1, which is about getting the public to understand more about biodiversity, when I went to CBD [Convention on Biological Diversity Conference of Parties] last year talking with other countries and with the Secretary General, just the name "biodiversity" puts up barriers to people on what does that really mean? There are things that we could do about perhaps changing it to the Convention for the Conservation of Nature.[101]

52. **Progress towards meeting the Aichi targets by 2020 falls woefully short, and meeting only five of them will not protect the UK's precious wildlife and fragile habitats.** *We recommend that* ***the Government engage with the public on the next set of targets before the 2020 UN Biodiversity Conference and set out clear priorities for action. The targets should be formally reviewed every four years and the Government should task Natural England and devolved administrations with the responsibility for their domestic delivery.***

Government policy and funding

25 Year Plan targets

53. The Government published its 25 Year Environment Plan in January 2018.[102] Our inquiry into the Plan concluded that it lacked detail on targets, implementation, governance and funding and it was unlikely its ambitions would be achieved.[103] Professor Peter Cox, University of Exeter, told us that "It is important to include in the metrics things we can measure and that we will be held to account on".[104] Dr Mulligan, King's College London, added that when he read the Plan, he "kept asking: 'How?' to those targets as we went through them. 'How are we going do that? What will be the mechanism?'".[105]

54. A second criticism of the Plan was the siloed nature of topics, with the Plan attempting to solve "one problem at a time within different sectors of the economy".[106] Professor Georgina Mace, University College London, stated that: "the actions that are laid out in the 25 Year Plan are nearly all within sectors. […] We will clean up the water, we will stop emissions of particulates into the air, but it is not addressing the systemic problem that these things are all linked together".[107]

99 Q393
100 Q393
101 Q393
102 HM Government, A Green Future: Our 25 Year Plan to Improve the Environment, (2018)
103 Environmental Audit Committee, Eighth Report of Session 2017–2019, The Government's 25 Year Plan for the Environment, HC803
104 Q154
105 Ibid.
106 Ibid.
107 Ibid.

55. **The Government's 25 Year Plan for the environment sets out actions that the Government intends to take but there are no SMART targets against which its performance can be measured.** ***Legislative targets are needed to drive action across Government Departments and not just DEFRA. We reiterate our previous recommendations that the Environment Bill must include a framework for statutory nature and biodiversity targets and interim milestones to be achieved by Government Departments, including by the Treasury, to help them achieve the Greening Government targets. Once these targets have been established through stakeholder collaboration, the Cabinet Office must issue guidance directing Departments to explain how their work programmes will achieve the delivery of these targets in their Single Departmental Plans and the next round of Greening Government Commitments.***

Biodiversity net gain

56. Biodiversity net gain is a commitment that any new construction or development leaves biodiversity in a better state than before. Where a development has an impact on biodiversity it requires developers to provide an increase in natural habitat and ecological features greater than that being lost by construction.

57. The Government's 25 Year Plan for the Environment explains that strengthening biodiversity net gain requirements would enable planning authorities to "develop locally-led strategies to enhance the natural environment, creating greater certainty and consistency and avoiding increased burdens on developers, including those pursuing small-scale developments".[108] It expects that this should have a net positive impact on overall development.

58. In December 2018, the Government held a consultation on biodiversity net gain, which sought: "views on how we can improve the planning system in England to protect the environment (biodiversity net gain) and build places to live and work". Kit Malthouse, then Minister of State (Housing, Communities and Local Government), told us that "subject to that consultation coming back, we will mandate [biodiversity net gain] in the upcoming Environment Bill".[109]

59. Kit Malthouse also told us that he was intending to embed biodiversity into the planning system. "We will also be bringing out planning guidance in the next two or three months, hopefully, around the [National Planning Policy Framework] and what the local authorities should be looking for and should be interpreting in planning to provide effectively, […] space for nature in new developments and generally across the piece".[110]

60. However, this effort is hampered by the significant budget cuts to Natural England, the public body responsible for ensuring protection and improvement of the natural environment. Matt Shardlow noted that Natural England "has suffered 40 per cent or so cuts. It is in a very bad place".[111]

108 HM Government, A Green Future: Our 25 Year Plan to Improve the Environment, (2018)
109 Q397
110 Q397
111 Q220

The Environment Bill

61. The *draft Environment (Principles and Governance) Bill*, was published on 19 December 2018 and sets out the future governance arrangements for the environment in England in the event the UK leaves the EU. We heard that sustainable development is already embedded in policy in Wales through the *Well-being of Future Generations (Wales) Act 2015*, which requires public bodies to "carry out sustainable development" and meet well-being objectives.[112] Witnesses stated that the *Future Generations Act* was a "pioneering bit of legislation".[113] The *Environment (Principles and Governance) Bill* is an opportunity for a similar obligation on public bodies in England to embed health and the environment, climate change and sustainable development into their decision making.

62. The second part of the Bill (intended to cover environmental themes other than governance and principles) should contain further details of UK environmental policy. Commentators have set out their hopes for what might be included in the Bill. Greener UK wrote that:

> Part II of the bill is essential to deliver the pioneering new green governance system the government has committed to. This must include the creation of a new overarching environmental duty along with binding objectives and a framework for legally binding targets, and the creation of mechanisms to achieve these targets and objectives, including a commitment to the effective spatial mapping, planning and delivery of nature recovery networks, improved cross-government working and new processes for environmental monitoring, reporting and reviewing.[114]

63. ***We are disappointed that Natural England has lost half of its budget over the last 10 years. It needs a rapid increase in funding to achieve current objectives. Any new obligations placed under new legislation should be adequately resourced. The Environment (Principles and Governance) Bill is an opportunity to consider holistically the governance frameworks for planetary health in the UK. We recommend that a principle to achieve a high level of environmental protection is put on the face of the Bill and all public bodies be required to achieve this. The Government provided us with the draft version of the first half of the Environment (Principles and Governance) Bill, on which we reported earlier this year. Much of the detail of the Government's proposals for environmental protection, such as on biodiversity net gain, will be contained in the second half of the Bill and we urge the Government to make this available to the Committee for pre-legislative scrutiny as soon as possible, especially given the severe environmental and public health risks of a no-deal Brexit on October 31st.***

64. ***The Environment (Principles and Governance) Bill should include provision for new targets to increase green and blue urban infrastructure. Our heatwaves report recommended that the revised National Planning Policy Framework should set a target for councils to achieve, which aims to increase urban green space to 2001 levels, and higher if possible.[115] This should also be included in the revised National Planning Policy Framework to ensure space for nature and people to help adaptation to climate change.***

112 Well-being of Future Generations (Wales) Act 2015, Part 2 Clauses 3(1) and 3(1)(a)

113 Q104; Q283

114 Greener UK (DEB0027)

115 Environmental Audit Committee, Ninth Report of Session 2017–19 Heatwaves: adapting to climate change. HC 826, para 91

Agriculture Bill

65. The *Agriculture Bill*, introduced in 2018, sets out a new payment system for farmers and landowners, should the UK leave the EU. It proposes a system that is based on "public money for public goods" as set out in the policy statement: The future of food, farming and the environment.[116]

66. We note that the *Agriculture Bill* was introduced in September 2018, and are disappointed that it has not reached Report stage one year on. We urge the Government to ensure that the Bill is carried over to the next Parliamentary session. Witnesses to this inquiry praised the Bill's intention to use "public money for public goods". Professor Cox, University of Exeter, considered that "how you value the relative use of land is really key".[117] Matt Shardlow, Buglife told us:

> The concept that we want to invest in public good[s] and put the money into improving the environment, reversing some of those bad things that have happened in the past and also creating new assets and new resources for the public to engage with and to deliver that biodiversity is absolutely right.[118]

Professor Georgina Mace, University College London, thought that there would need to be "synergies" between the *Agriculture Bill* and the *25-Year Plan* to deliver them "in parallel rather than as two separate plans".[119]

67. The Adaptation Committee of the Committee on Climate Change commented in its written evidence that: "With the Government's Agriculture Bill (and possibly also the proposed Environment Bill) set to direct future policy on agricultural land use, [the Committee on Climate Change's "*Land Use*" report] identified the current political climate to be an opportune time to define a better land strategy, including for crop and food production, that responds fully to the challenges of climate change".[120]

68. The need for change was outlined by the British Dietetic Association, which said that: "As a proportion of the UK's [greenhouse gas] output, agriculture and the food system are actually growing, because the sector has remained static while other areas, such as energy and waste, have improved. The Committee on Climate Change has raised its concerns about the fact that the agriculture sector has not seen progress since 2008, with nearly half of farmers not taking any action to reduce GHG emissions. The Committee makes it clear that a stronger framework for this sector is needed as voluntary approaches are not working, especially if the UK wants to meet its own emissions targets".[121]

116 Department for Environment, Food, and Rural Affairs, The Future for food, farming, and the environment: policy statement, (2018)
117 Q160
118 Q227
119 Q159
120 Committee on Climate Change (PLA0016)
121 British Dietetic Association (PLA0018)

69. Similar concerns were raised about pesticides regulation. When asked whether he thought the *Agriculture Bill* would allow better management of the rural environment, Matt Shardlow, Buglife, noted:

> I certainly hope so. The wording is there in the draft bill… On pesticides, I think it is a little bit more complex. We have talked about how some of these problems are difficult to fix at a national level. Pesticides are one because you are dealing with multinational industry. The United Nations Human Rights Council did a report on pesticides in 2017 that concluded the international trade in pesticides was a human rights abuse. This is because 25 per cent of developing countries have no pesticide regulation whatsoever. We sell them the chemicals we ban here because they damage human health and the environment, and they use them in those countries that have no regulations.[122]

70. ***In response to this report, the Government should set out the principles behind the design of the new environmental land management schemes, and the 'public money for public goods' principle, should the UK leave the EU as set out in the future for food, farming and the environment policy statement. These should include steps to minimise high pesticide use and actions to align land use, food production and mitigation and adaption to climate change.***

71. ***We were told that UK companies currently sell chemicals to countries with no regulation of pesticides whose use is banned here. UK policy should be consistent at home and abroad. In the event we leave the EU, the Government has said it will replicate the EU REACH system. Any new UK regulations should review pesticide laws. In the meantime, the Government should review pesticide export regulations and ensure that UK businesses protect planetary health and do not export toxic chemicals which are driving wildlife loss globally.***

122 Q227

4 Food systems

72. This chapter is divided into three main sections: the first considers the impact of climate change and other environmental challenges on global and domestic UK food production. The second part considers Government guidance and action on healthy eating, and the extent to which this promotes environmental sustainability and human health, and the third section considers the content of the anticipated National Food Strategy.

73. One of the key messages of the recent EAT–Lancet Commission on healthy diets from sustainable food systems was that:

> Transformation to healthy diets from sustainable food systems is necessary to achieve the UN Sustainable Development Goals [SDGs] and the Paris Agreement, and scientific targets for healthy diets and sustainable food production are needed to guide a Great Food Transformation.[123]

74. Witnesses including Professor Andy Haines, LSHTM, and Professor Mike Davies, University College London (UCL), saw a larger role for the SDGs in measuring success. They said that: "The Government should put metrics such as the SDG indicators, which reflect sustainable progress more effectively than an exclusive focus on GDP growth, at the heart of its policies".[124]

Food systems

75. Food systems are "the production, marketing, transformation and purchase of food, and the consumer practices, resources and institutions involved in these processes".[125] The British Dietetic Association told us that the global food system is "not working either for human health or for the planet. Rates of obesity and poor nutrition are growing while a significant proportion of the global population remain undernourished".[126] All the while:

> … the food we eat contributes 15–30 per cent of total greenhouse gas (GHG) emissions in the UK[127] and we waste 10 million tonnes of food every year.[128] 90 per cent of our fisheries are fully exploited or overfished.[129] Agriculture and livestock farming are by far the biggest contributors to deforestation, biodiversity loss, and soil pollution, as well as land and water use.[130]

76. The EAT-Lancet Commission recommended a "Great Food Transformation": an "unprecedented range of actions taken by all food system sectors across all levels… to normalise healthy diets from sustainable food systems".[131]

123 Walter Willett. et al., Food in the Anthropocene: the EAT- Lancet Commission on healthy diets from sustainable food systems, The Lancet Commissions, Vol. 393 (2019), pp.447–492

124 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012)

125 Global Panel on Agriculture and Food Systems for Nutrition, How can Agriculture and Food System Policies Improve Nutrition, (2014)

126 British Dietetic Association (PLA0018)

127 Food Standards Agency, Food and climate: A review of the effects of climate change on food within the remit of the Food Standards Agency, (2015)

128 WRAP, Estimates of Food Surplus and Waste Arisings in the UK, (2017)

129 World Economic Forum, 90 per cent of fish stocks are used up- fisheries subsidies must stop emptying the ocean, (2018)

130 British Dietetic Association (PLA0018)

131 Walter Willett. et al., Food in the Anthropocene: the EAT- Lancet Commission on healthy diets from sustainable food systems, The Lancet Commissions, Vol. 393 (2019), pp.447–492

Global food and water security

77. During our inquiry, we heard that although the "food system is currently producing sufficient dietary energy for the expanding global population", there has not been "sufficient emphasis on the production of nutritious foods including fruits and vegetables".[132] Future projections are worrying: "under a business-as-usual scenario with limited agricultural adaptation, environmental changes including global temperature increases and water scarcity will affect agricultural yields with particularly marked negative effects in tropical countries".[133] With further environmental change, there are "considerable concerns that vulnerable populations may face insufficiencies in dietary energy intake and in dietary quality".[134] Sir Charles Godfray, Oxford Martin School, explained that models suggest "by mid-century there could be in the order of 500,000 deaths that would not otherwise have occurred because of climate change".[135]

78. There is further concern that increased concentration of CO_2 will cause a reduction in nutritional value in many important crops.[136] Evidence suggests that, by the end of the century, grains will contain lower amounts of protein, zinc, vitamin B and iron, reducing the micronutrient profile in major dietary sources. Yields of vegetable and legume crops could fall by 30 per cent if carbon dioxide emissions continue to grow at the current trajectory.[137]

79. Fruit and vegetable yields may be particularly affected.[138] Professor Godfray, told us that: " … they will be harder to grow, they will be more expensive, and people will eat less of them with the effects on the environment".[139] This is particularly concerning in light of the recommendations that fruit and vegetables should be a core part of healthy and more sustainably produced diets.

80. The impact of climate-driven food changes will vary according to local determinants. For example, Dr Ivica Petrikova, Royal Holloway, wrote that

> … climate–change-induced rise in temperatures in Ethiopia will make parts of the country unsuitable for the growing of teff, the traditional grain rich in protein. Farmers in affected areas may switch production to maize, which is significantly less nutritious. In contrast, farmers in areas of India adversely affected by climate change–driven reductions in rainfall have been encouraged by the Indian government to switch away from growing wheat to growing millet, a coarse cereal that is both more drought-resistant and more nutritious than wheat.[140]

---

132 London School of Hygiene and Tropical Medicine (PLA0022)
133 Ibid.
134 Ibid.
135 Q51
136 Chunwu Zhu et al., Carbon Dioxide (CO_2) levels this century will alter the protein, micronutrients, and vitamin content of rice grains with potential health consequences for the poorest rice-dependent countries, Science Advances, Vol. 4 (2018)
137 Medact (PLA0027)
138 PFD Scheelbeek et al., Effect of environmental changes on vegetables and legumes yields and nutritional quality, NCBI, Vol. 115 (2018), pp.6804–6809
139 Q52
140 Dr. Ivica Petrikova (PLA0025)

Influence on political instability

81. Research has drawn links between climate-change, food system changes and political instability. Henry McGie, University of Manchester, suggests that: "Forced migration as a result of climate change impacts will lead to growing social tensions and marginalisation of vulnerable people".[141] Attributing the impacts of climate change on migration via food insecurity is not straightforward, but work on the Syrian conflict has found that conflict was likely exacerbated by food insecurity: "Between 2006 and 2009, around 1.3 million inhabitants of eastern Syria were affected by agricultural failures. An estimated 800 000 people lost their livelihoods and basic food supports".[142] The UN International Organization for Migration (IOM) reported that "whilst there are no reliable estimates of climate change induced migration [...] Future forecasts vary from 25 million to 1 billion environmental migrants by 2050, moving either within their countries or across borders, on a permanent or temporary basis".[143]

82. Water scarcity may similarly pose a risk of increased conflict. The lack of available water has led, in some countries, to civil unrest. The Pacific Institute, a global water think tank, has recorded the contribution of water to conflict. It noted that water affects conflict in a variety of ways:

- **Trigger**: Water as a trigger or root cause of conflict, where there is a dispute over the control of water or water systems or where economic or physical access to water, or scarcity of water, triggers violence.[144]
- **Weapon**: Water as a weapon of conflict, where water resources, or water systems themselves, are used as a tool or weapon in a violent conflict.[145]
- **Casualty**: Water resources or water systems as a casualty of conflict, where water resources, or water systems, are intentional or incidental casualties or targets of violence.[146]

83. **Climate change poses significant risks to international food and water security that may lead to hunger and undernutrition for millions of people. Some commentators have drawn links between food insecurity, political instability and conflict. Others have identified the risk of up to one billion climate refugees by 2050.**[147]

84. ***The Government needs to work with UN bodies and national Governments to ensure the Department for International Development budget helps to guarantee national and international food and water security, environmental protection and climate resilience.***

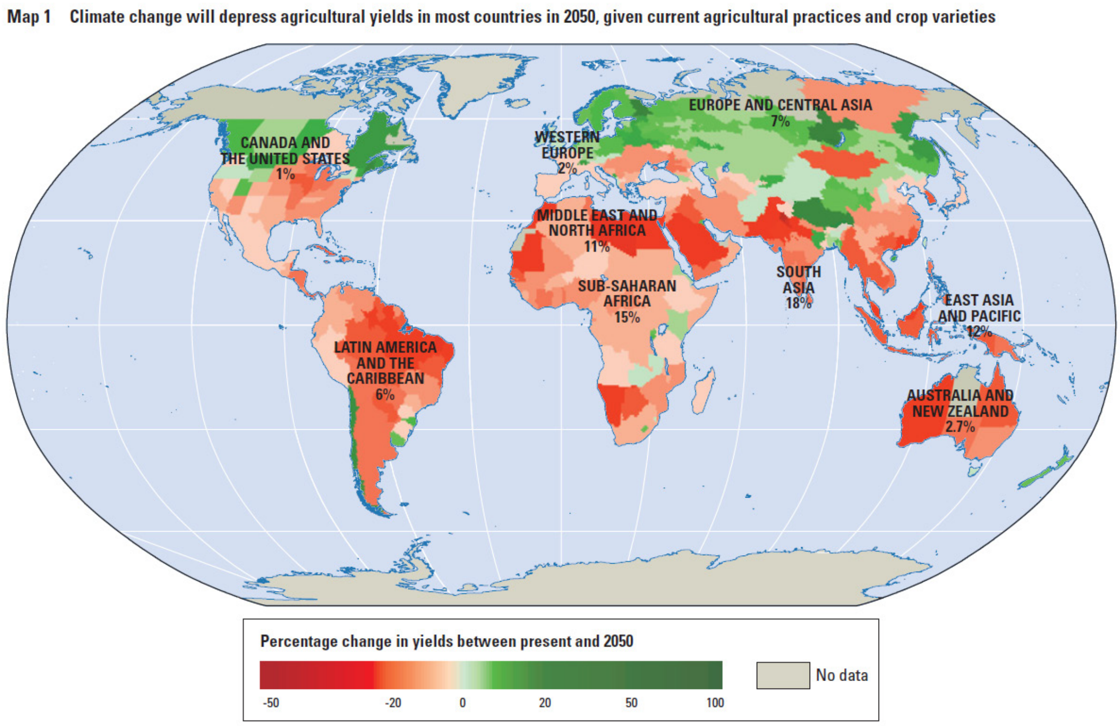
141 Mr Henry McGhie (PLA0021)
142 Peter H. Gleick, Water, Drought, Climate Change, and Conflict in Syria, Pacific Institute, (2014)
143 UN International Organization for Migration, Migration, Climate Change and the Environment [Accessed 01 July 2019]
144 Pacific Institute, Water Conflict [Accessed 01 July 2019]
145 Pacific Institute, Water Conflict [Accessed 01 July 2019]
146 Pacific Institute, Water Conflict [Accessed 01 July 2019]
147 UN International Organization for Migration, Migration, Climate Change and the Environment [Accessed 01 July 2019]

Impact of climate change on the UK food system

85. During our inquiry we heard that agriculture is both affected by, and a major contributor to climate change. The Parliamentary Office of Science and Technology notes that: "Agriculture is responsible for a substantial proportion of UK (10 per cent) and global (10–12 per cent) greenhouse gas (GHG) emissions that cause climate change".[148] It explains that "any level of climate change will affect growing conditions for fruit, vegetables, cereals and livestock, including changes to temperature and availability of water", e.g. a rise of 1°C in mean temperature would reduce yields of wheat by 6 per cent, rice by 3 per cent and maize by 7 per cent. Crop yields would also come under pressure from an increase in pests, weeds and diseases.[149]

86. In 2010, the World Bank Development Report provided a stark warning of the unequal impact, up to 2050, of climate change on yields of 11 major crops (wheat, rice, maize, millet, field pea, sugar beet, sweet potato, soybean, groundnut, sunflower and rapeseed).[150] Figure 4 shows the significant impacts that climate change is predicted to have on agricultural yields by 2050, given current agricultural practices.

Figure 4: Map of predicted climate change yields in 2050



Source: World Bank, (2010) World Development Bank Report 2010: Development and Climate Change

148 *Climate Change and Agriculture*, POSTnote600, Parliamentary Office of Science and Technology, (May 2019)
149 Ibid.
150 World Bank, World Development Bank Report 2010: Development and Climate Change, (2010)

87. In the UK, "more frequent extreme temperatures and changes to rainfall patterns will lead to overall negative impacts on production in the UK, even if a warmer UK climate may improve growing conditions for some crops".[151] Livestock would be vulnerable to disease, such as bluetongue (a disease affecting cattle and sheep that is transmitted by midges), and crops may be affected by water shortages following heatwaves.[152]

88. The 2011 Government Foresight report on International Dimensions of Climate Change and the CCC's Risk Assessment 2017, highlighted that global climate change will affect UK food security through trade networks. For example, "the UK imports 4 per cent of fruit and vegetables from highly climate vulnerable countries such as Belize and India, and a further 14 per cent from moderately vulnerable countries such as South Africa and Brazil".[153] This has implications for the UK's food security in the event of leaving the EU.

89. The UK Government has ignored advice on food security from the Committee on Climate Change. In its *UK Climate Change Risk Assessment 2017*, the Government stated that, although it recognised the "significant risks" posed by climate change to the supply of food in the UK, it took a "more optimistic view of the levels of resilience that are achieved through functioning markets and diverse sources of supply".[154] It stated that the CCC's recommendation that new policy is needed to manage risks to UK food prices does not align with the findings from its own research, including that carried out for the UK Food Security Assessment in 2009 and reviewed in 2012.[155]

90. ***We are concerned that the Government is complacent about the risks to food security posed by climate breakdown. The Government is due to publish an updated UK Food Security Assessment by the end of 2019. We recommend that the Government accepts the advice from the Committee on Climate Change about food security risks and set out how it plans to maintain UK food security in a changing climate. Government should publish immediately, in advance of the food security assessment due by the end of 2019, all information relating to food security and cost risks associated with no-deal Brexit.***

Long term food security in the UK

91. The UK externalises much of the costs of food production and its associated carbon footprint. Tim Lang, City, University of London, told us that:

> We have offshored it. We have had other people do our dirty work and that has to stop. […] the food industry is acutely aware now that consumers really have a complete lack of knowledge about the enormous footprint we have in how we eat.[156]

151 Committee on Climate Change, Land-use: Reducing emissions and preparing for climate change, (2018); *Climate Change and Agriculture*, POSTnote600, Parliamentary Office of Science and Technology, (May 2019)
152 *Climate Change and Agriculture*, POSTnote600, Parliamentary Office of Science and Technology, (May 2019)
153 Ibid.
154 HM Government, UK Climate Change Risk Assessment, (2017)
155 Ibid.
156 Q126

92. Professor Heffernan, Royal Veterinary College, suggested that the UK will need to produce more food in the future:

> We need to produce more food in the UK. We are very dependent on imports, but the problem is that from 2000 to 2013, 22,000 small farms have gone out of business… Our food system is very insecure.[157]
>
> There are two countries, Spain and the Netherlands […] that supply 69 per cent of the fresh vegetables in the UK. That is a very risky scenario. There are four countries that produce 44 per cent of the fresh fruit. We have to be very careful, if we are not producing our own food, where we are getting it from and that puts a variety of different stresses on food systems.[158]

93. The UK may need to look to technology to ensure that a sufficient amount of food is produced on the limited amount of farmable land available in the UK. Other than "strategic initiatives to maximise use of limited land resources (e.g. spatial planning, and protection of better-quality land"),[159] the CCC note that there are a number of technological methods that could be adopted. Dr Philip Thornton, CGIAR Research Programme on Climate Change, Agriculture and Food Security, told us that there is "a whole raft of technologies that are in different stages of development".[160]

94. Some of the options that have been suggested include:

- Breeding new crop varieties, through gene editing and other approaches, that are more resilient to changing environmental conditions, such as reduced water availability or increased salinity.[161]
- Breeding new livestock varieties that are more resilient to heat stress or diseases,[162] and adoption of heat stress abatement measures, such as improved ventilation in livestock housing.[163]
- Controlled-environment farming (CEF), where heat, light, water and CO_2 can be optimised for crop growth in enclosed environments. However, CEF requires high energy inputs. Using low-carbon electricity, waste heat or CO_2 from industrial processes can alleviate this.[164]
- Diversifying production […] In principle, a high diversity of crops and mixed land uses such as the integration of livestock increases the resilience of farm productivity to climatic changes.[165]

157 Q60
158 Q70
159 Committee on Climate Change (PLA0016)
160 Q79
161 Nigel Maxted and Shelagh Kell, Establishment of a Global Network for the In Situ Conservation of Crop Wild Relatives: Status and Needs, Commission on Genetic Resources for Food and Agriculture, (2009); *Climate Change and Agriculture*, POSTnote600, Parliamentary Office of Science and Technology, (May 2019)
162 Delia Grace et al., Climate and Livestock Disease: assessing the vulnerability of agricultural systems to livestock pests under climate change scenarios, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), (2015)
163 AHDB Beef and Lamb, Managing cattle and sheep during extreme weather events, (2015); *Climate Change and Agriculture*, POSTnote600, Parliamentary Office of Science and Technology, (May 2019)
164 *Climate Change and Agriculture*, POSTnote600, Parliamentary Office of Science and Technology, (May 2019)
165 Ibid

95. **Environmental change is projected to have increasingly major impacts on global food systems which would affect the UK's food security and ability to deliver healthy, sustainably produced diets. The development of a UK National Food Strategy is an important opportunity to link national food production, international food trade, and environmental protection.** ***The Agriculture Bill should support this by incentivising a switch in UK agriculture towards more sustainably produced food, including agroecological farming methods,[166] bringing about reductions in greenhouse gases associated with UK agriculture.***

Diets that don't cost the earth

96. Witnesses were unanimous in their support of shifting towards healthy diets produced sustainably. The British Dietetic Association identified "common traits between sustainable and healthy diets".[167] It noted that: "Modelling and real consumption data studies have repeatedly demonstrated that dietary patterns of higher nutritional quality, which are based on healthy plant foods and lower intakes of meat and dairy products, also have lower GHG emissions and better overall sustainability scores. Improving our diets can be a win-win–better for us and better for the planet".[168]

97. There were a range of opinions on the risks and benefits of consumption of animal source foods. We were informed that reducing meat consumption would benefit health. For example, the British Dietetic Association reported that in 2011, the Scientific Advisory Council on Nutrition " recommended that high red meat consumers (>90g per day) should reduce intakes to no more than 70g per day, to reduce colorectal cancer risk without compromising iron intakes".[169] The British Dietetic Association went on to say that "reduced intakes of saturated fat and salt while the inclusion of plant proteins in the diet results in an improved fat profile, lower energy density and significantly increased fibre content".[170] However, Professor Claire Heffernan, Royal Veterinary College, highlighted the dietary needs of different populations: "there are people in the global south who will want that animal source food because they have no other ways to get it"[171] since "the ability to grow food in the global south is going to be extremely limited".[172]

98. A 2018 report from the Institute of Agriculture and Trade Policy estimated that global industrialised meat production will absorb 81 per cent of our available carbon budget in 2050.[173] However, Professor Heffernan also pointed out that environmental impacts of livestock production might not be wholly negative:

> I think that we have to get away from this notion that beef is uniformly bad for the environment. There are very many types of livestock production systems and they all have very different impacts on the environment. The kind of research that is going on now is really exciting and I think it can dramatically change the outcomes of greenhouse gas emissions from the livestock sector.

---

166 Sustainable Food Trust (PLA0006)
167 British Dietetic Association (PLA0018)
168 Ibid.
169 Ibid.
170 British Dietetic Association (PLA0018); Scientific Advisory Committee on Nutrition, Iron and Health, (2011)
171 Q76
172 Q77
173 Feedback (PLA004)

99. There are also increasing calls to recognise the importance of livestock for health, livelihoods and culture in many countries. For example, Mr. Gebregziabher Gebreyohannes (State Minister in the Ministry of Agriculture of the Government of Ethiopia) said in February this year:

> Ethiopia, once a byword for hunger and want, has in recent decades become a dynamic success story, a leader in the fight against both poverty and malnutrition. In that achievement, livestock figure prominently. Our cows, sheep, goats, chickens, camels and other animals are bringing wealth to all actors in the livestock value chain, especially rural women who lack other opportunities to make money. They also create jobs for rural youth. And for our children, an egg or a cup of milk a day can make all the difference, helping to prevent stunting and the life sentence of cognitive deficits.[174]

100. Public Health England's Eatwell Guide provides recommendations for a healthy diet: 39 per cent of food by weight should be fruit and vegetables, 37 per cent starchy carbohydrates, 12 per cent meat, fish, eggs, beans/pulses and other protein sources, 8 per cent dairy or alternatives and very limited amounts of oils, and sweet and salty snacks.[175] The Carbon Trust estimated that if diets in the UK met the recommendations of the Eatwell Guide there would be a 32 per cent reduction in overall environmental impacts associated with diets.[176]

101. A more ambitious recommendation for a healthy diet that would not exceed planetary boundaries was presented in the EAT-Lancet Commission on healthy diets from sustainable food systems.[177] This set out to establish the impact on the environment from a global population of 10 billion people eating a healthy diet.

102. Professor Tim Lang, City, University of London, described the diet to us: "if we want to feed 10 billion people by 2050 we are going to have to eat very differently […] with much less meat, much more fruit and vegetables, much more plant growth at the farm level without using up more land, direct to humans, cutting down the waste".[178] Dr Sonja Vermeulen, Hoffmann Centre for Sustainable Resource Economy, Chatham House, told us that it is "a health-based diet, which we then tested against environmental parameters".[179]

103. Dietary change is not easy. Cost is a significant barrier, with people from lower socio-economic groups typically being less able to afford healthy, sustainable diets. Analysis of the affordability of the UK's Eatwell Guide by The Food Foundation found that the poorest fifth of the UK population would need to spend 42 per cent of their disposable income (after housing costs) to follow the Government recommended diet.[180] This mirrors contributions to our inquiry on the *Sustainable Development Goals in the UK follow up:*

174 Gebregziabher Gebreyohannes, Healthy Sustainable diets for all: A view from Ethiopia, Thompson Reuters Foundation News, (2019)
175 Public Health England, The Eatwell Guide, (2016)
176 The Carbon Trust, The Eatwell Guide: a More Sustainable Diet, (2016)
177 Walter Willett. et al., Food in the Anthropocene: the EAT- Lancet Commission on healthy diets from sustainable food systems, The Lancet Commissions, Vol. 393 (2019), pp.447–492
178 Q96
179 Q128
180 London School of Hygiene and Tropical Medicine (PLA0022); Courtney Scott, Jennifer Sutherland and Anna Taylor, Affordability of the UK's Eatwell Guide. The Food Foundation, (2018)

Hunger, malnutrition and food insecurity in the UK.[181] Adam Smith, founder of The Real Junk Food Project, an organisation that produces meals at low prices from discarded food, told us how working people were having to "choose between heating their own homes and going out and getting food".[182] He explained:

> We come across a lot of people who fit into that bracket who are forgotten about in this country—people who are suffering right now, who are actually going hungry, who are working, not in receipt of benefits, and cannot access foodbanks. […]People should not be in a situation where they cannot afford to feed their own children, while they are going to work and earning an honest living.[183]

104. Councillor Paulette Hamilton, Holyhead Ward, Birmingham City Council reflected on the challenges in her city:

> We are finding that because of food poverty within the home many of our young people are eating high calorific foods but the foods are not very good quality. We are finding that our young people are not having their five a day, but it is not just our young people. Also our adults are not having the five a day. You can go along many streets in the city where you do not see fruit and vegetables.[184]

105. Professor Chris Whitty, Chief Scientific Advisor, Department of Health and Social Care, noted the benefits of the Eatwell Guide but pointed out:

> If it was adopted it would have a significant positive impact on health and a significant positive impact on environmental issues. However, it would not deal with any of the problems of disparities in health that we currently face and I am not guaranteeing that every child would eat it.[185]

106. While supporting the benefits to the environment of the Eatwell Guide, Professor Ian Boyd, then Chief Scientific Advisor, DEFRA, noted the importance of including other stakeholders in these discussions:

> There are very good reasons for saying that if we all ate the Eatwell Guide diet we would do a lot more good to the environment. The question is how do we get that diet to people and how do we make sure we are doing it in a way that is congruent with developing a good industrial process, a good economic process for the food industry.[186]

107. Evidence was provided of the benefits to public finances of population-level shifts towards healthier diets. Professor Tim Benton, School of Biology, University of Leeds, wrote that the over-consumption of commodity crops, and "cheap calories" was putting pressure on the NHS:

181 Environmental Audit Committee (2019) Sustainable Development Goals in the UK follow up: Hunger, malnutrition and food insecurity in the UK. HC 1491.

182 Environmental Audit Committee (2019) Sustainable Development Goals in the UK follow up: Hunger, malnutrition and food insecurity in the UK, Q12 [Adam Smith]

183 Environmental Audit Committee (2019) Sustainable Development Goals in the UK follow up: Hunger, malnutrition and food insecurity in the UK, Q12 [Adam Smith]

184 Q293

185 Q341

186 Q348

> The externalised costs on the health system are considerable. For example, the costs of obesity to the UK economy is estimated at ~£27bn, which is approximately three times the economic value of the UK's agricultural production.[187]

108. **Healthier, more sustainable diets can deliver co-benefits for people and the environment. The Government has a responsibility to raise public awareness of the Eatwell Guide and identify ways to promote the consumption of healthy and sustainable diets, including how they will achieve at least a 20 per cent reduction in meat and dairy consumption as recommended by the Committee on Climate Change's Net Zero report, and a shift away from intensive livestock production systems. There is a need to coordinate efforts across Government to ensure that healthy and sustainable diets are available and affordable to all in the UK.** ***This should be reflected in the Government's procurement policies and in the next set of Greening Government Commitments. Food provided by the Government should be "sustainable by default" and comply with the Eatwell Guide recommendations. This could lead to an estimated reduction of 30 per cent in the carbon footprint of the Government's purchased food.[188] This is an important step in achieving net zero emissions by 2050.***

Promoting healthy, sustainable diets

109. Witnesses emphasised the potential to influence consumer choices towards healthy and sustainable diets. The British Dietetic Association wrote that: "Marketing strategies typically used to encourage consumption can also be geared to encourage healthier choices".[189] Judith Batchelar, J Sainsbury's PLC, told us about initiatives that Sainsbury's were taking to help consumers make healthier more sustainable food choices:

> We are trialling […] displaying meat-free alternatives, things like mushroom burgers and other meat-type products in the meat aisle for customers to actively switch out. […]. We are also looking at our online shop, so if someone searches "burger", putting the meat-free burger top of the search list. We are looking at those kinds of nudges to understand whether customers are receptive to that.[190]

110. There was widespread support for changing the way that food is marketed: The Ellen McArthur Foundation's report on *Cities and Circular Economy for Food*, recommended changing food design and marketing to reshape preferences and habits".[191]

111. One action to change the way food is marketed is to ban the advertising of high fat, salt and sugar (HFSS) foods. There has been a ban on the marketing of HFSS products in children's television programmes since 2007. This was estimated to have led to a "37 per cent reduction in children's TV HFSS food ad exposure"[192] in the first five years of operation. The emergence of social media platforms have brought new challenges to regulating advertising. In June 2019 the Government closed a consultation on the introduction of further advertising restrictions on TV and online for HFSS products.[193] We await its response.

---

187 Professor Tim Benton (PLA0026)
188 The Carbon Trust, The Eatwell Guide: a More Sustainable Diet, (2016)
189 British Dietetic Association (PLA0018)
190 Q113
191 Ellen McArthur Foundation, Cities and Circular Economy for Food, (2019)
192 Advertising to Children, Briefing Paper CBP08198, House of Commons Library, (June 2019)
193 Department of Health and Social Care and Department for Digital, Culture, Media & Sport, Further advertising restrictions for products high in fat, salt and sugar, (2019)

112. In February 2019 Mayor of London, Sadiq Khan, introduced a ban on all HFSS food advertising across the public Transport for London (TfL) network. TfL's advertising space is considered the most valuable out-of-home advertising estate in the world.[194]

113. Food labels can provide information so consumers can make more informed decisions about the food they buy. David Rutley, former Minister, DEFRA, noted the Government's intention, in the event of leaving the EU, to have "a full review of labelling of food and that will be thinking about how we do that from a health perspective, a sustainability perspective and a welfare perspective".[195]

114. However, Judith Batchelar, J Sainsbury's PLC, told us that the average time someone looks at the label of a product was just six seconds.[196] Professor Tim Lang, City, University of London, pointed out that labelling might only be able to convey limited information:

> It is very useful to have information, not least because it makes the producers, the manufacturers and the retailers declare what is in the food, but no label tells you what the biodiversity impact is, no label tells you what the embedded water in your food is, no label says how this has been grown.[197]

115. Professor Frumkin, Wellcome Trust, noted that there was limited evidence of the success of labels in shifting behaviours:

> it turns out there is quite a mixed record when the impact of environmental labelling is studied. People profess in interviews and in surveys that they care about environmental purchasing, but the labelling does not make much of a difference.[198]

He suggested instead that "price signals do have a big impact, [and] celebrity endorsements matter a lot in our popular culture-oriented world and powerful media presentations like Sir David Attenborough's films make a big difference".[199]

116. Contributors tended to agree that marketing, "nudging" (the use of indirect suggestions as ways to influence the behaviour and decision making of groups or individuals) and other methods were needed to stimulate changes in dietary behaviours, but there was disagreement about how much Government involvement was needed. When we asked Ms Batchelar whether taxes and subsidies might assist in encouraging dietary change, she said "I am not sure [that] is the answer, because a lot of these things are around economies of scale and what is the norm. The things that we are developing now are pretty small scale. While the trend is there, they are not mainstream. The challenge is to make those things more mainstream",[200] although she thought that the "pace of change" in consumer choices was "unprecedented".[201]

194 Mayor of London, Mayor confirms ban on junk food advertising on transport network, (2018) [Accessed 01 July 2019]
195 Q419
196 Q127
197 Q127
198 Q32
199 Q32
200 Q114
201 Q115

117. However, Simon Billing, Eating Better, disagreed, suggesting that "he would not discourage us thinking about incentives", to increase the accessibility and affordability of vegetable and plant-based diets.[202] He also suggested: "Potentially looking at different fiscal measures. Tax is one way that has been discussed quite a lot", including the pricing of meat.[203] The EAT-Lancet Commission supported this, stating "taxes and subsidies should encourage healthy and sustainable diets".[204] In its submission to us, the Government noted the success of the soft drinks levy which has led to "the equivalent of removing 45 million kg of sugar every year, some products in the sugar reduction programme exceeding their first year targets, for example yoghurts are achieving a 6 per cent reduction in sugar, and significant investments being made in schools to promote physical activity and healthy eating".[205] The British Dietetic Association encouraged this policy: "Reformulation, restrictions on advertising and measures like the soft drinks industry levy need to be implemented or expanded where they are already in place".[206]

118. We asked Professor Cosford, Director of Health Protection and Medical Care, Public Health England, about subsidies for fruit and vegetables, particularly to increase their consumption by children. He agreed:

> We know that children really like free fruit in schools … and they took that back to their families and that helped to stimulate changes in adult diets as well. We have work going on in our social marketing campaigns, on One You and Change4Life and so on, that support the change in people's diets to go along with that.[207]

119. ***Consumer information, including clear labelling, can help shift diets. The Government should expand the restriction of advertising on high fat, sugar and salt products and consider using financial incentives to promote access to, and consumption of, healthy and sustainably produced food.***

National food strategy

The Government has begun working on a National Food Strategy, led by Henry Dimbleby, lead non-executive board member at DEFRA, and Director of the Sustainable Restaurant Association. David Rutley, then Minister, DEFRA, told us:

> We need to do more to promote [balanced diets] and one of the things we are going to be looking to do within the national food strategy, which is very embryonic at this stage, is to make sure that we look at the whole of the food supply chain from end to end, see how we can move that forward, looking at it from a healthiness perspective but also about sustainability and from a welfare perspective, which I know is a huge issue for you as well.[208]

202 Q116
203 Q117
204 ML Niebylski et al., Healthy food subsidies and unhealthy food taxation: A systematic review of the evidence. Nutrition, Vol. 31 (2015), pp.787–95; Marco Springmann et al., Mitigation potential and global health impacts from emissions pricing of food commodities. Nature Climate Change, Vol. 7 (2017), pp.69–74
205 DEFRA (PLA0028)
206 British Dietetic Association (PLA0018)
207 Q414
208 Q406

Mr Rutley highlighted that to deliver the National Food Strategy "there is greater need for closer co-operation between Government Departments".[209]

120. Professor Sir Patrick Vallance, Government Chief Scientific Adviser, provided useful guidance on the National Food Strategy:

> It seems to me that a food strategy should absolutely cover issues of consumption and how that consumption is modified. It should cover nutritional quality, production sustainability, transport and delivery and the environment. Any food strategy needs to cover those areas in order to be a holistic, systems-based food strategy for the future.[210]

121. Others suggested that in order deliver holistic change to the food system what is needed is a much more collaborative approach to nutrition guidance. Professor Tim Lang, City, University of London, stated:

> We should have a food policy council. We should have a national council that provides expert advice on this holism and what is missing in it. We do not have that at the moment. The Nordic countries have that. No wonder they are streets ahead. They are taking it seriously. They are bringing together data, they are calling together people … Some co-ordination mechanism the British Government should lead.[211]

122. The Nordic Council hosts inter-parliamentary co-operation among the Nordic countries. It consists of five countries (Denmark, Finland, Iceland, Norway and Sweden) and three territories (Faroe Islands, Greenland and the Åland Islands) who cooperate on policy issues including growth and development, welfare and climate change and the environment.[212] The Council has also provided a forum for sharing expertise and setting guidelines for healthy diets and nutrition, producing guidance on food labelling[213] and nutrition intake[214] that is shared across its members.

123. Judith Batchelar, J Sainsbury's PLC, supported Professor Lang's calls for a food policy council. She suggested that this should learn from the shortcomings of the now defunct Council of Food Policy Advisors established by DEFRA in 2008. She added that improvements in knowledge and data on food systems and diets since then mean that a collaborative council could have greater chance of success if the right parameters were set:

> We did not know anything like the information that we know now around the environment and the impact of our food system on the environment. We are in a very different place and there is that sense of urgency. The biggest thing that group would have to address, in a very intelligent and data-informed way, is, "What does that transition programme look like?" I think we all know where we are trying to get to. The question is how we get there in the most efficient and least disruptive way.[215]

---

209 Q376
210 Q355
211 Q104
212 The Nordic Council: About the Nordic Council Committees [Accessed 01 July 2019]
213 Nordic Council of Ministers, Nutrition Labelling: Nordic Recommendations Based on Consumer Opinions, (2004)
214 Nordic Council of Ministers, Nordic Nutrition Recommendations 2012: Integrating nutrition and physical activity, (2014)
215 Q105

124. ***We recommend that the Government establish a National Council for Food Policy similar to the work of the Nordic Council of Ministers - to bring together the bodies responsible for food production, nutrition, public health, citizens representatives, and environmental experts to share data and expertise, and ensure greater alignment around promoting healthy diets from sustainable production.***

125. ***The National Food Strategy and other Government policy actions relating to food and diets, must place equal emphasis on the importance of healthy diets produced sustainably and national food security. Public Health England's Eatwell Guide should be revised to emphasise foods with lower environmental footprints and make clear recommendations to help the public choose healthy and sustainable diets. To deliver the transformational changes necessary in UK diets the Government should establish a National Food Council as part of its upcoming Environment (Principles and Governance) Bill. It should lead on the roll out of the National Food Strategy.***

126. ***We recommend that the National Food Strategy:***

a) ***Recognises the risks to national food security from the UK importing 40 per cent of the food we consume, and explores policies to mitigate these risks and ensure that the UK delivers healthy diets to all, especially in the event of a no-deal Brexit.***

b) ***Works with farmers, supermarkets and the food industry to deliver transformational shifts in access to and affordability of healthy and sustainable diets.***

c) ***Sets out annual targets to reduce food waste at every level of the food supply chain consistent with the Government's aim to achieve net zero emissions by 2050 at the very latest. This target should be consistent with SDG 12.3 (reduce food waste) to halve food waste by 2030.***[216]

d) ***Recommends policies made by the Committee on Climate Change including shifts towards lower meat and dairy consumption, to achieve the net zero target. The Strategy should set out how public procurement teams, as well as the food and agriculture industry can deliver this goal.***

e) ***Incentivises production of fruit and vegetables using sustainable methods in the UK to close the fresh fruit and vegetable trade gap and reduce food security risk.***

f) ***Set out clear guidelines for Government procurement of food in schools, hospitals and prisons to be sustainable by default.***

g) ***Alongside this, increase teaching within schools around food production, nutrition, food preparation and the environmental impacts associated with the food system.***

216 UN, Sustainable Development Goal 12, accessed 5 September 2019: " By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses".

5 Sustainable Cities

127. This chapter will focus on planetary health challenges from the growth and modernisation of cities, looking at how Government Departments should promote sustainability in cities and consider the inter-related challenges posed by urban living.

Cities and urban living trends

128. The UN estimates around 55 per cent of the world's population lived in urban areas in 2018. This is expected to rise to 60 per cent by 2030 and 68 per cent by 2050. Most of this increase in urban populations is expected to occur in Asia and Africa, with India, China and Nigeria accounting for 35 per cent of the projected growth of the world's urban population by 2050.[217] The number of cities worldwide with one million or more inhabitants was 548 in 2018–by 2030 it is projected to be 706. The number of cities with over 10 million inhabitants ("megacities") is expected to rise from 33 in 2018 to 43 in 2030.[218]

129. The UK's population is expected to grow from 66 million people today to 73 million by 2040.[219] As well as increasing, it is also growing older which presents challenges for policy makers and planners.[220] The World Bank estimates that 83 per cent of the UK's population lived in urban areas in 2017.[221]

130. A number of actions need to be taken to manage the challenges that urbanisation poses to environmental, and thus human health. The 2015 Rockefeller Foundation–Lancet Commission noted that:

> The growth in urban populations emphasises the importance of policies to improve health and the urban environment, such as through reduced air pollution, increased physical activity, provision of green space, and urban planning to prevent sprawl and decrease the magnitude of urban heat islands.[222]

Health and urban living

131. Urban areas can produce specific physical- and mental-health challenges related to air quality, crowding, noise, lack of green spaces and physical inactivity.

132. According to a 2017 report on rural health by the Local Government Association and Public Health England, "Overall, health outcomes [in England] are more favourable in rural areas than in urban areas".[223] The report states:

217 United Nations, 2018 Revision of World Urbanization Prospects, (2018)
218 United Nations, The World's Cities in 2018—Data Booklet, (2018)
219 Office for National Statistics, National Population Projections: 2016-based statistical bulletin, (Accessed 13 August 2019)
220 Office for National Statistics, National Population Projections: 2016-based statistical bulletin, (Accessed 13 August 2019)
221 The World Bank, UK Urban population (per cent of population), (Accesses 13 August 2019)
222 Sarah Whitmee et al., 'Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health', The Lancet, Vol. 386 (2015), pp.1973–2028
223 Local Government Association and Public Health England, Health and wellbeing in rural areas, (2017)

> Average life expectancy is higher [in rural areas], infant mortality is lower and the number of potential years of life lost (PYLL) from common causes such as cancers, coronary heart disease (CHD) and stroke is lower. […] Life expectancy has been highest in districts with at least 80 per cent of their population living in rural settlements and larger market towns. Men born in these areas in 2008/10 were expected to live over two years longer than men born in major urban areas, and women were expected to live one and half years longer than women born in major urban areas.[224]

133. Health problems that have been associated with urban environments include non-communicable diseases such as cancer, diabetes and asthma and mental-health problems such as depression.[225] Our 2018 report on heatwaves found that the rise in average temperatures combined with the urban heat island effect—urban areas being significantly warmer than their surrounding rural areas due to human activities—is likely to increase heat-related deaths from 2000 per year today to around 7000 per year by the 2050s.[226]

Environment and cities

Climate breakdown

134. Cities contribute to climate change. Rachel Huxley, C40 Cities, told us that cities "occupy only 2 per cent of the [global] land area but they are responsible for 70 per cent of the [global] emissions and that increases when you include consumption".[227] She noted that if policies on tackling climate change were right, then, "we are not just averting the global catastrophe of climate change, but we are creating much more liveable, healthy, prosperous cities".[228]

Poor air quality

135. City design and lifestyles contribute to poor air quality. The impact of pollution is a problem for both human and environmental health, with issues ranging from asthma to diabetes, and have an estimated mortality impact of up to 40,000 deaths a year.[229] Estimates of the costs to society and the economy exceed £22 billion per year.[230] Actions to limit air pollution not only reduce the health burden of poor air, but bring co-benefits and improve well-being through incentivising outdoor activities like walking and gardening which, in turn, can help mitigate climate change.[231]

---

224 Ibid.

225 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012); Wellcome Trust (PLA0019)

226 Environmental Audit Committee, Ninth Report of Session 2017–19, Heatwaves: Adapting to Climate Change, HC 826

227 Q290

228 Ibid.

229 Committee on the Medical Effects of Air Pollutants, Associations of long-term average concentrations of nitrogen dioxide with mortality, (2018); Royal College of Physicians, Every breath we take: the lifelong impact of air pollution, (2016)

230 Royal College of Physicians, Reducing air pollution in the UK: Progress report 2018, (2018)

231 UK Health Alliance on Climate Change (PLA0013)

136. We heard that indoor air pollution was becoming a major area of concern. Dr Anastasia Mylona from the Chartered Institution of Building Services Engineers (CIBSE) said that "air pollution and urban heat island effect are some of the issues that we face today, but they are projected to be even worse. This will have an effect on people's indoor air quality, so in their homes and in the places where they work".[232]

137. In our joint report with three other House of Commons Select Committees, *Improving Air Quality*, published March 2018,[233] we noted the impacts of poor air quality on human health. We recommended the introduction of a new Clean Air Act to improve existing legislation and enshrine the right to clean air in UK law. The Government subsequently published the Clean Air Strategy 2019 (January 2019), in which it stated that: "We plan to set out our ambitions in primary legislation".[234] The last Clean Air Act was in 1993.[235] The Strategy stated that: "New legislation will create a stronger and more coherent framework for action to tackle air pollution. This will be underpinned by new England-wide powers to control major sources of air pollution, in line with the risk they pose to public health and the environment, plus new local powers to take action in areas with an air pollution problem".[236]

138. **We look forward to the introduction of air quality legislation as soon as possible, and encourage the Government to draft it with cross-cutting planetary health outcomes in mind.** ***We recommend that any new legislation on clean air brings UK legal limits for air pollution in line with WHO recommended limits (10ug/m^3).***

Urban planning

139. Integrated urban planning is essential to ensure better planetary health outcomes. For example, Dr Mylona, CIBSE, told us that: "it is a very important aspect, the urban planning, at this point. If we manage to improve the outdoor environment, opening windows will get the fresh air that we are supposed to be getting as well, just to go back to the point that there are multiple benefits in looking at these different aspects of urban planning".[237] Integrated urban planning should also limit urban sprawl. Professor Mike Davies pointed out the problems with a lack of integrated planning policy:

> In the absence of effective policies to reduce environmental footprints, rapid urbanisation impinges on peri-urban arable land historically used for agriculture. Peri-urban green space, which supports biodiversity and ecosystem services such as flood protection as well as assisting in passive cooling of the cities is also vulnerable to urban expansion.[238]

232 Q242
233 Environment, Food and Rural Affairs, Environmental Audit, Health and Social Care, and Transport Committees, Fourth Report of the Environment, Food and Rural Affairs Committee, Fourth Report of the Environmental Audit Committee, Third Report of the Health and Social Care Committee and Second Report of the Transport Committee of Session 2017–19, Improving air quality, HC433
234 Department for Environment, Food and Rural Affairs, Clean Air Strategy, (2019)
235 Department for Environment, Food and Rural Affairs, Clean Air Strategy, (2019)
236 Ibid.
237 Q257
238 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012)

140. In addition, UPSTREAM[239] recommended that the UK Government should "commission a full examination of the urban planning and development system with a focus on aligning those in control of planning and development with planetary health objectives".[240]

141. There has been a call for sustainable urban planning, to promote healthier lifestyles with cities built "clean by design".[241] Professor Cosford, Public Health England, told us that "Whenever a new community is developed, it has to have all the elements of clean housing, good quality housing, but also walking/ cycling routes, ways of making that the easy choice".[242]

Transport networks and urban planning

Transport and planetary health

142. We were told that: "The transport sector is the largest consumer of energy in the UK, and relies heavily on unsustainable fossil fuel energy".[243] Transport is a major contributor to climate change and air pollution, which contributes to poor environmental outcomes (for example, impacts on biodiversity).[244]

143. We were also told that cars contribute significantly to poor human health outcomes. Professor Mike Davies explained that:

> Motorised urban private travel also contributes to reduced physical activity and increased risk of obesity, poorer mental health, social severance and increased risk of injuries which could be prevented by the use of (affordable) public transport or active travel (walking and cycling), though care is needed to ensure improved separation of walking and cycling routes from road traffic to reduce injury risks.[245]

144. We also heard that: "Even if we switched to entirely zero-emission vehicles, we would still get a huge amount of particulate matter from tyre and brake wear".[246] There was strong support from witnesses for a reduction in the use of private vehicles in cities, and as Rachel Huxley, C40 Cities, stated, it would require "bold, ambitious policies".[247]

Transport and sedentary lifestyles

145. Cars are a contributor to sedentary lifestyles, and the rise in non-communicable diseases, like obesity and diabetes. The LSHTM told us: "on average, 21 per cent of men and 25 per cent of women are classified as inactive".[248]

239 UPSTREAM is a three year research project funded by the Wellcome Trust and led by the University of West England to look at how cities can support an escalating global population whilst adapting to health and environmental concerns.
240 UPSTREAM (PLA0010)
241 Q436 [Professor Paul Cosford]; also UPSTREAM (PLA0010)
242 Q436
243 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012)
244 Ibid.
245 Ibid.
246 Q297
247 Q297
248 London School of Hygiene and Tropical Medicine (PLA0022)

146. In order to reduce poor health outcomes, witnesses encouraged "active transport".[249] Professor Michael Davies *et al* stated that "Increased physical activity from urban walking and cycling could bring major health benefits and avert costs to the NHS amounting to about £17bn over 20 years".[250]

147. There are ways in which cycling can be encouraged. Rachel Huxley, C40 Cities, mentioned that in New Orleans, by painting on the roads, it sends a message that: "as a cyclist you are meant to be here, and you are welcome here".[251] However, painted road markings in the UK have been criticised by Britain's cycling and walking commissioners, describing them as "gestures" which do not deliver improved safety for cyclists.[252] This view is supported by recent research showing on-road bicycle lanes have the effect of reducing passing distance from motor vehicles, making roads less safe for cyclists.[253]

148. Walkers, cyclists, and car drivers are exposed to air pollution, with research suggesting that the risks are highest for those in cars. A Lancet review of air pollution found that car commuters lost up to one year in life expectancy more than cyclists.[254] Rachel Huxley, told us that: "The concern that as a cyclist you are exposed to more pollution is not necessarily always true and the benefits you gain from physical activity outweigh the pollution risk by an order of magnitude".[255]

149. Professor Blythe, Chief Scientific Adviser at the Department for Transport (DfT), told us that one of the Department's goals included: "trying to persuade people to use their vehicles less and to use more sustainable forms of transport such as public transport, walking and cycling more".[256] Kit Malthouse, then Minister, Ministry of Housing, Communities and Local Government, told us about Government initiatives including the Healthy New Town Standard,[257] alongside the Department of Health and Social Care; the Manual for Streets 3 Guidance;[258] and the Walking and Cycling Investment Strategy,[259] alongside the DfT.[260] He also told us that there is a "general obligation" on local authorities, through the National Planning Policy Framework, to use their planning policies to encourage sustainable modes of transport.[261] Dr Thérèse Coffey, DEFRA, told us that:

249 Including the LSHTM Planetary Health Alliance (PLA0020); UK Health Alliance on Climate Change (PLA0013)
250 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012)
251 Q295
252 'Painted bike lanes are waste of money, say cycling commissioners', The Guardian, (17 June 2019)
253 Ben Beck et al., How much space do drivers provide when passing cyclists? Understanding the impact of motor vehicle and infrastructure characteristics on passing distance, Accident Analysis & Prevention. Vol. 128 (2019), pp.253–260
254 Magda Cepeda et al., Levels of ambient air pollution according to mode of transport: a systematic review, The Lancet Public Health. Vol. 2 (2016), pp.23–34
255 Q297
256 Q321
257 NHS England, Healthy New Towns, (2016)
258 Department for Transport, Manual for Streets, (2007)
259 Department for Transport, Cycling and Walking Investment Strategy, (2017)
260 Q433
261 Ibid.

> Councils are producing walking and cycling strategies. They use things like the air quality grant fund. That is also what we have done to help with certain schemes. A lot of money has gone from the DfT in particular to areas they have nominated as cycle cities. There is also wider funding available from the DfT for councils to bid for.[262]

150. Daniel Black and Associates pointed to a good example of urban planning, which ensured that green spaces and active transport networks were combined:

> The outstanding example that urban planners have been pointing to for a long time is the Vauban district of Freiburg in southern Germany, an urban extension of 5,000 inhabitants where just 16 per cent [of people] use a car and only 40 per cent of people own a car, and where walking, cycling and use of public transport is at 75 per cent (Grant et al, 2008,[263] Hall, 2014[264]). The low car usage and significant green infrastructure means it is also quiet and positive for mental health despite it being a high-density urban environment.[265]

Buildings and urban planning in the UK

151. Poor quality housing has significant harmful impacts on public health and life expectancy. For example, Professor Yvonne Rydin, UCL, told us that: "The review that we did suggested that low-quality housing in the UK cost the National Health Service £1.4 billion in first-year treatments".[266] We also heard that UK building stock was a major contributor to national greenhouse gas emissions. Professor Michael Davies wrote that: "In the UK in 2017, direct greenhouse gas (GHG) emissions from buildings were 85 $MtCO_2e$ and buildings were responsible for a further 48 $MtCO_2e$ of indirect emissions related to electricity consumption–thus accounting for ~29 per cent of UK GHG emissions in total".[267] Reducing the burden of UK buildings on the climate is possible, but may lead to adverse human health problems. Professor Davies, told us that:

> The design of buildings and quality of materials used contribute to energy efficiency through improved insulation and ventilation control but, without careful design, implementation and maintenance, there are dangers of adverse effects on indoor environmental quality. Those adverse effects include possible increases in a range of indoor air pollutants which can increase risks of some types of cancer, including radon-related lung cancer,[268] cardiorespiratory diseases and associated mortality/morbidity. Increases in thermal insulation and efficient heating systems of homes have the potential to reduce the still substantial burden of winter- and cold-related mortality/morbidity in the UK and help tackle fuel poverty.[269]

---

262 Q432
263 Grant et al. (2008) Freiburg Study Tour: Planning, Public Health, Urban Design. WHO Collaborating Centre for Healthy Cities and Urban Policy and NHS South West
264 Hall. P (2014) Good Cities, Better Lives: How Europe Discovered the Lost Art of Urbanism. Routledge, Abingdon
265 UPSTREAM (PLA0010)
266 Q253
267 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012)
268 James Milner et al., Home energy efficiency and radon related risk of lung cancer: modelling study, BMJ. Vol. 348 (2014)
269 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012)

152. The Adaptation Sub-Committee of the Committee on Climate Change recently published a report, *UK housing: Fit for the future*?.[270] Professor Davies, told us that the majority of UK housing stock, almost 29 million homes, are not fit for the risks of climate change, and need to be swiftly decarbonised.[271] The CCC's report found that:

- the UK's legally-binding climate change targets will not be met without the near-complete elimination of greenhouse gas emissions from UK buildings.[272]
- emissions reductions from the UK's 29 million homes have stalled, with uptake of energy efficiency measures having declined significantly in recent years. Installation of loft and wall cavity insulation is at just 5 per cent of the peak market delivery in 2012.[273]
- "energy use in homes"–which accounts for 14 per cent of total UK emissions–increased between 2016 and 2017".[274]
- efforts to adapt the UK's housing stock to the impacts of the changing climate, for higher average temperatures, flooding and water scarcity, are lagging far behind what is needed to keep us safe and comfortable, as these climate change risks grow.[275]

153. The CCC's report recommended that future homes should not be built on the gas grid.[276] In the Spring Statement, the Treasury partially accepted this recommendation introducing a Future Homes Standard, which will mandate the end of fossil-fuel heating systems in all new houses from 2025. However, the CCC had advised that new houses should be fully disconnected from the gas grid, ending the use of gas for cooking and heating water, not just for heating. This would reduce energy demand and could help tackle poverty in cities driven by high energy costs.

154. ***We recommend that the Government adopts the Committee on Climate Change's recommendations on off-grid new housing in full. This would include stopping the connection of new homes to the gas grid from 2025. The Government should respond to each recommendation from the Committee on Climate Change's report on UK housing.***

155. ***We note that the number of energy efficiency installations (e.g. loft and wall cavity insulation) has collapsed since 2012.***[277] ***A new energy efficiency scheme should be developed and implemented by no later than April 2020 to create warmer homes which are cheaper to run.***

156. ***DEFRA should also manage risk of water security in cities and set a default 100 litres per capita per day consumption target for water as recommended by the Committee on Climate Change.***

270 Committee on Climate Change, UK housing: Fit for the future?, (2019)
271 Q246
272 Committee on Climate Change, UK housing: Fit for the future?, (2019)
273 Committee on Climate Change, UK housing: Fit for the future?, (2019)
274 Committee on Climate Change, UK housing: Fit for the future?, (2019)
275 Committee on Climate Change, UK housing: Fit for the future?, (2019)
276 Committee on Climate Change, UK housing: Fit for the future?, (2019)
277 Committee on Climate Change, UK housing: Fit for the future?, (2019)

Building regulations

157. Our witnesses criticised other building regulations that are currently in place. Dr Mylona, CIBSE, noted how Part F of the building regulations on adequate ventilation of buildings, "assumes that the air outside is clean".[278] Professor Davies, UCL, thought that there was "certainly a strong need for the relevant parts of the regulations to be addressed",[279] but that the "complex system of indoor air pollutants, which are generated indoors and pollutants that are generated outdoors… [made it]. difficult to develop generic rules".[280]

158. UPSTREAM, a research project on urban planning and health, suggest that "poor indoor air quality costs £250 per person per year mainly in terms of lost productivity (due to headaches), while lack of green space costs over £220 per person per year due to mental health problems alone".[281]

159. The CCC report on the future of UK housing recommended that the Government modify the building regulations (specifically part F and part L) in order to keep pace with improvements in the energy efficiency of buildings, in order to mitigate these negative impacts.[282]

160. In addition to the content of building regulations, witnesses were also concerned about enforcement, particularly in light of the Grenfell Tower tragedy.[283] Professor Rydin, UCL, explained:

> You need to look at how the whole building reg system is resourced, the ability of local councils to have officers to check that they are being implemented appropriately, because we do know that the building industry has skills loopholes, shall we say, which mean that what we plan does not always end up being what is built on the ground.[284]

161. Kit Malthouse, former Minister, MHCLG, recognised the importance of effective building regulations and told us: "Through the planning system and the building regulation system we try to set the framework within which the delivery arm, local authorities, is able to operate and deliver the kind of policies that are devised as a whole across Government".[285] He also told us that: "As a Department, we rely on a variety of technical advice that we glean from outside experts".[286] The Minister informed us of ongoing consultations reviewing building regulations including how to improve environmental standards.[287]

278 Q254
279 Q256
280 Q257
281 UPSTREAM, Moving planetary health upstream in urban development decision-making – a three-year pilot research project, (2019)
282 Committee on Climate Change, UK housing: Fit for the future?, (2019)
283 Q258 [Professor Rydin]
284 Ibid.
285 Q371
286 Ibid.
287 Q428

162. The Minister also commented on enforcement, agreeing that this was a major issue for future work:

> One of things that came out, sadly, from the awful Grenfell tragedy was the fact that notwithstanding us having a building regulation system, the effectiveness of that system, and the policing and the implementation of it also need review. As part of our packet implementation plan, we are looking generally at the building regulation system and at what are the conflicts within it, to ensure that not only are we putting the rules in place but that they are being adhered to.[288]

163. **Air pollution (indoor and outdoor) from human activity is an increasing concern and harms public health. The Committee on Climate Change Adaptation Sub-Committee has provided expert guidance on ways to strengthen the building regulations for new and existing housing. We welcome the Government's plans to update the building regulations, including reviewing whether the current enforcement regime is effective.**

164. ***We recommend that the Government's review of the building regulations takes an integrated approach to ensure that sustainability and public health are properly reflected in any new code. We recommend that, in line with advice from the Committee on Climate Change, the Government change building regulations (specifically part F and L) to mitigate negative impacts of indoor air pollution.***

Green spaces and urban planning

165. In written evidence, UPSTREAM stated that the "UK's main urban development leaders, from both the public and private sector […] fully acknowledge that health is not adequately accounted for in the urban planning and development process".[289] They noted that urban planning is driven by "landowners, investors and developers" and the costs to health from poor urban planning should be better communicated.[290] UPSTREAM suggest that "the lack of green space costs over £220 per person per year due to mental health problems alone".[291]

166. A number of witnesses to this inquiry proposed the improvement and expansion of urban green spaces to promote health. Professor Michael Davies, UCL, argued:

> Increased access to green space may yield mental health and other benefits particularly for disadvantaged groups and ecosystem approaches such as wetland protection or biodiversity corridors can increase resilience to extreme events.[292]

288 Q428
289 UPSTREAM (PLA0010)
290 ibid
291 ibid
292 Professor Michael Davies, Professor Sir Andy Haines, Professor Paul Wilkinson, Professor Tony Capon and Dr Melanie Crane (PLA0012); See also WHO Europe, Urban Green Space Interventions and Health, (2017)

167. Professor Rydin from UCL, identified new opportunities in urban planning to increase activity in cities, incorporate more green spaces, reduce air pollution and improve public health:

> … how we can make cities better connected for walking and cycling… That can involve also a lot of incorporation of green infrastructure, which has been shown to be important for combating air pollution and for mental health as well. I think there has been a big shift in the urban planning agenda towards this kind of new way at looking at things.[293]

168. UPSTREAM researchers found:

- a strong link between an increase in neighbourhood walkability and a reduction in the risk of high blood pressure;
- a strong link between improved access to open green space and improved mental health;
- a strong link between improved infrastructure for cycling and increased physical activity.[294]

169. Increasing green space can also reduce the urban heat island effect, reducing the health risks of heatwaves. The surface temperature in an urban green space may be 15–20°C lower than that of surrounding streets, resulting in an air temperature 2–8°C cooler.[295] However, urban green space in England has declined from 63 per cent of urban area in 2001 to 56 per cent in 2016.[296] With the average number of heat-related deaths in the UK expected to more than triple to 7,000 a year by the 2050s, increasing green space in cities could mitigate some of the risks of rising temperatures.[297]

170. The Government told us that there were a number of competing priorities in the allocation of land. Kit Malthouse, former Minister of State for Housing, MHCLG, told us:

> What we try to do in the planning system is create an obligation on the local authorities to think about the sustainability of their communities and those that they are constructing, and that includes the provision of green space and play space and all those kinds of things. At the same time, though, we have to recognise that there are some local authorities where that is a challenge, because of constraints that they have, green belt, AONBs [Areas of Outstanding Natural Beauty], whatever it might be. They need to think about notions of density within an urban environment, even gentle density, and how they can accommodate that so as to protect what green space they have.[298]

293 Q251
294 Daniel Black et al., Moving Health Upstream in Urban Development: Reflections on the Operationalization of a Transdisciplinary Case Study. Global Challenges. Vol. 3 (2018)
295 Environmental Audit Committee, Ninth Report of Session 2017–19, Heatwaves: Adapting to Climate Change, HC 826
296 Charles Ffoulkes, Research to provide updated indicators of climate change risk and adaptation action in England, Submission to the Committee on Climate Change, (2017)
297 Environmental Audit Committee, Ninth Report of Session 2017–19, Heatwaves: Adapting to Climate Change, HC 826
298 Q400

171. The Government's *Urban Tree Challenge Fund* aims to stimulate tree planting in cities.[299] However, current tree planting targets of 20,000 hectares/year across the UK nations, due to increase to 27,000 by 2025, are being missed by 50 per cent. Less than 10,000 hectares were planted, on average, over the last five years.[300] The Committee on Climate Change have advised at least three times current rates (30,000 hectares a year) will be needed to achieve net zero emissions by 2050.[301]

172. **Urban green space can improve public health and mental health outcomes, particularly for disadvantaged groups. *The National Planning Policy Framework needs to be better updated to promote opportunities for active travel, green spaces and access to healthy, sustainable food in planning authorities' local plans.***

173. **Green space is proven to reduce the urban heat island effect, reducing the risks from heatwaves. *Our 2018 'Heatwaves: adapting to climate change' report recommended that national targets be set to increase urban green space back up to 2001 levels or higher. We repeat this recommendation.***

174. **Increasing tree planting should be a priority to improve air quality, capture carbon and create green spaces in cities. Whilst we welcome the 'Urban Tree Challenge Fund', we note that tree targets are not being met, with only half the target number of trees having been planted in the last five years. *The Government should update targets to align with the recommendation from the Committee on Climate Change. The Government should review its Tree Challenge Fund and set out how it will meet the CCC's target of 30,000 hectares of tree planting a year. Councils should be mandated to state how many trees they will plant per house built with a minimum standard of one tree per house. Green infrastructure should be specified in planning permission.***

Food and urban planning

175. A number of witnesses highlighted the problems around food and urban living. They pointed to a lack of access to healthy food and a proliferation of unhealthy fast food outlets, leading to a rise in the prevalence of obesity.[302] Contributors emphasised the challenges of dietary change in communities with few food choices. Medact said that: "A focus on "individual behaviour" and "nudging" will do little to provide alternative, healthy, local and sustainable food to certain communities when the most readily available food on the market is ultra-processed, high-fat and high sugar".[303]

176. Dr Jennifer Cole, Royal Holloway, University of London, wrote that:

> UK diets reflect the typical Western/urban shift from fresh, healthy food with low fat/sugar/salt content to poor quality packaged food. The government, public and private sector needs to do more to address this through making healthier food easier to access and more affordable rather than just 'shaming' fast food and ready meals; this will become increasingly important as food prices may increase as climate impacts become more severe.[304]

299 Forestry Commission, Urban Tree Challenge Fund, (Accessed 08 August 2019)
300 Forest Research, Provisional Woodland Statistics, (2019)
301 Committee on Climate Change, Reducing UK emissions, 2019 Progress Report to Parliament, (July 2019)
302 For example, Dr Jennifer Cole (PLA0003); Q312 (Rachel Huxley); London School of Hygiene & Tropical Medicine (PLA0022)
303 Medact (PLA0027)
304 Dr Jenifer Cole (PLA003)

177. Dr Cole argued that urban lifestyles with poor diet and low levels of physical activity, were not a "'lifestyle choice' as it is often presented which blames the poorer socioeconomic groups", but instead were "a consequence of systems that make any other options impractical for too many people".[305]

178. We heard evidence that in Birmingham, the UK's second largest city by population, urban planning was leading to poor health outcomes. Councillor Paulette Hamilton, Birmingham City Council, explained that residents have easy access to unhealthy food that was contributing to the obesity epidemic. Councillor Hamilton told us that: "Between school and the house [children] probably pass about 10 fast food places. The issue is between the planners and licensing and what have you are not joined up enough".[306]

179. Dr Cole, Royal Holloway, University of London, argued that insufficient effort was being made to address over-consumption saying that there should be "stronger action against junk food sold on high streets and sweets/ crisps/ ready meals sold in supermarkets".[307]

180. When asked about access to healthy foods and the proliferation of fast food outlets, Professor Cosford, Public Health England (PHE), echoed the Committees concerns:

> There are 50,000 [fast food outlets] across the country and we know that they are more frequent in areas where diets tend to be poorer anyway, where people tend to have less-good health and they tend to push less-healthy diets—not always, not every fast food outlet is necessarily unhealthy, but the majority will be in that direction. As part of our guidance on what the evidence says about planning for health, that is one of the issues that we think is really important, fast food outlets close to schools.[308]

181. Professor Cosford told us that PHE aims to "translate a complex set of evidence into practical tools that local government can use in its planning processes. We do that in relation to fast food outlets and healthy planning, to air pollution and planning, for healthy, sustainable communities. The extent to which local authorities manage to implement them is a separate question".[309]

182. Kit Malthouse, then Minister of State for Housing, MHCLG, told us that the National Planning Policy Framework, "does give local authorities the ability to set limits of use within the high street they are curating, if the evidence allows them. If there is a proliferation of a particular use, they can limit it through their planning powers now".[310] But the Minister noted that the local authorities had to provide sufficient evidence and that "the problem comes where you already have a proliferation and beyond shutting them down, there is not much that can be done about it at the moment".[311]

305 Ibid.
306 Q293
307 Dr Jenifer Cole (PLA003)
308 Q430
309 Q431
310 Q430
311 Q431

183. **The Government has a responsibility to increase equitable access to healthy, sustainable food for city dwellers.** ***The Government should review its planning policy guidance to measure how well the current restrictions on fast food outlets are working in practice and it should ensure that planning authorities are able to restrict the numbers of fast food outlets without stringent evidence requirements. The Government's forthcoming National Food Strategy should set out how the Government will work with food providers, including restaurants, fast food outlets and supermarkets to transform the way that people consume food in the UK.***

6 Governance for planetary health

Global Action

184. Whilst many of the impacts of planetary health transcend national boundaries, local action and governance can be effective. Professor Georgina Mace, UCL, noted that there was "not really any effective global governance of the environment at the moment".[312] She stated that the United Nations Framework Convention on Climate Change (UNFCCC) is "an important force" and reflected that this was because climate is "an interconnected global system".[313] However, Professor Mace said she was not convinced that international governance was needed:

> We can do an awful lot with better national governance of local environmental problems. A lot of the things we have talked about—biodiversity, insect declines, water quality and air quality—can be managed nationally.[314]

185. The Government has announced an independent review of the link between biodiversity and economic growth, led by Professor Sir Partha Dasgupta. The review intends to report in 2020, ahead of the 15th meeting of the Conference of the Parties (COP15) to the Convention on Biological Diversity (CBD) in October 2020.[315] This is an ideal opportunity for the UK to show international leadership on the protection and governance of biodiversity, and we urge Prof Gupta to consider the relationship between biodiversity and interconnected planetary health concerns, including food security and urban planning.

Leadership

186. The UK was the first Government to legislate for climate change targets in 2008,[316] and is the first major economy to set legally binding net zero emissions targets.[317] As UPSTREAM noted, the UK Government should "communicate clearly the threat posed to our society from climate change and planetary health".[318] The public should know about the dangers from environmental damage posed to their health and the environments that they live in and depend on for survival.

187. The prospect of the UK hosting the 2020 UN Climate Change Conference provides another opportunity for global leadership on this issue.[319]

188. **To tackle the urgent concerns relating to public health, food security and the environment raised in this planetary health inquiry, strong national and international governance is required.** ***Continuing the global leadership shown by legislating for net zero emissions by 2050, the UK Government should now highlight planetary health at forthcoming international meetings, including the 2020 Conference of the Parties to the***

312 Q166
313 Q174
314 Ibid.
315 Gov.UK, 'Spring Statement 2019: Philip Hammond's speech' (March 2019)
316 Climate Change Act 2008
317 Gov.UK, 'UK becomes first major economy to pass net zero emissions law', (27 June 2019)
318 UPSTREAM (PLA0010)
319 Madeleine Cuff, 'COP26: UK and Italy strike partnership clearing way for UK to host crucial climate summit', Business Green, (18 June 2019)

Convention on Biological Diversity. As host of the 2020 UN Climate Change Conference (Conference of the Parties) the Government should ensure that planetary health is a key theme of the discussions.

Cross-departmental working

189. A theme of our inquiry has been the need for cross-departmental working. Professor Ian Boyd, Chief Scientific Adviser, DEFRA, used air quality, and DEFRA and the Department for Transport's Joint Air Quality Unit, as an example of needing to be "very aware of other departmental interests".[320]

190. In particular, the Ministry of Housing, Communities and Local Government (MHCLG), Department for Environment, Food & Rural Affairs (DEFRA), the Department of Health and Social Care, (DHSC) and Department for Transport (DfT) need to work together closely to ensure that the future of living in cities in the UK is healthier and more sustainable. We were therefore concerned to hear that there had been no Chief Scientific Adviser in the MHCLG for seven years, although an appointment has now been made.[321]

Operating in silos: health organisations

191. A major concern amongst witnesses has been the tendency for departments and decision-making organisations to work in silos. Dr Richard Horton, the Lancet, expressed frustration that even the healthcare bodies were not interacting with each other:

> In terms of the vision across our health infrastructure just think about it. We have a dozen or so royal colleges. We have the British Medical Association. We have a CMO [Chief Medical Officer]. We have Public Health England. Are they working together in a coordinated fashion? The answer is "no". The Chief Medical Officer does fantastic work but she is utterly disconnected from the work of Public Health England. Our colleges are utterly disconnected from public health. This is no way to run the health system.[322]

192. A lack of co-operation contributes to a fragmented, and therefore weakened voice from health organisations when advising the Government on issues such as planetary health.

Data sharing

193. The UK possesses a huge wealth of knowledge about the environment, but not enough of that data is available to health organisations or medical professionals. Professor Lora Fleming, University of Exeter Medical School, told us that:

> There are huge amounts of environmental data out there—things like the Met Office, world famous, fabulous data—but how do you link that up with human health data and how do you train people to be able to work with these huge datasets linking up variables that traditionally are not analysed

320 Q316
321 Q359–60; Gov.UK 'MHCLG announces Chief Scientific Adviser appointment' (July 2019)
322 Q236

> as such? There is almost a research and training gap there to prepare people to really be able to look at things on a planetary scale from an analysis point of view.[323]

194. There is a role for Government to play in ensuring that the data is shared appropriately. Professor Howard Frumkin, Wellcome Trust, told us that:

> As a governance issue, what that may mean is directing or incentivising the owners of different databases to get those databases to be interoperable and then to perform the analytics that are needed.[324]

195. We heard evidence that the Government is using data for health-related work. Professor Charlotte Watts, Department for International Development (DfID), told us that it was "doing a range of activities to respond and to support countries to respond to what we foresee as the extreme impacts of climate change",[325] and that DfID was "using data to understand what might be future rainfalls, risks of flooding, what might be the flow of a river and what might be the next round of infectious disease spread and how we ensure that the programmes we are supporting are aware of what is coming ahead and are responding effectively".[326]

196. **We note that Government departments and agencies are increasingly seeking to share data and work together to tackle planetary health concerns. However, more needs to be done. Improving public health in the UK while improving the environment will require significantly improved data sharing and cross-departmental working in the future.**

197. ***To ensure cross-government working we recommend that the Government ensures single point accountability for planetary health at both ministerial and senior civil service levels. The Government should also establish a forum or joint unit to manage planetary health across Government. To support these meetings, health leaders and organisations must be in attendance: the Chief Scientific Advisers, Public Health England and the Chief Medical Officer all have a major role to play in providing advice on this crucial matter.***

198. **We find it extraordinary that MHCLG had not had a Chief Scientific Adviser for 7 years, especially given that UK buildings are a source of significant harm to public health and make up nearly a third of the UK's carbon footprint. We note the crucial importance of scientific advice in policy making and support the Chief Scientific Adviser network in their excellent work.** ***We recommend that the Government Chief Scientific Adviser (GCSA) assumes responsibility for oversight of the Chief Scientific Adviser network to ensure that such personnel gaps do not happen again. The GCSA should also ensure that the Government's digital service makes its data available to researchers to map hunger, obesity and poverty so they can be incorporated into emerging policy solutions. The next round of research funding should include an element of planetary health research to combine the strong evidence base and expertise in this area from the UK research community.***

323 Q9
324 Ibid.
325 Q329
326 Ibid.

Conclusions and recommendations

Environmental change and human health

1. Without rapid action to curb greenhouse gas emissions and efforts to safeguard the environment we risk causing irreversible damage to the planet. This is already having a significant and growing impact on human health, with impacts set to become more severe. (Paragraph 21)

2. We are concerned that the NHS and the pharmaceutical industry is not sufficiently resourced to deal with these projected changes. Non-communicable diseases (NCDs) kill 41 million people each year, equivalent to 71 per cent of all deaths globally. We note that more people now die from non-communicable diseases than communicable diseases. We also note the recent stalling in life expectancy in the UK as a result of lifestyle changes with increased pressure for NHS resources. Public Health England should broaden its key performance indicators to include climate resilience and adaptation measures to tackle emerging diseases. These should include guidance to general practitioners and the pharmaceutical industry on Lyme disease, malaria, the zika virus and other emerging tropical diseases. We repeat our recommendation from our toxic chemicals report that Public Health England should introduce a comprehensive UK wide human and wildlife bio-monitoring scheme to measure the effects of toxic chemicals. A focus on lifestyle change means that it does not prioritise the impacts that wider economic and ecological changes will have on human health. Secondly, Public Health England must work across Government to advise local Government on the impacts of heat stress and protecting vulnerable communities, particularly the elderly, people living in care homes and those with kidney failure. (Paragraph 22)

3. *The NHS has shown some progress in reducing carbon emissions by 18.5 per cent since 2007. It is deeply disappointing that it will miss its Climate Change Act target of a reduction in emissions of 34 per cent by 2020. As the largest employer, and one of the largest consumers of goods and services in the UK, the NHS should bring forward its targets to end the use of coal (2023/24) and oil (2028/29) for primary heating on NHS sites. This target should now be revised to reflect the Government's commitment to achieve net zero greenhouse gas emissions by 2050 at the very latest. A new pathway for carbon reduction should be developed by April 2020 and communicated to all stakeholders. The NHS' carbon footprint should be clearly communicated to staff, patients and suppliers, with messages on how they can contribute.* (Paragraph 31)

4. *Fluorinated gases remain a major problem, with inhalers contributing to over 3 per cent of total annual emissions from the NHS. We reiterate our recommendation that Government should work with medical professionals, pharmacists, the pharmaceutical industry and patients to significantly improve the recycling of Metered Dose Inhalers (MDIs); this makes both environmental and economic sense. We encourage the Government to investigate all the means of removing the barriers to the safe re-use of those valuable quota-restricted gases. The Government should also ensure that by 2020, at least 50 per cent of MDIs are recycled. It should also set out how it will reduce medical waste, such as MDIs, in its waste strategy.* (Paragraph 32)

5. We are concerned that, at current rates of progress, the NHS will fall far short of the Committee on Climate Change's recommendation of 100 per cent of low emission vehicles by 2035 at the latest. The current target of 66 per cent of vehicles being low emission by 2028 is not ambitious enough. The NHS should be taking the lead in the mitigation of climate change, given its size, budget and workforce, particularly when a major impact of climate change is likely to be a deterioration of several measures of population health. The Committee on Climate Change is clear that early uptake of electronic vehicles (EVs) brings co-benefits from reductions in air pollution. NHS direct fleet procurement and "Grey fleet" purchased through tax schemes should prioritise EVs. *We recommend that the NHS aligns its plans with the Committee on Climate Change's cost-efficient path for electric vehicle uptake to benefit from the financial savings and co-benefits (e.g. reduction in air pollution) of earlier EV uptake.* (Paragraph 34)

Nature, wildlife and the environment

6. Progress towards meeting the Aichi targets by 2020 falls woefully short, and meeting only five of them will not protect the UK's precious wildlife and fragile habitats. *We recommend that the Government engage with the public on the next set of targets before the 2020 UN Biodiversity Conference and set out clear priorities for action. The targets should be formally reviewed every four years and the Government should task Natural England and devolved administrations with the responsibility for their domestic delivery.* (Paragraph 52)

7. The Government's 25 Year Plan for the environment sets out actions that the Government intends to take but there are no SMART targets against which its performance can be measured. *Legislative targets are needed to drive action across Government Departments and not just DEFRA. We reiterate our previous recommendations that the Environment Bill must include a framework for statutory nature and biodiversity targets and interim milestones to be achieved by Government Departments, including by the Treasury, to help them achieve the Greening Government targets. Once these targets have been established through stakeholder collaboration, the Cabinet Office must issue guidance directing Departments to explain how their work programmes will achieve the delivery of these targets in their Single Departmental Plans and the next round of Greening Government Commitments.* (Paragraph 55)

8. *We are disappointed that Natural England has lost half of its budget over the last 10 years. It needs a rapid increase in funding to achieve current objectives. Any new obligations placed under new legislation should be adequately resourced. The Environment (Principles and Governance) Bill is an opportunity to consider holistically the governance frameworks for planetary health in the UK. We recommend that a principle to achieve a high level of environmental protection is put on the face of the Bill and all public bodies be required to achieve this. The Government provided us with the draft version of the first half of the Environment (Principles and Governance) Bill, on which we reported earlier this year. Much of the detail of the Government's proposals for environmental protection, such as on biodiversity net gain, will be contained in the second half of the Bill and we urge the Government to make this available to the Committee for pre-legislative scrutiny as soon as possible, especially given the severe environmental and public health risks of a no-deal Brexit on October 31st.* (Paragraph 63)

9. *The Environment (Principles and Governance) Bill should include provision for new targets to increase green and blue urban infrastructure. Our heatwaves report recommended that the revised National Planning Policy Framework should set a target for councils to achieve, which aims to increase urban green space to 2001 levels, and higher if possible. This should also be included in the revised National Planning Policy Framework to ensure space for nature and people to help adaptation to climate change.* (Paragraph 64)

10. *In response to this report, the Government should set out the principles behind the design of the new environmental land management schemes, and the 'public money for public goods' principle, should the UK leave the EU as set out in the future for food, farming and the environment policy statement. These should include steps to minimise high pesticide use and actions to align land use, food production and mitigation and adaption to climate change.* (Paragraph 70)

11. *We were told that UK companies currently sell chemicals to countries with no regulation of pesticides whose use is banned here. UK policy should be consistent at home and abroad. In the event we leave the EU, the Government has said it will replicate the EU REACH system. Any new UK regulations should review pesticide laws. In the meantime, the Government should review pesticide export regulations and ensure that UK businesses protect planetary health and do not export toxic chemicals which are driving wildlife loss globally.* (Paragraph 71)

Food systems

12. Climate change poses significant risks to international food and water security that may lead to hunger and undernutrition for millions of people. Some commentators have drawn links between food insecurity, political instability and conflict. Others have identified the risk of up to one billion climate refugees by 2050. (Paragraph 83)

13. *The Government needs to work with UN bodies and national Governments to ensure the Department for International Development budget helps to guarantee national and international food and water security, environmental protection and climate resilience.* (Paragraph 84)

14. *We are concerned that the Government is complacent about the risks to food security posed by climate breakdown. The Government is due to publish an updated UK Food Security Assessment by the end of 2019. We recommend that the Government accepts the advice from the Committee on Climate Change about food security risks and set out how it plans to maintain UK food security in a changing climate. Government should publish immediately, in advance of the food security assessment due by the end of 2019, all information relating to food security and cost risks associated with no-deal Brexit.* (Paragraph 90)

15. Environmental change is projected to have increasingly major impacts on global food systems which would affect the UK's food security and ability to deliver healthy, sustainably produced diets. The development of a UK National Food Strategy is an important opportunity to link national food production, international food trade, and environmental protection. *The Agriculture Bill should support this by*

incentivising a switch in UK agriculture towards more sustainably produced food, including agroecological farming methods, bringing about reductions in greenhouse gases associated with UK agriculture. (Paragraph 95)

16. Healthier, more sustainable diets can deliver co-benefits for people and the environment. The Government has a responsibility to raise public awareness of the Eatwell Guide and identify ways to promote the consumption of healthy and sustainable diets, including how they will achieve at least a 20 per cent reduction in meat and dairy consumption as recommended by the Committee on Climate Change's Net Zero report, and a shift away from intensive livestock production systems. There is a need to coordinate efforts across Government to ensure that healthy and sustainable diets are available and affordable to all in the UK. *This should be reflected in the Government's procurement policies and in the next set of Greening Government Commitments. Food provided by the Government should be "sustainable by default" and comply with the Eatwell Guide recommendations. This could lead to an estimated reduction of 30 per cent in the carbon footprint of the Government's purchased food. This is an important step in achieving net zero emissions by 2050.* (Paragraph 108)

17. *Consumer information, including clear labelling, can help shift diets. The Government should expand the restriction of advertising on high fat, sugar and salt products and consider using financial incentives to promote access to, and consumption of, healthy and sustainably produced food.* (Paragraph 119)

18. *We recommend that the Government establish a National Council for Food Policy similar to the work of the Nordic Council of Ministers - to bring together the bodies responsible for food production, nutrition, public health, citizens representatives, and environmental experts to share data and expertise, and ensure greater alignment around promoting healthy diets from sustainable production.* (Paragraph 124)

19. *The National Food Strategy and other Government policy actions relating to food and diets, must place equal emphasis on the importance of healthy diets produced sustainably and national food security. Public Health England's Eatwell Guide should be revised to emphasise foods with lower environmental footprints and make clear recommendations to help the public choose healthy and sustainable diets. To deliver the transformational changes necessary in UK diets the Government should establish a National Food Council as part of its upcoming Environment (Principles and Governance) Bill. It should lead on the roll out of the National Food Strategy.* (Paragraph 125)

20. *We recommend that the National Food Strategy:*

    a) *Recognises the risks to national food security from the UK importing 40 per cent of the food we consume, and explores policies to mitigate these risks and ensure that the UK delivers healthy diets to all, especially in the event of a no-deal Brexit.*

    b) *Works with farmers, supermarkets and the food industry to deliver transformational shifts in access to and affordability of healthy and sustainable diets.*

c) *Sets out annual targets to reduce food waste at every level of the food supply chain consistent with the Government's aim to achieve net zero emissions by 2050 at the very latest. This target should be consistent with SDG 12.3 (reduce food waste) to halve food waste by 2030.*

d) *Recommends policies made by the Committee on Climate Change including shifts towards lower meat and dairy consumption, to achieve the net zero target. The Strategy should set out how public procurement teams, as well as the food and agriculture industry can deliver this goal.*

e) *Incentivises production of fruit and vegetables using sustainable methods in the UK to close the fresh fruit and vegetable trade gap and reduce food security risk.*

f) *Set out clear guidelines for Government procurement of food in schools, hospitals and prisons to be sustainable by default.*

g) *Alongside this, increase teaching within schools around food production, nutrition, food preparation and the environmental impacts associated with the food system.* (Paragraph 126)

Sustainable Cities

21. We look forward to the introduction of air quality legislation as soon as possible, and encourage the Government to draft it with cross-cutting planetary health outcomes in mind. *We recommend that any new legislation on clean air brings UK legal limits for air pollution in line with WHO recommended limits (10ug/m^3).* (Paragraph 138)

22. *We recommend that the Government adopts the Committee on Climate Change's recommendations on off-grid new housing in full. This would include stopping the connection of new homes to the gas grid from 2025. The Government should respond to each recommendation from the Committee on Climate Change's report on UK housing.* (Paragraph 154)

23. *We note that the number of energy efficiency installations (e.g. loft and wall cavity insulation) has collapsed since 2012. A new energy efficiency scheme should be developed and implemented by no later than April 2020 to create warmer homes which are cheaper to run.* (Paragraph 155)

24. *DEFRA should also manage risk of water security in cities and set a default 100 litres per capita per day consumption target for water as recommended by the Committee on Climate Change.* (Paragraph 156)

25. Air pollution (indoor and outdoor) from human activity is an increasing concern and harms public health. The Committee on Climate Change Adaptation Sub-Committee has provided expert guidance on ways to strengthen the building regulations for new and existing housing. We welcome the Government's plans to update the building regulations, including reviewing whether the current enforcement regime is effective. (Paragraph 163)

26. *We recommend that the Government's review of the building regulations takes an integrated approach to ensure that sustainability and public health are properly reflected in any new code. We recommend that, in line with advice from the Committee on Climate Change, the Government change building regulations (specifically part F and L) to mitigate negative impacts of indoor air pollution.* (Paragraph 164)

27. Urban green space can improve public health and mental health outcomes, particularly for disadvantaged groups. *The National Planning Policy Framework needs to be better updated to promote opportunities for active travel, green spaces and access to healthy, sustainable food in planning authorities' Local Plans.* (Paragraph 172)

28. Green space is proven to reduce the urban heat island effect, reducing the risks from heatwaves. *Our 2018 'Heatwaves: adapting to climate change' report recommended that national targets be set to increase urban green space back up to 2001 levels or higher. We repeat this recommendation.* (Paragraph 173)

29. Increasing tree planting should be a priority to improve air quality, capture carbon and create green spaces in cities. Whilst we welcome the 'Urban Tree Challenge Fund', we note that tree targets are not being met, with only half the target number of trees having been planted in the last five years. *The Government should update targets to align with the recommendation from the Committee on Climate Change. The Government should review its Tree Challenge Fund and set out how it will meet the CCC's target of 30,000 hectares of tree planting a year. Councils should be mandated to state how many trees they will plant per house built with a minimum standard of one tree per house. Green infrastructure should be specified in planning permission.* (Paragraph 174)

30. The Government has a responsibility to increase equitable access to healthy, sustainable food for city dwellers. *The Government should review its planning policy guidance to measure how well the current restrictions on fast food outlets are working in practice and it should ensure that planning authorities are able to restrict the numbers of fast food outlets without stringent evidence requirements. The Government's forthcoming National Food Strategy should set out how the Government will work with food providers, including restaurants, fast food outlets and supermarkets to transform the way that people consume food in the UK.* (Paragraph 183)

Governance for planetary health

31. To tackle the urgent concerns relating to public health, food security and the environment raised in this planetary health inquiry, strong national and international governance is required. *Continuing the global leadership shown by legislating for net zero emissions by 2050, the UK Government should now highlight planetary health at forthcoming international meetings, including the 2020 Conference of the Parties to the Convention on Biological Diversity. As host of the 2020 UN Climate Change Conference (Conference of the Parties) the Government should ensure that planetary health is a key theme of the discussions.* (Paragraph 188)

32. We note that Government departments and agencies are increasingly seeking to share data and work together to tackle planetary health concerns. However, more needs to be done. Improving public health in the UK while improving the environment will require significantly improved data sharing and cross-departmental working in the future. (Paragraph 196)

33. *To ensure cross-government working we recommend that the Government ensures single point accountability for planetary health at both ministerial and senior civil service levels. The Government should also establish a forum or joint unit to manage planetary health across Government. To support these meetings, health leaders and organisations must be in attendance: the Chief Scientific Advisers, Public Health England and the Chief Medical Officer all have a major role to play in providing advice on this crucial matter.* (Paragraph 197)

34. We find it extraordinary that MHCLG had not had a Chief Scientific Adviser for 7 years, especially given that UK buildings are a source of significant harm to public health and make up nearly a third of the UK's carbon footprint. We note the crucial importance of scientific advice in policy making and support the Chief Scientific Adviser network in their excellent work. *We recommend that the Government Chief Scientific Adviser (GCSA) assumes responsibility for oversight of the Chief Scientific Adviser network to ensure that such personnel gaps do not happen again. The GCSA should also ensure that the Government's digital service makes its data available to researchers to map hunger, obesity and poverty so they can be incorporated into emerging policy solutions. The next round of research funding should include an element of planetary health research to combine the strong evidence base and expertise in this area from the UK research community.* (Paragraph 198)

Formal minutes

Tuesday 3 September 2019

Members present:

Mary Creagh, in the Chair

Geraint Davies	Ruth Jones
Philip Dunne	Kerry McCarthy

Draft Report (*Our Planet, Our Health*), proposed by the Chair, brought up and read.

Ordered, That the Chair's draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 198 read and agreed to.

Summary agreed to.

Resolved, That the Report be the Twenty First Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

[Adjourned till 4 September 2019 at 10am

Witnesses

The following witnesses gave evidence. Transcripts can be viewed on the inquiry publications page of the Committee's website.

Tuesday 15 January 2019

Professor Lora E. Fleming, Chair, European Centre for Environment and Human Health, University of Exeter Medical School, **Professor Sir Andy Haines**, Professor of Environmental Change and Public Health, London School of Hygiene and Tropical Medicine, **Professor Howard Frumkin**, Head of Our Planet, Our Health, Wellcome Trust Q1–49

Tuesday 29 January 2019

Professor Sir Charles Godfray, Director, Oxford Martin School, **Professor Claire Heffernan**, Director and Professor of International Development, Royal Veterinary College, **Dr Philip Thornton**, Flagship Leader and Principal Scientist, CGIAR Research Programme on Climate Change, Agriculture and Food Security, **Dr Sonja Vermeulen**, Associate Fellow, Hoffmann Centre for Sustainable Resource Economy, Chatham House, **Professor Tim Lang**, Professor of Food Policy, City, University of London, **Judith Batchelar**, Director of Sainsbury's Brand, Corporate Responsibility and Public Affairs, J Sainsbury's PLC, **Simon Billing**, Executive Director, Eating Better Q50–130

Tuesday 12 February 2019

Professor Georgina Mace, Professor of Biodiversity and Ecosystems, University College London, **Dr Mark Mulligan**, Head of the Department of Geography, King's College London, **Professor Peter Cox**, Professor of Climate System Dynamics, University of Exeter, **Dr Richard Horton**, Editor-in-Chief, The Lancet, **Sonia Roschnik**, Director, Sustainable Development Unit, **Matt Shardlow**, Chief Executive Officer, BugLife–the Invertebrate Conservation Trust Q131–239

Tuesday 12 March 2019

Professor Mike Davies, University College London, **Professor Yvonne Rydin**, University College London, **Dr Anastasia Mylona**, Head of Research, Chartered Institution of Building Services Engineers, **Daniel Black**, Independent consultant and company Director, Daniel Black and Associates, **Mr Lawrie Robertson**, Head of Strategic Planning, BuroHappold Engineering, **Councillor Paulette Hamilton**, Holyhead Ward, Birmingham City Council, **Rachel Huxley**, Director of Knowledge and Learning, C40 Cities Q240–312

Tuesday 2 April 2019

Sir Patrick Vallance, Government Chief Scientific Advisor, **Professor Chris Whitty**, Chief Scientific Adviser, Department of Health and Social Care, **Professor Ian Boyd**, Chief Scientific Advisor, Department for Environment, Food and Rural Affairs, **Professor Charlotte Watts**, Chief Scientific Adviser, Department for International Development, and **Professor Phil Blythe**, Chief Scientific Adviser, Department for Transport; **Dr Thérèse Coffey MP**, Parliamentary Under-Secretary of State and **David Rutley MP**, Parliamentary Under-Secretary of State, Department for the Environment, Food and Rural Affairs, **Kit Malthouse MP**, Minister of State for Housing, Ministry of Housing, Communities and Local Government, **Jonathan Marron**, Director General, Community and Social Care, Department for Health and Social Care, and **Professor Paul Cosford**, Director of Health Protection and Medical Director, Public Health England Q313–437

Published written evidence

The following written evidence was received and can be viewed on the inquiry publications page of the Committee's website.

PLA numbers are generated by the evidence processing system and so may not be complete.

1 Anglian Water Services (PLA0011)

2 Benton, Professor Tim (PLA0026)

3 Black, Mr Daniel (PLA0029)

4 British Dietetic Association (PLA0018)

5 British Retail Consortium (PLA0023)

6 British Veterinary Association (PLA0002)

7 Cole, Dr Jennifer (PLA0003)

8 Committee on Climate Change (PLA0016)

9 Davies, Professor Michael (PLA0012)

10 Davies, Professor Michael (PLA0030)

11 Defra (PLA0028)

12 Feedback (PLA0004)

13 Game & Wildlife Conservation Trust (PLA0031)

14 Gee, David (PLA0009)

15 Lang, Professor Tim (PLA0033)

16 London School of Hygiene & Tropical Medicine (PLA0022)

17 LSHTM Planetary Health Alliance (PLA0020)

18 Magnone, Dr Daniel (PLA0005)

19 McGhie, Mr Henry (PLA0021)

20 Medact (PLA0027)

21 Met Office (PLA0015)

22 National Trust (PLA0032)

23 Petrikova, Dr Ivica (PLA0025)

24 Soil Association (PLA0014)

25 Summers, Mr William (PLA0001)

26 Sustainable Food Trust (PLA0006)

27 UK Faculty of Public Health (PLA0017)

28 UK Health Alliance on Climate Change (PLA0013)

29 UK Research and Innovation (PLA0024)

30 The University of Sydney (PLA0008)

31 UPSTREAM (PLA0010)

32 VermEcology (PLA0007)

33 Wellcome Trust (PLA0019)

List of Reports from the Committee during the current Parliament

All publications from the Committee are available on the publications page of the Committee's website. The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2017–19

First Report	Plastic bottles: Turning Back the Plastic Tide	HC 339
Second Report	Disposable Packaging: Coffee Cups	HC 657
Third Report	The Ministry of Justice: Environmental Sustainability	HC 545
Fourth Report	Improving air quality	HC 433
Fifth Report	UK Progress on Reducing F-gas Emissions	HC 469
Sixth Report	Green finance: mobilising investment in clean energy and sustainable development	HC 671
Seventh Report	Greening Finance: embedding sustainability in financial decision making	HC 1063
Eighth Report	The Government's 25 Year Plan for the Environment	HC 803
Ninth Report	Heatwaves: adapting to climate change	HC 826
Tenth Report	Hand car washes	HC 981
Eleventh Report	UK Progress on Reducing Nitrate Pollution	HC 656
Twelfth Report	The Changing Arctic	HC 842
Thirteenth Report	Sustainable Development Goals in the UK follow up: Hunger, malnutrition and food insecurity in the UK	HC 1491
Fourteenth Report	Sustainable Seas	HC 980
Fifteenth Report	Interim Report on the Sustainability of the Fashion Industry	HC 1148
Sixteenth Report	Fixing fashion: clothing consumption and sustainability	HC 1952
Seventeenth Report	Pre-appointment hearing with the Government's preferred candidate for Chair of Natural England	HC 1979
Eighteenth Report	Scrutiny of the Draft Environment (Principles and Governance) Bill	HC 1951
Nineteenth Report	UK Export Finance	HC 1804
Twentieth Report	Toxic Chemicals in Everyday Life	HC 1805
First Special Report	The Future of Chemicals Regulation after the EU Referendum: Government Response to the Committee's Eleventh Report of Session 2016–17	HC 313
Second Special Report	Marine Protected Areas Revisited: Government Response to the Committee's Tenth Report of Session 2016–17	HC 314

Third Special Report	Sustainable Development Goals in the UK: Government Response to the Committee's Ninth Report of Session 2016–17	HC 616
Fourth Special Report	Plastic bottles: Turning Back the Plastic Tide: Government Response to the Committee's First Report	HC 841
Fifth Special Report	Disposable Packaging: Coffee Cups: Government's Response to the Committee's Second Report	HC 867
Sixth Special Report	The Ministry of Justice: Environmental Sustainability: Government's Response to the Committee's Third Report	HC 982
Seventh Special Report	Improving air quality: Government Response to the Committee's Fourth Report	HC 1149
Eighth Special Report	UK Progress on reducing F-gas Emissions: Government's Response to the Committee's Fifth Report Eighth	HC 1406
Ninth Special Report	Green finance: mobilising investment in clean energy and sustainable development: Government Response to the Committee's Sixth Report	HC 1450
Tenth Special Report	Heatwaves: adapting to climate change: Government Response to the Committee's Ninth Report	HC 1671
Eleventh Special Report	Greening Finance: embedding sustainability in financial decision making: Government Response to the Committee's Seventh Report	HC 1673
Twelfth Special Report	The Government's 25 Year Plan for the Environment: Government Response to the Committee's Eighth Report	HC 1672
Thirteenth Special Report	UK Progress on Reducing Nitrate Pollution: Government Response to the Committee's Eleventh Report	HC 1911
Fourteenth Special Report	Hand car washes: Government Response to the Committee's Tenth Report	HC 1910
Fifteenth Special Report	The Changing Arctic: Government Response to the Committee's Twelfth Report	HC 2069
Sixteenth Special Report	Pre-appointment hearing with the Government's preferred candidate for Chair of Natural England: Government Response to the Committee's Seventeenth Report	HC 2096
Seventeenth Special Report	Sustainable Seas: Government Response to the Committee's Fourteenth Report	HC 2118
Eighteenth Special Report	Fixing fashion: clothing consumption and sustainability: Government Response to the Committee's Sixteenth Report	HC 2311
Nineteenth Special Report	Sustainable Development Goals in the UK follow up: Hunger, malnutrition and food insecurity in the UK: Government Response to the Committee's Thirteenth Report	HC 2310

Department for Environment Food & Rural Affairs

UK Food Security Report 2021

Presented to Parliament pursuant to Section 19 of the Agriculture Act 2020

Ordered by the House of Commons to be printed on 16 December 2021

We are the Department for Environment, Food and Rural Affairs. We're responsible for improving and protecting the environment, growing the green economy, sustaining thriving rural communities and supporting our world-class food, farming and fishing industries.

We work closely with our 33 agencies and arm's length bodies on our ambition to make our air purer, our water cleaner, our land greener and our food more sustainable. Our mission is to restore and enhance the environment for the next generation, and to leave the environment in a better state than we found it.

This publication is available at https://www.gov.uk/government/collections/united-kingdom-food-security-report

Any enquiries regarding this publication should be sent to us at

foodsecurityreport@defra.gov.uk

www.gov.uk/defra

ISBN 978-1-5286-3111-2

E02702656 12/21

Printed on paper containing 75% recycled fibre content minimum

Printed in the UK by HH Associates Ltd. on behalf of the Controller of Her Majesty's Stationery Office

Contents

Introduction

Executive summary

This report is an analysis of statistical data on food security in the United Kingdom. It is the first in a series of reports which will be published under a new duty in the Agriculture Act 2020 to report to Parliament on food security in the United Kingdom at least once every three years.

The UK Food Security Report (UKFSR) examines past, current, and predicted trends relevant to food security, to present the best available and impartial analysis of food security in the UK, and to lay the groundwork for future Food Security Reports.

Food security is a complex and multi-faceted issue. To address the subject's many diverse aspects, the UKFSR is structured around five principal 'themes', each addressing an important component of modern-day food security in the UK. They are as follows: **global food availability**, which describes supply and demand issues, trends and risk on a global scale, and how they may affect UK food supply; **UK food supply**, which looks at the UK's main sources of food at home and overseas; **supply chain resilience**, which outlines the physical, economic, and human infrastructure that underlies the food supply chain, and that chain's vulnerabilities; **household-level food security**, which deals with issues of affordability and access to food; and **food safety and consumer confidence**, which details food crime and safety issues.

The report draws on a broad range of published statistical data from government and other sources. These quantitative sources are supplemented with case studies and qualitative analysis where necessary and helpful. In some cases, where quantitative evidence is not available due to data being limited or confidential, or where the report references recent events which are not yet reflected in published statistics, only qualitative analysis is available.

Context

As set out under Section 19 of the Agriculture Act 2020: *"The Secretary of State must, on or before the relevant day and at least once every three years thereafter, prepare and lay before Parliament a report containing an analysis of statistical data relating to food security in the United Kingdom."*

The UKFSR is the first comprehensive review of the UK's food security to be published since the UK Food Security Assessment (UKFSA), which was first published in 2009 and updated in 2010. In the decade since the UKFSA, the food security landscape has changed significantly. The UK’s departure from the European Union has brought along changes in areas as diverse as trade, farming, and access to fisheries, representing both challenges and opportunities in food security. Climate change and its impacts on farming and the food supply chain are now also better understood. The COVID-19 pandemic and other concurrent events happening towards the end of 2020, such as the UK leaving the EU and increased food demand due to Christmas, have stress-tested the supply chain, highlighting both the vulnerabilities in this complex system and the resilience and flexibility of the UK’s food supply. In addition, the pandemic has increased public awareness in a range of food security areas. This includes the complexities and dependencies of the UK’s food supply chain, notably the advantages and risks of just-in-time food supplies, as well as the issues surrounding household food insecurity as households struggled to afford food.

While the UKFSR is a different document to the UKFSA, it has some important similarities. It shares a number of common data sources and covers a similar spread of topics in its five themes as the UKFSA did in its six.

The production of this report is the responsibility of the Department for Environment, Food and Rural Affairs (Defra). It has been produced in collaboration with relevant officials in the Devolved Administrations, and with UK food safety bodies. An area as all-encompassing as food security touches on a wide range of government bodies. Agricultural and food supply policy is devolved to each national administration. National Security and Counter Terrorism (CT) policy is a specific reservation under the Home Affairs heading. As lead departments for food as a Critical National Infrastructure (CNI) sector, Defra and the FSA manage those risks specifically relating to National Security and CT across the UK. For all other areas of risk, food supply chain resilience and security are the responsibility of Defra in England; DAERA and Department for Communities in Northern Ireland; Scottish Government in Scotland; and Welsh Government in Wales. The FSA is responsible for food safety and tackling food crime in England, Northern Ireland, and Wales. Food Standards Scotland are responsible for food safety and food crime in Scotland.

What is food security?

Food security has many dimensions. As a topic, it encompasses the state of global agriculture and markets on which the UK is reliant; the sources of raw materials and foodstuffs in the UK and abroad; the manufacturing, wholesale, and retail industries that ultimately bring food to shelves and plates, and their complex supply chains of inputs and logistics; and the systems of inspection that allow consumers to be confident their food is safe, authentic, and of a high standard.

Accordingly, this report examines the issue of whether the UK is food secure across five 'themes.'

Theme 1: Global Food Availability looks at food security in terms of supply and demand at a global level. It is concerned with the security and stability of the international food supply system, on which the UK relies for nearly half of its food. It assesses trends in global agriculture and food production set against population growth, the impacts of climate change and other factors on food production, and the state of key inputs to agriculture, such as labour, water and fertiliser. It also looks at trends in global trade, which is essential for the UK to access food produced abroad.

Theme 2: UK Food Supply Sources looks at food security in terms of where the UK gets its food. It focuses specifically on the UK's principal sources of food at home and overseas. It describes the UK's domestic production, and trends in agricultural productivity; fisheries; and food manufacturing. It considers important factors in maintaining domestic productivity, such as soil health; pesticide use; and biodiversity. It discusses the principal sources the UK relies on for its food imports, and food waste in the system. It also considers the indicators which will help future reports assess the food security impacts of the UK's 2020 departure from the European Union, both in terms of changes to domestic production practices and to the UK's trading relationship with the world. As a number of these factors would not be expected to change significantly in the short term, longer term monitoring of these indicators will be required to fully understand the impacts.

Theme 3: Supply Chain Resilience looks at food security in terms of the physical, human and economic infrastructure underlying the supply chain. It describes the sophisticated infrastructure of just-in-time supply chains, their strengths and potential vulnerabilities. It considers how the supply chain responds to issues, for example the impacts the Covid-19 pandemic had throughout the supply chain. It also describes the risk of cyber-attacks, labour issues in the supply chain, and other significant vulnerabilities.

Theme 4: Food Security at Household Level looks at food security in terms of whether households can reliably afford and access sufficient healthy and nutritious food. It discusses the affordability of food and drink, in real terms and compared to other living costs. It considers whether people have access to food shops. The theme covers household food security levels in the UK and breaks this down into various factors that may impact these levels. It also looks at the use of food aid in the UK including during the COVID-19 pandemic.

Theme 5: Food Safety and Consumer Confidence looks at food security in terms of the perceived and actual safety and authenticity of food in the UK. It describes the inspections and surveillance regime for ensuring food standards in the UK are upheld and examines trends in food safety issues such as food crime, foodborne pathogens, labelling and metrics on public trust in the food system.

How to read the UKFSR

Each theme of the UKFSR begins with an introduction, which sets out the broader context and reasoning behind the theme, and a summary, which provides the headline conclusions. The body of each theme is then comprised of indicators and case studies, each of which sets out a specific aspect of food security and the available data.

Each indicator, in turn, has a *Headline* summary and a more detailed *Context and Rationale* section for why the indicator has been included. A *Data and Assessment* section then sets out the relevant data and what it tells us. Finally, a *Trends* section articulates what this assessment means in terms of food security and what can usefully be observed. Where there is an observable past or future trend in the data, this section will articulate it. Relevant information on survey methodology and notes explaining specific concepts are included in an annex.

The great variety of data sources and the different collection periods of the available information mean it is not always possible to talk about every indicator in the exact same way. Some indicators contain data that has only recently started to be collected and therefore, this iteration of the UKFSR can only serve as a starting point for a future time series.

The UKFSR is not a policy document. Its purpose is to understand the landscape and the issues at stake, and to set out and interpret the best available evidence regarding food security. It is not a showcase of current or future government policy. It aims to provide policymakers across the UK nations with the best possible information and analysis they need to maintain the UK's food security, in all its many aspects.

Theme 1: Global Food Availability

This chapter of the UK Food Security Report looks at the food security of the United Kingdom in terms of supply and demand at a global level. It is concerned with the security and stability of the international food supply system. It assesses trends in global agriculture and food production set against population growth, the impacts of climate change and other factors on food production, and the state of key inputs to agriculture, such as labour, water, and fertiliser. It also looks at trends in global trade, key for the UK to access food produced abroad.

In terms of this theme, food security means stable global production and a well-functioning global trading system that reliably, efficiently and sustainably meets the needs of the UK and the world.

Key messages

- Global food supply and availability has improved since 2010, which is a positive sign for the UK's overall food security.
- The coronavirus (COVID-19) pandemic caused some disruption to trans-boundary supply chains but global trade in products is expected to recover and to continue in the long term.
- Projected growth in agricultural production will be largely due to increasing cereal yields and efficiency improvements in meat and dairy production, and less due to expansions in agricultural land and herd size growth.
- Several factors threaten the stability and long-term sustainability of global food production: climate change and climate variability, biodiversity loss caused by agricultural land expansion, and overexploitation of natural capital resources, including fish stocks and water resources. Current data on undernourishment as well as obesity levels across the world may indicate that global food production is not equitably meeting populations' nutritional requirements, including the UK's.

The UK has relied on imported foodstuffs to supplement domestic production for over two centuries and currently almost half of food consumed in the UK is imported, although the UK is around 75% self-sufficient in foodstuffs that can be produced domestically. Sourcing food from global markets contributes to the UK's food resilience. Diverse supply chains and global trade in agricultural and food commodities reduce the risk of food becoming unavailable and, as the risks are shared across the globe, can mitigate price shocks. as the risks are shared across the globe. It also allows consumers to access fresh, out-of-season foods which cannot be produced in the UK. However, an over-reliance on global trade can expose food supplies to global risks including logistical, political, and production disruption.

Balance of Global Food Production and Consumption

As the world population continues to grow from 7.7 billion people in 2021 to an estimated 8.5 billion in 2030, it is essential to understand how agricultural production levels will keep up with growing food demand.[1]

The rate of increase in global food production output per capita currently outpaces global food demand, though global food production is unevenly distributed across regions. For the UK, global food sources are secure and expected to remain so for the coming years. However, substantial amounts of food are lost or wasted across the global supply chain. Reductions in loss and wastage could increase the sustainability of food production.

Stock to consumption ratios are an indicator of global resilience to food shortages and price stability. Food stocks can serve as buffers to supply or demand shocks. If stocks are low, markets become more sensitive to any potential shocks and the probability of price spikes increases. The world's stock to consumption levels fluctuate, with good harvests leading to higher stocks.

Cereal yield growth rates have been growing at a slower pace since 2010, compared to earlier periods, but are keeping pace with overall global food demand. Some of the main risks for cereals in the future will be climate variability and change, and the effects it will have on cereal growth rates in different regions. Changing climate, pests and diseases, harvest losses, inefficient use of inputs, and under-investment can all hamper yields and yield growth. Evidence indicates that between 20% and 40% of global crop production is lost annually due to plant diseases and pests. Impacts of wheat rust diseases on the world's wheat production are of note for the UK's food security.

Current stocks are healthy with the exception of soybeans. Poor soybean harvests or other supply disruptions could cause price fluctuations and present a risk to imported soy-based animal feed, an important input into UK meat production.

Global meat production has grown significantly since 2010 and is projected to increase over the coming years. Consumption increases are likely to vary, with high-income countries potentially having reached peak meat consumption per capita, and lower- and middle-income countries expected to see more increases in consumption rates. Milk production is also set to continue to increase, mainly driven by improvements in efficiency and less due to increases in herd size. Animal disease outbreaks in the late 2010s have substantially reduced pig herd numbers, particularly in China.

[1] UN, 'World Population Prospects 2019: Data Booklet', h[redacted].

While most of the fish stocks that the UK relies on are considered sustainable, global fish stocks are overexploited. Consumption of fish has increased globally in the last two decades (including in the UK), while the proportion of fish stocks at biologically sustainable levels has fallen. Around one third of all stocks are being fished at unsustainable levels. As well as overfishing, stocks are at risk from the effects of climate change, particularly through ocean acidification and algal blooms.

Overall, the global availability of agricultural commodities is driven by the fundamental market forces of supply and demand and exchange rate dynamics. Population growth will play the most significant role in food demand growth over the coming years. Increasing incomes in low- and middle-income countries are likely to lead to increased calorie consumption and meat consumption. In high-income countries other factors, such as health and environmental concerns, are likely to be more relevant in determining consumers' food preferences.

Shorter term shocks to supply and demand also influence price. The financial crisis of 2007 to 2008 caused a significant price spike, followed by a gradual decline. The COVID-19 pandemic led to new price spikes, albeit not as severe as that which followed the financial crisis. The Food and Agriculture Organisation of the United Nations (FAO) projects that real prices will return to a general downward trend once COVID-19 measures have been lifted.

Agricultural inputs

Agricultural production puts strain on key inputs such as fertilisers and labour as well as natural capital resources such as water, soil, and land. Increased global pressure to intensify food production to meet demand may also exacerbate the harmful impacts agricultural practices and the food system have on the environment and wildlife in the form of habitat destruction and pollution. Combined, these may undermine the fundamentals upon which production systems rely if production cannot become more sustainable.

Around one third of the land on Earth is used for growing food. This proportion has stayed broadly stable since 2010, although there has been a decline in forest land and some significant regional changes, particularly in South America. Most projected increases in global food production are the result of more intensive practices rather than of the creation of new farmland. Both increases in agricultural land and intensified production pose a threat to biodiversity. The role of biodiversity in food production is crucial: more than 75% of the leading types of global food crops rely to some extent on animal pollination for yields and/or quality.

Fertilisers are key to global industrial farming methods. Phosphate rock is the only large-scale source of phosphorus, an essential element for plant growth and an important chemical fertiliser. The UK has no phosphate reserves and relies on imports. Phosphate consumption has declined both in the UK and globally as a result of more efficient usage, and known reserves of exploitable phosphate rock have increased since 1995.

Water is essential to food production. Agriculture accounts for around 70% of fresh water withdrawn (from rivers, reservoirs, or groundwater extraction) globally. Water withdrawals for irrigation have increased globally, most significantly in Organisation for Economic Development (OECD) and EU countries. However, they have declined in the Middle East and North Africa. Climate change is likely to increase the importance of irrigation relative to rainfed agriculture and increase pressures on water withdrawals. There has been a strong trend towards the use of more water-efficient crops and better water management practices. Higher water efficiency can also be gained by using nitrogen-based fertilisers.

The availability of agricultural workers is an important factor in global food production and on global food supply. The number of people employed in agricultural labour has decreased globally since 2010 by 44.5 million due to productivity increases and mechanisation. Besides permanent agricultural workers, seasonal workers are required to meet fluctuating demand across the world. The COVID-19 pandemic, however, has highlighted how the sector’s reliance on seasonal workers for critical harvesting periods can be a potential risk to production if there are factors that reduce the availability of these workers.

Global commodity markets

Global trade in agricultural and food products plays an essential role in providing food security for the UK, but also for the rest of the world. Volume and freedom of trade are key, as is diversity of global supply into those markets.

The proportion of agricultural products traded has increased since the 2000s. A growing global trade in agricultural products increases resilience to supply shocks affecting geographical areas and allows for a more efficient global food supply chain. However, reliance on the global trading system increases vulnerability to events, such as trade restrictions, which disrupt the system. The COVID-19 pandemic caused some disruption to trans-boundary supply chains but global trade in products is expected to recover and continue growing in the long term.

High concentration of a particular commodity in a few countries could have negative impacts on price, supply, and food security globally. Since 2010 Ukraine has increased its market share for maize, reducing the overall concentration of world supplies. Brazil is now the world largest producer and exporter of soybeans representing an overall increase in the concentration of soybean production across the world over the last decade. India is now the world's biggest producer of rice, where there has been a recent uptick in concentration of world supply in the last few years. Russia is now the world's biggest producer of wheat, while concentration of wheat production around the world has remained stable along with most other major agricultural commodities. Palm oil and soybean oilseed represent the two commodities with the most concentrated production globally. No major changes are expected for the concentration in world agricultural commodity markets and the top exporting countries of these commodities. Over the last decade, stable trade relations with key exporters have ensured that the UK's access to global food supplies remains secure. The emergence of other exporting countries such as Vietnam for rice, and continued strong trade relations with key exporting countries, will further support the stability of the UK's access to food.

Indicator 1.1.1 Global output per capita

Headline

The rate of increase in global food production output per capita now outpaces global food demand. This means that the global food sources that the UK accesses are secure and expected to remain so in the coming years. However, substantial amounts of food are lost or wasted across the global supply chain. Global food production is unevenly distributed across regions. In addition, growth in obesity and malnutrition may indicate that global production is not meeting nutritional needs.

Context and Rationale

Global production of food relative to global population size is a fundamental indicator of global food security. Demographic and demand increases, availability of suitable land, water resources, bio-fuel production, climate change, and other factors play an important role in determining the levels of global food production and availability.

A secure global food supply is essential to guaranteeing the availability and affordability of food in the UK in the long term. Any deterioration in global availability, or associated increases in prices, will also impact the UK's food security.

While evidence suggests that, at the global level, agricultural production can be increased enough to satisfy the additional demand projected to 2050, fair resource distribution across all countries will remain a challenge, as outlined further in **Indicator 1.2.2**. Moreover, there are indications that food prices can be volatile. Economic shocks such as the financial crisis, disease outbreaks, and extreme weather events can adversely impact production and consumption costs leading to spikes in food prices. This volatility could lead to a call for a more sustainable use of food and inputs needed to grow food. This is discussed in more depth in **Indicators 1.1.7, 1.1.8, and 1.1.9**.

Food waste in medium and high-income countries occurs largely at the consumption stage, arising from consumer behaviour. In lower-income countries, food is lost mainly within the food supply chain before it reaches the consumer. These losses are due to financial, managerial, and technical limitations in harvesting techniques, as well as poor storage and cooling facilities in difficult climatic conditions. Inadequate infrastructure, transportation, packaging, and marketing systems also contribute.[2]

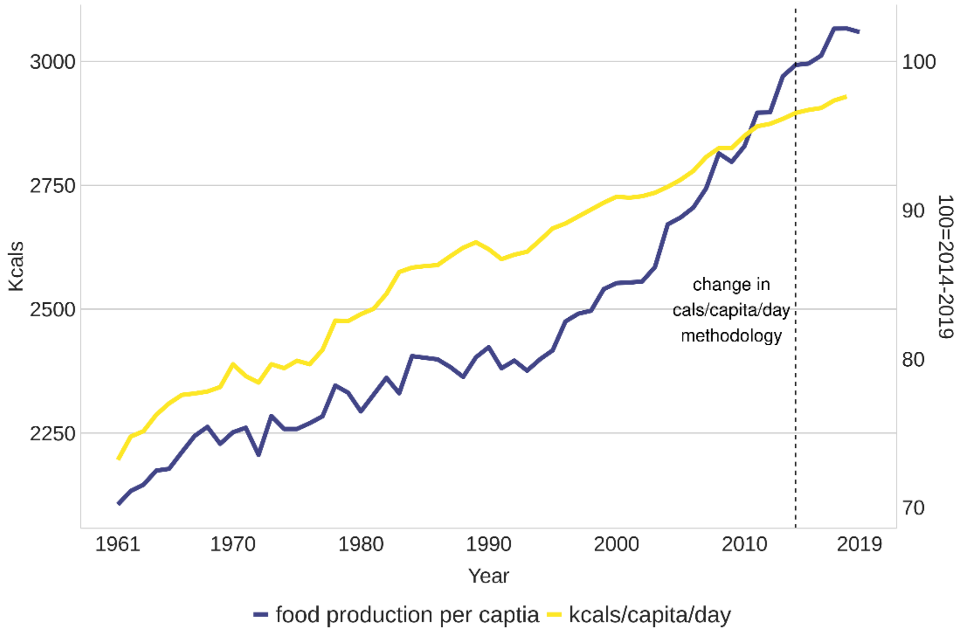
Data and Assessment

Indicator: Calories and world agricultural production per person; global food loss and waste

Source: FAO; UNEP Food Waste Index Report 2021; Fefac; Alltech

Figure 1.1.1a: World food production per capita 1961-2019

(See appendix for an explanation of index numbers.)

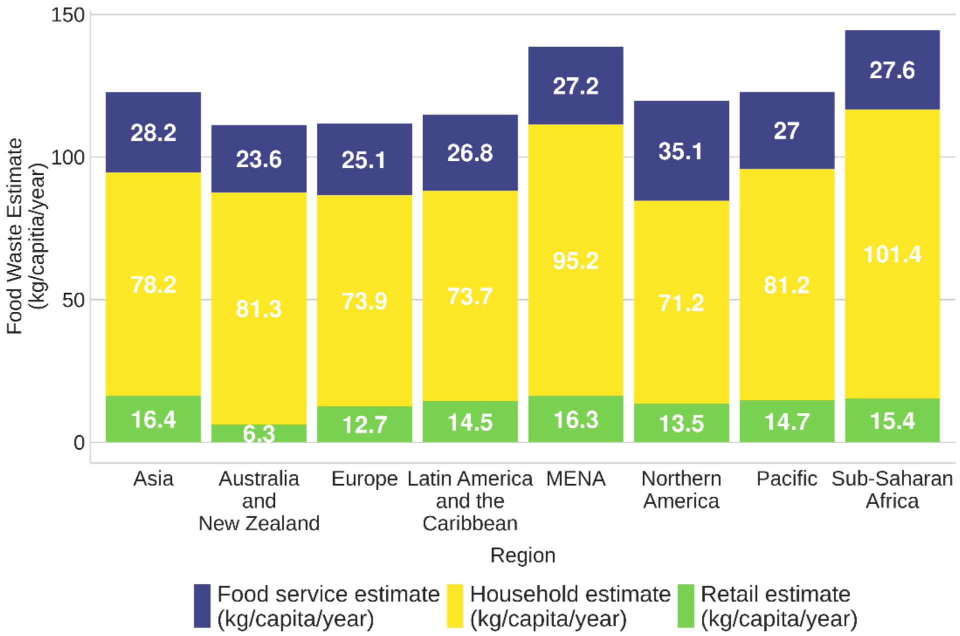


Food production per capita has risen since the 1960s. The rate of increase in the production of food now outpaces the increase in calorie demand per capita. The food production index includes seed and feed, which is not intended for human consumption and therefore slightly skews the real availability of food for humans. The use of animal feed has also increased significantly since 2012 by 149 million tonnes per annum to 1,103 million tonnes in 2019 as is shown in figure 1.1.1d.

---

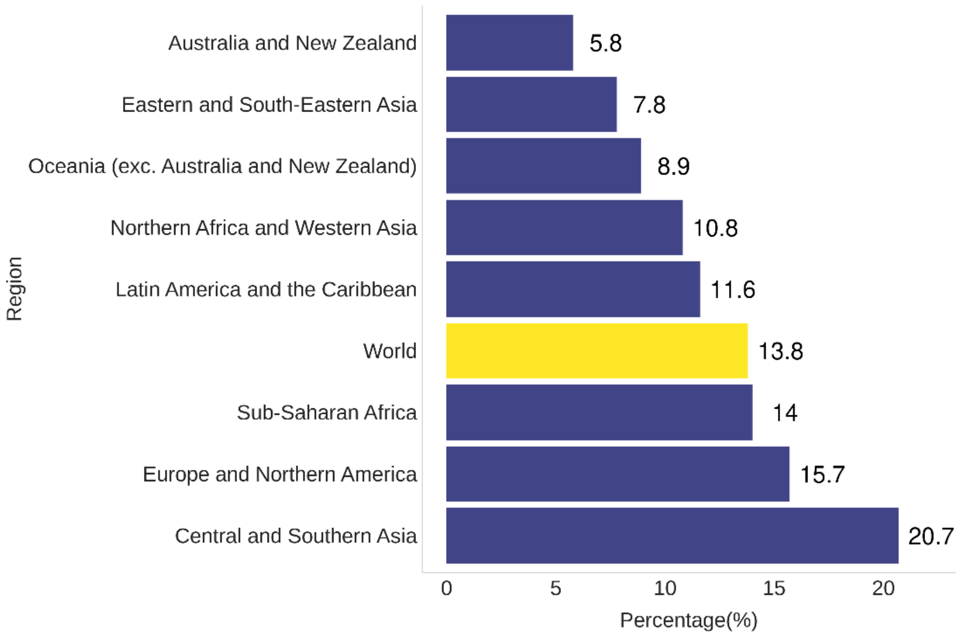
[2] **UNCTAD, 'Goal 12: Responsible consumption and production',**
[redacted]

Figure 1.1.1b: Food waste at food service, household, and retail level per region, kg/capita/year from UNEP 2021 Food Index



The quality of data on food waste varies significantly by region. Drawing any definite conclusions on regional variation is therefore problematic. From available data, food waste per capita appears relatively constant globally. Household food waste accounts for the largest proportion of food waste.

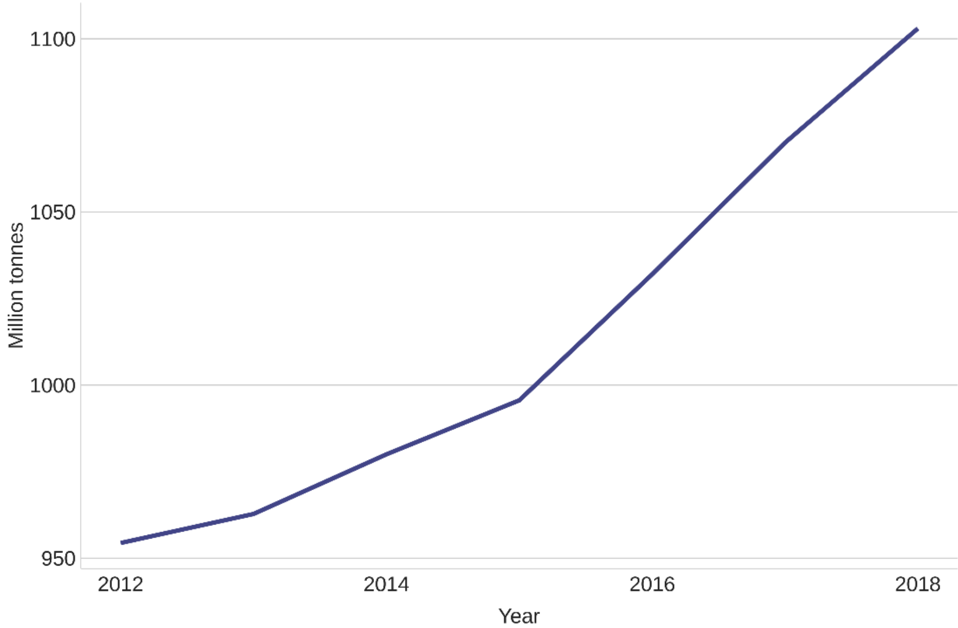
Figure 1.1.1c: Percentage of food loss by region, 2016



Food loss, as shown in figure 1.1.1c, is highest in Central and Southern Asia at 20.7%, followed by Europe and Northern America at 15.7% and Sub-Saharan

Africa at 14%. All these regions exceeded the world average percentage of food loss of 13.8%. Australia and New Zealand have the lowest food waste percentage globally at 5.8%.

Figure 1.1.1d: Animal Feed consumption at global level, million tonnes 2012-2018



Trends

Global food production output has been on a permanent upward trend, with enough calories being produced to feed the growing world population now and in future years. Therefore, the UK's ability to meet its import demands from global food production is in a good state. Risks concerning global food production levels are discussed in more detail in **Indicators 1.1.2, 1.1.5, 1.1.6, 1.1.7.**

The Food and Agriculture Organization (FAO) of the United Nations projects that global agricultural production will increase by 1.4% per annum over the next ten years if most COVID-19 measures are lifted by the end of 2021. This is a slightly slower growth rate compared to the last decade, which saw an increase of 1.7% per annum. Most of the agricultural production growth will likely take place in low-income countries. These increases will be driven by productivity-increasing investments in agricultural infrastructure and research and development, wider access to agricultural inputs and improved management skills. High-income countries will contribute less to production growth, mainly due to constraints imposed by environmental policies.[3]

Although calories per capita are rising globally, distribution is unequal. The UN estimates that between 720 and 811 million people were undernourished in 2020. This constitutes an increase from 650 million in 2019 as a result of the COVID-19 pandemic.[4] Moreover, the type of food that makes up the consumed calories also plays an important role in determining whether the world population can meet their nutritional requirements. Some regions still suffer from undernourishment, while others are dealing with increasing obesity levels.

Indicator 1.1.2 Cereal yield growth rates by region

Headline

Growth in cereal yields is keeping pace with overall global food demand, although has been slower in the last decade compared to earlier periods. Some of the main risks for cereal production in the future will be climate variability and change, and the effects these will have on the growth rates in different regions.

Context and Rationale

Yield growth rates are an important measure to assess the world's supply of food. Yields measure the harvested production per unit of harvested area, and yield growth denotes an increase in harvested production within a unit of area. Historically, yield growth has been a key factor in food production increases. It is expected that most of the increase in production over the next 40 years will also come from improved yields and less so from expansions in agricultural land.[5]

The agricultural sector is both affected by and the cause of some risks. Changing climate, pests and diseases, harvest losses, inefficient use of inputs, and underinvestment can all hamper yields and yield growth. Some of these risks are further outlined below. Efficient applications of fertiliser and water usage are key factors in yield growth. However, yield growth driven by applying greater quantities

---

[3] FAO, 'OECD-FAO Agricultural Outlook 2021-2030', [redacted].

[4] Action against Hunger. 'World Hunger: Key Facts and Statistics 2021', [redacted]s.

[5] FAO, 'World Agriculture towards 2030/2050: The 2012 revision', [redacted]

of fertiliser and water can be environmentally damaging. Fertilisers and water resources are covered in more depth within **Indicators 1.1.8, 1.1.9, and Theme 2** in this report.

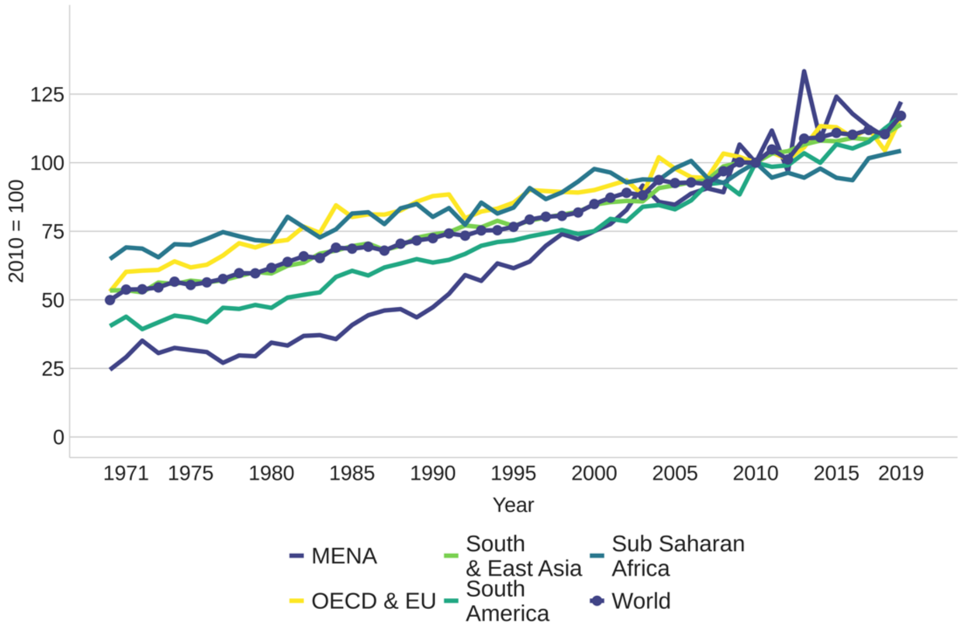
Data and Assessment

Indicator: Cereals yields and yield growth rates

Source: FAO

(See appendix for further information on OECD and an explanation of index numbers.)

Figure 1.1.2a: Cereal yield growth rates by region 1970-2019



Note: 2010 is designated as the base year for this graph to measure the growth rate against.

Figure 1.1.2b: Cereal yields and yield growth rates by region

	Yields(tonnes)				Growth of Yields	
Area	**1970**	**1999**	**2009**	**2019**	**1999-2009**	**2009-2019**
MENA	1.1	3.2	4.7	5.4	47.8	14.6
OECD & EU	2.5	4.3	4.9	5.6	14.6	14.0
South & East Asia	2.0	3.1	3.7	4.2	21.7	14.0
South America	1.6	3.0	3.6	4.7	19.5	32.2
Sub-Saharan Africa	1.0	1.4	1.4	1.5	3.7	8.1
World	1.6	2.7	3.3	3.8	22.4	16.9

Cereal yields have increased dramatically since the 1970s. Since 2011, however, growth of yields has significantly slowed. This can be seen in the Middle East and North Africa (MENA), which had a 14.76% growth between 2009 and 2019 compared with a 47.98% growth between 1999 and 2009. This represents a greater volatility in the yield in the last decade than previously seen. South America saw the largest acceleration in growth in yield at 32.2% over the last decade.

Trends

Data from the FAO suggests that the increase in improvements in yields in the last two decades can mostly be attributed to increased use of irrigation, pesticides and fertilisers, better farming practices, and the use of high yield crops. Increased growth rates, therefore, are largely due to improved technologies rather than expansions of cultivated areas.[6]

Although yield growth rates have been slowing down in recent years, this should not be taken as cause for concern given that overall food production, as outlined in indicator 1.1.1, has been increasing and is projected to continue to do so. Falling real commodity prices have reduced some of the incentives to improve yield growth at the same pace as in the late 20th century.

[6] FAO, 'World Food and Agriculture: Statistical Yearbook 2020[redacted]

The FAO estimates that global crop production will grow by 18% over the next ten years. 88% of this growth is expected to come from yield improvements. The additional output is projected to mainly originate in the Asian and Pacific region. Lower-income countries will improve their yields through better adapted seeds and improved crop management. In high-income countries, yield increases will come mainly from improvements in cultivated varieties and the adoption of precision farming technology to optimise the application of inputs.[7]

Despite the current positive status and projections for cereal yields, there are concerns about how climate variability and change will impact future yield growth rates. These risks, and how they could impact the UK's food supply chains, are discussed in further detail below.

Risk: Global dimensions of climate variability and change

The UK's food security is dependent on growing conditions in other parts of the world. Not only does the UK import 45% of the food it consumes, large parts of animal feed for the UK's domestic production are also imported. Climate variability presents a risk to the availability and stability of these supplies. The likelihood of yield reductions is expected to increase due to more frequent adverse weather conditions such as droughts, floods, and hurricanes, or due to food production being pushed out of its safe climatic space. Beyond primary production, changing climate variability may also affect the way food is processed, stored, and transported, which could impact on food quality, quantity, and prices.

Around 80% to 85% of wheat milled in the UK is home-grown, with 1 to 2 million tonnes per year imported, half of which comes from France, Germany, and Canada.[8] While typical year-to-year UK wheat yield variations are not highly correlated with those in France, Germany or Canada, simultaneous yield reductions can occur because of large-scale weather patterns that result in droughts and floods. Climate change is projected to increase the occurrence of adverse conditions including droughts and floods, and is, therefore, expected to increase the likelihood of yield shocks.

The United States and China combined provide 60% of the world's maize and are, therefore, crucial to global food security. Severe water stress is known to be a risk factor for maize production, with climate models showing up to a 6% chance per decade that these conditions could occur simultaneously in the United States and

---

[7] FAO, 'OECD-FAO Agricultural Outlook 2021-2030',[redacted]

[redacted] Statistics', [redacted]

China. These conditions are also expected to occur more frequently in the future as the climate continues to warm, increasing the likelihood of experiencing large reductions in global maize availability. While most of the 1 to 3 million tonnes of maize imported by the UK each year come from Europe, maize yield shocks in the United States and China could affect global markets and UK access to maize. Domestic production of maize is increasing, in part because of a warming climate, which may partly offset increased risk of international production shocks.

The UK typically requires 2.5 to 3 million tonnes of soybean products every year, used primarily for animal feed, human consumption, and pharmaceutical or industrial purposes. Virtually all soybean requirements are currently met by imports, the vast majority of which come from Argentina, Brazil, and the USA – the world's largest soybean producers and exporters. The high concentration of soybean production in the Americas means that global soybean supplies are vulnerable to adverse weather conditions, such as droughts and floods, which are expected to become more frequent in a warmer climate. In addition, China is the world's largest importer of soybean products, primarily for animal feed. China's increasing demand for consuming meat products fed on soybean may therefore affect the UK's access to soybeans.

Case Study 1.1 Plant diseases and pests

Overview

Plant diseases and pests have the potential to have significant impacts on global food availability. The FAO estimates that 20% to 40% of global crop production is lost annually due to plant diseases and pests. Climate change may alter the range or increase frequency of plant diseases and pest incidence. Impacts of wheat rust and Panama Disease on the world's wheat and banana production are of note for the UK's food security.

Background

More than half of the world's calories come from a limited number of varieties of three 'mega-crops': rice, wheat, and maize.[9] Plant diseases and pests affect global food availability and food security in that they can cause significant food losses, with impacts being especially severe if they affect staple food production. The FAO counts locusts, armyworm, and fruit flies among the most destructive

[9] International Development Research Centre, 'Facts and Figures on Food and Biodiversity 2010', [redacted].

plant pests, and banana disease, cassava disease, and wheat rust among the most harmful plant diseases. Climate change, trade, passenger movement, and reduced resilience in production systems due to agricultural intensification all risk increasing the spread of these diseases and pests.[10]

Discussion

The FAO estimates that 20% to 40% of global crop production could be lost because of plant and pest diseases each year.[11] A recent scientific review undertaken by the International Plant Protection Convention, which is overseen by the FAO, has concluded that climate change will likely alter or increase the risks of plant diseases and pests. These risks include range expansion or retreat of certain diseases and pests, increased risks of disease or pest introduction, as well as increased pest population growth rates. Although the overall risk trend for plant and pest diseases to occur is expected to increase due to climate change, there are some regional variations. For instance, some studies[12] show that the risk for diseases affecting rice in the Philippines may reduce. In general, most pests, weeds, and diseases tend to favour higher temperatures up to a certain threshold, which means that climate change might increase risks within a type-specific temperature range.[13]

Most recently, outbreaks of desert locust in Eastern Africa, Southwest Asia, and the Red Sea area in 2020 and 2021 caused significant impacts on crops and pasturelands. This upsurge in desert locust was caused by favourable climatic conditions. While there are various locust species, the desert locust is considered the most important species and the most destructive migratory pest in the world. Large swarms can pose serious food security risks, either locally or at a wider scale, depending on the affected region. A single square kilometre of locust swarm can contain up to 80 million adults, with the capacity to consume the same amount of food in one day as 35,000 people. Food security impacts due to desert locust in Eastern Africa have mainly been contained to the region.[14]

---

[10] FAO, 'Plant pests[redacted]https://www.fao.org/emergencies/emergency-types/plant-[redacted]

[11] FAO, 'International Year of Plant Health 2020', [redacted]

[12] Luo, Y., D.O. TeBeest, P.S. Teng, and N.G. Fabellar, Simulation studies on risk analysis of rice blast epidemics associated with global climate change in several Asian countries, Journal of Biogeography 22 (1995), pages 673 to 678; Luo, Y., P.S. Teng, N.G. Fabellar, and D.O. TeBeest, 'The effects of global temperature change on rice leaf blast epidemics: a simulation study in three agroecological zones', Agriculture, Ecosystems and Environment 68 (1998), pages 187 to 196.

[13] FAO, 'Scientific review of the impact of climate change on plant pests – A global challenge to prevent and mitigate plant pest risks in agriculture, forestry and ecosystems' (2021),[redacted]

With wheat being a key global source for food and feed, it is worth noting the impacts that various strands of wheat rust, a disease caused by fungal pathogens, can have on global food production levels. Wheat rust diseases are counted amongst the most serious biotic (meaning resulting from living organisms) risks to wheat productivity levels. The most common wheat rusts include stem rust, stripe rust, and leaf rust. While these diseases can threaten the production in any wheat-growing region, the areas currently affected or at most risk include North and East Africa, the Near East, Central Asia, and some Asian countries.[15] The FAO estimates that around 30% of global wheat production stemming from the previously mentioned regions are at risk of being impacted by wheat rust diseases. Rust diseases are also among the major concerns in more developed wheat producing countries. Due to improved technology, capacity, and awareness, however, the implementation of management strategies is easier and has reduced some risks.[16]

The FAO counts the banana as the most important fruit in the world. In the UK, too, bananas make up large parts of a person's total fruit consumption based on Kantar data. Four races of the Panama Diseases, which pose a risk to different banana varieties, have been identified to date. Due to race one of the Panama Disease, banana producers had to shift from the Gros Michel banana variety in the 1950s to the Cavendish variety used today. Race four, a more recent strain of the disease, however, can infect the Cavendish variety. With the Cavendish banana being the only traded variety, and no existing disease control available yet, this disease poses a serious risk to global fruit consumption.[17]

Indicator 1.1.3 Real agricultural commodity prices

Headline

Agricultural commodity prices reflect the results of global supply and demand for particular commodities. They are relevant both to the availability of foodstuffs and to the prices consumers pay for food. The financial crisis caused a significant price spike, followed by a gradual decline. The COVID-19 pandemic led to new price

---

[15] FAO, 'Strengthening capacities and promoting collaboration to prevent wheat rust epidemics' (2014), [redacted].

[16] FAO, 'NSP-FAO Wheat Rust Disease Global Programme', htt[redacted]

[17] Safe Food, 'The Impact of Plant Diseases', [redacted]

spikes, albeit not as severe as ten years ago. The FAO projects that real prices will return to a general downward trend once COVID-19 measures have been lifted.

Context and Rationale

This indicator reflects the global availability of agricultural commodities as it is driven by the fundamental market forces of supply and demand and exchange rate dynamics. Higher prices signal relative shortages, whilst falling prices signal improved supply or even oversupply. Higher prices give an incentive for producers to increase supplies and for consumers to reduce demand. It is partly an outcome indicator of any underlying supply issues, and a leading indicator of potential price changes to consumers.

Many factors can affect commodity prices, including favourable or poor harvests, production costs, market structure, and external factors, such as economic sanctions. The food supply chain includes the transformation of goods and the incorporation of services along the chain. Its characteristics mean that price shocks are at times absorbed by producers or passed on to consumers. In general, prices of agricultural commodities have been following long-term downward trends.[18] This has been the result of productivity improvements in agriculture and related industries, which has lowered the marginal production costs of the main food commodities. Deviations from the general trend, such as price peaks during 2007 to 2014, were temporary and did not alter the long-term declining trend.

Commodity prices send the appropriate signals when the global market is over or undersupplied. In the medium to longer-term, supply and demand of agricultural commodities would ideally be in balance and be reflected in relatively affordable prices.

Data and Assessment

Indicator: Global real prices for selected agricultural commodities

Source: UNCTAD; OECD-FAO Agricultural Outlook

---

[18] Our World in Data, 'Real commodity price index, food products',
[redacted]

Figure 1.1.3a: Commodity prices for palm oil, rice, soybeans, wheat January 1995-April 2021

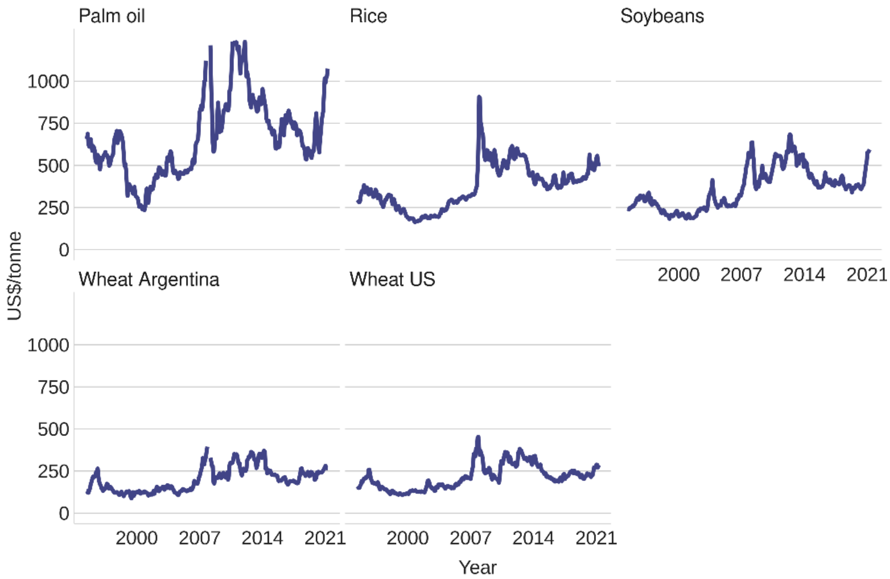


Figure 1.1.3b: Commodity prices for beef January 1995-April 2021

Figure 1.1.3c: Commodity prices for sugar January 1995-April 2021

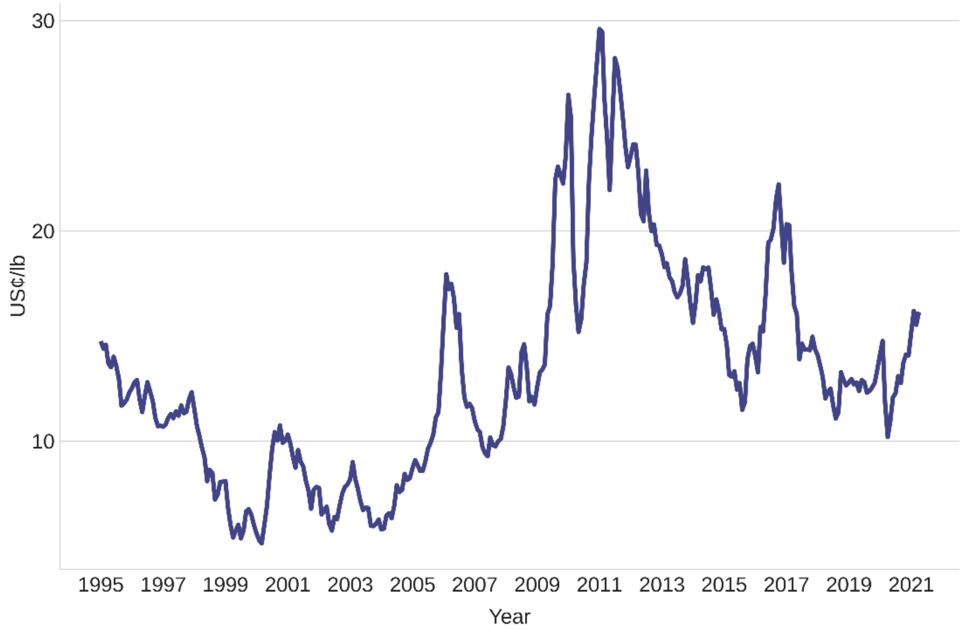
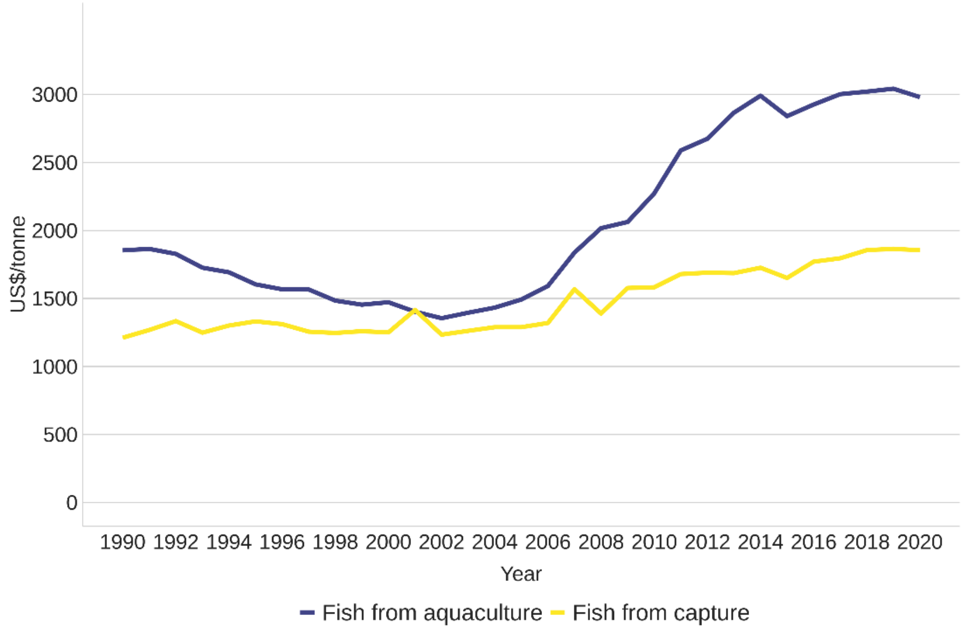


Figure 1.1.3d: Commodity prices for fish 1990-2020



There was a sharp spike in commodity prices during the financial crisis. Prices started to rise again in late 2010 and early 2011 and remained at inflated levels until early 2016. This was much longer than has been seen in previous commodity price spikes.[19] Palm oil and sugar were particularly badly affected. There have also been price spikes in sugar and beef which are not part of this general trend. The beef price has shown strong growth since the turn of the century whilst still being affected by the same variation in price as previously described. This is likely to be due to rising demand for red meat in emerging economies such as Brazil. Fish prices have risen steadily in the last decade, with a greater increase in price rises from aquaculture than from capture.

After an initial drop in the first quarter of 2020, there have been sharp commodity price rises during the COVID-19 pandemic. Beef, palm oil, soybeans and sugar have been particularly strongly affected, showing strong rises in 2021. The sugar price drop was fuelled by a slump in the crude oil price which led to a lower demand for sugar cane for ethanol production.

Trends

Global events can have a significant impact on supply and demand, which in turn affects global commodity prices. This was the case for 2020, where many of the price highs not seen since the mid-2010s experienced in commodities such as wheat, rice, soybeans, and palm oil have been attributed by the FAO to the COVID-19 pandemic. While the current situation for real commodity prices (Real prices denote the value of a commodity after adjusting for inflation expressed in constant dollars, which reflects buying power relative to a base year) means that prices are above the general downward trend, the FAO expects real prices for most commodities to decline over the next ten years. Any future events either at the global level or in agriculturally significant regions may, however, lead to unexpected price spikes.

Real wheat prices are expected to decline in the coming years based on large supplies being produced in the Black Sea region and slow growing global food demand. Assuming a return to normal growing and logistical conditions, export prices for rice, that may impact on prices in the UK, are expected to decrease to trend level by 2023, with declines thereafter promoted by ample global availabilities and intensifying competition for markets amongst exporters.

Real soybean and palm oil prices are expected to return to trend levels in the early 2000s, reflecting an increase in global supply. This is based on average production prospects in major producing countries, and the gradual elimination of COVID-19 related logistics constraints. After this correction, the declining price trend is expected to slow. This price trend will be subject to multiple uncertainties,

---

[19] FAO, 'World Food and Agriculture: Statistical Yearbook 2020', https://www.fao.org/family-farming/detail/en/c/1316738/.

such as weather variations in major producing countries and shifts in demand preferences. China's demand for soybean imports in their effort to rebuild their pork production following the African Swine Fever outbreak (see African Swine Fever case study) will also play a crucial role in determining market outcomes in the coming years.

Meat prices are anticipated to rebound from COVID-19 induced lows in 2020 and to rise moderately over the medium term as demand recovers due to the reopening of the hospitality sector. Thanks to ongoing feed productivity gains within the meat sector, feed price increases will have less of an impact on meat prices.

Real sugar prices are projected to resume their long-term decline due to productivity gains from better yields. Overall, real prices should fall below the average level of the last twenty years, when prices were under upward pressure due to competition for the land from growing biofuel crops. Some domestic policies and the dominance of few exporters, however, may result in some price variability of international sugar prices over the next ten years.[20]

Real fish prices are expected to decline slightly over the next decade, though remaining relatively high. There may be some price volatility for individual fish species due to supply and demand fluctuations. In addition, as aquaculture is expected to represent a higher share of world fish supply, prices for fish from aquaculture could have a stronger impact on overall fish price formation in international markets.[21]

Indicator 1.1.4 Stock to consumption ratios

Headline

Stored stocks of agricultural commodities serve as an important buffer against poor harvests and demand shocks. The world's stock to consumption levels fluctuate, with good harvests leading to higher stocks. Current stocks are healthy with the exception of soybeans. Poor soybean harvests or other supply disruptions

---

[20] FAO, 'OECD-FAO Agricultural Outlook 2021-2030', [redacted]/.
[21] FAO, 'The State of World Fisheries and Aquaculture 2020', [redacted]

could cause price fluctuations and present a risk to imported soy-based animal feed, an important input into UK meat production.

Context and Rationale

Stock to consumption ratios are an indicator of global resilience to food shortages and price stability. Food stocks can serve as buffers to supply or demand shocks. If stocks are low, markets become more sensitive to any potential shocks and the probability of price spikes increases.[22] Therefore, observing stock to consumption ratios can serve as an early warning for possible shortages and price spikes, and enable an early response to potential food security risks. Especially for crops, supply shocks are a regular feature of the market, which is why this indicator focuses on cereals.

Sufficient stock levels provide the market with some resilience to supply or demand shocks. It is, however, difficult to establish an ideal stock ratio as high stock levels could also indicate a structural oversupply of markets. Any changes in the stock ratio also require careful interpretation to fully understand the root causes and possible effects.

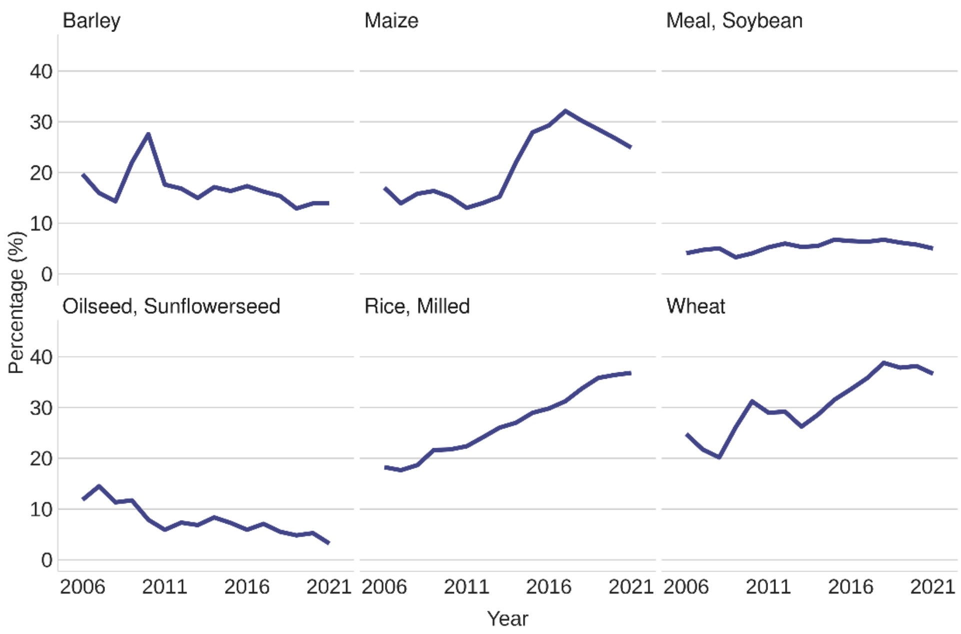
Data and Assessment

Indicator: Global stock to consumption ratios

Source: USDA

[22] Defra, 'Food Statistics in your pocket: Global and UK supply', https://www.gov.uk/government/statistics/food-statistics-pocketbook/food-statistics-in-your-pocket-global-and-uk-supply.

Figure 1.1.4a: Stocks to consumption ratio: barley, soybean, rice, maize, sunflower seed, wheat April 2006-April 2021



Since 2016, there has been a significant increase in stock of wheat, peaking in 2019 at 57.9%. This fell sharply in 2020 to 30.9% and fell again in 2021 to 27.4%, remaining, however, above the 2016 stock level of 20.3%. A similar pattern can be seen in milled rice, although that showed a sharp rebound in 2021, rising by 17.3% to 33.6%. Maize also follows a similar pattern as it has risen by 18.2% to 34.6%. There has been a sharp rebound in the stock to consumption ratio, rising by 22.5% from 12.2%.

Trends

Most stock to consumption ratios are either at or below the early 2010 levels, with rice and wheat having experienced some peaks in the years since then. Given that the record global harvest in 2008 to 2009 drastically increased stock levels at the time, slight drops in the ratio for commodities such as barley, soybean, and sunflower seeds are not of concern currently. Overall, stock to consumption ratios are at a comfortable level for most commodities, with the FAO expressing some concern for soybeans.

Overall, the stock to consumption ratio for soybean remains low compared to the past two decades, which implies that harvest failures could quickly lead to market shortages. Such a scenario could have impacts on UK farmers and their costs where soybean is used for animal feed, as almost all requirements are met through imports. Although substitutes are available, soybeans remain one of most effective animal feeds.[23]

Indicator 1.1.5 Global livestock and dairy production

Headline

Global meat production has grown significantly since 2010 and is projected to increase over the coming years. Consumption increases are likely to vary, with high-income countries potentially having reached peak meat consumption per capita, and lower and middle-income countries expected to see more increases in consumption rates. Milk production is also set to continue to increase, mainly driven by improvements in efficiency rather than increases in herd size. Animal disease outbreaks in the late 2010s have substantially reduced pig herd numbers, particularly in China.

Context and Rationale

Meat makes up an important source of nutrition for many people. Global demand for meat has grown over the last 50 years, leading to a trebling of meat production over that period. In that same time span, there has also been a geographical switch in the leading meat production sites. Asia now accounts for 40% to 45% of total global meat production, having overtaken Europe and North America as the dominant producers.

While pig meat is the most popular source of meat at the global level, the production percentage of poultry meat has seen the highest increases in the last 50 years compared to other types of meat. In the UK, poultry meat is the most popular type of meat, followed by pork and then beef.[24]

The UK is not exposed to a significant degree to changes in global availability of milk and dairy products due to a high supply-to-demand ratio for milk and only some reliance on cheese imports from the EU.

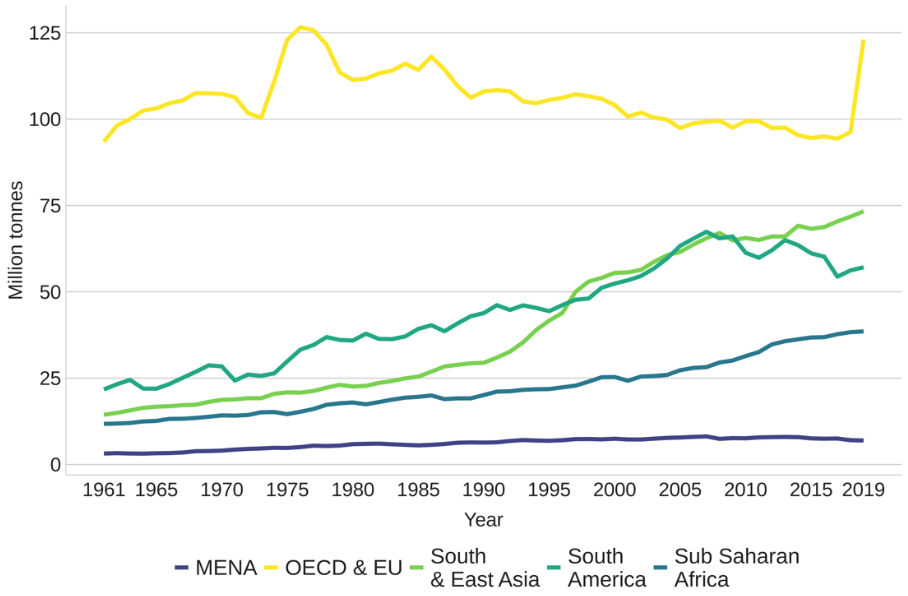
---

[23] FAO, 'OECD-FAO Agricultural Outlook 2021-2030', [redacted]

[24] Our World in Data, 'Meat and Dairy Production', [redacted]

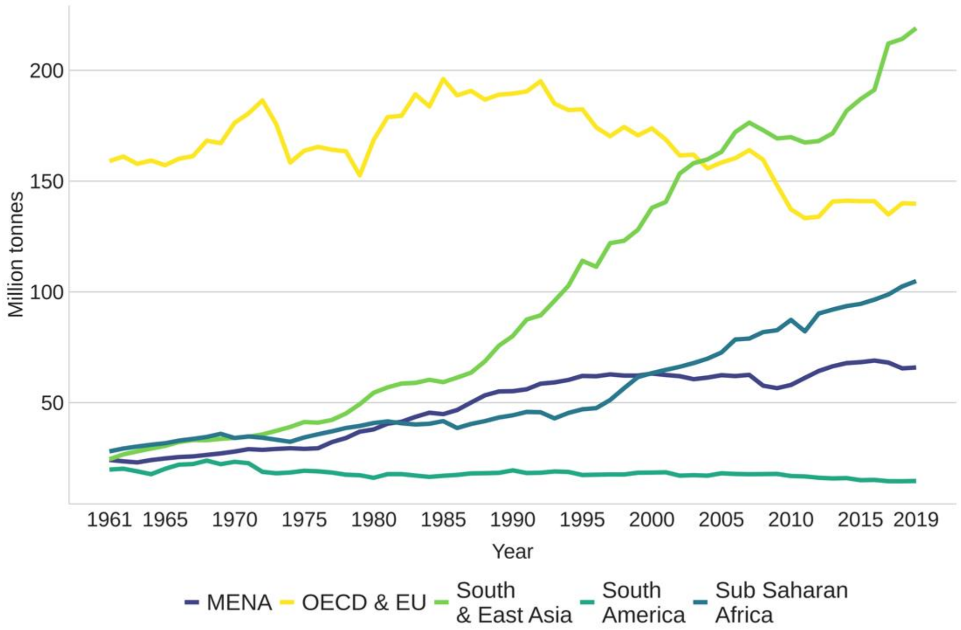
Data and Assessment

Indicator: Meat production by region; global dairy production. **Source:** FAO
Figure 1.1.5a: Million tonnes of meat by region, beef 1961-2019



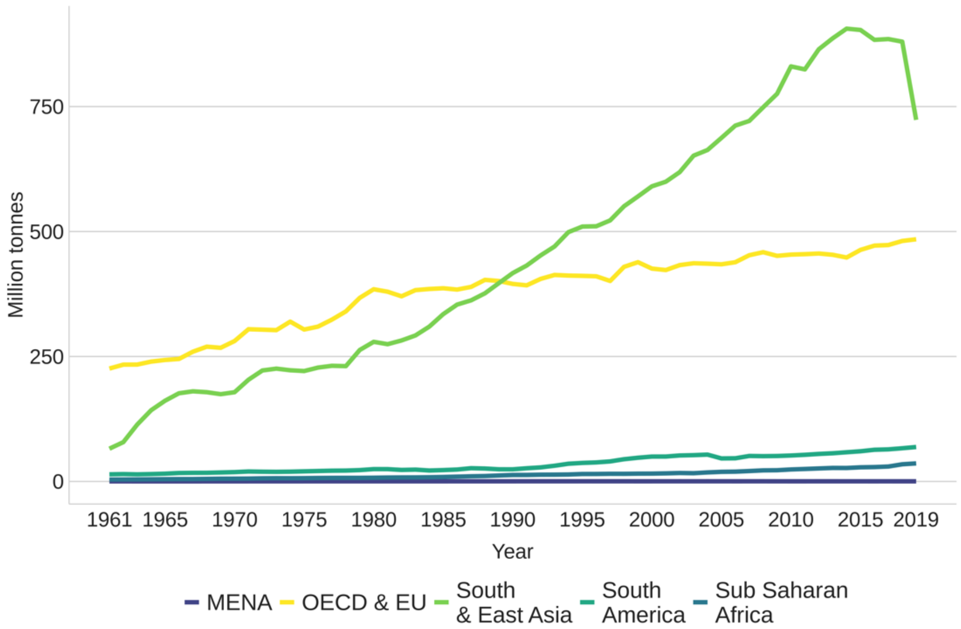
Beef production has shown growth in Sub-Saharan Africa at 22.8%, as well as in South and East Asia at 11.8%. OECD and EU countries also show a large growth in beef production, but that is due to a sharp spike in 2020 caused by a change in the way beef production is recorded. Otherwise, there has been a gradual decline between 2010 and 2019. Beef production between 2010 and 2020 fell in South America by -6.9% and the Middle East and North Africa by -8.4%.

Figure 1.1.5b: Million tonnes of meat by region, lamb 1961-2019



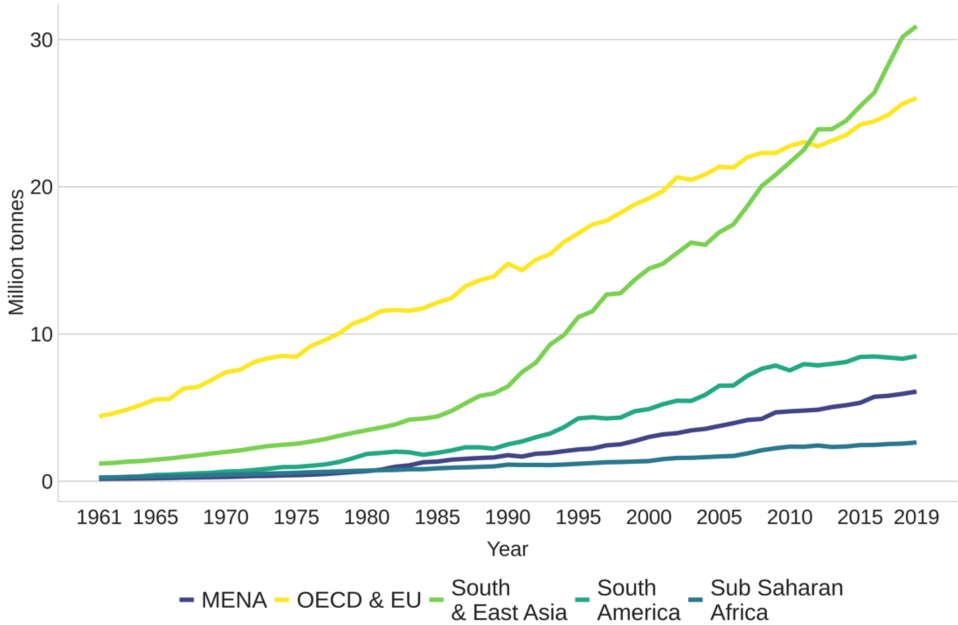
Lamb production has risen in the Middle East and North Africa by 13.6%, in Sub-Saharan Africa by 20.1%, and in South and East Asia by 29%. The dramatic rise in South and East Asia is driven by the rapid expansion of sheep farming in China. Sheep production in OECD and EU countries has grown slightly by 1.9% and fallen in South America by 13.4%. South America, it should be noted, has never been a large producer of sheep, which means that the drop in production will not be of meaningful significance.

Figure 1.1.5c: Million tonnes of meat by region, pig meat 1961-2019



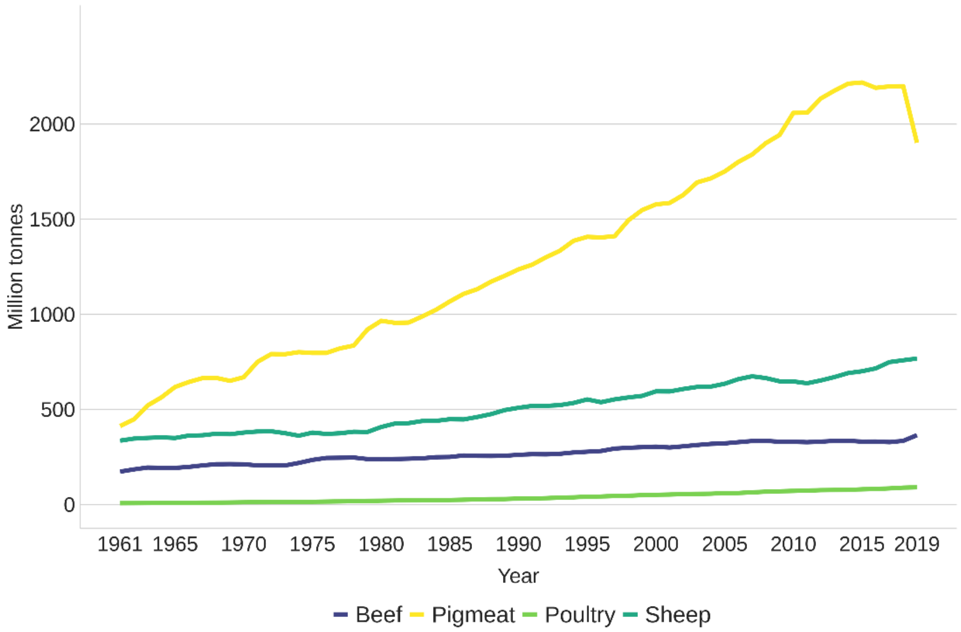
Pig meat production has risen in OECD and EU countries by 6.8%, in South America by 32.7%, and in Sub-Saharan Africa by 50.4%. In South and East Asia there was a sharp drop in production in 2019 by 12.9% due to the spread of African Swine Fever into China and South East Asia. The impacts of African Swine Fever on the global pig production are covered in more detail in the case study on African Swine Fever below. The Middle East and North Africa also fell by 4.4%, but the region is not a major producer of pigs.

Figure 1.1.5d: Million tonnes of meat by region, poultry 1961-2019



All regions have shown a rise in poultry meat production. The largest producer was South and East Asia, which also had the largest percentage rise in production at 42.7%. The next biggest producers were OECD and EU countries, which had a 14.3% rise between 2010 and 2019. The percentage rises of the other regions are 28.2% for the Middle East and North Africa, 12.9% for South America, and 12.0% for Sub-Saharan Africa.

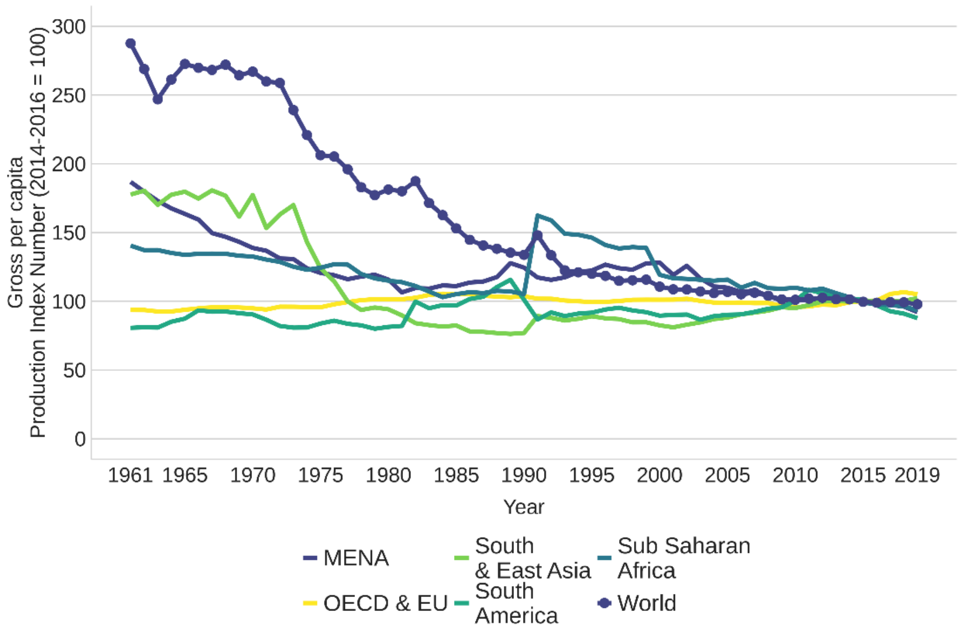
Figure 1.1.5e: Meat production tonnes global 1961-2019



Pigmeat has highest production of any meat global by a significant margin despite recent loss of production due to African Swine Fever.

Figure 1.1.5f: Milk produced per capita by region 1961-2019

(See appendix for an explanation of index numbers.)



Milk production per capita has consistently risen since 2000 in all regions until 2015. Between 2010 and 2019, milk production in South America has fallen 6.45% to 91.1. Production in the Middle East and North Africa has fallen by 9.9% to 92.2, and Sub-Saharan Africa has fallen by 15% to 93.5. There has been a rise in

OECD countries by 9.7% to 105.1 as well as in South and East Asia by 4.4% to 100.4.

Trends

While COVID-19 impacted global meat production temporarily due to logistical hurdles, reduced food services and household spend, the FAO expects global meat production to increase by 13% over the next ten years, due to increases in the number of animals and higher output per animal.

Poultry meat is projected to make up more than half of the growth in meat production levels in the next decade, with China, Brazil, and the US accounting for large parts of this growth. Following behind poultry, increases in pig meat production levels will make up a third of total meat production growth. Large parts of this increase are expected to come from the production recovery in Asian countries by 2023, particularly China and Vietnam, from African Swine Fever. Beef and sheep meat production is expected to increase the least, contributing 9% and 6% respectively to overall growth.

With global consumption patterns moving towards including more meat in diets, there is also an expected increase in the quantities of crops being used as feed. The current 1.7 billion tonnes of cereals, protein meals, and processing by-products used between 2018 and 2020 for animal feed are forecast by the FAO to increase to two billion tonnes by 2030. Overall growth rate in future is likely to be slower than in the last ten years. This reflects efforts by large meat producers to lower the protein meal share in feed. There are also some climate risks associated with the projected amount of animal feed to be produced by 2030. Maize yields, which is one of the most important commodities used as feed, alongside protein meal, are particularly vulnerable to volatility in terms of supply, price, and extreme weather events.

High-income countries already have the highest meat consumption levels. The FAO expects changes in those consumption levels to be low over the coming ten years, with some regions, such as the US and the European Union, having likely reached the saturation point in their meat consumption levels. Moreover, due to health and environmental concerns, consumers are expected to increasingly replace red meat with poultry meat and dairy products. Meat consumption increases are projected to mainly take place in developing regions due to high population levels and growth rates. Especially Africa and Asia are expected to have high growth rates in the coming years.

Risk: Impact of animal disease on meat production

Animal diseases carry a potential threat to the supply of meat and livestock related foods. Several animal diseases result in either the animal's death as a direct result of the disease, or the animal being culled for the purpose of disease control. Moreover, animal diseases carry additional risks in terms of zoonotic diseases which have the potential to transmit to the human population. There is also the risk that animal disease outbreaks could have a negative impact on consumer confidence in animal-sourced foods.

While disease outbreaks can have a marked impact on the animal population of individual countries, the UK has not experienced significant impacts on its meat supply in recent years.

Source: FAO, OIE

Figure 1.1.5g: Percentage of disease related deaths in livestock population: World 2005-2019

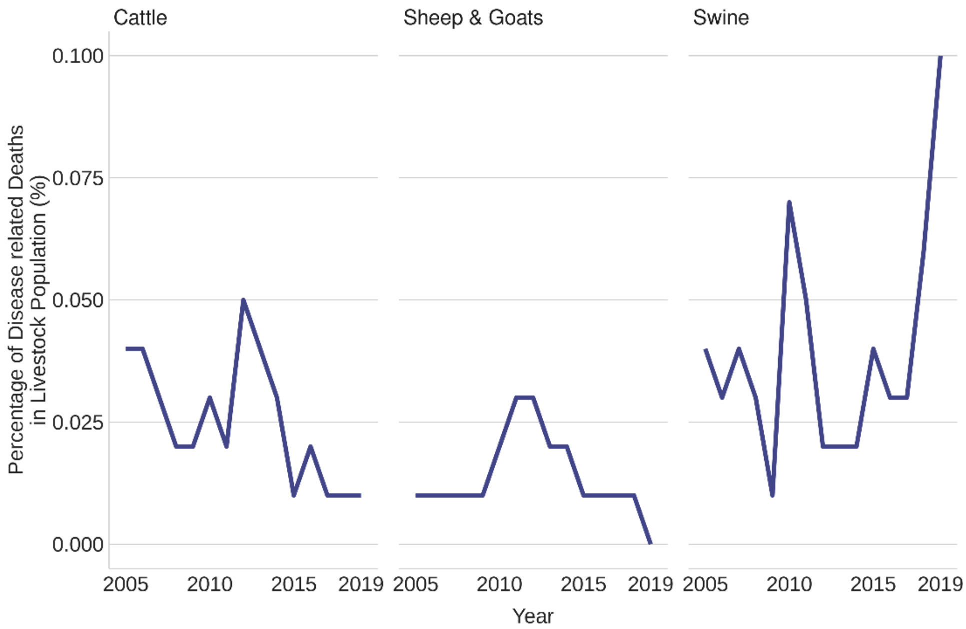


Figure 1.1.5h: Disease Deaths as a percentage of animal population: World 2005-2019

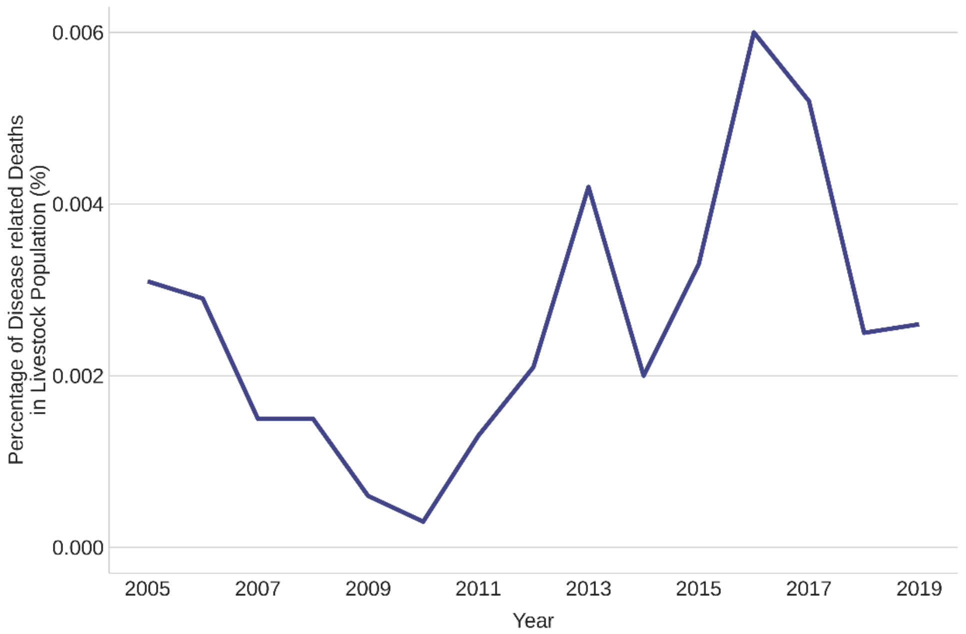


Figure 1.1.5i: Disease Deaths as a percentage of animal population: EU 2005-2019

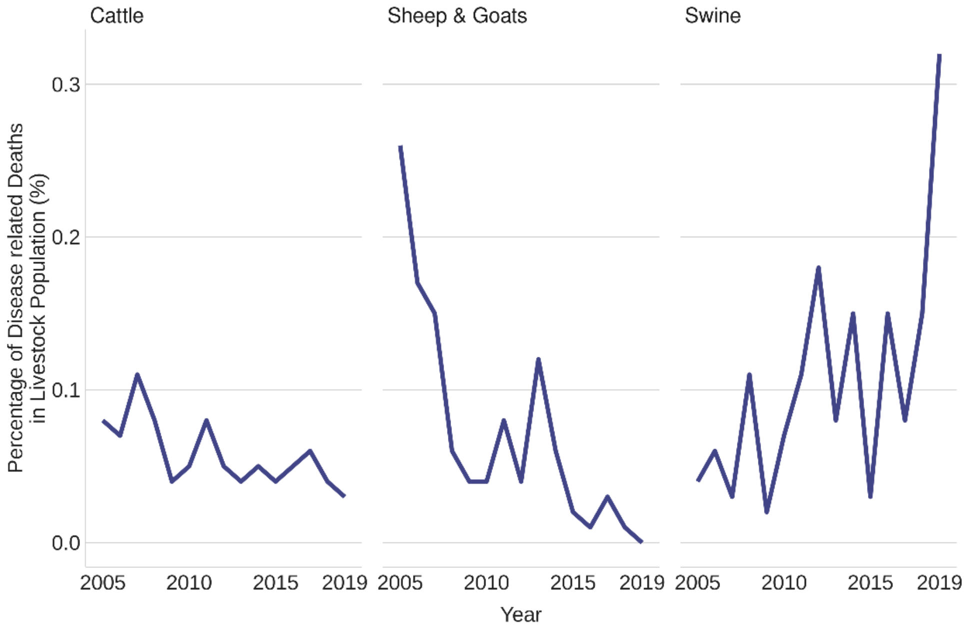
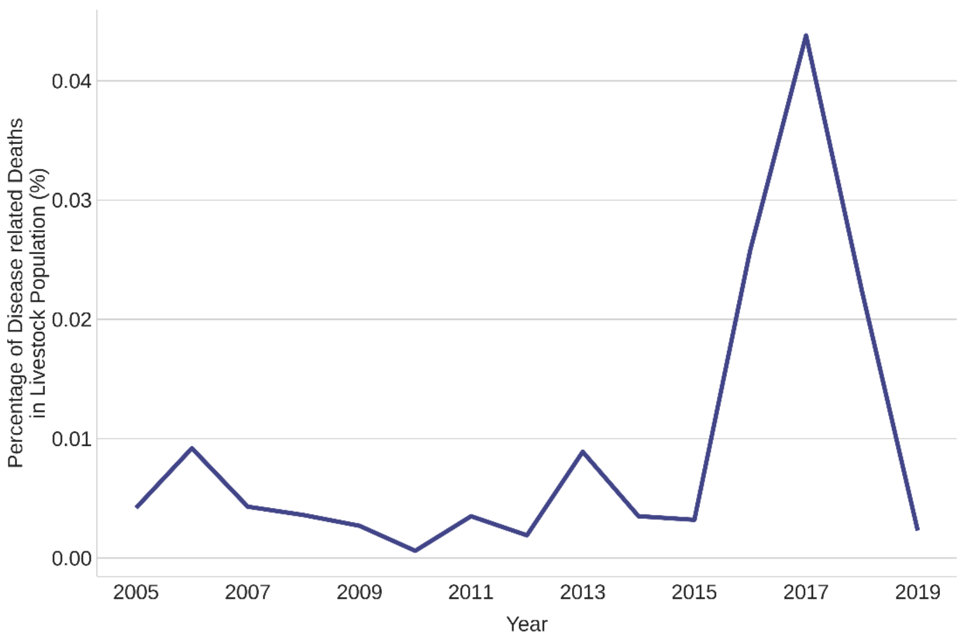


Figure 1.1.5j: Disease Deaths as a percentage of animal population: EU 2015-2019



Some of the notable animal disease outbreaks in recent years outlined in figures 1.1.5 g to j include the Avian Influenza outbreak in 2016 to 2017 in the EU and UK, which led to the culling of many birds across Europe. Most recently, the UK had to declare to the World Organisation for Animal Health (OIE) in November 2020 that the UK was no longer free from notifiable Avian Influenza following an outbreak of H5N8, highly pathogenic Avian Influenza. The Chief Veterinary Officers for England, Scotland, and Wales also agreed to impose a housing order for all birdkeepers in Great Britain from December 2020 to March 2021. Risk to public health was assessed to be low by Public Health England.[25]

The peak in pig deaths in Europe in 2011 was due to a Classical Swine Fever outbreak in Russia and the Baltic States as well as an outbreak of Aujesky's Disease. The African Swine Fever outbreak in China in 2018 had large impacts on China's domestic meat production and is discussed in more detail in the case study on African Swine Fever. The steep rise in pig deaths after 2017 is due the incursion of African Swine Fever into Eastern Europe. An outbreak of brucella melitensis in North Macedonia contributed to the particularly high mortality in sheep and goats before 2008 in Europe.

Pests, pathogens, and invasive non-native species (INNS) pose a significant threat to agriculture. Estimates of the economic costs of INNS are in the region of £1.3 billion per year in England.[26] Climate Change will likely increase these costs. For example, Bluetongue virus outbreaks in livestock may happen every year in the UK by 2070 due to milder winters.[27]

Case Study 1.2 African Swine Fever

Overview

African swine fever (ASF) is a viral disease that can be spread by live or dead pigs as well as pork products. It is not, however, a risk to human health. China has seen one of the largest ASF outbreaks, which started in 2018 and has led to 1.2 million pigs having to be culled since then. With China needing to fill domestic production shortfalls via imports, global exports to China grew drastically and led to an increase in global pig prices. This effect has started to reverse, with China restocking its pig herds, having a knock-on effect on global prices again. The UK is currently ASF-free. However, due to the geographic proximity of ASF cases in Eastern Europe and some EU countries, the risk has been at medium level since 2018 due to the possibility of the disease being imported via pork products.

---

[25] Defra, 'Avian influenza (bird flu) in Europe, Russia and in the UK', https://www.gov.uk/government/publications/avian-influenza-bird-flu-in-europe.
[26] Environment Agency, '2021 river basin management plans: Invasive non-native species challenge' (2019), https://consult.environment-agency.gov.uk/++preview++/environment-and-business/challenges-and-choices/user_uploads/inns-challenge-rbmp-2021-1.pdf.
[27] UK Climate Risk Independent Assessment, 'Technical Report: Chapter 3: Natural Environment and Assets', [redacted], page 160.

Background

African swine fever (ASF) is a highly contagious haemorrhagic viral disease of domestic and wild pigs, which is responsible for serious economic and production losses. This transboundary animal disease can be spread by live or dead pigs, domestic or wild/feral pigs, and pork products. ASF can survive for months to years in smoked, dried, cured, and frozen meat from affected pigs or wild boar. Transmission can also occur via contaminated feed and fomites (non-living objects) such as shoes, clothes, vehicles, knives, equipment, and others, due to the high environmental resistance of the ASF virus. ASF is, however, not a risk to human health

Currently there is no approved vaccine for ASF. Prevention in countries free of the disease depends on implementation of appropriate import policies and biosecurity measures, ensuring that neither infected live pigs nor pork products are introduced into areas free of ASF. As observed in Europe and in some regions of Asia, the transmission of ASF seems to depend largely on the wild boar population density and wild boars' interaction with low-biosecurity pig production systems.

Discussion

The most notable outbreak of ASF in recent years started in China in 2018. Since then, the disease has spread across many South East Asian countries, including Mongolia, Vietnam, the Philippines, India, and others. Based on FAO reports, more than 1.2 million pigs had to be culled between 2018 and 2021 in China alone. Outside of Asia and Oceania, there are also ongoing cases of ASF in wild boars and domestic pigs in Eastern Europe as well as Belgium and Germany.

The risk level to the UK was raised to medium in August 2018 and has remained at that level to-date as a result of the number of outbreaks of ASF being reported in Eastern Europe, and subsequent detection of ASF in wild boar in Belgium in September 2018. Although case numbers were higher in Asia and Oceania, the geographical distance to those outbreak sites meant that these outbreaks did not add to the risk level in the UK.

Illegal importation of infected pork meat from affected parts of Asia and Oceania, however, presents a significant route of entry of ASF virus into the UK. While it is legal to import pork products from unaffected areas of the EU, personal imports from affected countries also poses a risk as the subsequent food waste could be discarded in areas where wild boar, feral pigs, or domestic pigs could access it. Some of the risks of passengers bringing back pork products to the UK from affected countries was reduced when COVID-19 movement restrictions were in place.

At the time of publication, no ASF cases have been detected in the UK. To prevent an outbreak of ASF in the UK, the UK government has raised awareness of ASF amongst travellers via various information campaigns. In addition, the government has worked with the pig sector to ensure all the relevant biosecurity measures are being followed.

ASF occurred in the Chinese pig sector in 2018 and has had significant impact on its ability to supply China's domestic market. The volume of pigs exported to China from third countries, including the UK, increased dramatically over the period between 2018 and 2020. This increased pig prices generally.

Indicator 1.1.6 Global fish stocks

Headline

Despite some regional improvements in sustainable fishing, the over-exploitation of world fishery stocks remains a major issue. These unsustainable practices will have significant impacts on the medium- to long- term global fishing stock availability.

Context and Rationale

Over the last few decades, overall fish consumption at the global level has seen a steady increase. While the nutritional composition of fish varies between species, fish constitutes a valuable source of protein, accounting for about 17% of total animal protein consumed globally in 2017.[28] Production has increased thanks to technological improvements in the way fish is caught, processed, stored, and distributed. Demand for fish has also increased in correlation with rising incomes and awareness amongst consumers of its health benefits.

International markets and aquaculture have had significant impacts on the availability and consumption of fish. They have reduced the importance of geographical location, broadened the markets for many species, and offered wider choices to consumers, often at cheaper prices.

Threats to fish production include over-exploitation of fish stocks, water pollution, and climate change. Rising water temperatures and acidification impact marine

[28] FAO, 'The State of World Fisheries and Aquaculture 2020',
[redacted]

biodiversity and affect both the productivity and the distribution of marine fish stocks.

Data and Assessment

Indicator: Share of marine fish stocks under or moderately exploited

Source: UN Sustainable Development Goal 14, 2020

Figure 1.1.6a: Percentage of fish stocks within biologically sustainable levels, Atlantic Ocean, 2004 to 2017

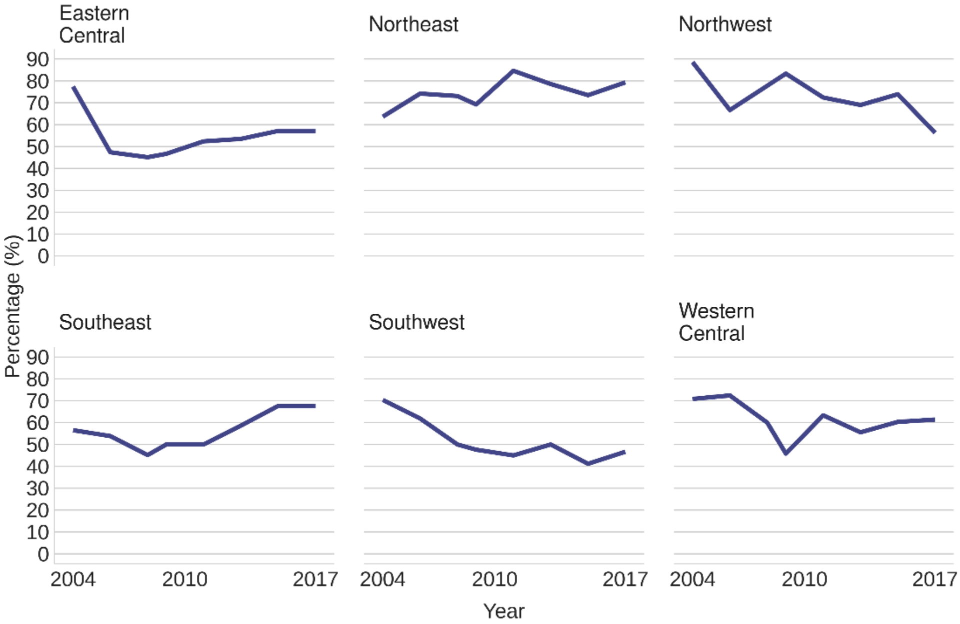


Figure 1.1.6b: Proportion of fish stocks within biologically sustainable levels, Indian Ocean, 2004 and 2017, percentage

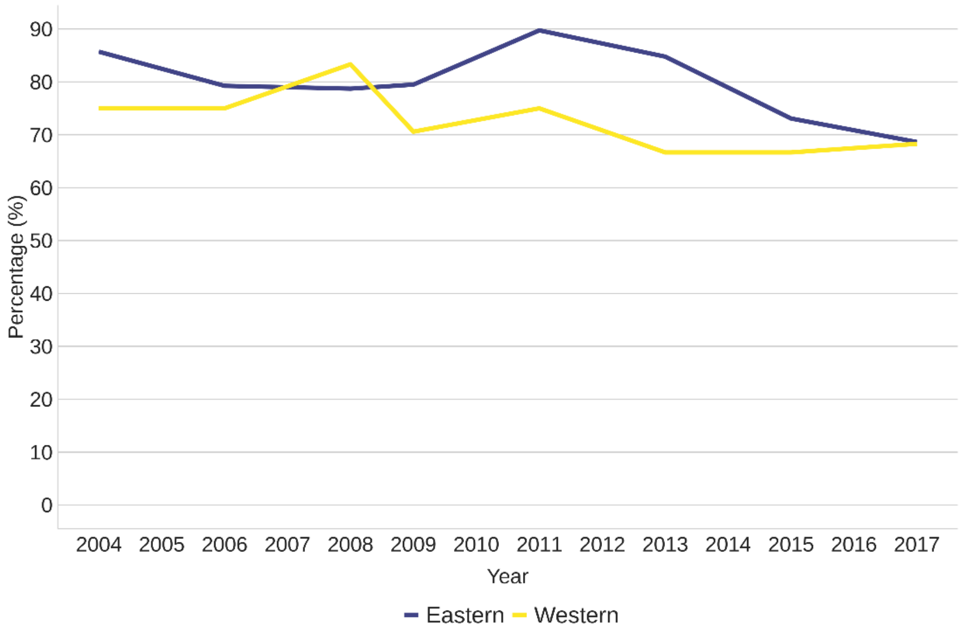


Figure 1.1.6c: Proportion of fish stocks within biologically sustainable levels, Mediterranean and Black Sea, 2004 to 2017, percentage

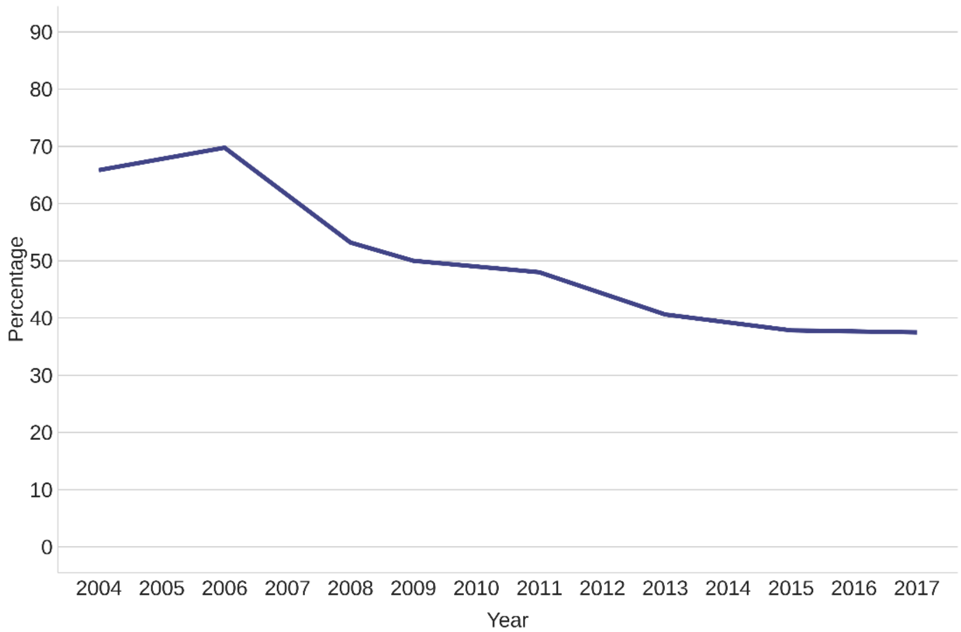


Figure 1.1.6d: Proportion of fish stocks within biologically sustainable levels, Pacific Ocean,
2004 to 2017, percentage

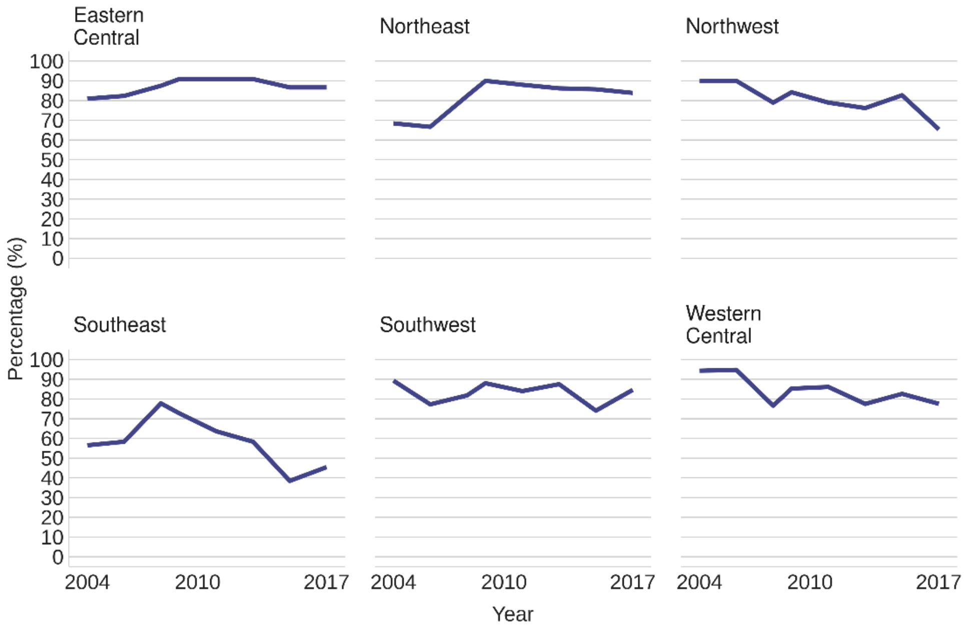
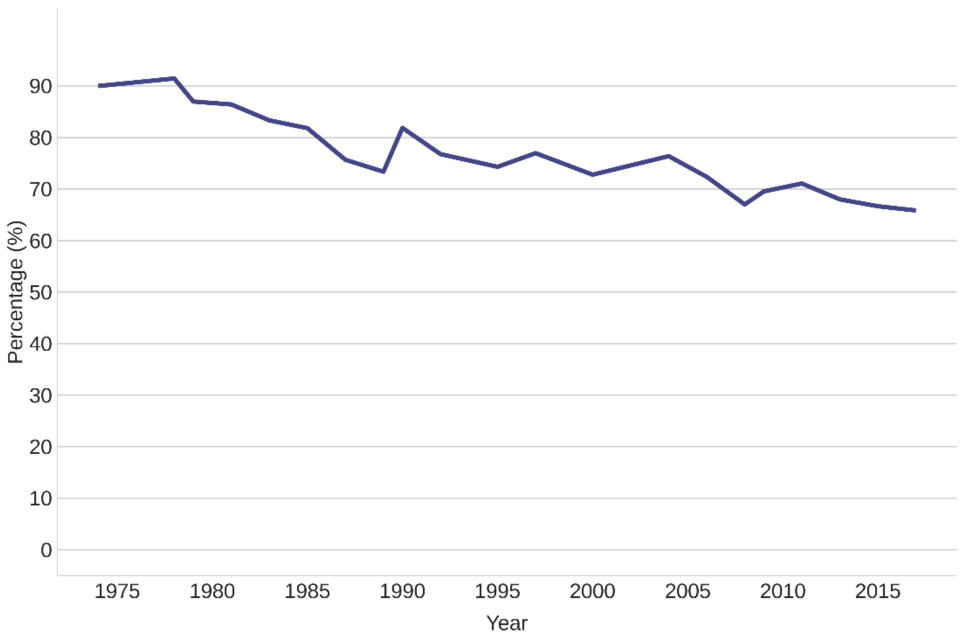


Figure 1.1.6e: Percentage of global fish stocks within biologically sustainable levels, 1974-2017



In 2013, 68% of global fish stocks were within biologically sustainable levels. This fell to 66.7% in 2015, and 65.9% in 2017 as seen in figure 1.1.6e. Between 2015 and 2017, the share of stocks fished sustainably fell at a slower rate than for the period between 2013 to 2015. Improved regulations on fishing, along with monitoring and surveillance, have proved effective in some regions. Uptake of these measures remains slow, however, particularly in developing countries, and remains a medium-term risk of collapse in stocks. Therefore, the level of sustainable fisheries varies significantly by region.

Between 2011 and 2017 there were reductions in the share of stocks fished sustainably in some regions, with large declines in the Eastern Indian Ocean of 21.1%, Pacific Southeast 18.2%, Pacific Northwest 13.6% and Northwest Atlantic 16.2%. Improvement was noted in the South-western Pacific at 0.6% - it rose 9.9% between 2015 and 2017; and in the South-eastern Atlantic of 17.7%, South-western Atlantic 1.67% and Eastern Central Atlantic 4.8%

As of 2017, marine fishing regions with the lowest share of stocks fished sustainably were the South-western Atlantic at 46.7%, South-eastern Pacific at 45.5%, and Mediterranean and Black Sea at 37.5%.

Trends

Despite regional improvements in sustainable fishing practices, the over-exploitation of world fishery stocks remains a major concern for this indicator. Over-exploitation not only creates negative ecological consequences, but also reduces fish production in the long-term. The FAO estimates that 33.1% of fish stocks were being fished at biologically unsustainable levels in 2015. These levels can differ greatly between individual fish species. The UN's Sustainable Development Goal 14.4 aims to restore fish stocks in the shortest time possible. While the trend of overfished stocks is still moving upwards, some regions, such as the US and Australia, have managed to increase the proportion of stocks fished within biologically sustainable levels.

The FAO's ten-year outlook foresees that global fish production will continue to grow, albeit more slowly than in the last ten years. This future growth in fish production will mainly stem from increased aquaculture production. Intensification, expansion into new spaces, and innovative technologies for land-based and offshore farms are expected to be the main drivers of growth. However, many factors have the potential to limit this growth, such as reduced availability of land and water, disease outbreaks, feed, and genetic resources.

Most of this growth is expected to occur in Asia, which is set to become the main producing region by 2030, with 88% of global aquaculture production and 71% of global fish production. America, Europe, and Oceania are all expected to experience growth rates under 1% per annum by 2030. These lower growth rates reflect modest growth in capture fisheries production and the lower contribution of aquaculture to total fish production in these continents.[29]

The UK is a net importer of seafood, with key species purchased at retail and out of home satisfied by imports, alongside domestic production in the case of salmon. Key species for out of home seafood consumption include cod, tuna and salmon, and prawns. In 2019, based on imported value, the top 5 imported species, accounting for around 70% of imports, were salmon, prawns (warm water and cold water), cod, tuna, and haddock.

Imported salmon and warm water prawns mainly stem from aquaculture, and their sustainability is therefore not assessed in this indicator as its focus lies on wild caught fish and seafood. Most cold-water prawns sold in the UK come from wild capture fisheries in the North Atlantic, and future supply is likely to remain stable. Most imports of cod are caught in the Atlantic, with fishing assessed by the Sea Fish Industry Authority, a UK public body, to be below maximum sustainable yield and stock biomass at full reproductive capacity. Tuna imports mainly come from the Pacific and Indian Ocean. While there are some concerns over illegal, unregulated, and unreported fishing for continued sustainability, overfishing for tuna from the Indian Ocean is assessed to be a low risk by the FAO's Indian Ocean Tuna Commission. Haddock imports largely come from the Arctic, which is not covered by the data in this indicator, and the North Atlantic. Fish stocks from both oceans is assessed to be in good condition.

Risk: Rising temperatures and ocean acidification

Projections of a 1 to 2-degree Celsius increase over a 40-year period in ocean temperatures, alongside reductions in oxygen content, foresee a decline in body size for several globally important fish species. Algal blooms, which can become toxic to fish, and an increased risk of disease outbreak, pose a further threat both to the fishing and aquaculture industry. Higher ocean temperatures also produce shifts in the distribution of aquatic species so that species can keep to their thermal or related ecological preferences. Recent evidence reviewed by the FAO indicates that poleward expansion will result in a net local increase in species richness in most places, except in tropical regions, where strong decreases in richness are expected.[30]

---

[29] FAO, 'OECD-FAO Agricultural Outlook 2021-2030', [redacted].

[30] UK Climate Risk Independent Assessment, 'Technical Report: Chapter 7: Natural Environment and Assets', [redacted]; FAO, 'The State of World Fisheries and Aquaculture 2016', [redacted]

Ocean acidification is also a risk to fish and shellfish production. Ocean acidification occurs when the pH level of the ocean is reduced. Due to the rising carbon dioxide levels in the atmosphere, more carbon dioxide is being sequestered in the oceans, leading to a more acidic pH level. Acidification particularly affects shellfish, such as oysters and clams, in that it makes building and maintaining shells more difficult. It also impacts other species vital to the marine ecosystem, such as reef-building corals that provide a habitat to some fish species.

Indicator 1.1.7 Global land use change

Headlines

Although the changes in global land use have been minimal over the last decade, even small changes in the way land is used can have significant impacts on biodiversity levels and ecosystems. Any losses in these areas could lead to negative consequences for global agricultural production.

Context and Rationale

Global agricultural production can not only be increased by improved yields (as outlined in indicator 1.1.2), but also by converting more land to farmland. Over the last twenty years, however, there has been very little change globally in the share between agricultural, forest, and other land. Given that total agricultural production has been increasing over the same period, this indicates that food is being produced more efficiently, requiring less land resources.

Land use has become one of the central environmental concerns. Agricultural production, while fundamental for human well-being, also has significant impacts on biodiversity, ecosystems, and climate change. The challenges of reversing biodiversity declines, preventing further outbreaks of zoonotic diseases, and mitigating climate change, while producing sufficient food to ensure zero hunger, must be resolved together.

Biodiversity plays a vital role in food production. For instance, more than 75% of the leading types of global food crops rely to some extent on animal pollination for yields and / or quality. Therefore, making land use systems sustainable is central to securing continued global food availability.

Data and Assessment

Indicator: Global land use change

Source: FAO

Figure 1.1.7a: Agricultural land-use change 1961-2019

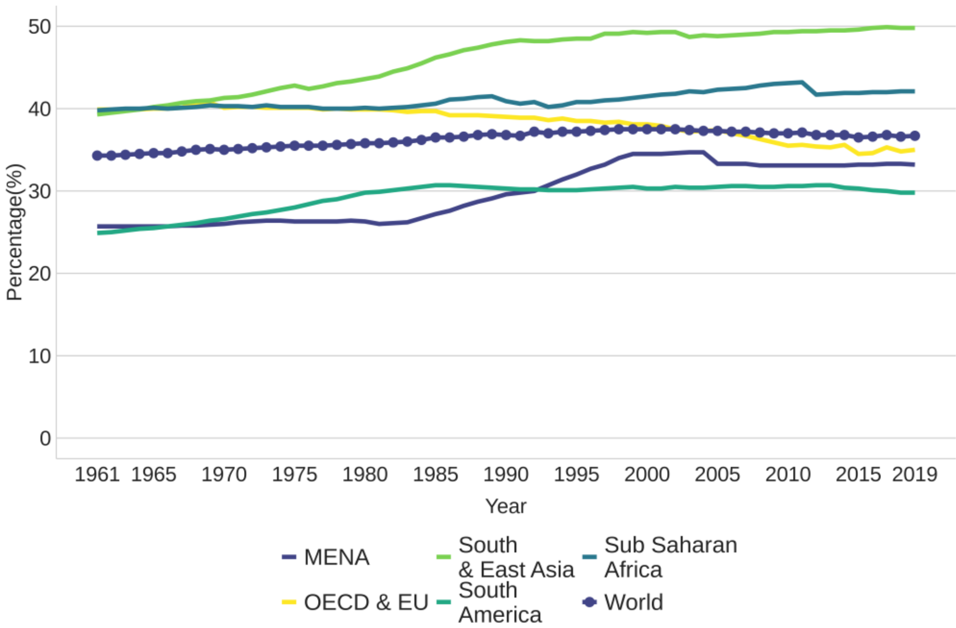


Figure 1.1.7b: Crop land-use change 1961-2019

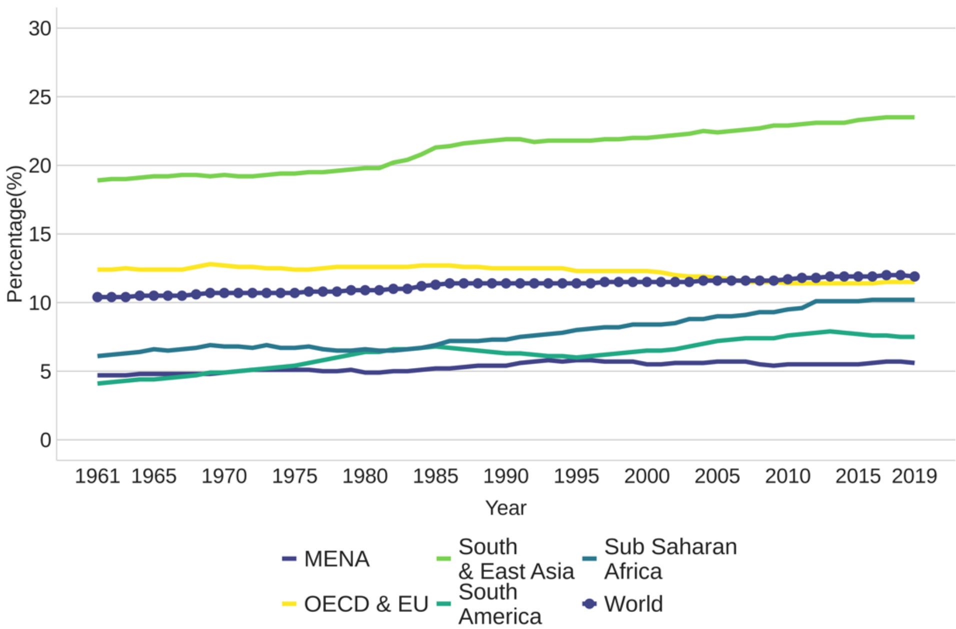


Figure 1.1.7c: Land used for pasture change 2002-2019

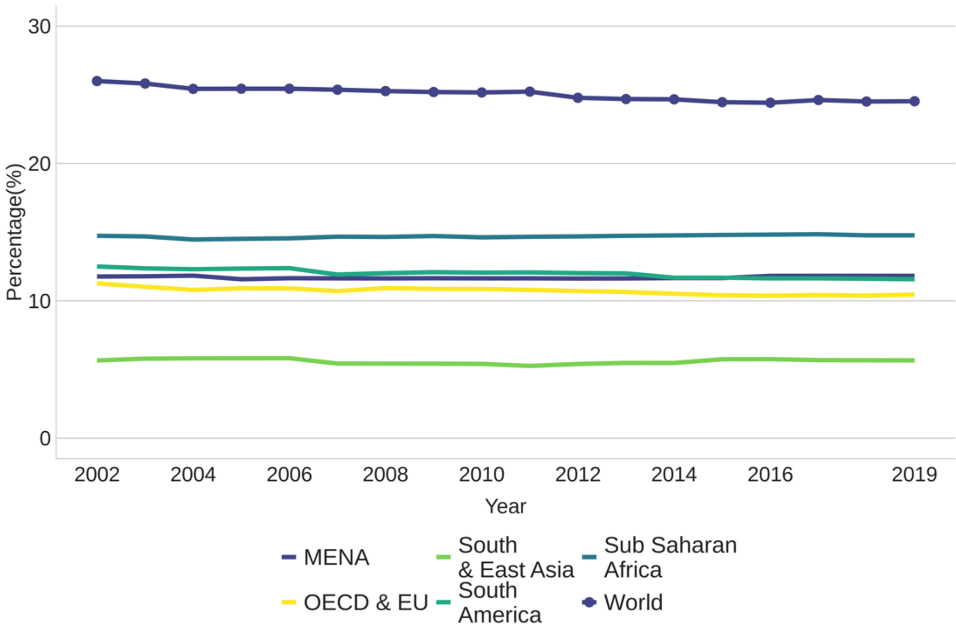
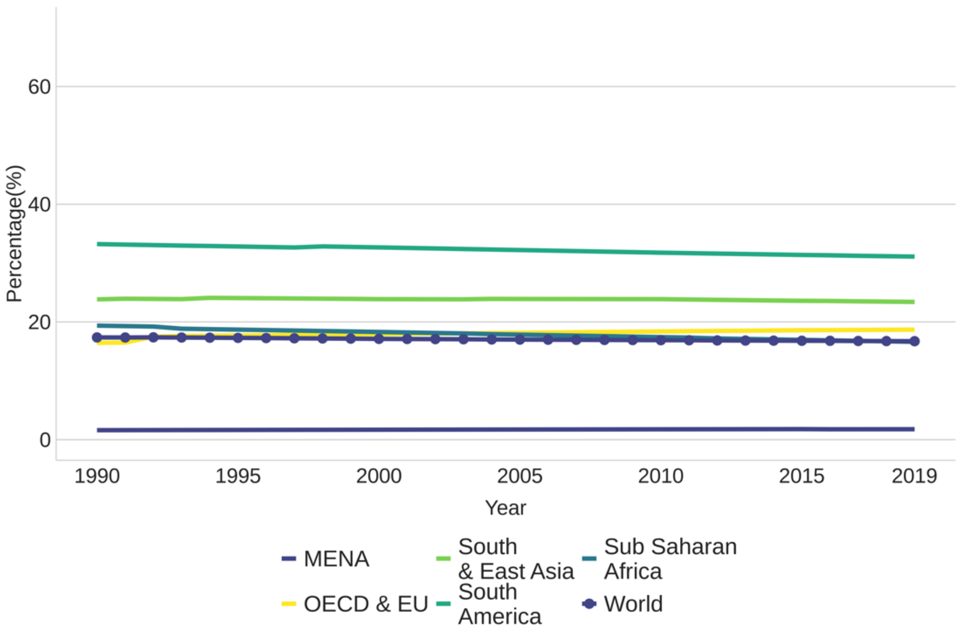


Figure 1.1.7d: Forestland-use change 1990-2019



The amount of global agricultural land has remained relatively constant, with relevantly little decline in forest and permanent pastures over the last couple of decades. There has been an increase in cropland and land under irrigation in this period. However, the majority of the increase in food production is down to increased yields rather than increased land area used for agricultural production.

In OECD and EU countries, there has been a marked decline in the amount of land used for agriculture from 39.9% in 1961 to 35% in 2019. Since 2010, the percentage for the Middle East and North Africa has risen by 0.1% to 33.2%, in Sub-Saharan Africa it has fallen by 1% to 42.1%, in South and East Asia it has risen by 0.5% to 49.8%, and in South America it has fallen by 0.8% to 29.8%. The change in South America is the most significant change in agricultural land use since 2010.

In OECD and EU countries, cropland has fallen by 1% since 1961 to 11.4% in 2019, and risen by 0.1% since 2010. Since 2010, the percentage for Sub-Saharan Africa has risen by 0.7% to 10.2%, in South and East Asia it has risen by 0.6% to 23.5%, in South America it has decreased by 0.1% to 7.5%, and in the Middle East and North Africa it has risen by 0.1% to 5.6%. The increase in the Sub-Saharan Africa is the most significant change in cropland use since 2010.

In OECD and EU countries, pastureland has fallen by 0.4% since 2010 to 12% 2019. Since 2010, the percentage for the Middle East and North Africa has risen 0.1% to 15.3%, in Sub-Saharan Africa it has fallen by 0.8% to 16.3.%, in South and East Asia it has risen by 0.1% to 13.5%, and in South America it has fallen by 0.4% to 12%. The decrease in Sub Saharan Africa is the most significant change in pastureland use since 2010.

In OECD and EU countries, forestland has risen by 0.2% since 2010 to 32.7% 2019. Since 2010, the percentage for the Middle East and North Africa has risen 0.1% to 2.1%, in South and East Asia it has risen by 0.4% to 29.3%, in South America it has fallen by 1.3% to 48.2%. and in Sub-Saharan Africa it has fallen by 1.6% to 26.6%. The decreases in South America and Sub-Saharan Africa are the most significant changes in forestland use since 2010.

Trends

Although land use change has been relatively stable in the last few decades, there has still been an overall decline in forest land between 2000 and 2018 of 89 million ha, or expressed in percentages, a drop from 32.2% of forest land to 31.2%.[31] While not indicated in the data, forest land is of ecological significance for a variety of reasons, including biodiversity. The Dasgupta review from 2021 points out how intrinsically linked human wellbeing is to nature's diversity, but acknowledges how difficult it is to measure the 'worth' of nature as a whole due to people's failure to understand some of the hidden benefits nature is providing to

[31] FAO, 'World Food and Agriculture: Statistical Yearbook 2020', [redacted]

humanity. Therefore, even slight declines in forest land should be of concern due to the known and unknown consequences they will have for the world.

The FAO expects that agricultural land use will remain at current levels during the coming decade as an increase in cropland offsets a decrease in pastureland. Most regions will see a decline in overall agricultural land, except for Latin America, which will see the most substantial increase, followed by the Near East and North Africa with a minor growth in land use. Out of the Latin American countries, Brazil will see the highest increase in crop land, while at the same time, its forest land is projected to decrease by about 4%. This is likely linked to increased meat production in Brazil.

Expansion of cropland is projected to account for 6% of total growth in crop production over the next decade. Cropland expansion will continue to be less important for overall food production levels as the transition to more intensive production systems is foreseen to persist. The largest expansion of cropland is likely going to take place in Latin America, where profitable large-scale farms are expected to attract investments for cultivation of new land.

The largest decline in pastureland is projected for Asia and the Pacific region due to the expected substitution from ruminant to non-ruminant production. There is an expected switch to pig meat, following the recovery from African Swine Fever, and poultry, which require less pastureland.[32]

Risk: Land degradation and biodiversity loss

Agricultural expansion is the most widespread form of land-use change. Currently, over one third of the terrestrial land surface is used for cropping or animal husbandry.[33]

The UN Environment Programme lists land use change as the most important direct driver of land degradation and loss of biodiversity on land, as well as the most important driver impacting freshwaters.

Agricultural expansion through clearing or conversion of forest, shrub land, savannah, and grassland has been responsible for substantial CO_2 emissions,

---

[32] FAO, 'OECD-FAO Agricultural Outlook 2021-2030', [redacted]

[redacted] [redacted] 'Summary for policymakers of the global assessment report on biodiversity and ecosystem services', [redacted], page 12.

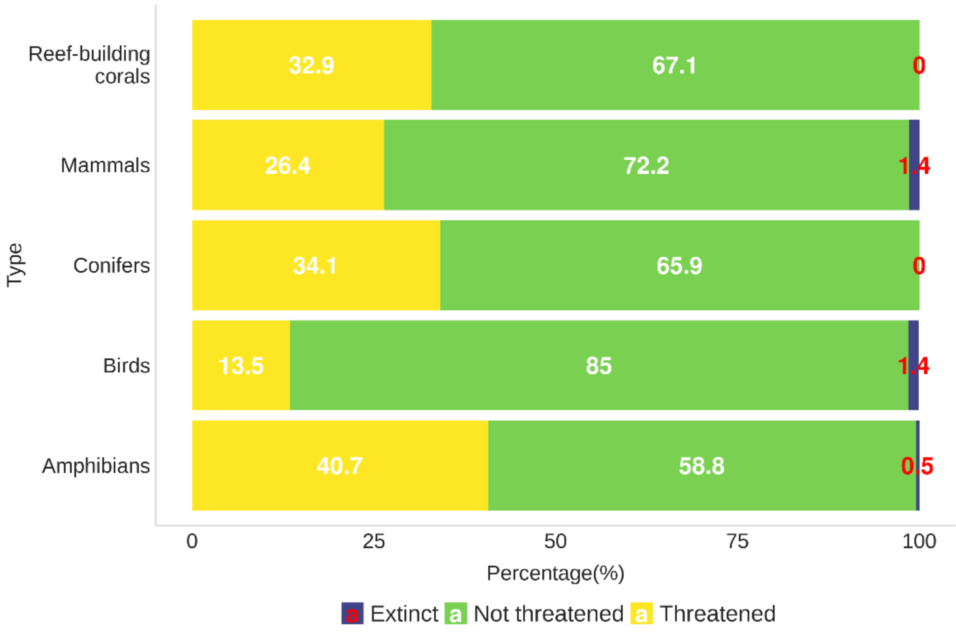
including from the loss of carbon sinks, and is associated with negative effects on biodiversity.

Agriculture relies on biodiversity for the provision of essential ‘ecosystem services’. These services are vital to human well-being and include crop pollination, water purification, flood protection, and carbon sequestration. Globally, these ‘services’ are worth an estimated $125 to 140 trillion per year, more than one and a half times the size of the global GDP.[34]

Different agricultural practices have both advantages and drawbacks. Less intensive forms of agriculture can promote biodiversity within the farming system but require more land for an equivalent food output. Conversely, more intensive forms of agriculture require greater inputs of energy, fertilisers, and feeds, but can provide significant yield benefits per unit of land. They are inherently biodiversity-poor, as increased use of fertilisers and pesticides, specialisation, and rationalisation can contribute to a loss of both semi-natural habitats and species abundance. As these agricultural practices require less land, however, they can contribute to habitat creation elsewhere.

Source: UN Sustainable Development Goal 15

Figure 1.1.7e: Best estimates of the proportions of species threatened with extinction in the Red List Index, by species group, 2021



[34] OECD, ‘Biodiversity: Finance and the Economic and Business Case for Action’ (2019), [redacted]

The UN reports that human activities are causing biodiversity to decline faster than at any other time in human history. Countries participating in the UN Sustainable Development Goals have fallen short on their 2020 targets to halt biodiversity loss. The Red List Index of the International Union for Conservation of Nature, as shown in figure 1.1.7e, monitors the overall extinction risk for various species. The figure shows an overall % decline since 1993 of 10%. Among 134,400 species assessed, 28% (more than 37,400 species) are threatened with extinction, including 41% of amphibians, 34% of conifers, 33% of reef-building corals, 26% of mammals and 14% of birds. The main drivers of species loss are agricultural and urban development, unsustainable harvesting through hunting, fishing, trapping, and logging, and invasive alien species.[35]

Indicator 1.1.8 Phosphate rock reserves

Headline

Phosphate rock is the only large-scale source of phosphorus, an essential element for plant growth and an important chemical fertiliser. The UK has no phosphate reserves and relies on imports; Exploitable reserves of phosphate rock have increased since 1995. At the same time, some regions, including the UK, have reduced their use of phosphate rock as a fertiliser while increasing agricultural production. Many countries are also in the process of making more efficient use of phosphate rock, which could reduce the demand for this type of fertiliser.

Context and Rationale

Phosphorus is an essential element for life, second only to nitrogen as the most limiting element for plant growth. Food production everywhere is dependent on the availability of phosphorus for plant uptake in an available form. Over the past century phosphate rock has been one of the main sources of phosphorus for agriculture but is limited to certain geological deposits, which makes this both a finite and important resource globally. It is conventionally added to the soil in preparation for plant uptake and can take many years to increase or decrease soil reserves. A deficiency of phosphate lowers crop yield and quality, a surplus of phosphate can lead to environmental pollution.

[35] UN, 'Sustainable Development Goal 15', h[redacted].

Phosphorus cannot be produced, unlike nitrogen or potassium, the two other main fertilisers. In addition, phosphate rock is a geologically finite resource and is also a geopolitical issue due to the location of phosphate rock deposits. The UK solely relies on imports of phosphate rock to meet its demands. It is desirable in the medium to long term to transition away from consuming finite resources and instead focus on more sustainable ways of providing phosphorus for the food chain, such as the increased use of manure. More details are provided on the sustainability aspect in a UK context in **Theme 2**.

Data and Assessment

Indicator: Phosphate rock reserves relative to production

Source: US Geological Survey [36]

Figure 1.1.8a: Phosphate Rock Production and reserves from US Geological Survey (USGS)

	Production			Reserve Base			Global share	
	1995	2019	Change	1995	2019	Change	Production	Reserves
	Mt	Mt	%	Mt	Mt	%	%	%
World	131	227	73	34,000	71,000	109		
USA	44	23	-48	4,400	1,000	-77	10.1	1.4
Algeria		1			2,200		0.4	3.1
Australia		3			1,100		1.3	1.5
Brazil	4	5		370	1,600		2.2	2.3
China	21	95	352	210	3,200	1424	41.9	4.5
Egypt		5			2,800		2.2	3.9
Finland		1			1,000		0.4	1.4
Israel	4	3		180	57		1.3	0.1
Jordan	5	9		570	800		4.0	1.1
Morocco / W Sahara	20	36	80	21,000	50,000	138	15.9	70.4
Russia	9	13	44	1,000	600	-40	5.7	0.8
S Africa	3	2		2,500	1,400		0.9	2.0
Saudi Arabia		7			1,400		3.1	2.0
Tunisia	7	4		270	100		1.8	0.1
R of W	14	20	43	3,500	3,743	7	8.8	5.3

[36] The US Geological Survey (USGS) defines global reserves as Reserves, referring to the world supply, which can be profitably extracted with present technology and prices, and Base Reserves, which is the total quantity of known phosphate rock deposits, regardless of whether it can be profitably extracted at present. However, there is no accepted worldwide system for classifying phosphate rock reserves and resources, so those summarised here should not be taken as definitive. Apart from the Reserves and Base Reserves distinction, data does not differentiate reserves according to cost-effectiveness of extraction. The higher the price of phosphate, the more economical it becomes to invest in extracting less accessible reserves.

Mt= million tonnes https://www.usgs.gov/centres/nmic/phosphate-rock-statistics-and-information

Source: FAO, World fertiliser trends and outlook to 2022, (2019)

Figure 1.1.8b: Anticipated world balance of nitrogen (N), phosphate (P2O5), and potassium (K2O) for 2022, Europe

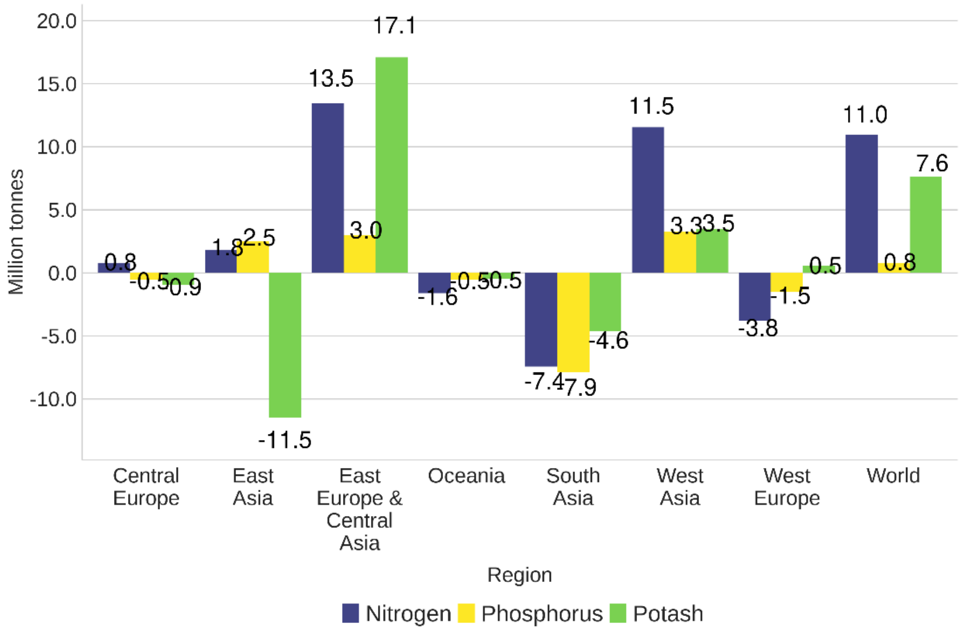
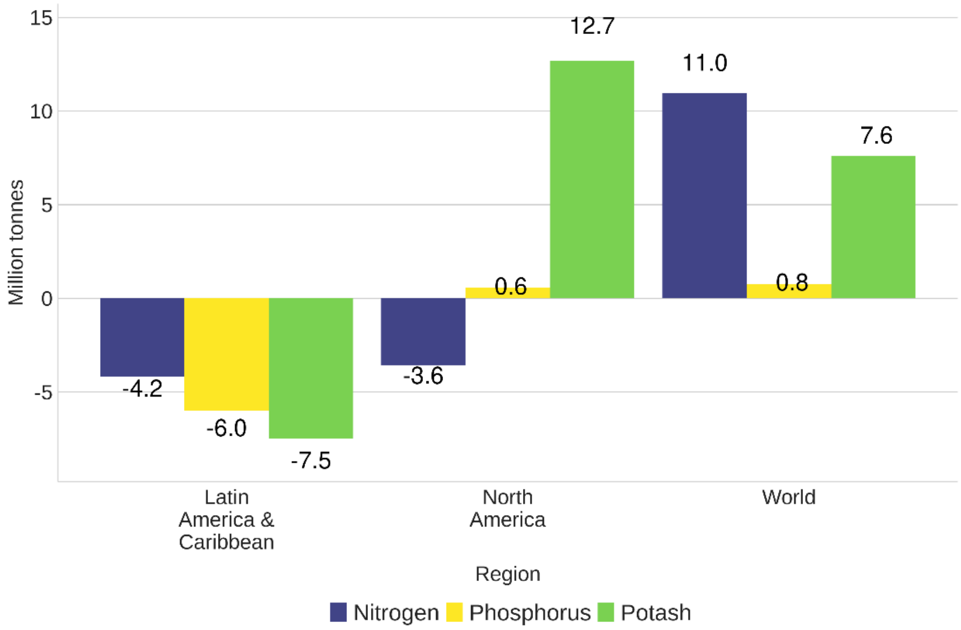


Figure 1.1.8c: Anticipated world balance of nitrogen (N), phosphate (P2O5), and potassium (K2O) for 2022, Americas



World reserves have increased on average and this means that the risk of running out of phosphate rock resources is low.

Volatility in the global supply of rock phosphate is likely to be affected more by global supply chain risks such as financial crashes, geopolitical decision making, or environmental regulations than by the reserve base itself.

From the USGS estimated figures in figure 1.1.8a, there was a 73% increase in production and a 109% increase in the reserve base from 1995 to 2019. This suggests that there is no significant risk in the short to medium term supply of phosphate rock from global reserves.

The location of key reserves remains in a selection of key countries, namely Morocco, China, the US, and to some extent Russia and South Africa.

In areas with historically high phosphate use such as the UK, soil reserves are high and food production continues to increase despite decreasing use of inorganic phosphate fertilisers from phosphate rock. This is further illustrated in figure 1.1.8b, which shows the differences of phosphate use between different global regions.

More efficient use of phosphate fertiliser, increased use and availability of recycled phosphate from organic materials, such as anaerobic digestate, animal manures, and sewage sludge, will mean a higher percentage of phosphate requirements in certain countries could be replaced by organic sources.

Trends

With world reserves of phosphate rock having increased, as well as the fact that some regions have managed to increase food production while decreasing phosphate rock use, the current and future status for this indicator is positive. In addition, the UK and other countries are also working toward making better use of phosphate fertiliser, which could further extend the availability of phosphate reserves.

According to the USGS, the rated capacity of global phosphate rock mines is projected to increase to 261 million tons in 2024 from 238 million tons in 2020, including production of marketable phosphate rock in China of between 80 million and 85 million tons per year. Most of the increases in production capacity are planned for Africa and the Middle East, where major expansion projects are in progress in Algeria, Egypt, Guinea Bissau, Morocco, Senegal, and Togo.

World consumption of phosphate rock is projected to increase to 49 million tons in 2024 from 47 million tons in 2020. Asia and South America are expected to be the leading regions of growth.[37]

Indicator 1.1.9 Water withdrawn for agriculture

Headline

Water is essential to food production. Agriculture accounts for around 70% of fresh water withdrawn (from rivers, reservoirs, or groundwater extraction) globally. Water withdrawals for irrigation have increased globally, most significantly in OECD and EU countries, but have declined in the Middle East and North Africa. Climate change is likely to increase the importance of irrigation relative to rainfed agriculture and increase pressures on water withdrawals.

Context and Rationale

The principal sources of water resources for agriculture are rainfall and 'stored' sources, mainly surface water (rivers and lakes) and groundwater (shallow and deep aquifers). Rainfed agriculture relies on precipitation water that does not run over the surface in the form of streams (and subsequently rivers and lakes) or soak down to enter groundwater reservoirs. Irrigated agriculture relies on drawing freshwater from surface water or groundwater sources in competition with other sectors and human activities.

Rainfed agriculture is facing the greatest challenges from changing weather patterns resulting from climate change. These challenges include droughts, floods, and extreme rainfall and weather events. Precipitation anomalies on grazing lands are also a threat to livestock production.

A majority of world agriculture currently relies on rainfall rather than irrigation. However, irrigated agriculture plays a crucial role in global food supply. Low-income and lower-middle income countries as well as landlocked developing countries heavily rely on water withdrawals for agriculture compared to other sectors, such as industries and municipalities. Irrigation leads to a fall in the overall volatility of agricultural output, raises cropping intensity and encourages the

[37] USGS, 'Mineral Commodity Summaries [redacted].

cultivation of high-value crops. Irrigation is an important source of global agricultural output growth. Agriculture is by far the largest user of freshwater, accounting for more than 70% of global withdrawals of water, which are continuing to increase. In the past two decades, industrial withdrawals have declined, while municipal withdrawals have increased only marginally since 2010. Agricultural withdrawals have continued to grow at a faster pace, although more slowly since 1980, and the share of agricultural withdrawals has increased slightly since 2000.

Demand for water resources does not only come from agriculture, but also from other industry sectors and a human need for water to meet drinking and sanitation needs. There is increasing concern about how these various demands will be met going forward alongside threats from climate change that could diminish water availability and increase demand in some sectors and regions. Therefore, this indicator considers one aspect of this wider issue, the amount of water withdrawn for agriculture. Water challenges, in the form of physical lack of freshwater and inadequate infrastructure or shortages through inadequate rainfall, affect different regions to greater or lesser extents.

There has been a strong trend towards the use of more water efficient crops and better water management practices. Higher water efficiency can also be gained by using nitrogen-based fertilisers.

Data and Assessment

Indicator: Agricultural water withdrawal

Source: World Resources Institute (WRI); FAO Statistics

Figure 1.1.9a: Agricultural water withdrawal, by region m³/year

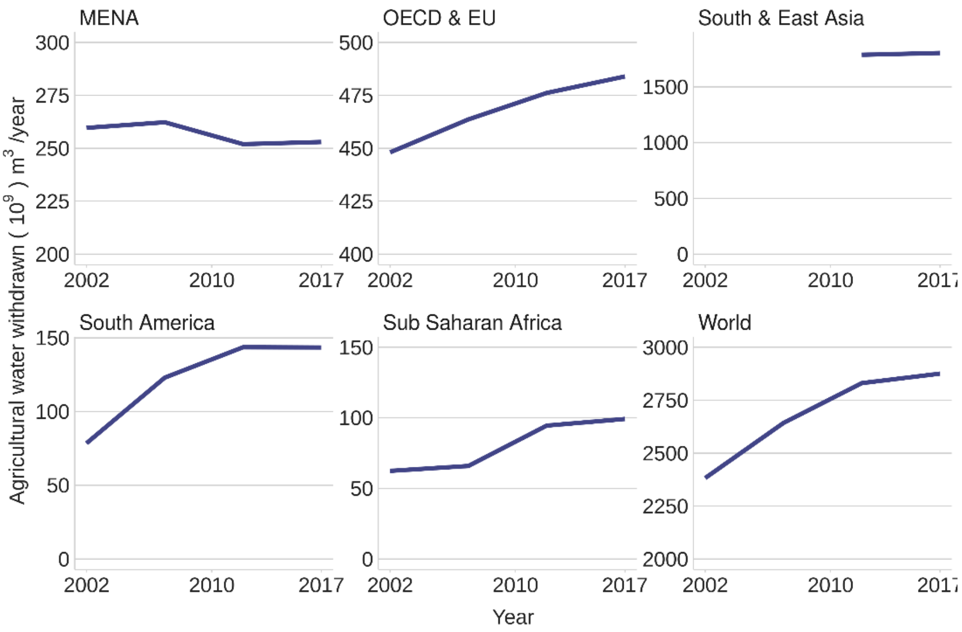


Figure 1.1.9b: Percentage change of irrigated land area by region

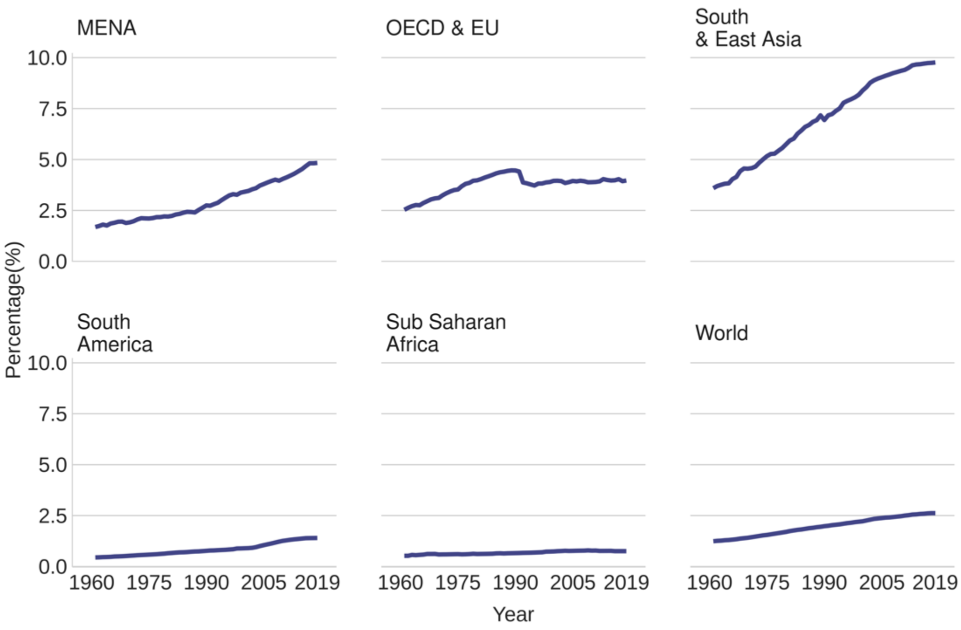
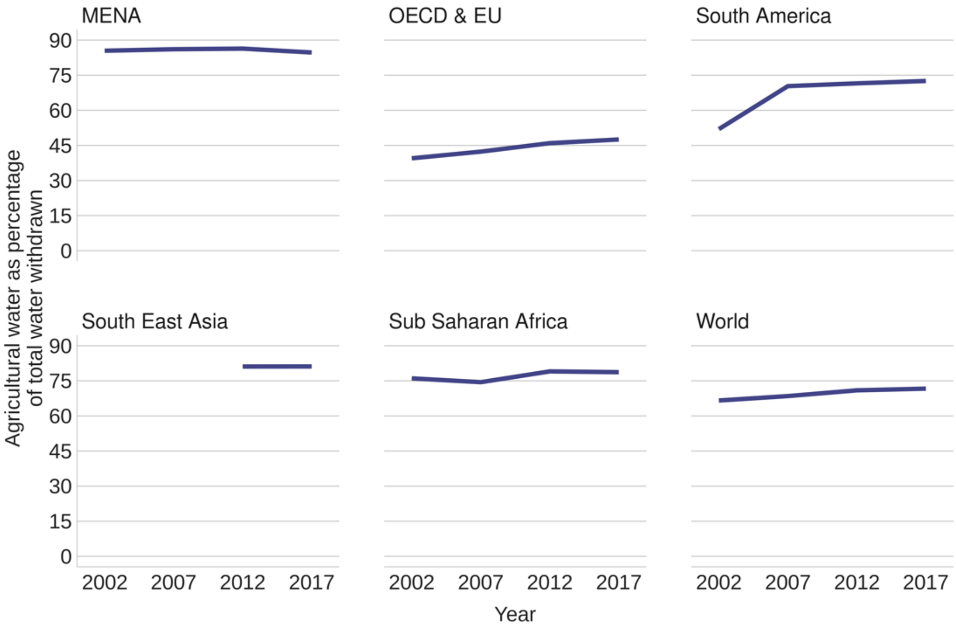


Figure 1.1.9c: Water withdrawal for use by agriculture as a percentage of total internal renewable water resources



Water extracted for agriculture has risen in all regions except the Middle East and North Africa, which has seen a small fall of 3.5% between 2007 and 2017 as seen in figure 1.1.9a. Note that each region has been plotted on different scale for clarity.

Sub-Saharan Africa has seen the largest rise in water extraction since 2007 with a 50.5% rise in usage, followed by South America with 16.6% and OECD and EU countries with 4.4%.

Since 2010, the percentage of land area irrigated has remained relatively constant with small rises in the Middle East and North Africa (0.8%), South and East Asia (0.4%), South America (0.1%), and OECD and EU countries (0.08%). Sub-Saharan Africa saw a small drop of 0.003%, which is due to an increase in land area. However, in some cases these increases represent quite a large change in the amount of land irrigated. For instance, South America currently has 1.4% of agricultural land irrigated, South and East Asia 9.7%, the Middle East and North Africa 4.8%, Sub-Saharan Africa 0.6%, and OECD and EU countries 4%.

Figure 1.1.9c shows that between 2007 and 2017, the percentage of water withdrawn for agriculture has risen in all regions except the Middle East and North Africa, which fell by 1.4% to 84.7%. The Middle East and North Africa, however, remains the region with the highest proportion of water extracted for agriculture.

OECD and EU countries had the largest rise in water extracted for agriculture of 5.2%, to 47.5%. However, this is still significantly below the other regions, reflecting the proportion of industrialised economies within OECD and EU countries. South America at 2.2% and Sub-Saharan Africa at 4.3% have had small rises in the proportion of water extracted for agriculture. The Middle East and North Africa has recorded a small fall of 1.4% in the proportion of water extracted for agriculture, but this is still the highest proportion of any region at 84.7%.

Aquastat only has a representative sample of countries from South and East Asia since 2012. The complete dataset has only been collected for two years, so it’s not possible to draw any firm conclusion of trends about water extraction. However, water extraction for agriculture appears to be stable.

Overall, this data shows that agriculture is placing more stress on water resources than other sectors.

Trends

The levels of water efficiency in crops vary between regions. High-income countries in Europe and Northern America have a capital-intensive and efficient agriculture sector as well as a high rate of public expenditure on agricultural research and development. Such countries have a greater capacity to address the water efficiency and scarcity challenges. By contrast, in Sub-Saharan Africa, where countries have lower levels of agricultural capital intensity and expenditure on research and development, farmers have difficulty in accessing irrigation equipment, modern inputs and technologies, including technologies to optimize the efficiency of water use in rainfed agriculture. Conversely, countries in Southern Asia irrigate and employ modern inputs on about half of the region’s cropland, while most irrigated areas are highly water stressed

As outlined in the risk section of indicator 1.1.2, climate variability and change will increase the likelihood of extreme weather events, such as droughts and changes in rain patterns. This will further increase reliance on withdrawn water rather than on rainwater. More than 62 million hectares of crop and pasture land already experience both very high water stress and drought frequency, with 15 times that area suffering from either one or the other. Global temperature rises on the way to 2^{o}C will cause a steep increase in exposure to water scarcity from reduced precipitation, particularly in Northern and Eastern Africa, the Arabian Peninsula and Southern Asia. River flow will also drop, increasing water scarcity in regions including the Mediterranean, Near East and large parts of Northern and Southern America. The scale of the impact is highly uncertain however, with a range of models producing different results. Drought frequency and severity will also increase, with particular impacts in parts of Southern America, Western and Central Europe, Central Africa, and Australia. Direct climate impacts on heavily irrigated regions could see 20 to 60 million hectares of irrigated land reverting to dependency on rainfall.[38]

Indicator 1.2.1 Global agricultural labour force capacity

Headline

Productivity increases and mechanisation have meant the number of people employed as agricultural labour has decreased globally since 2010. The COVID-19 pandemic, however, has highlighted how the sector's reliance on seasonal workers for critical harvesting periods can be a potential risk to production if there are factors that reduce the availability of these workers.

Context and Rationale

The availability of agricultural workers plays an important factor in global food production and the impacts this has on global food supply. Besides permanent agricultural workers, there is also a great need for seasonal workers to meet the fluctuating seasonal labour needs across the world. The COVID-19 pandemic has particularly shown the contributions internal and international seasonal workers make towards ensuring food supply when travel restrictions hindered their ability to work within the agri-food system.

Lower-income countries tend to have a higher percentage of people employed in the agriculture sector compared to high-income countries. The economic importance of the agriculture sector, and with it the number of employees, decreases the richer a country becomes. At the same time, agricultural workers in high-income countries add more value to the gross domestic product than in lower-income countries. This likely means that thanks to technological advances, more efficient farming practices, and other factors, fewer agricultural workers are needed in high-income countries than in low-income ones.

Over the last twenty years, there has been a decline in the number of people working in the agriculture sector due to productivity increases, requiring fewer workers. Despite that, agriculture is still the second largest source of employment

[38] FAO, 'The State of Food and Agriculture: Overcoming Water Challenges in Agriculture' (2020), [redacted] pages 28, 40 and 41.

in the world after the service sector, with China and India accounting for almost half of the global agricultural labour force.

This indicator tracks the employment figures within the agriculture sector at the global level. The data needs to be carefully interpreted given that any changes in the global agricultural labour force could be a sign of productivity gains, meaning technological improvements have reduced the need for large numbers of workers, or of emerging issues within the sector.

Data and Assessment

Indicator: Number of employees in the agriculture sector by region

Source: FAO; UN Department of Economic and Social Affairs International Migration

Figure 1.2.1a: Number of total agricultural employees by region

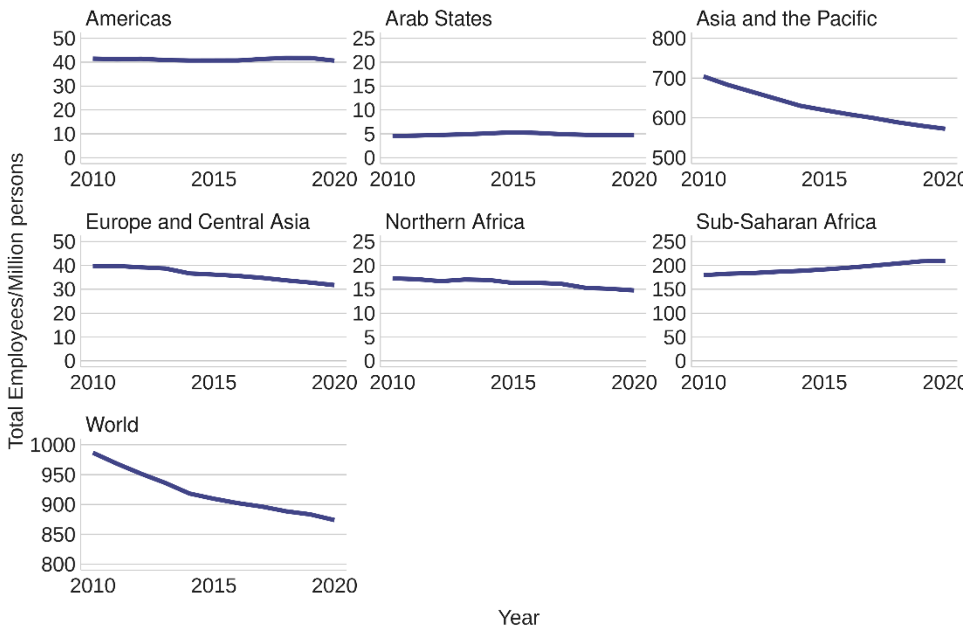


Figure 1.2.1b: International migrant workers as a percentage of total local population by region

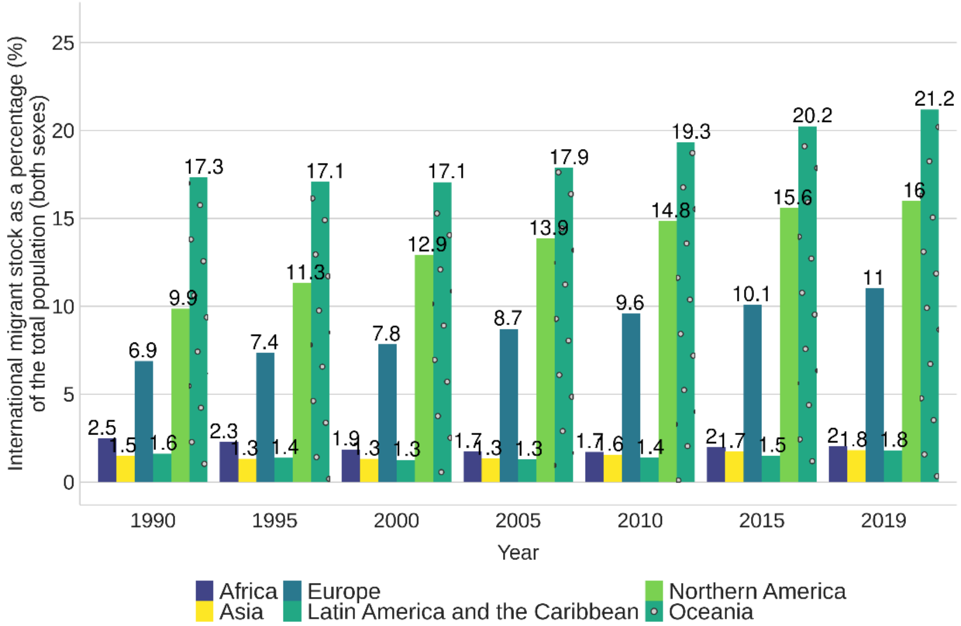
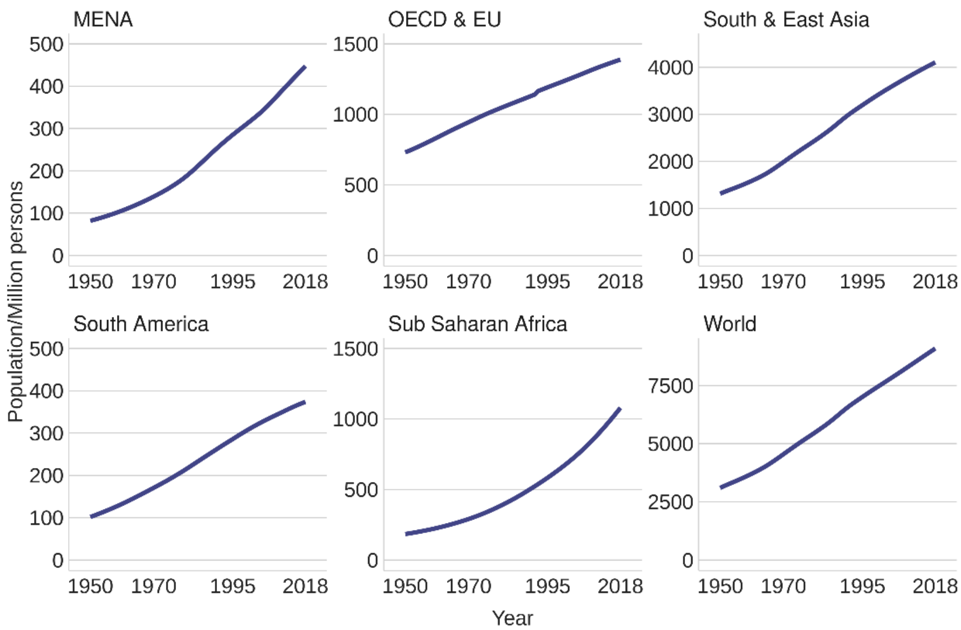


Figure 1.2.1c: Total population of each region, in millions

Figure 1.2.1c: Total population of each region, in millions



Assessment

The number of agricultural employees globally continues to decline, most likely due to increased mechanisation in Asia and the Pacific Region, which employ 572,488,000 workers. Sub-Saharan Africa, employing 209,392,000 workers. These continue to have the highest number of agricultural employees and show an increase in the number of agricultural employees of 29,757,000 workers, since 2010. The Arab States are the only other region to show an increase of 231,000 workers. In developed countries, agricultural labour constitutes a lower proportion of the workforce.

Europe (11%), North America (16%), and Oceania (21.2%) have a particularly high availability of migrant labour compared to Africa (2.03%), Asia (1.82%), and Latin America and the Caribbean (1.8%). The proportion of migrant stock has risen faster in these regions: in Europe by 1.4%, North America by 1.15%, and Oceania by 1.9% compared to Africa at 0.32%, Asia at 0.25%, Latin America and Caribbean at 0.4%. All regions, however, are seeing a higher proportion of migrants today than in 2010.

Trends

In 2020, COVID-19 movement restrictions impacted on the availability of seasonal workers, especially in high-income countries. Many governments enacted policies to counteract such shortfalls by extending the stay of seasonal workers already present in the country, incentivising the domestic population to work in the agriculture sector, or facilitating limited entry of seasonal workers under strict health protocols.[39] Despite the success of some of these policies in mitigating against the worst predicted labour shortages, the COVID-19 pandemic has shown the vulnerability the agriculture sector faces regarding its reliance on seasonal workers during critical harvest periods. The data above suggests both that the global agricultural workforce is declining over time and that the reliance on migrant labour in increasing. Although both trends are very gradual at the global level, stronger trends are seen at a country-by-country and region-by-region basis.

Whether this represents an increased vulnerability in relation to the global food system will depend upon which food product is being considered and its individual reliance on labour, whether domestic or migrant.

---

[39] IOM UN Migration, 'COVID-19: Policies and Impact on Seasonal Agricultural Workers' (2020), [redacted]

Indicator 1.2.2 Components of global food demand growth

Headline

Population growth will play the most significant role in food demand growth over the coming years. As outlined in indicator 1.1.1, global food production is projected to outpace global food demand. While increasing incomes in low and middle-income countries will lead to increased calorie consumption and meat consumption, other factors, such as health and environmental concerns, will be more relevant in determining consumers' food preferences in high-income countries.

Context and Rationale

Global demand growth for food is closely linked to the issues outlined in indicator 1.1.1 regarding the capacity of global agriculture to increase food supply to meet demand. It is, therefore, essential to understand the underlying factors that will drive global food demand growth over the coming decades to predict whether food supply can meet demand. The factors that have the most influence on global food demand are population growth, increasing calorie consumption, and changing consumption patterns:

- Population growth is expected to be the main driver of demand growth for most agricultural commodities.
- The average dietary energy supply, measured as calories per capita per day, indicates whether people can meet their daily calorific needs. In 2019, the average global energy supply stood at 2950 calories per person, indicating that there is, theoretically, enough food produced globally to meet people's calorie requirements.[40] These calories, however, are not evenly distributed across regions, with high-income countries consuming more calories than low-income ones. The calories also do not reflect the quality of people's diet and whether they enable people to meet their nutritional requirements.
- Changing consumption patterns will also have an impact on overall demand growth. These patterns are determined by populations' food preferences and available income to realise them.

Data and Assessment

[40] FAO, 'World Food and Agriculture: Statistical Yearbook 2020', [redacted]

Indicator: Components of global food demand

Source: FAO

Figure 1.2.2a: Change in demand for food products and calorie consumption per capita per day by region, 1961 – 2018

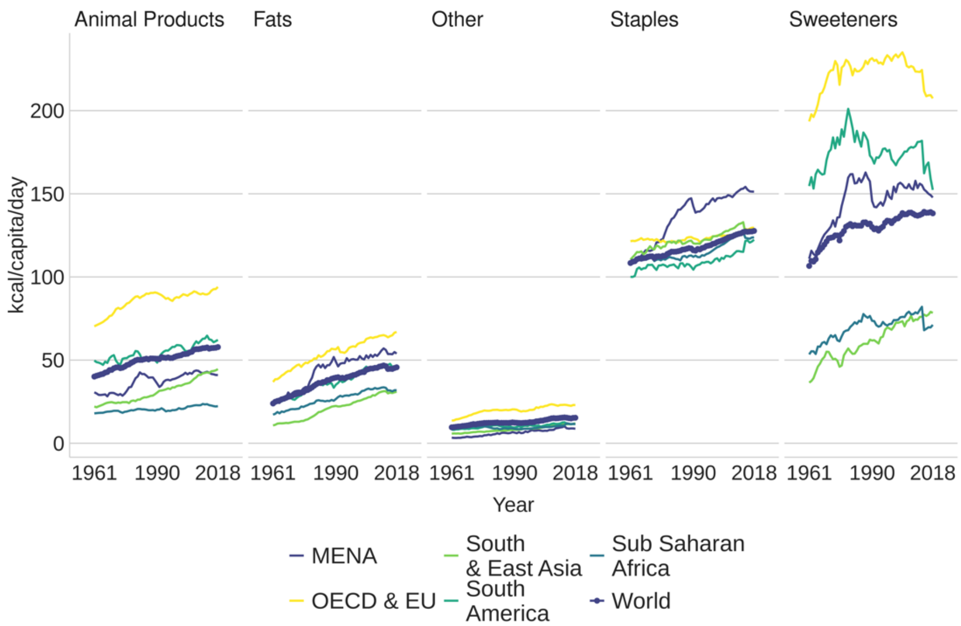
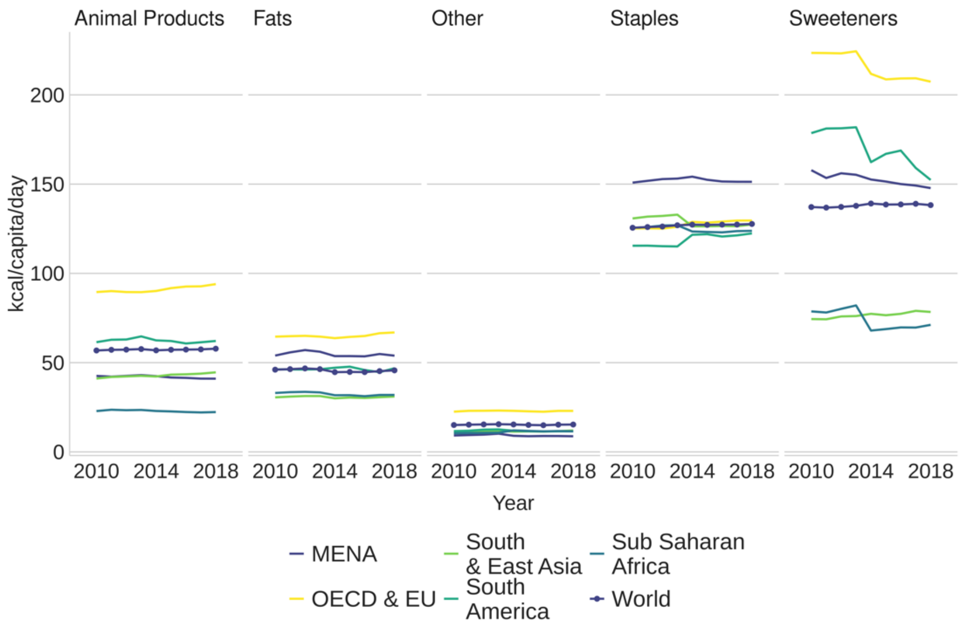


Figure 1.2.2b: Change in demand for food products and calorie consumption per capita per day by region, 2010 – 2018



OECD-FAO Outlook 2020-2030 Shows demand for all food products type is rising across all regions. Expect for Fish which forecast to fall in Europe and Central Asia, Staples which forecast to fall in the Near East and North Africa and North America and Sweeteners which demand is forecast to fall in Europe and Central Asia and Latin America and Caribbean.

The OECD and EU countries have consistently had the highest calorie intake across different food products except for staples, which is led by the Middle East and North Africa. Sub-Saharan Africa and South and East Asia typically have the lowest calorie intake except for staples, South America has the lowest calorie intake of staples.

Since 1961, the amount of animal products, fats and staples consumed has slowly increased, Consumption of other products has remained reasonably stable, and the consumption of sweeteners has been quite volatile.

Since 2010, global demand has risen for all product types other than fats which have fallen slightly (0.4 kcals per capita). Regionally, the picture is slightly more complicated. OECD and EU countries have seen a rise in per capita consumption of all products except sweeteners which have fallen by 16.1 kcals/capita/day to 207.4 kcals/capita/day.

MENA per capita consumption has fallen for all products except staples that has risen 0.5 kcals kcals/capita/day to 151.3 kcals/capita/day.

Sub Saharan Africa per capita consumption has fallen for all products except other products that has risen 1.1 kcals kcals/capita/day to 11.5 kcals/capita/day.

South and East Asia per capita consumption has risen for all products except other products that has fallen 3.4 kcals kcals/capita/day to 127.3 kcals/capita/day.

South America per capita consumption has risen for all products except other products and sweeteners that have fallen 0.1 kcals kcals/capita/day to 11.5 kcals/capita/day and 26.2 kcals kcals/capita/day to 152.3 kcals/capita/day.

Trends

The FAO expects an annual growth rate of 0.9% for the global population size over the next ten years to 8.5 billion people in 2030. Population growth will be mainly concentrated in developing regions, such as Sub-Saharan Africa and India. This is an important figure to observe to determine how changes in food demand will impact the UK's food supply as agricultural demand growth will mainly be driven by population growth and less so by per capita demand growth.

Global demand for agricultural commodities, including for non-food uses, is projected to grow at 1.2% per annum over the coming decade. This is well below the growth experienced over the last decade, which amounted to 2.2% per annum. This is mainly due to an expected slowdown in demand growth in China and other emerging economies, and lower global demand for biofuels.

While it is estimated that demand will rise for all agricultural commodities, a larger increase will likely be seen in high-value products such as vegetable oils, livestock products, and fish. In high-income countries, per capita availability of animal protein is expected to grow slowly over the coming decade. The increase in poultry meat availability is projected to account for over half of additional animal protein availability over the coming decade. Demand for poultry meat is projected to grow steadily as consumers see it as a healthier and more environmentally sustainable product than beef and pig meat. Poultry is also more affordable than other meat types, which will also contribute to growing poultry demand in middle and low-income countries. By contrast, beef, pig meat and sheep meat consumption levels are expected to remain stable. Weakening demand for beef in high-income countries is due to several factors, including concerns about the climate impact of cattle production, and dietary recommendations by governments, which in several countries, advise limiting weekly intakes of red meat. In the UK it is advised to limit your intake to under 70g per day.

There are some uncertainties when creating projections for consumption patterns. Consumers' purchasing decisions are increasingly driven by factors beyond prices and taste, such as health and environmental concerns. One expression of such environmental concerns is the increase in vegetarian and vegan lifestyles in high-income countries.[41]

Looking at the average dietary energy supply, the FAO has produced different predictions for high, low, and middle-income countries based on different future scenarios. Depending on the level of change towards more sustainable practices, high-income countries would reach a daily calorie consumption between 3,271 and 3,408 calories by 2030, while low and middle-income countries could achieve between 2,724 and 2,923 calories per day. Throughout all of these scenarios, animal products make up a larger number of calories in high-income countries than in low and middle-income countries. The food group providing the most calories in low and middle-income countries are cereals.[42]

[41] FAO, 'OECD-FAO Agricultural Outlook 2021-2030', [redacted]

[42] FAO, 'The future of food and agriculture: Alternative pathways to 2050' (2018), [redacted]

Indicator 1.2.3 Share of global production internationally traded

Headline

The proportion of agricultural products traded has increased since the 2000s. A growing global trade in agricultural products increases resilience to supply shocks affecting particular geographical areas and allows for a more efficient global food supply chain. However, reliance on the global trading system increases vulnerability to events which disrupt to this system, such as trade restrictions. The COVID-19 pandemic caused some disruption to supply chains but global trade in products is expected to continue in the long term.

Context and Rationale

Global trade in agricultural and food products plays an essential role in providing food security for the UK, but also for the world. Trade allows for a more efficient global food system where products can move from regions with more suitable conditions and resources for production to countries with less ideal conditions or higher demand for food than can be met by domestic production. A functional trading system also allows to spread the risks of supply shortages or price spikes if a country can import agricultural and food products from multiple supply sources.

Thinly traded commodity markets can reflect substantial trade protectionism, an increase in bilateral land deals, but also the costs of transporting goods between countries. If some type of shock occurs in such a market, the impacts on the availability and affordability of the commodity will be greater than in a more active market.

In the last few decades, international trade in agricultural and food products has more than doubled in real terms due to technical and economic trade barriers having been lowered or removed. Developing countries are increasingly participating in global markets, and their exports make up more than one-third of global agri-food trade.

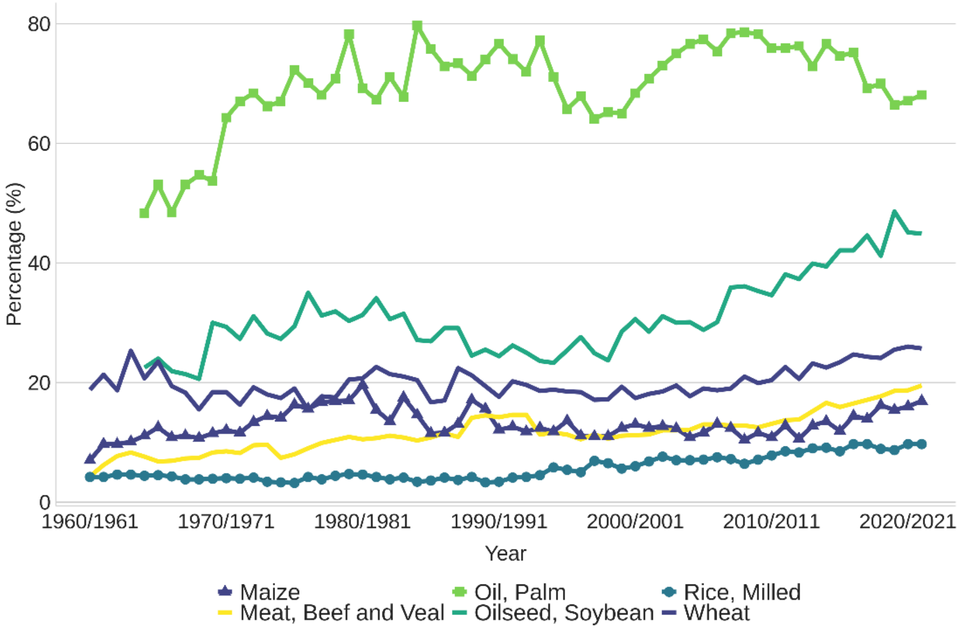
Increasing or stable trends in the percentage of commodities internationally traded would be desirable in order to strengthen the resilience of the global commodity markets and the UK's food security.

Data and Assessment

Indicator: Share of global production internationally traded

Source: FAO

Figure 1.2.3a: Percentage of global production internationally traded



Assessment

Since the early 2000s, growth in agricultural trade has been facilitated by a lowering of agri-food tariffs, reforms to trade-distorting producer support, and the signing of multiple trade agreements. Agricultural trade has also been supported by strong economic growth in emerging countries, particularly in China, and by growing demand for biofuels as countries seek to reduce their CO2 emissions and their dependence on fossil fuels. This expansion in trade has contributed to a more efficient allocation of agricultural production across countries and regions.

The percentage of global commodity trade has remained relatively constant since 2010/2011. Palm oil has been the most volatile commodity, falling to 66.4% in 2019/2020 from 78.3% in 2009/2010. Soybeans remain the second highest commodity traded globally by percentage at 48.6% in 2020/2021.

Trends

Overall, trade in terms of value has been increasing over the last twenty years. High-income and upper-income countries account for the highest increase in global agri-food exports, having grown their exports from about 25% in 2001 to 36% in 2018. Lower-middle income and low-income countries export and import fewer agricultural and food products in comparison, although notable exceptions are Vietnam, Nepal, and Uganda, which have managed to slowly increase their exports over this time period.[43]

Primary production, processing, trade, logistics (both domestic and international), and final demand have been affected by COVID-19 measures. Nevertheless, global food markets remained well balanced over the last year.

The FAO expects that trade will increasingly reflect diverging demand and supply developments among trading partners over the next ten years. Some regions are projected to experience large population or income-driven increases in food demand but do not necessarily have the resources for a corresponding increase in agricultural output. Moreover, socio-cultural and lifestyle-driven changes in consumption patterns are transforming the profile of demand in most regions. Agricultural trade will therefore play an increasing role in ensuring global food security and nutrition over the next decade, by connecting producers to diversified consumer demand around the world.

Divergent productivity growth, climate change impacts on production, the outdoor workforce, food safety, as well as transport being affected by extreme weather events such as storm surges, heat and flooding, and developments in crop and animal diseases may all pose a risk to food supply.

Globally, about 17% of cereal production is traded internationally, with shares for single commodities ranging from 9% for rice to 25% for wheat. The share for total cereals is projected to increase to 18% by 2030, largely due to increased trade in rice. Rice will nevertheless remain a thinly traded commodity. India, Vietnam, and Thailand will continue to lead global rice trade, but Cambodia and Myanmar are expected to play an increasingly important role in global rice exports. Russia surpassed the European Union in 2016 to become the largest wheat exporter and is expected to increase its lead throughout the next ten years, accounting for 22% of global exports by 2030. Concerning maize, the United States will remain the leading exporter, followed by Brazil, Ukraine, Argentina, and Russia. The

---

[43] FAO, 'The State of Agricultural Commodity Markets 2020', [redacted].

European Union, Australia, and the Black Sea region are expected to continue to be the main exporters of other coarse grains.[44]

Risk: Restrictions and barriers to trade

Global markets and trade play an important role in managing disruptions to food supply. Some countries may respond to supply disruption by reducing or banning exports to shore up domestic supplies. This can reduce the availability of global commodities and drive prices up, which may cause further shocks to markets. During the COVID-19 pandemic, the International Food Policy Research Institute tracked the number of food export restrictions imposed by countries. In 2020, a total of 19 countries imposed temporary export bans on certain agricultural goods, all of which were lifted within the same year.[45] None of these restrictions had a significant impact on UK food supply.

Indicator 1.2.4 Concentration in world agricultural commodity markets

Headline

The concentration in world agricultural commodity markets shows how diversely traded a commodity is. A strong concentration for a particular commodity in a few countries could have negative impacts on price, supply, and food security. No major changes are expected for the concentration in world agricultural commodity markets and the top exporting countries of these commodities. This stability means that there are no concerns in relation to the UK's ability to access global food supply.

Context and Rationale

The concentration of production and market power over a commodity in a particular country or region can have harmful effects both in terms of price, supply, and overall food security. If production is heavily concentrated, overall markets are vulnerable to localised supply shocks including those from weather and climate

[44] FAO, 'OECD-FAO Agricultural Outlook 2021 to 2030', https://www.fao.org/publications/oecd-fao-agricultural-outlook/2021-2030/en/.
[45] IFPRI, 'COVID-19 Food Trade Policy Tracker' (2020), https://www.ifpri.org/project/covid-19-food-trade-policy-tracker.

change. They are also vulnerable to economically or politically motivated national actions.

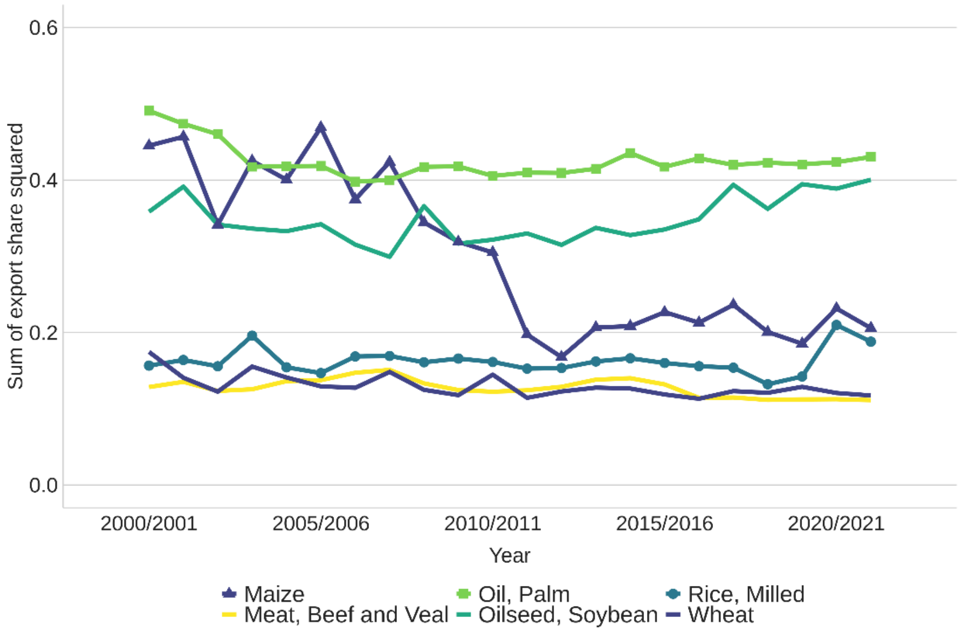
Greater diversity in countries supplying some of the main agricultural and food commodities provides a higher level of food security. Attempts by individual countries to restrict export supplies, for whatever reason, would not result in any substantial, sustained increase in prices or actual shortages.

Data and Assessment

Indicator: Herfindahl index of exporter concentration for various commodities / Share of top 3 leading exporting countries[46]

Source: USDA PSD

Figure 1.2.4a: Herfindahl indices of export concentration



[46] The Herfindahl Index (HI) measure of market concentration is often used by competition authorities, but it also provides a measure of export market concentration. The HI is a sum of the squares each market share has, this gives larger market share a stronger influence on the results or heavier weighting. Thus, a market completely dominated by one country would give a HI of 1.0. If all top 20 suppliers had equal shares, the index would be 1/20 =0.05. This is considered a better measure than the concentration ratio (CR) of the top 3 or 5 suppliers because it accounts for the shares of all suppliers, and it is affected by the split of the market between the largest suppliers. For example, if a country had 50% of the export market and the remaining 50% of market was equally divided between 10 countries. The Herfindahl Index would account for all 11 countries. The 3 suppliers CR would be 60% and 5 suppliers CR 70% whereas the HI would be 0.3. Market concentration here is defined in terms of exporting *countries* rather than *firms*.

Figure 1.2.4b: Table on shares of the leading supplier countries (*data from 2018)

Commodity	2010/2011		2020/2021	
	Top 3 Exporters	Share of global trade	Top 3 Exporters	Share of global trade
Beef	Brazil	20.4%	Brazil	22.4%
	Australia	17.7%	Australia	13.0%
	USA	9.9%	USA	11.8%
Maize	USA	50.8%	USA	39.3%
	Argentina	17.9%	Brazil	21.1%
	Brazil	9.2%	Ukraine	13.4%
Palm oil	Malaysia	45.9%	Indonesia	56.0%
	Indonesia	44.0%	Malaysia	32.9%
	Papua New Guinea	1.5%	Guatemala	1.7%
Rice	Thailand	30.2%	India	40.7%
	Vietnam	19.9%	Vietnam	12.6%
	USA	10.0%	Thailand	11.%
Soybeans	USA	44.7%	Brazil	49.5%
	Brazil	32.7%	USA	37.4%
	Argentina	10.1%	Paraguay	1.5%
Wheat	USA	26.4%	Russia	19.1%
	EU	17.4%	EU	14.8%
	Australia	14.0%	USA	13.4%

Assessment

The overall trade picture remains stable. There has been considerable diversification in Maize supplies in recent years, as is indicated by the HI falling by 0.492 to 0.206. Maize HI has fallen 0.1 since 2010. Oilseed showed a small upward trend rising from 0.322 in 2010/2011 to 0.400 in 2020/2021. Other products have remained relatively constant. The main countries of export are remaining relatively static with two out of three remaining in the top three in 2019 compared to 2009.

Trends

The FAO expects no change in the top three exporting countries for wheat, maize, and rice over the next ten years. While normal growing conditions are expected to lead to positive production prospects for the main grain-producing regions, inter annual climate variability and extreme weather events accentuated by climate change may cause higher volatility in cereal yields, thereby affecting global supplies and prices. Wheat and maize yields are particularly volatile in some large exporting countries such as Russia, Ukraine, Brazil, and Argentina, compared to Canada, the United States, and the European Union.

Meat exports, including beef, sheep, pork, and poultry, are concentrated, and the combined share of the three largest meat exporting countries, Brazil, the European Union, and the United States. These are projected to remain stable and account for around 60% of global world meat exports over the next ten years. In Latin America, traditional exporting countries are expected to retain a high share of the global meat trade, benefiting from the depreciation of their currencies and surplus feed grain production.

Regarding exports of soybeans, Brazil has taken over the role of main exporting country with steady growth in its export capacity and is projected to account for 50% of total global exports of soybean over the next ten years.

Indonesia and Malaysia are expected to continue to account for 60% of total vegetable oil exports, mainly palm oil, during the next decade. However, the share of exports in production is projected to contract slightly in these countries as domestic demand for food, oleochemicals, and, especially, biodiesel uses is expected to grow.[47]

[47] FAO, 'OECD-FAO Agricultural Outlook 2021-2030', [redacted]

Theme 2: UK Food Supply Sources

This chapter of the UK Food Security Report looks at food security in terms of where the UK gets its food from. It focuses specifically on the UK's principal sources of food at home and overseas. It describes the UK's domestic production, and trends in agricultural productivity, fisheries and food waste both before and after the "farm gate". It considers important factors in maintaining domestic productivity, such as soil health, fertiliser use, agricultural inputs, and biodiversity. The chapter also discusses the principal sources on which the UK relies for its food imports. It considers data points which will help future UK Food Security Reports assess the food security impacts of the UK's 2020 departure from the EU, in terms both of changes to domestic production practices and to the UK's trading relationship with the world. These impacts are likely to take some time to become apparent in statistics.

In terms of this theme, food security means strong and consistent domestic production of food combined with a diversity of supply sources that avoids overreliance on any one source.

Key messages

- The UK has diverse and longstanding trade links that meet consumer demand for a range of products at all times of the year. Trade is dominated by countries in the EU and it is too early to say what effect leaving the EU might have on that trade.
- Domestic production is also stable, with variations in yield and consumer demand balanced by imports and exports. Both agricultural production and manufacturing have become increasingly efficient and are geared towards meeting consumer demand, although food waste is still high.
- The biggest medium to long term risk to the UK's domestic production comes from climate change and other environmental pressures like soil degradation, water quality and biodiversity. Wheat yields dropped by 40% in 2020 due to heavy rainfall and droughts at bad times in the growing season. Although they have bounced back in 2021, this is an indicator of the effect that increasingly unreliable weather patterns may have on future production.

Domestic production

To ensure a consistent supply of food, the UK relies both on its own production and on imports. Home-grown produce is the largest source of food for the UK. Resilience is ensured through a combination of strong domestic production from the UK's productive agriculture and food manufacturing sectors, and a diverse range of overseas supply sources.

The UK currently produces about 60% of its domestic food consumption by economic value, part of which is exported. This means just under half of the actual food on plates is produced in the UK, including the majority of grains, meat, dairy, and eggs. This figure would be higher without exports. UK supply comprises domestic production excluding exports, plus imported food. The production to supply ratio, important for understanding the UK's self-sufficiency, has remained stable over the last two decades, and for crops that can be commercially grown in the UK has been around 75%.

The UK has a productive agricultural sector and a domestic agri-food manufacturing industry that produces food to high standards. The amounts and types of food produced are driven by market forces and consumer demand for goods, rather than by assessment of overall quantity of food or of self-sufficiency. Many factors affect the output of domestic production, including:

- The availability and suitability of land for particular forms of production.
- Inputs such as labour, water, fertiliser, pesticides, and seeds.
- Climate and environmental factors such as soil health and rainfall.

In 2020 71% of UK land area was used for agricultural production, the majority of this being grassland for grazing rather than crops. Not all land is suitable for growing crops, and some is suitable only for specific crops. Land use overall has changed little in the last thirty years, with annual variation between specific crops due to factors such as the weather and prices rather than long-term or systematic variation. Domestic production faces a number of long-term and short-term risks, including soil degradation, drought and flooding, diseases, risks to fuel and fertiliser supplies, and changing labour markets. In the long term, climate change impacts are likely to have a negative effect on the proportion of high-grade arable farmland available in the UK.

Diverse international supply sources

Overreliance on one geographical area and dependence on particular supply sources makes food supply more vulnerable, while diversity of sources makes it more resilient. UK consumer preferences and diets include a range of products that cannot be grown in the UK or cannot be grown year-round. Therefore, the UK does not produce everything it eats or eat everything it produces.

In 2020, the UK imported 46% of the food it consumed. Having a diverse range of international sources makes food supply more resilient, as if the production or output of one source is disrupted, other sources can meet demand. No one country provided more than 11% of those imports, a picture which has been stable for some time. By value, £48 billion of food, feed, and drink (FFD) was imported and £21.4 billion was exported.

Overall, the UK's food supply is concentrated on the UK and Europe, with over 80% of supply coming from these main sources. The remainder is mostly spread between Africa, Asia, North America, and South America. This picture has changed little in the last 10 years. EU countries continue to be the main source for FFD imports and are therefore essential to the UK's food security. 39% of FFD imports by value were despatched from 4 EU countries (the Netherlands, Republic of Ireland, Germany, and France) in 2020.

The landscape of UK imports and domestic production is currently in a state of change after leaving the European Union, the UK's largest trading partner in agri-food. The impact of the UK's new trading relationship is not yet visible in data. Domestic production may also change in future with the removal of subsidies managed through the European Common Agricultural Policy (CAP) and through the planned introduction of new environmental land management schemes in parts of the UK.

The UK is more reliant on particular countries or regions for specific foodstuffs at different times of the year, due to a variety of growing seasons across the world. Seasonality is complex and product specific. The UK depends on diverse supply lines to meet demand for out-of-season products throughout the year, following growing seasons across the world. Year-round access to out of season fresh fruit and vegetables (FFV) has increased in the last 20 to 30 years, leading to longer and more complex supply chains.

Focusing on food categories:

- The UK is largely self-sufficient in production of grains, producing over 100% of domestic consumption of oats and barley and over 90% of wheat. Average yields over recent decades have been broadly stable but fluctuate from year to year as a result of better or worse weather. Increasingly unpredictable and extreme weather as a result of climate change is likely to exacerbate these fluctuations. Wheat yields in 2020 were the lowest since 1981 due to of unusually bad weather. However, preliminary data indicates they have since increased in 2021.
- In meat, milk, and eggs, the UK produces roughly equivalent volume to what it consumes. In 2020 it produced 61kg of meat, 227L of milk and 172 eggs per person per year. By value, the UK is a net importer of dairy and beef. This reflects UK consumer preferences for eating higher value products, while lower value products are exported.
- The UK produces a significant proportion of its other crop needs, including around 60% of sugar beet, 70% of potatoes and 80% of oilseeds. Apart from a recent pest-related reduction in oilseeds, these proportions have remained stable over the last ten years. Climate change represents a risk to production both in terms of making conditions unsuitable for some crops and allowing new pests to proliferate but it may also benefit new types of crops.
- The UK produces over 50% of vegetables consumed domestically, but only 16% of fruit. 93% of domestic consumption of fresh vegetables was fulfilled

by domestic and European production, while fruit supply is more widely spread across the EU, Africa, the Americas, and the UK.

- The UK both produces and consumes fish and seafood, but is a net importer overall. UK consumer preference is for fish mainly caught outside UK waters, such as cod, haddock, tuna, and shrimp and prawns. This means that the UK exports much of what it catches and imports much of what it eats. Supply sources for imports are diverse, with northwest Europe and China the most significant sources. Most of the fisheries which supply UK imports are well managed and have sustainable stocks, although climate change presents a risk to fish stocks. The UK has a significant fishing fleet which mainly exports to the EU, US and China. Important exports include herring, mackerel, salmon and nephrops (scampi).

Inputs and waste in domestic production

There are a range of contributing inputs and risk factors which can affect the UK's domestic production capacity and food security both in the short and medium term.

Agriculture relies on specific inputs to produce food. The cost of these inputs varies year to year. This presents a significant risk to farming economies, and therefore to food security. Profit margins in agriculture are low and so fluctuations in prices can cause problems. Feed is both the most significant expense for UK farmers and the least stable in terms of price. The overall supply, diversity, and sustainability of fertilisers, pesticides, seeds, and fuel amongst other inputs are also important and vary in different degrees for different categories.

Inefficiencies and wastage in food production and processing reduce both the quantity of food that can be consumed domestically or be exported. They also represent unnecessary land and resource use, contributes millions of tonnes of carbon emissions, and involves billions of pounds of wasted value.

Estimated annual combined surplus and waste in primary production is 3.6 million tonnes (Mt), which is between 6 and 7% of total output. Wastage in households and post farm gate businesses also reduces the effective supply of UK food. Waste post-farmgate is estimated at 9.5Mt, of which 7.7Mt is in households and hospitality and 1.8Mt in manufacturing and retail. These figures compare to around 43Mt of food purchased for consumption in the UK. The highest contributor to this total by weight were UK households, with 70% of post-farmgate waste arising in the home. Long term trends do show a reduction in UK household food waste but average waste of 4 key products was generally around 20% between 2018 and 2021. Household food waste fell sharply at the outset of the coronavirus (COVID-19) pandemic with improved food management behaviours leading to a significant reduction in self-reported household food waste in 2020. These positive changes, however, have started to decline with people returning to a pre-pandemic lifestyle and food waste levels have increased again in 2021 to pre-pandemic levels.

Long term sustainability of UK food production

The UK's agriculture sector relies on natural capital, and the degradation of this natural capital poses an underlying threat to the UK's ability to produce food. The ecosystems services from natural capital provide key inputs to food production, which often go uncounted, as does the impact of agriculture on the environment which produces them. The UK is not unique in this around the world and understanding and adapting to produce food sustainably and to maintain and improve natural capital stocks in the long term is key.

Sustainable production methods help to ensure the UK's long term food security by protecting the natural capital embedded in soil, water, and biodiverse ecosystems. In England, three new environmental land management schemes will incentivise producers in to farm more sustainably. A Sustainable Farming Scheme is currently being considered by the Welsh Government. The impacts of these schemes on agricultural land use are not currently clear but will be monitored in future UK Food Security Reports.

Key natural capital assets for food production are soils. Estimates suggest soil degradation, erosion, and compaction are costing about £1.2 billion each year and reducing the capacity of UK soils to produce food. Whilst trends appear to be negative, specific data is currently lacking.

The wider impacts of human exploitation of the atmosphere as a natural asset through climate change and emissions also pose significant risks to production and food security. As a consequence of unusual weather patterns linked to climate change, wheat yields in 2018 were 7% below the 2016 to 2020 average, and 17% down in 2020. Total economic losses for wheat, potatoes and oilseed rape in the UK caused by ozone were calculated to be £185 million in 2018, with more than 97% of those losses occurring in England. Based on modelling by the Met Office, significant future risks to UK food production include heat stress to livestock, drought, pests and pathogens, and increased soil erosion risks.

Indicator 2.1.1 UK Production Capability

Headline

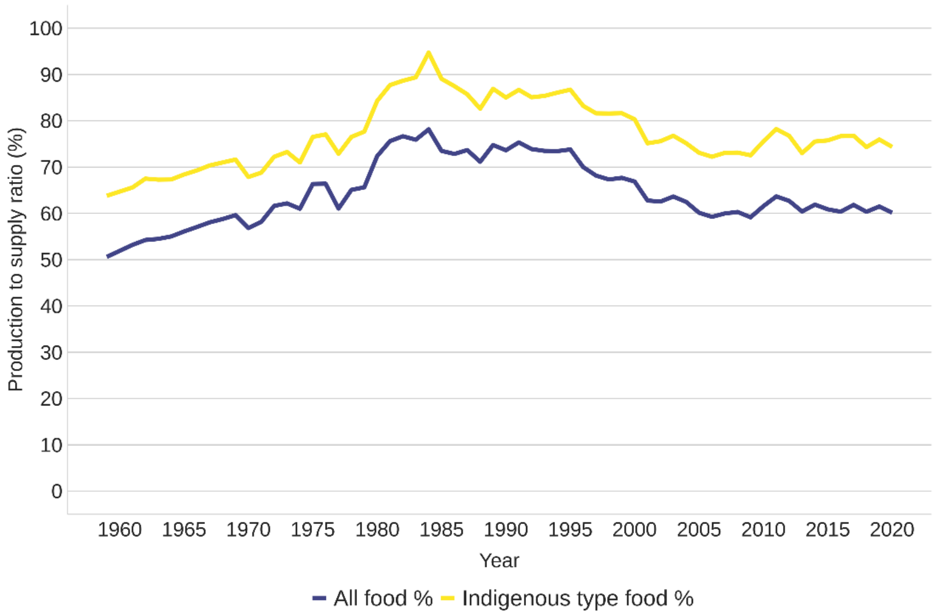
The UK currently produces the equivalent of about 60% of domestic consumption by value, part of which is exported. About 54% of food on plates is produced in the UK, including the majority of grains, meat, dairy, and eggs. Self-sufficiency is about 54% in fresh vegetables, and 16% in fruit, as subsequent indicators will set out. UK food production is driven by market forces rather than aiming to maximise calorie production from available land.

Context and Rationale

The Food Production to Supply Ratio is calculated as the farmgate value of raw food production divided by the value of raw food for human consumption. Essentially it compares the value of what is produced in the UK with what is consumed. The production to supply ratio is higher for indigenous type food, the food products which can be produced in the UK. For all food it is lower because this accounts for consumption of food types which cannot be produced in the UK for reasons of climate, soil, or other factors.

Data and Assessment

Figure 2.1.1a: UK food production to supply ratio



Source: Defra Agriculture in the United Kingdom (AUK) 2020

The production to supply ratio is estimated to be 60% for all food in 2020 and 76% for indigenous type food (that which can be commercially grown domestically). Actual consumption of UK-produced food is closer to 54%, as a part of UK production is exported.

Trends

From a peak in the mid-1980s the production to supply ratio declined into the early 2000s and has not changed significantly since then. Market prices and the economics and risks inherent in agricultural production have led the ratio to settle at about 60%. Alterations in the proportion of domestic production to supply would change the level of exposure to national scale risks, including climate change and extreme weather events.

Indicator 2.1.2 Current land area in production

Headline

In June 2020, 71% of the UK's land, or 17.3 million hectares, was used for agricultural production, of which 72% was grassland and 26% cropland, with the remainder being set-aside or fallow land. Trends in land use have been generally stable over the last 30 years, but climate change poses a threat to high quality arable farmland and competition for land use is increasing.

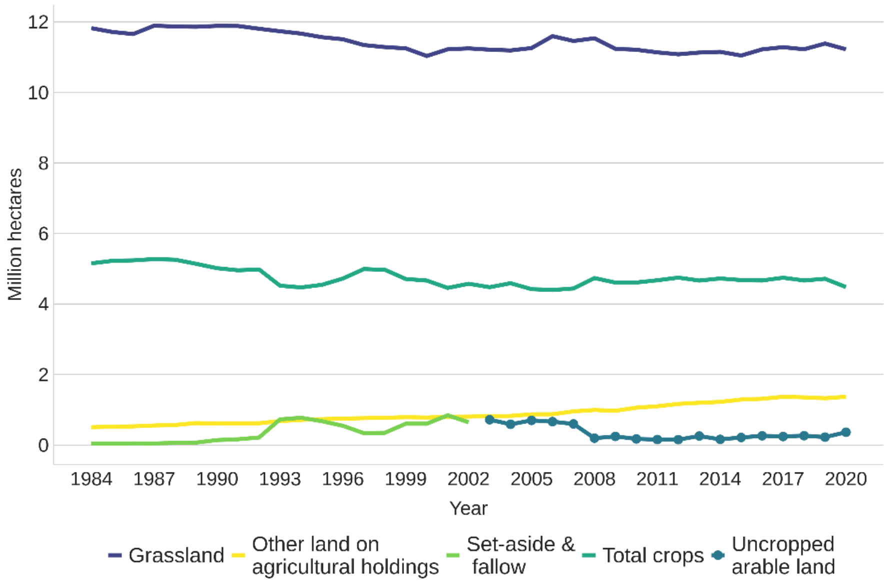
Context and Rationale

Measuring the land area in production gives a sense of the place of food production in overall land use. The definition of land used for agricultural production includes arable, horticultural, uncropped arable, common rough grazing, grassland (temporary and permanent), and land for outdoor pigs, but not woodland or other non-agricultural land.

It is important to recognise that not all land is created equal. Grass will grow almost anywhere, but gradient, soil quality, rainfall, water levels, and other factors make much of the UK's agricultural area unsuitable for crops, while other parts are suitable only for specific crops.

Data and Assessment

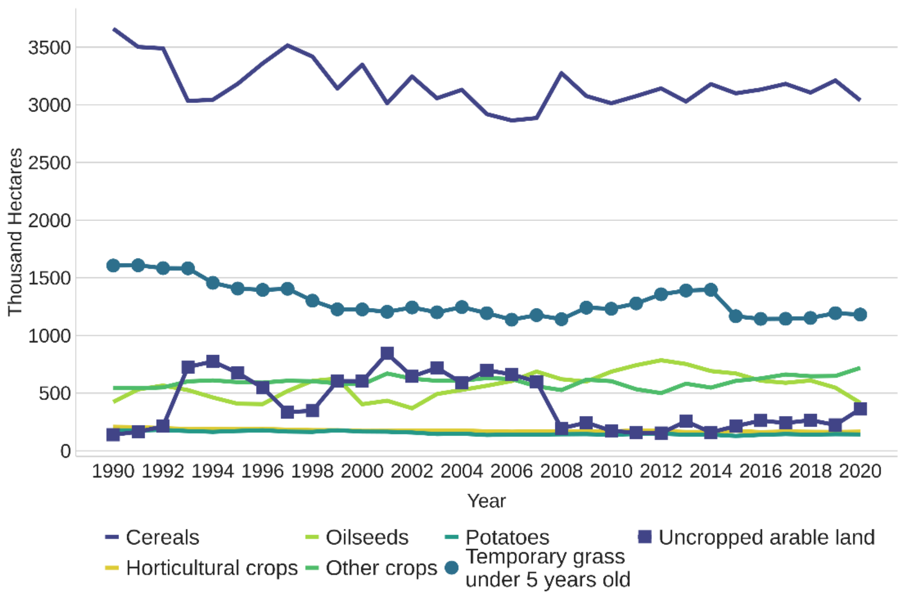
Figure 2.1.2a: UK agricultural land use



Source: Defra AUK 2020

Total agricultural land use, divided here into grassland and cropland, has declined a little since 1990. The high proportion of grassland primarily reflects the unsuitability of much of the UK's land for growing crops, and the relative suitability of those areas for grazing. As illustrated by the next figure, a small proportion of this grassland (1.2 million ha) is temporary grassland on croppable land, for example in crop rotations.

Figure 2.1.2b: Breakdown of UK croppable area on agricultural holdings



Source: Defra AUK 2020

The majority of the UK's croppable land is used for grain production (3 million ha), with 415,000 ha used for oilseed, 142,000 ha for potatoes, 166,000 ha for horticultural crops, and 719,000 ha for other crops in 2020. Much of the annual variation between specific crops is due to factors such as the weather and prices rather than any long-term and more systematic variation. An exception is the decline since 2018 in land given to oilseeds, which partly reflects increased pesticide resistance among stem flea beetles and the withdrawal of neonicotinoid insecticides. An increase in 'Other crops' suggests farmers are planting a larger variety of crops than previously.

Trends

Over the last 30 years land use has been fairly stable for most crops, allowing for fluctuations in prices and weather conditions. However, Defra-commissioned research suggests climate change impacts under a medium emissions scenario could reduce the proportion of 'best and most versatile' arable farmland (ALC 1, 2, and 3a) from 38.1% of agricultural land on a 1961 to 1990 baseline to 11.4% by 2050, with consequences for food production and meeting Net Zero. Under a high emissions scenario it could reduce to 9.2% of agricultural land; however there is quite high uncertainty about projections of this kind.[48] Meeting Net Zero, climate change mitigation, and biodiversity goals will increasingly add to existing, competing pressures on land use.

Indicator 2.1.3 UK food imports and exports

Headline

In 2020, the UK imported 46% of the food it consumed. No one country provides more than 11% of those imports, a picture which has been stable for some time. By value, £48 billion of FFD was imported and £21.4 billion was exported.

---

[48] Keay and others, 'The impact of climate change on the suitability of soils for agriculture as defined by the Agricultural Land Classification - SP1104' (2014), [redacted], page 65.

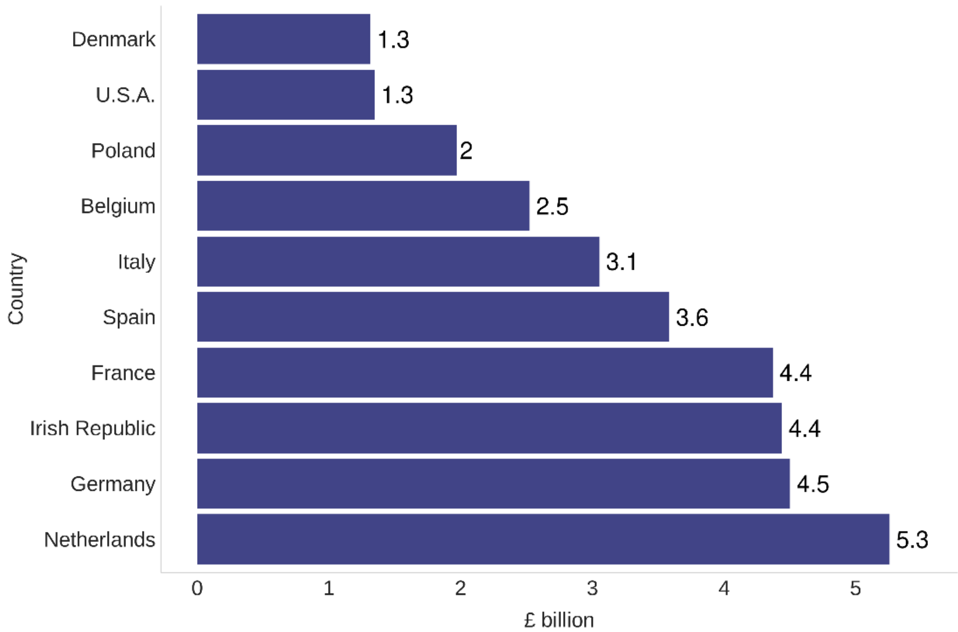
Context and Rationale

The scale of the UK's imports highlights the value to the UK of imported food and drink. Being well connected with producer countries and having a strong internal economy to compete for their exports puts the UK in a more secure position in terms of food security.

Imports and exports also support consumer preference for particular types of products. In the meat industry, for example, international supply chains allow UK consumers to buy their preferred cuts, while others are exported for profit. Exports also make valuable economic contributions to the sector, helping to sustain domestic production and local economies all around the UK. For food security purposes, considering exports alongside imports gives perspective to the scale of imports, as well as providing an overview of the value of UK production which is not consumed in the UK. It should be noted that this economic value is not equivalent to nutritional value for consumers when considering imports and exports; for example, whisky is the UK's most valuable FFD export.

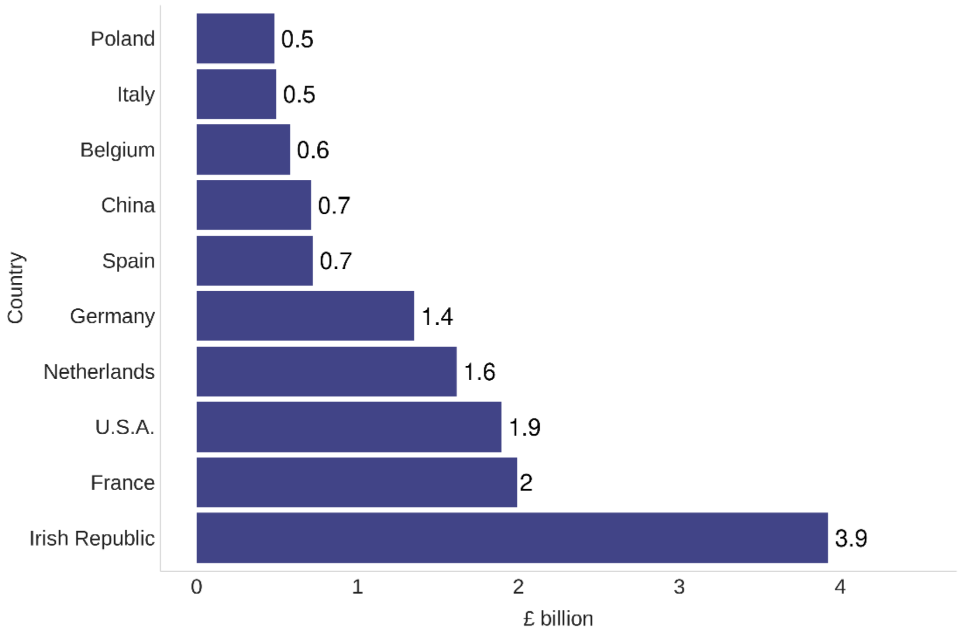
Data and Assessment

Figure 2.1.3a: UK imports of FFD by value and by country of dispatch, 2020



Source: Defra AUK 2020

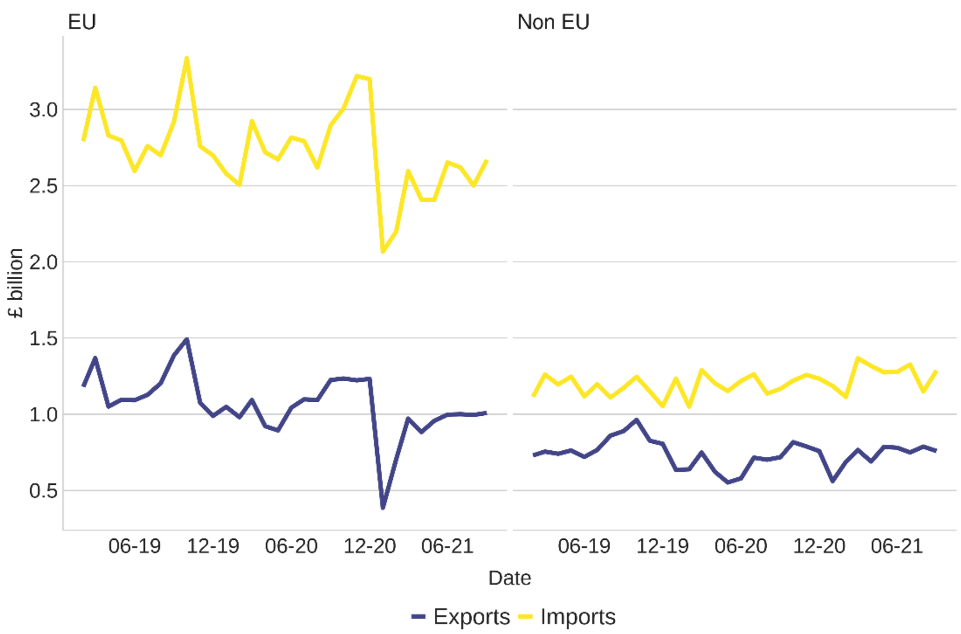
Figure 2.1.3b: UK exports of FFD by value and by country of destination, 2020



Source: Defra AUK 2020

The UK's top trading partners in value terms, with the exception of the USA, are all close geographical neighbours. In the case of Ireland, there is a shared land border, whilst France and the Netherlands represent the shortest sea crossing and a major international port facility respectively. In addition, the climate in Italy, southern France, and Spain, coupled with UK consumer expectations for year-round availability, mean that these countries are essential for trade in fresh produce.

Figure 2.1.3c: Values of UK FFD trade EU and non-EU, 2019 to 2021



Source: HMRC

From the latest available data, which covers the period up to September 2021, the overall value of FFD trade has recovered from the low levels seen in early 2021 and is largely back to levels seen in previous years. In Q3 2021, the total value of exports was 6% lower than Q3 2020 and the total value of imports was 2% lower than Q3 2020.

For many commodities, imports were higher than usual at the end of 2020, suggesting that some trade may have been brought forward to avoid potential issues at the border in early 2021. In addition, for some sectors (including meat and fish), imports have continued to be affected by reduced requirements for hospitality as a result of the pandemic.

Trends

The make-up of leading trading partners has been very stable over many years, with occasional intermittent small changes to the order of the top 10. The departure of the UK from the European Union and the Single Market on 1 January 2021 has changed the rules and regulations that govern export and import processes with the EU, and in 2020, COVID-19- had a temporary impact on availability of some products, like pasta and eggs. Changes have also been evident to trade patterns between GB and Northern Ireland as a result of the Northern Ireland Protocol (NIP). Geographical proximity will still be a major factor in trading arrangements, particularly for relatively low-value short shelf-life products.

Indicator 2.1.4 EU share of UK imports

Headline

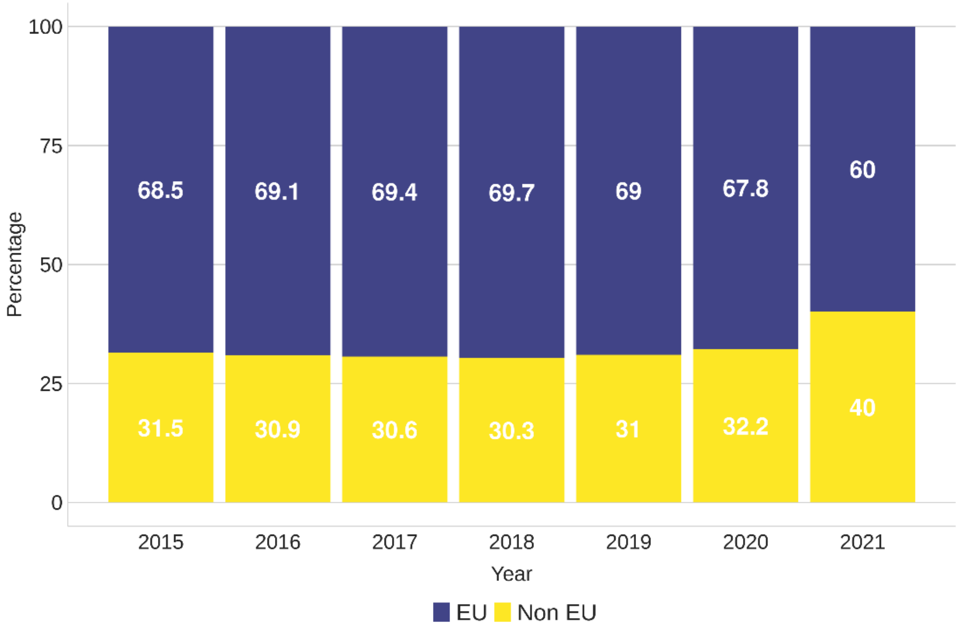
EU countries continue to be the main source for FFD imports and are therefore essential to the UK's food security. 39% of FFD imports by value were despatched from 4 EU countries (the Netherlands, Republic of Ireland, Germany, and France) in 2020.

Context and Rationale

Data on imports shows the continued importance of the EU for food imports. In winter months countries in the south of the EU are particularly significant in terms of fruit and vegetables and the nutritional value and consumer choice those products provide.

Data and Assessment

Figure 2.1.4a: Balance of EU and non-EU imports by value



Source: HMRC

The geographical proximity of the EU influences the amount of trade that it accounts for, and for some animal products like bacon and ham, milk, cream, and eggs, all imports are sourced from the EU. But there are also products where imports are more diverse, such as rice, spices, coffee, and citrus fruits.

Trends

The EU's share of UK imports has remained very stable at around 70% in recent times. It remains to be seen if this will be affected by the UK having left the EU in January 2021. Whilst there appears to be some shift in 2021 from EU to non-EU, this shift is not necessarily new sources of goods. For some items such as fish, coffee, and some fruit, this is thought to be a "trade hub" effect with some imports (including third country origin material) now coming directly to the UK (or recorded as doing so) rather than being previously cleared in the EU before moving to the UK.

Indicator 2.1.5 Overall diversity of supply

Headline

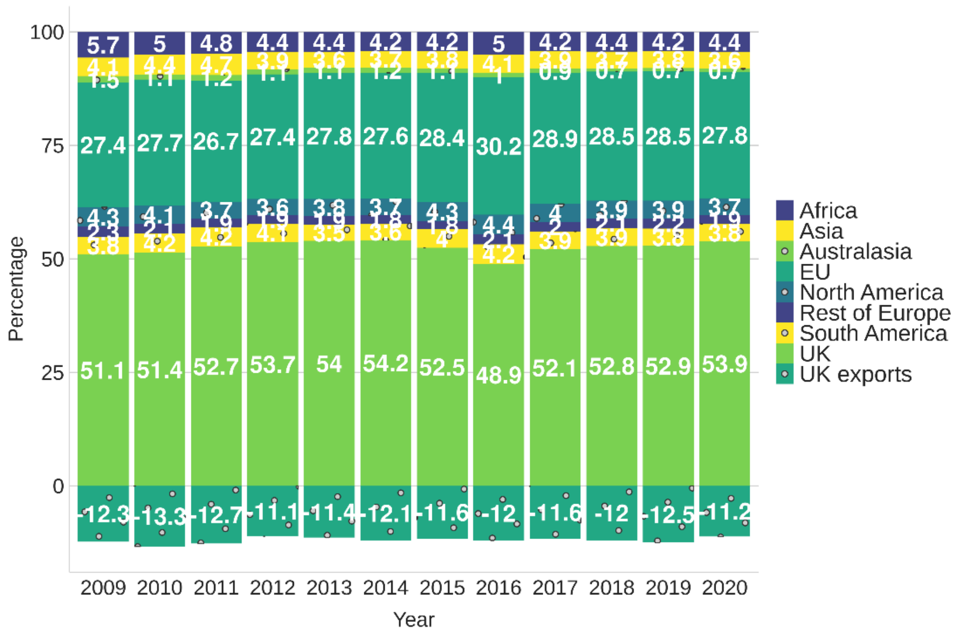
The UK's food supply is concentrated on the UK and EU countries, with over 80% of supply coming from these main sources. The remainder is mostly spread fairly evenly between Africa, Asia, North America, and South America. This picture has changed little in the last 10 years.

Context and Rationale

Diversity of supply reflects the range of supply sources the UK has, including domestic production. Tracking this data allows the UK to prepare in case environmental, economic, or political changes affect the ability of a given country to produce or export a key product, for example due to a natural disaster.

Data and Assessment

Figure 2.1.5a: Origins of food consumed in the UK, 2009-to 2020



Source: HMRC

Supply includes domestic production plus imports, and excludes exports of home production. In 2020, 54% of domestic consumption came from UK production (based on unprocessed value at farmgate), 28% from the EU and the remaining 18% from the rest of the world. 42 countries accounted for 90% of imported supply, and 27 for 80%. Some countries or regions are uniquely important to supply of particular products like bananas from the Caribbean and Central America, reducing the security of this supply.

Trends

These percentages have changed little over the last 10 years (longer term trends in domestic production as a percentage of supply can be found in the indicators that follow). The vagaries of the weather and harvest impact UK production from year to year, as they do throughout the world. Underlying trends in consumption and demand evolve very slowly over time and structural shifts in trading arrangements also lag.

Indicator 2.1.6 Domestic grain production

Headline

The UK is largely self-sufficient in grain production. Production of grains is dependent on weather conditions and can be volatile year to year but is fairly stable in the long term. Yields were unusually low in 2020 due to bad weather, but provisional results for 2021 show a return to the 5-year average.

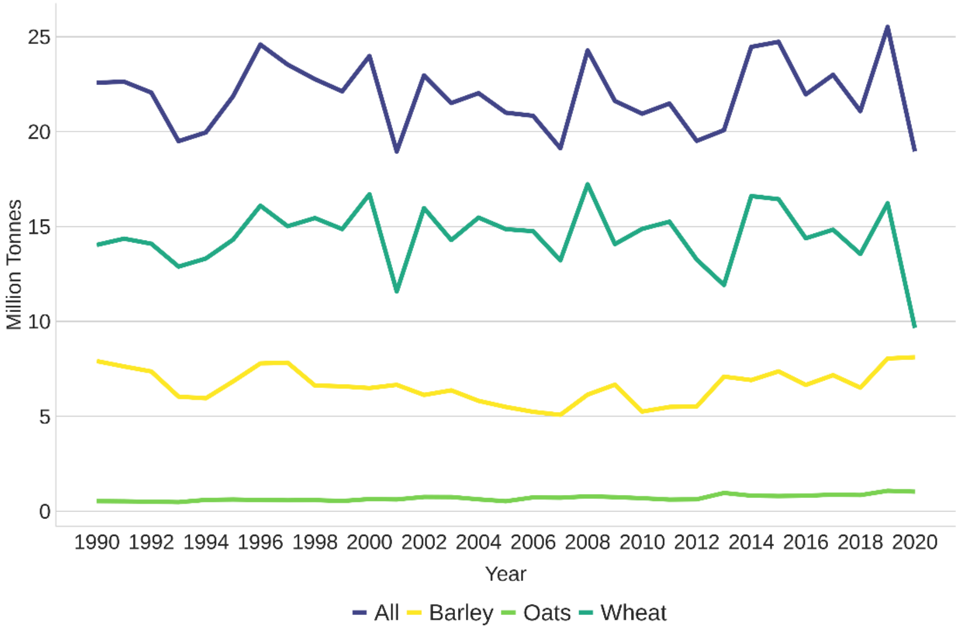
Context and Rationale

Wheat plays a vital part in the UK's diet, environment and economy, accounting for about 30% of daily food energy intake per person in the UK during 1961 to 2011.[49] It is consumed in bread and bakery products, in breakfast cereals, in pasta, and indirectly (via animal feed) in meat and some types of alcohol such as beer and whisky. Grain is generally also the most efficient form of production in terms of calories per hectare, though the bulk of it is grown intensively, relying on inputs in the form of fertilisers, pesticides, and tractor diesel. Grain production has a significant environmental impact, due to the lack of biodiversity in conventional grain fields, damage to the soil through ploughing, environmental harms caused by fertilisers and pesticides, and the oil use embedded in fertilisers and field operations.

[49] Shewry, P.R. and S.J. Hey, 'The contribution of wheat to human diet and health', Food and Energy Security 2015: volume 4, [redacted], pages 178 to 202.

Data and Assessment

Figure 2.1.6a: Domestic UK grain production



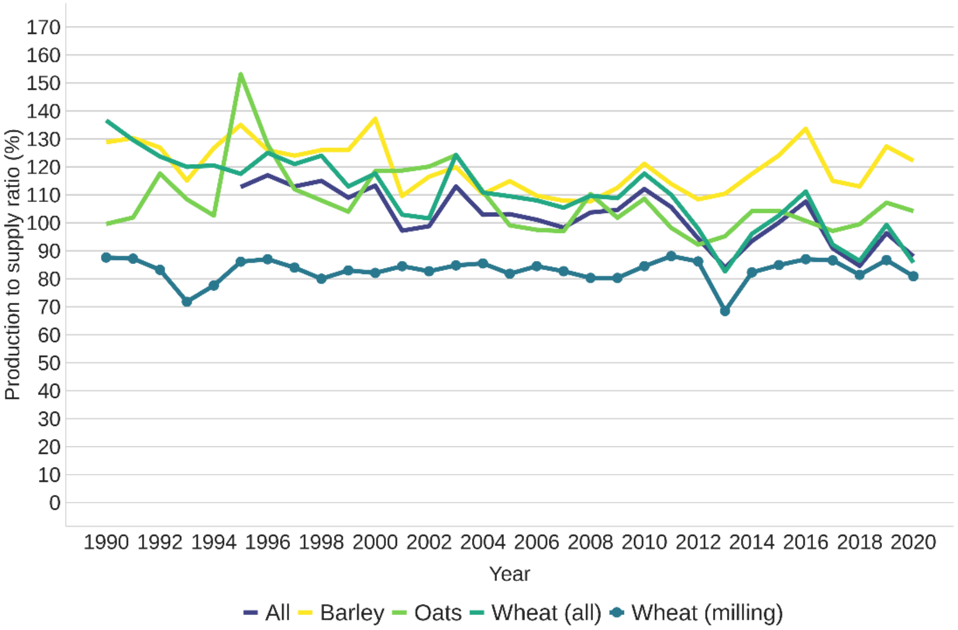
Source: Defra AUK 2020

The UK grows roughly 15 million tonnes of wheat annually, occupying nearly 2 million hectares with some of the highest yields in the world at around 8 tonnes per hectare. The 2018 financial value of wheat produced in the UK was roughly £2 billion, representing a significant contribution to the total value of £9.3 billion for all crops produced by the UK that year.

Production of barley and oats has been fairly stable, with wheat (primarily a winter-grown crop) a little more volatile depending on weather patterns during planting and growing, as seen in 2020. At 9.6 million tonnes, wheat production was its lowest since 1981 due to unusually poor weather conditions at critical points of crop production: very wet weather for preparing the soil and sowing, too dry in the spring when the crops should have established, and bad weather for harvesting. This appears to be an outlier compared to recent years, and provisional results for 2021 indicate a return to the 5-year average; however, climate change is projected to increase the frequency of such events. Barley production on the other hand was 1 million tonnes higher than the 2015 to 2019 average.

In 2020, 11.9 million tonnes of wheat, barley, and oats were used as animal feed, 5.9 million tonnes of wheat and 0.6 million tonnes of oats were milled, while 1.6 million tonnes of barley went into brewing and distilling, and about 0.5 million tonnes of these three grains were used for seed.

Figure 2.1.6b: Domestic UK grain production as percentage of consumption



Source: Defra AUK 2020

The UK is largely self-sufficient in barley and oats, and 81% self-sufficient in milling wheat (slightly higher for wheat overall), which is the most significant grain crop for food consumption in the UK. It is not likely or desirable for this figure of 81% to rise much higher, as the remaining percentage is largely made up of hard wheat types not suited to the UK's climate and soils. Further to this, global competition in wheat production and prices means there is significant economic risk involved with trying to fully meet domestic milling needs, since any surplus could be undervalued relative to the costs incurred during production. UK farmers instead grow what they are best able to, a mix of milling and feed wheat according to market demand and prevailing weather conditions.

For these reasons, the mix of grain grown in the UK differs somewhat from the grain consumed in the UK. Grain alone does not provide a healthy and nutritious diet or meet consumer demand for a varied diet. However, from a purely calorific perspective, the (below average) grain yield in 2020 of 19 million tonnes would be sufficient to sustain the population. It is equivalent to 283kg per person, 0.8 kilos per day. A kilo of wheat provides 3,400 calories (and barley slightly more at 3520 calories), making 0.8 kilos of grain over 2,600 calories, compared to recommended calorie intake of 2 to 2500 for adults. From these figures it is easy to demonstrate that, even without accounting for other domestic products like potatoes, vegetables, grass-fed meat and dairy, and fisheries, current UK grain production alone could meet domestic calorie requirements if it was consumed directly by humans in a limited choice scenario.

Defra currently supports a long-term research platform for the genetic improvement of arable crops and fresh produce. These Genetic Improvement Networks (GINs) aim to improve the productivity, sustainability, resilience, and nutritional quality of UK crops, including wheat, oilseed rape, leafy vegetables, and pulses. This includes significant research to enhance resilience to climate change risks such as drought and heat stress. Overall resilience is supported by trading with a variety of external partners and the UK imports and exports flexibly as production and prices dictate.

Trends

Long term grain production is stable, though the 40% reduction in wheat production in 2020 shows the sensitivity of the sector to unusual weather patterns, and therefore to climate change. Water stress is already a significant factor for wheat yields in southern and eastern England, and is likely to worsen in future, while excess wetness is also expected to rise in the winter season, preventing access to fields for cultivation and sowing.

Indicator 2.1.7 Livestock

Headline

In meat, milk, and eggs, the UK produces a roughly equivalent volume to what it consumes. In 2020 it produced 61kg of meat, 227 litres of milk and 172 eggs per person per year. By value the UK is a net importer of dairy and beef, reflecting consumer preferences for eating higher value products and exporting lower value products.

Context and Rationale

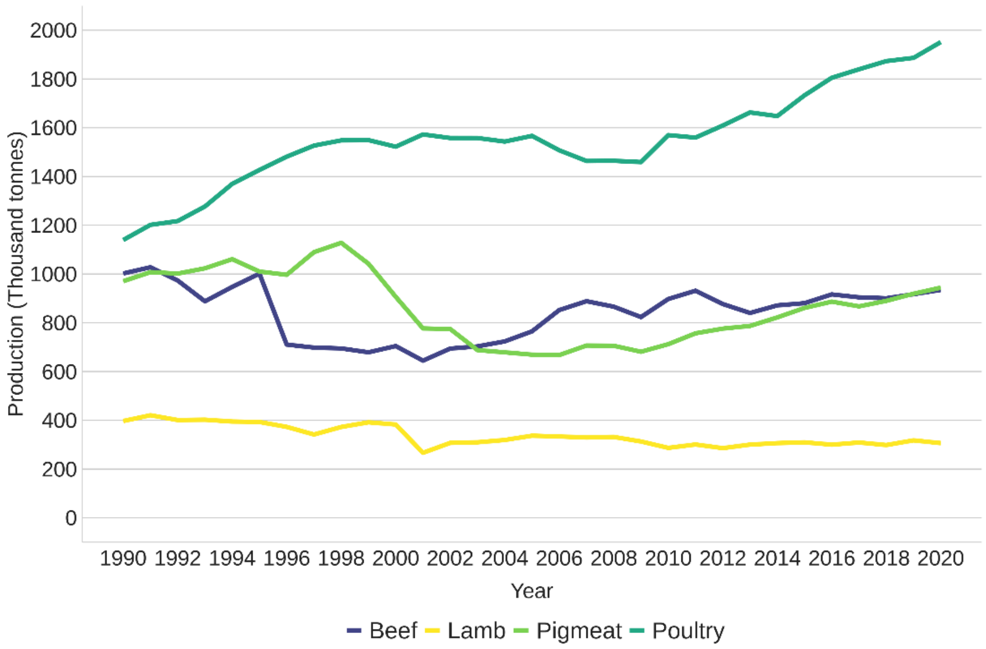
Meat, dairy, and eggs make up an important part of the UK's overall diet and agricultural economy and are areas where the UK is largely self-sufficient in volume. Imports of high value dairy and beef allow consumers their preferred cuts of meat and dairy products. These products are all contributors to a healthy diet, providing important proteins, amino acids, omega oils, vitamins, and minerals such as calcium.

Livestock sectors have higher average greenhouse gas emissions than plant-based products, though the impact of livestock varies greatly depending on the production method. Well-managed livestock can provide benefits like supporting biodiversity, protecting the character of the countryside, generating important income for rural communities, and contributing to production of other crops as part of rotational systems.

High UK production of animal products partly reflects the large proportion of UK land suited to both extensive and intensive grass production. Grass-based livestock production is often augmented by the feeding of both domestic and imported grain and to a reducing degree imported soyameal, particularly in intensive systems – for example, some dairy, chicken, and pig farms. Animal feed is considered in more detail in the section below on inputs.

Data and Assessment

Figure 2.1.7a: Domestic UK meat production



Source: Defra AUK 2020

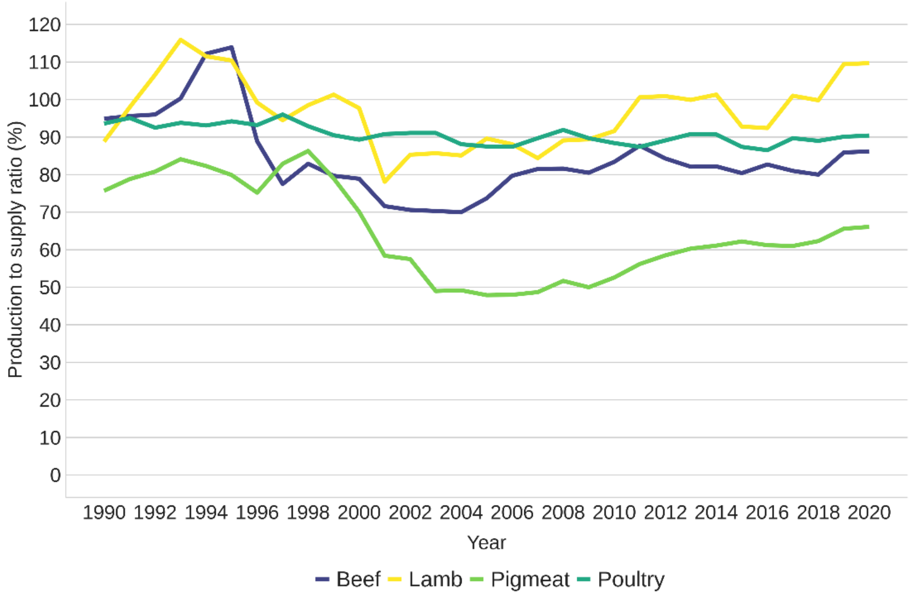
There are noticeable dips in beef production in the mid-1990s and early 2000s, showing the effects of the bovine spongiform encephalopathy (BSE) and foot and mouth crises. An increasing proportion of beef, currently estimated at over 50%, is produced as a by-product of dairy farming, rather than from specialist beef herds. At 1.5 million, the number of beef cows in the national herd is similar to in the 1980s, having peaked at just under 2 million in the late 1990s. This herd supports sales for beef of 2.9 million animals per year, down from 4.5 million in 1980; the numbers sold for beef dropped from 3.8 million to 2.4 million between 1995 to 1996 due to the impact of BSE on sales. Total cattle and calf numbers including beef and dairy have been around 10 million head in June (when the data is collected) for the last 20 years.

Pig and poultry production has increased substantially over the last 12 years, which may reflect higher demand for cheaper meats in more economically challenging times, and greater efficiency in poultry production. Total head count for pigs in June has reduced from 7.8 million in 1980 to 5.1 million in 2020, with a steep decrease of over 3 million between 1998 and 2003; annual sales are around 10 million head. Poultry population for meat in June has doubled from 60 million in 1984 to about 120 million in 2020, with over 1 billion birds sold for meat.

Mutton and lamb production has remained stable throughout this period and while demand has varied, production generally met or exceeded demand over the last decade. Total flock size in June rose from 31.4 million in 1980 to about 45 million throughout the 1990s, then declined again to 32.7 million by 2020; sales per year are at about 15 million head.

For all four species there has been an improvement in yield relative to number of animals.

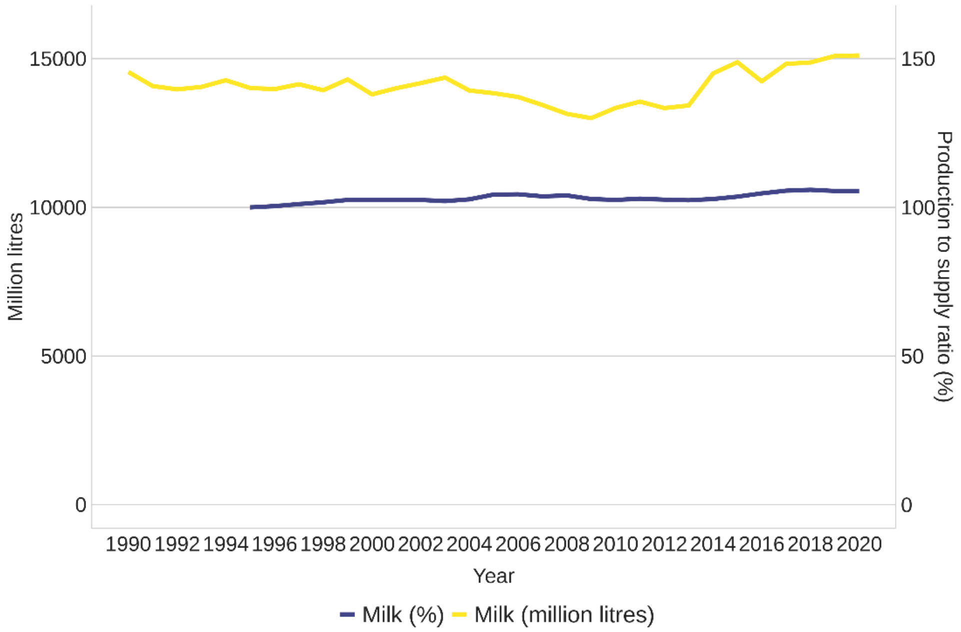
Figure 2.1.7b: Domestic UK meat production as percentage of consumption



Source: Defra AUK 2020

The UK is close to self-sufficient in lamb and poultry. Most beef consumption is also met by domestic production, with imports from the Republic of Ireland making up the bulk of the remainder, though there is some trade reflecting consumer preference for particular cuts. Pigmeat is lowest in terms of self-sufficiency at 66% of consumption. Considering production and percentages of consumption together, it seems overall meat consumption has increased over the period, driven by increased poultry consumption.

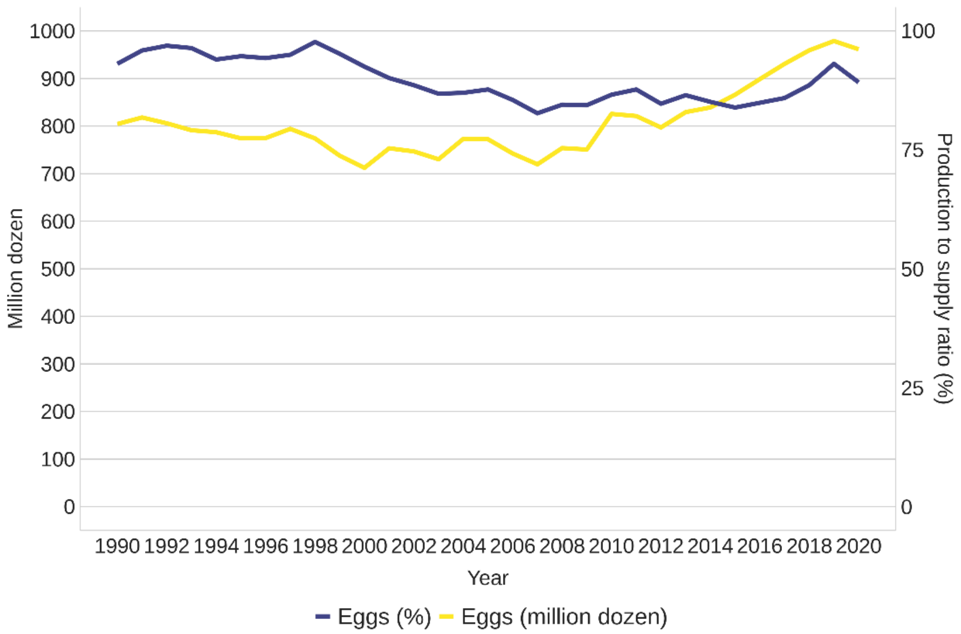
Figure 2.1.7c: Domestic UK raw milk production and consumption



Source: Defra AUK 2020

Raw milk production has held steady and generally exceeded consumption, with a notable rise following the end of milk quotas in March 2015. Herd size has decreased from 3.5 million to 1.9 million since 1973, while yield per animal has more than doubled.

Figure 2.1.7d: Domestic UK egg production and consumption



Source: Defra AUK 2020

Egg production has also been consistent, meeting between 89% and 98% of domestic demand and increasing substantially over the last decade, despite a significant move to free range methods, which now make up about half of production. It is likely that a slight dip in 2020 was caused by the COVID-19 pandemic reducing demand from hospitality and canteens. Although production has increased slightly, laying fowl numbers have decreased from 53 million in 1984 to 40 million in 2020, with the main reduction taking place in the 1980s and 1990s.

Trends

Poultry, pigmeat, and egg production is increasing, while beef, lamb, and milk remains largely stable. The UK now consumes less milk and more eggs relative to production. Changing domestic production is broadly reflected in consumption percentages for beef, pigmeat, and mutton and lamb, with a slight decrease in demand for beef and mutton and lamb in the last two years. Poultry production has increased considerably but is still a smaller percentage of consumption than in 1985, indicating a marked dietary shift towards poultry.

Climate change is projected to cause more than tenfold increases in thermal heat-stress for livestock across the UK. For example, risk of dairy cattle thermal heat stress is projected to increase in the next 30 to 50 years by over 1000% in the South West, the region with the most dairy cattle (see **Theme 2, Indicator 2.3.3, Case Study 2.1**.).

Indicator 2.1.8 Other domestic crops

Headlines

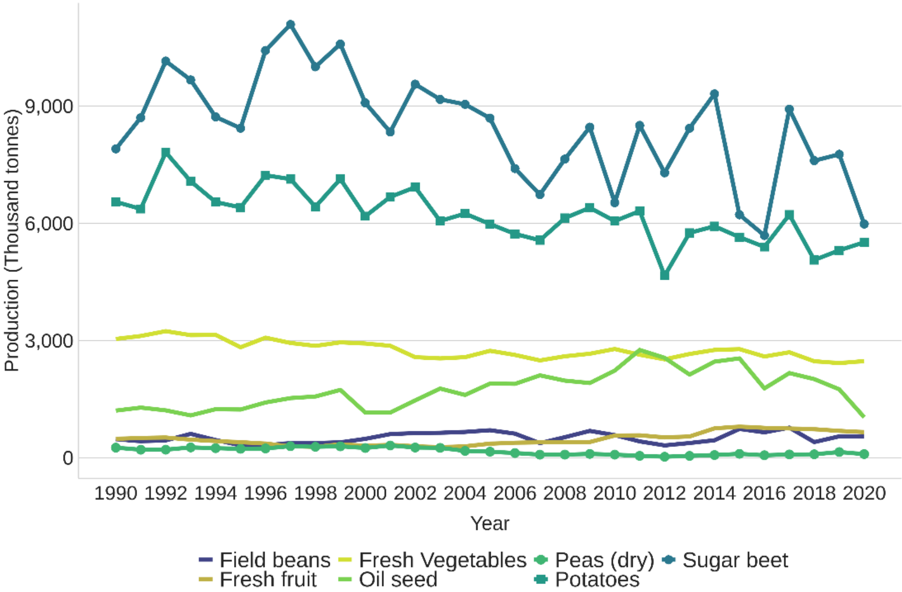
The UK produces a significant proportion of the other domestic crops it needs, including 54% of fresh vegetables, 67% of sugar beet, 71% of potatoes, and 79% of oilseeds, though only 16% of fresh fruit. Apart from a reduction in oilseeds, these proportions have remained stable over the last ten years. Climate change represents a risk to existing production both in terms of making conditions unsuitable for some crops and allowing new pests to proliferate, although it may also benefit new types of crops.

Context and rationale

Cooking oil, sugar, potatoes, other vegetables, and fruit are significant for domestic consumption, with fruit and vegetables particularly important for a healthy diet. Fruit and vegetables are areas where the UK is more dependent on imports, as detailed in **Indicators 2.1.9** and **2.1.10**.

Data and assessment

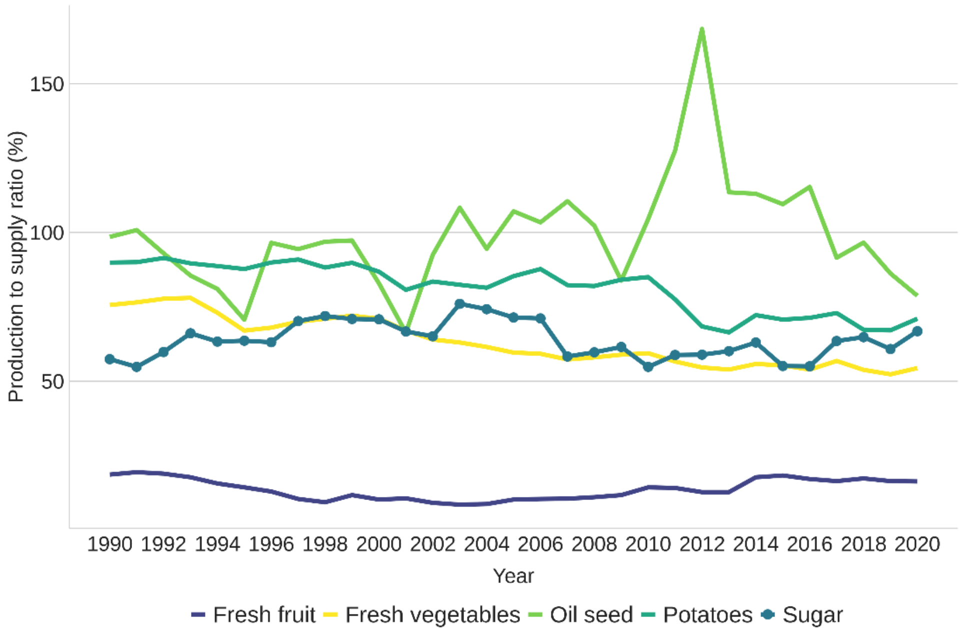
Figure 2.1.8a: Domestic UK production of other crops



Source: Defra AUK 2020

Production of most of these crops is fairly stable. The most noticeable change is a reduction in oilseed production in recent years due to stem flea beetle damage, as discussed under **Indicator 2.1.2**. However, longer-term trends over the last 35 years show that oilseed production is still comparable to the 1990s. Sugar beet trends follow demand from processing factories (dominated by British Sugar (Silver Spoon)), overall down slightly through this period but still higher than in the 1980s, with annual variations due to weather. Sugar beet yields per hectare have improved, suggesting greater production efficiency. Fresh fruit production is small in terms of tonnage and percentage of domestic consumption, but as a crop it is among the most valuable, so should not be underestimated as an economic contributor to the sector. In 2019, horticulture, including potatoes, contributed 17% of farm gate output in value from less than 2% of farmed land.

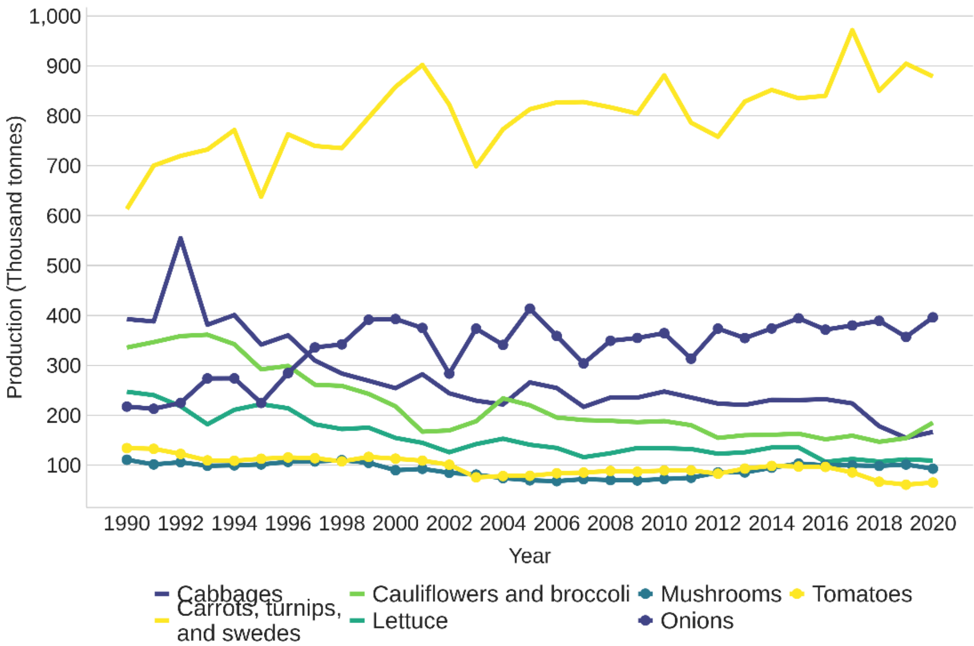
Figure 2.1.8b: Domestic UK production of other crops as percentage of consumption



Source: Defra AUK 2020

Despite the dip in oilseed production, domestic production still fulfils 79% of consumption. Some imported vegetable oils can be linked to tropical deforestation, so there is a risk of offshoring environmental and social harms if domestic production were to reduce further. For sugar beet (63% in 2020), the remaining percentage of sugar demand can vary significantly and is primarily met by imported cane sugar. Potato production to consumption is at 71%. Fresh vegetables are at 54%, and fresh fruit are at 16%, making the UK more reliant on imports for these products.

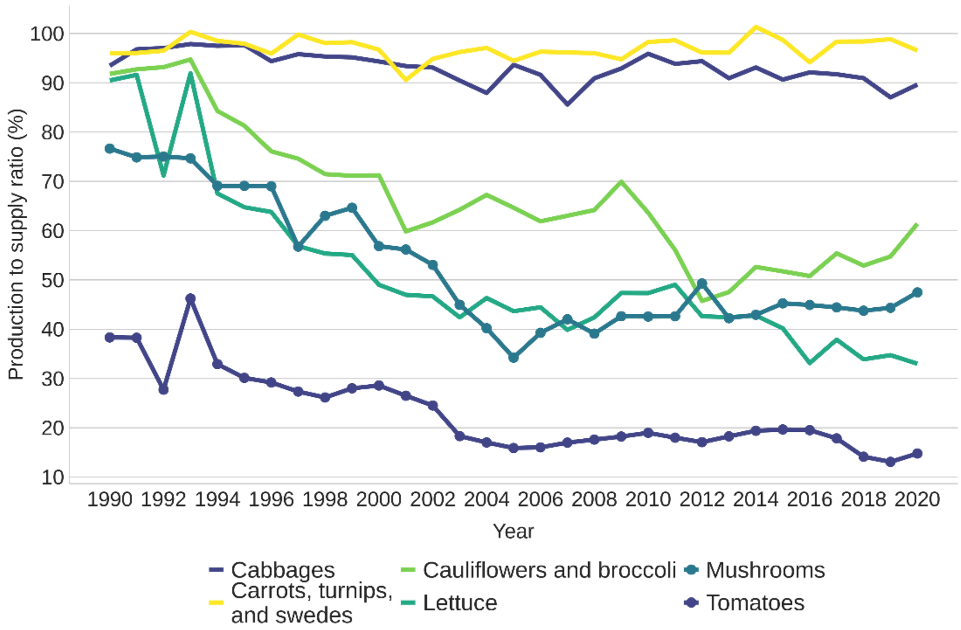
Figure 2.1.8c: Domestic UK production of fresh vegetables



Source: Defra Horticulture Statistics 2020

For field vegetables overall there has been a steady decline in production (down 10%), which varies between crops following consumer tastes. For example, brassica production has halved over this period, but within this category cauliflower production has fallen to approximately a third of 1990 production while broccoli production has nearly tripled over the same period. Production of root crops has increased, notably onions (by 80%) and carrots (by 60%) while turnips and swedes (down 25%) are no longer as much in favour.

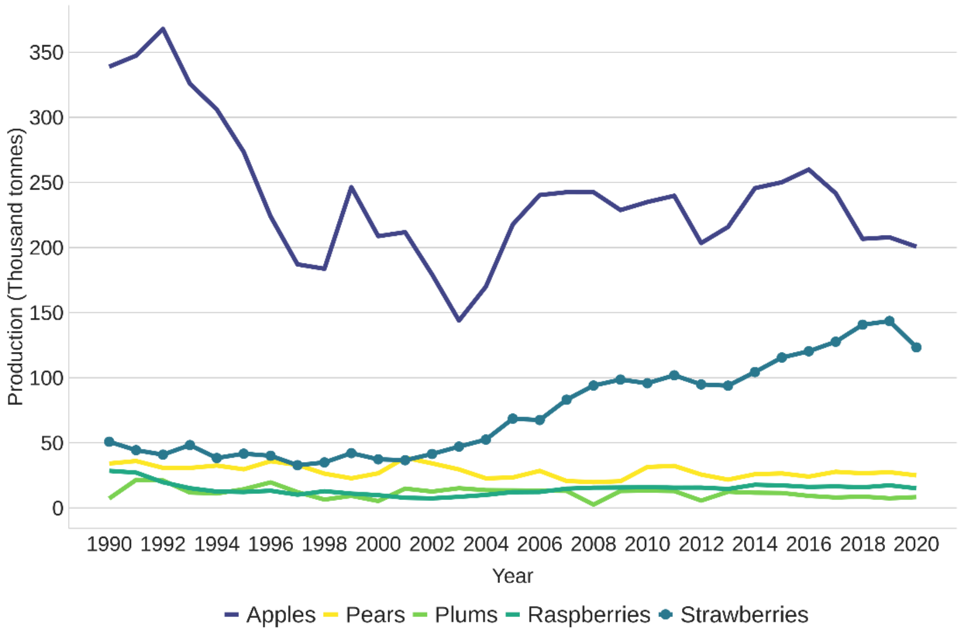
Figure 2.1.8d: Domestic UK production of fresh vegetables as percentage of consumption



Source: Defra Horticulture Statistics 2020

The UK is essentially self-sufficient in root vegetables and cabbage but produces a smaller but rising proportion of other greens, such as cauliflowers and broccoli than in 1990. Domestic fulfilment of demand is also lower for lettuce, mushrooms and especially tomatoes, domestic production of which has halved since 1990. Detailed percentage of consumption data for onions is not available but is believed to be around the 50% mark. Over the last 15 years imports of onions have hovered between about 300,000 tonnes and 400,000 tonnes (with exceptionally high years beyond that in 2013, 2014 and 2019), varying in relation to domestic production.

Figure 2.1.8e: Domestic UK production of fresh fruit

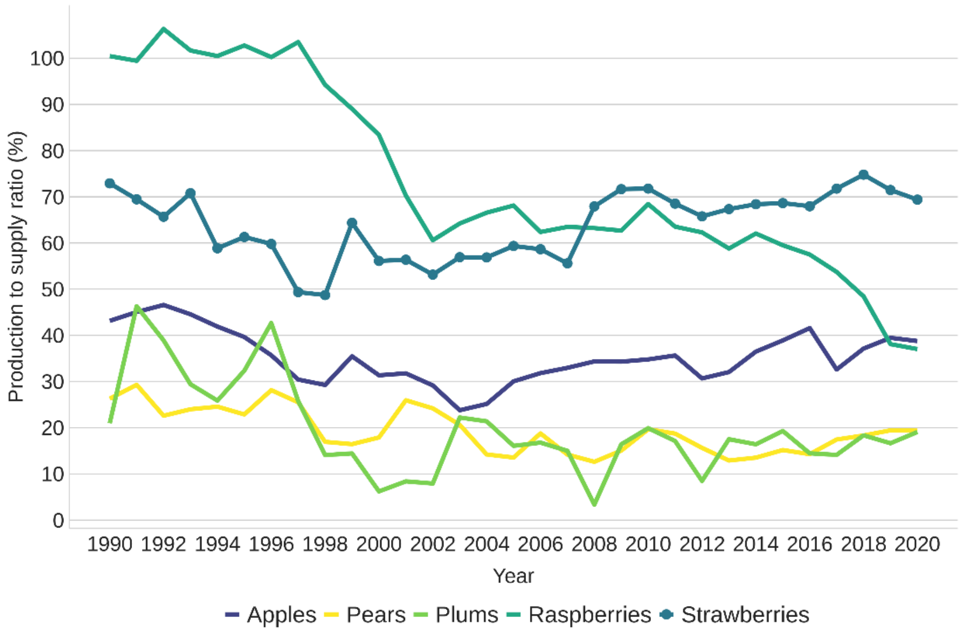


Source: Defra Horticulture Statistics 2020

Total volume of fruit production is more volatile than vegetable production. Fruit production fell in the 1990s but recovered from about 2000 onwards and, with a couple of dips (most likely due to adverse weather) increased slowly up to 2020. Fruit production has doubled in real term value from approximately £0.5bn to £1bn, while production increased from below 300,000 tonnes in the early 2000s to 657,000 tonnes in 2020.

There has been significant change to the variety of apples grown, with a move away from traditional varieties such as Cox’s and Discovery to new higher-yielding varieties such as Gala and Braeburn. Apple production has increased during a period when the production area has nearly halved. For soft fruits, strawberry production has more than doubled due to new varieties and longer growing seasons and partly due to innovations like LED lighting and table-top production. Raspberry production has almost halved, blackcurrant production is stable, and overall production of other soft fruit not covered in the chart has nearly doubled.

Figure 2.1.8f: Domestic UK production of fresh fruit as percentage of consumption



Source: Defra Horticulture Statistics 2020

Demand for soft fruit has increased, with the domestic strawberry supply to use ratio similar to 1990 despite production being two to three times greater. Raspberry demand also grew slightly despite a reduction in domestic production, bringing the supply ratio down sharply from 100% to 40%. Supply ratios for apples, pears and plums is more consistent, and reflects trends in production year on year.

Trends

Changing and extreme weather will have varied effects on different crops. Potato yields are vulnerable to hot dry summers, as the 20% fall in the 2018 harvest shows, but other new crops like red wine grapes are already benefitting from changing weather patterns. A related risk is of imported pests and diseases; Plant Health checks at borders are already important and will become more so as climate changes expose the UK to new threats of this kind. The changing UK climate will likely alter the emergence, survival rates, and spread of both indigenous and invasive pests, weeds, and diseases (see **Indicators 2.3.3** and **2.3.4**).

Indicator 2.1.9 Supply sources of UK fresh fruit and vegetable imports

Headlines

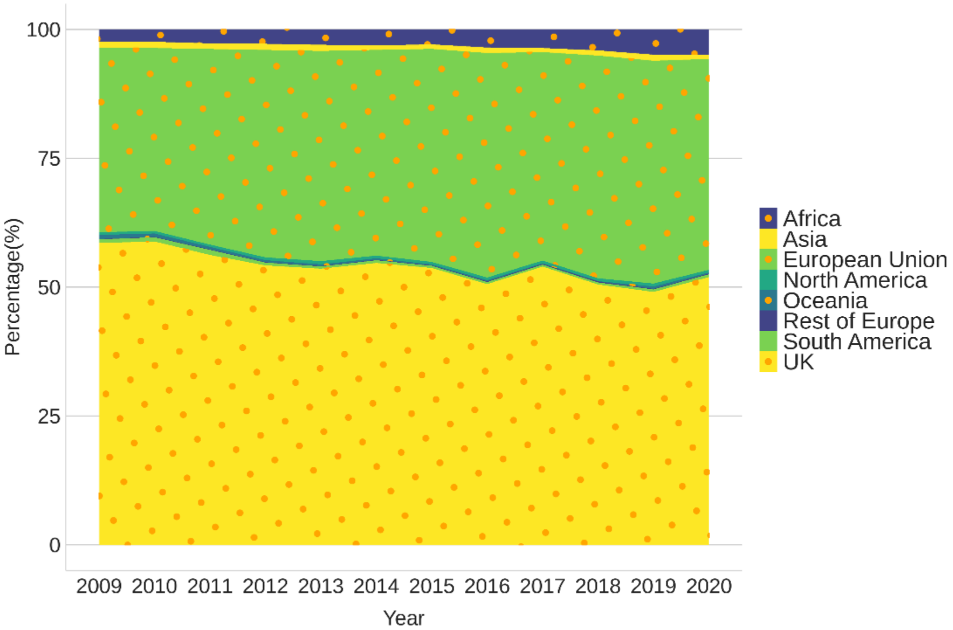
The UK produces over 50% of vegetables consumed domestically, but only 16% of fruit. In 2020, 93% of domestic consumption of fresh vegetables was fulfilled by domestic and EU production, while fruit supply was more widely spread across the EU, Africa, the Americas, and the UK.

Context and rationale

The UK has a high dependency on FFV, so monitoring the diversity of supply is necessary to ensure supply routes are adequate. Many imported products (tomatoes, courgettes, and oranges for example) are part of the regular diet of UK consumers, so are important for nutritional value and consumer choice.

Data and assessment

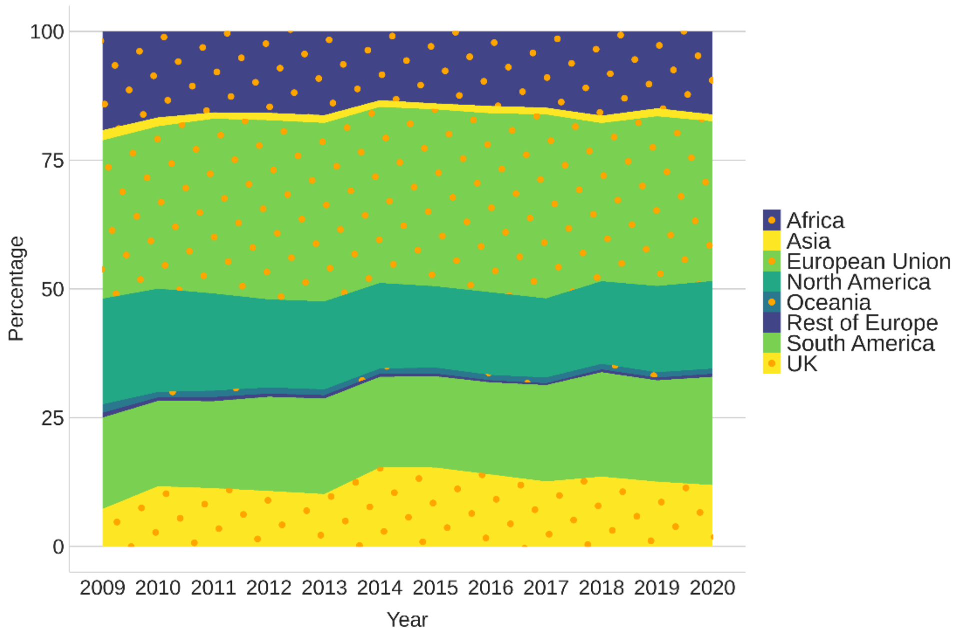
Figure 2.1.9a: Origins of fresh vegetables in UK domestic consumption



Source: HMRC

93% of domestic consumption of fresh vegetables was fulfilled by domestic and EU production, reflecting the importance of geographical proximity for importing fresh produce of relatively low value. UK production to consumption has declined slightly over the last decade, while reliance on EU and African supply sources has increased.

Figure 2.1.9b: Origins of fresh fruit in UK domestic consumption



Source: HMRC

Origin of fresh fruit consumption is more diverse, with 97% by volume from the UK, EU, South America, North America, and Africa. This reflects UK consumer demand for tropical and out-of-season fruit which cannot be sourced domestically or from Europe. UK production to consumption has increased a little since 2009 but remains low.

Trends

There are concerns about water availability for fruit and vegetable production in many of the countries on which the UK currently depends, for example in the Mediterranean region.[50] The spread of plant diseases could also be significant for fruit and vegetable imports. For example, diseases such as Fusarium wilt (Panama TR4) could significantly affect the future availability of bananas in the UK and worldwide. While this might not impact directly on food security, the disruption of supply chains for staple foods such as bananas could have a serious impact on consumer confidence and trust.

---

[50] WRAP, 'Working together to protect critical water resources',
[redacted]

Indicator 2.1.10 Seasonality

Headlines

The relationship of supply to the time of year is complex and depends on the product. The UK has diverse supply lines to meet demand throughout the year.

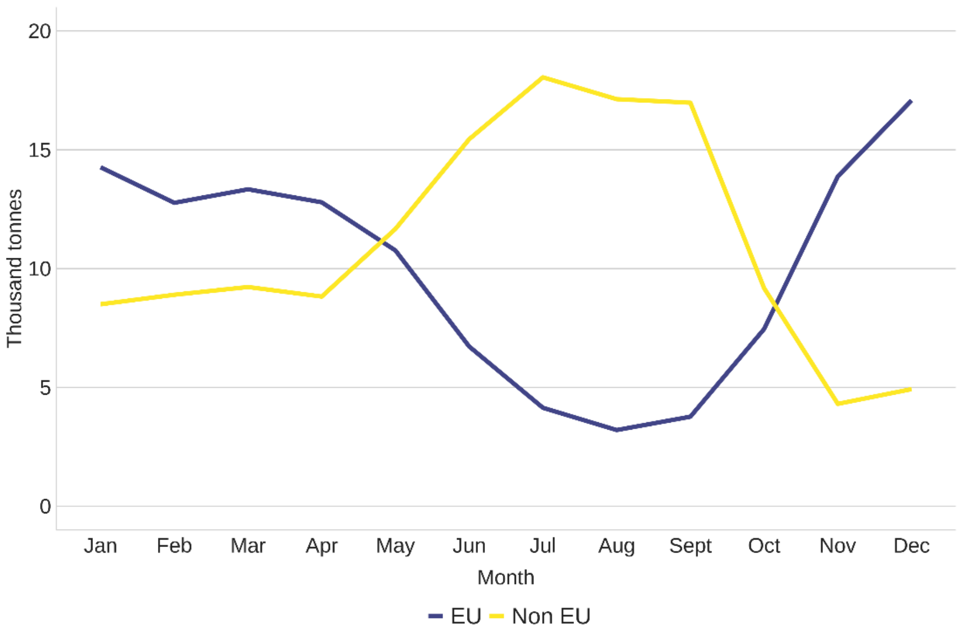
Context and rationale

Seasonality varies with product, growing season, and growing method, and is important for understanding how the UK's fresh fruit and vegetable (FFV) supply changes during the year. Domestic production is concentrated in the summer months, particularly for higher value crops like berries.

There is year-round FFV production in the UK, but winter crops are more limited in range, being dominated by root vegetables and leafy greens. In winter months the UK is particularly dependent on imports to keep supermarkets stocked with diverse out-of-season FFV. Over the last thirty years consumer preferences have developed, favouring more ingredients which cannot be grown in the UK and expecting access to out-of-season fruit all year round.

Data and assessment

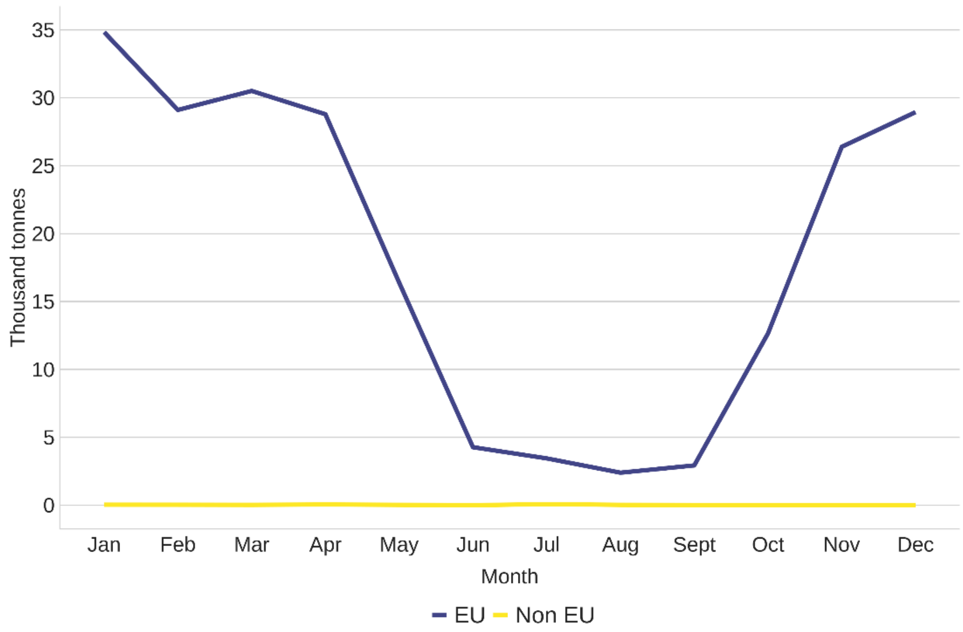
Figure 2.1.10a: UK citrus fruit imports seasonal variation



Source: HMRC

Citrus fruit imports reflect global harvest seasons, which are generally in winter months, so EU imports are highest in the UK winter when produce comes from the Mediterranean countries. In the UK summer, imports are sourced from the southern hemisphere, especially South Africa.

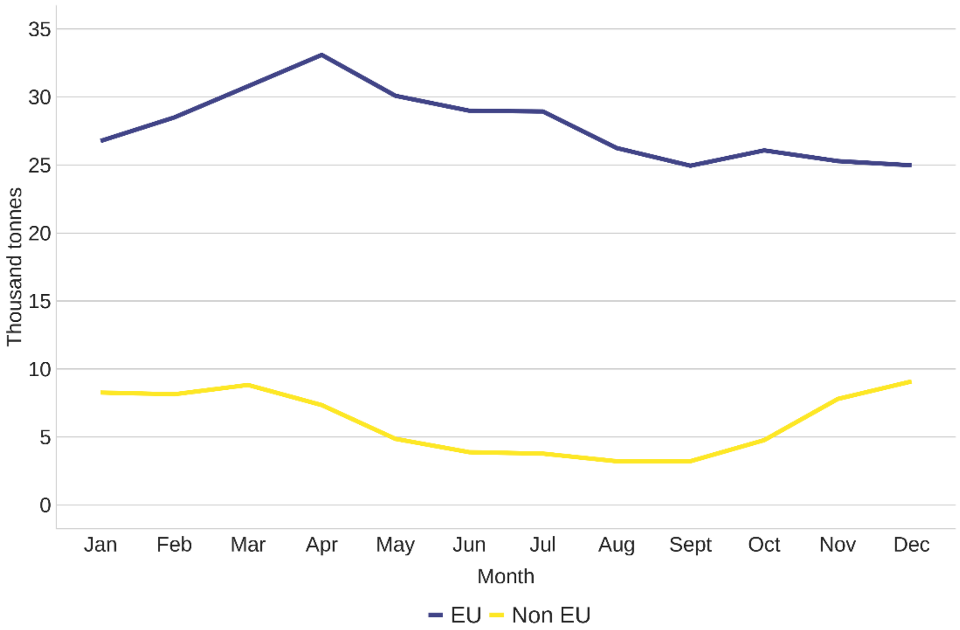
Figure 2.1.10b: UK lettuce imports seasonal variation



Source: HMRC

Other seasonal effects for some products reflect the UK growing season. Imports of lettuce come almost exclusively from the EU during the autumn and winter, whilst domestic production reduces trade in the spring and summer, as shown in the large dip in imports during those months.

Figure 2.1.10c: UK tomato imports seasonal variation



Source: HMRC

For many products seasonality is less marked. For example, tomatoes can be produced year-round, including in greenhouses in the UK but domestic production capacity is far below total demand and is supplemented throughout the year by imports.

Trends

The UK continues to rely on seasonal supplies of some products in order to meet consumer demand, particularly fresh fruit and vegetables. The seasonality of supplies can be driven by a number of factors, including global and domestic production seasons. The examples presented above show that the EU has previously been an important source of supply for those products for much of the year. It is not yet apparent whether UK supply chains have changed permanently after 31 December 2020. Future Food Security Reports will note if there has been a change in the balance of EU and non-EU imports.

Year-round access to a full range of FFV in all seasons has increased over the last 20 to 30 years, leading to longer and more complex supply chains, alongside a drop in domestic supply ratio of fresh vegetables from 76% to 54% since 1990 (see **Indicator 2.1.8**).

Indicator 2.1.11 Fish

Headlines

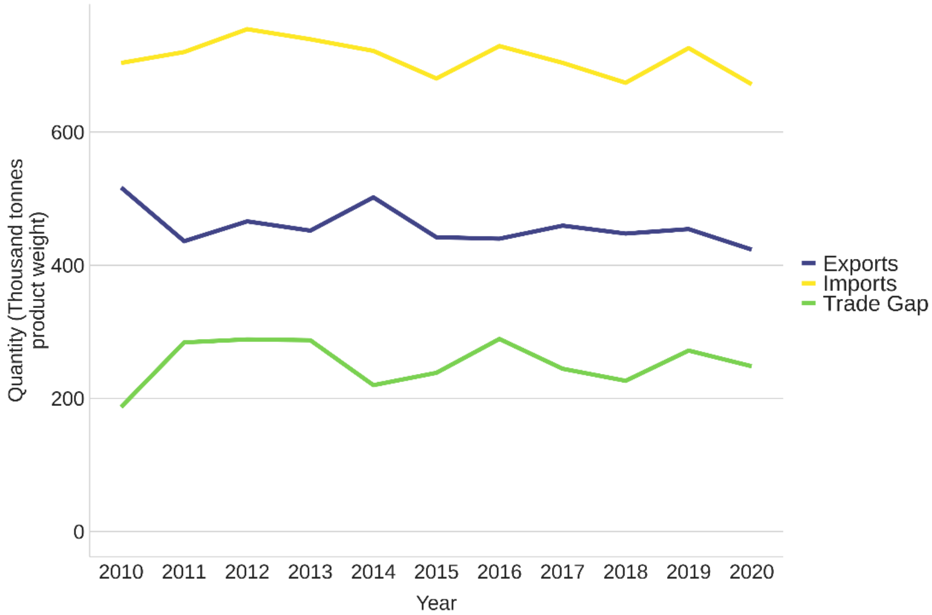
The UK is a net importer of fish, and heavily dependent on imports for the types of fish consumers prefer, as these are different to the main types caught domestically. Fisheries in general are threatened by overfishing and climate change, but most of the fisheries which export to the UK are sustainably managed and have healthy stocks.

Context and rationale

Fish represent a small but significant part of UK production and consumption. The picture of UK imports and exports is complicated by the fact the consumption of fish in the UK is dominated by non-native species, so much of the UK's catch is exported and fish for domestic consumption are imported instead.

Data and assessment

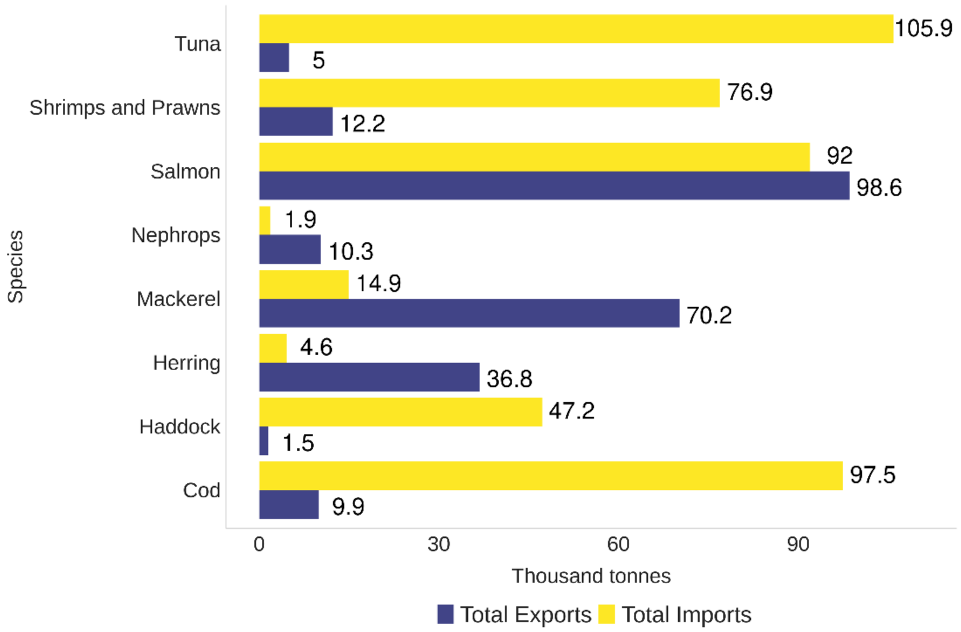
Figure 2.1.11a: UK fish imports and exports by weight



Source: HMRC

The UK exports around 452,000 tonnes and imports around 721,000 tonnes of fish globally. The UK is a net importer with imports exceeding exports by 269,000 tonnes (the trade gap).

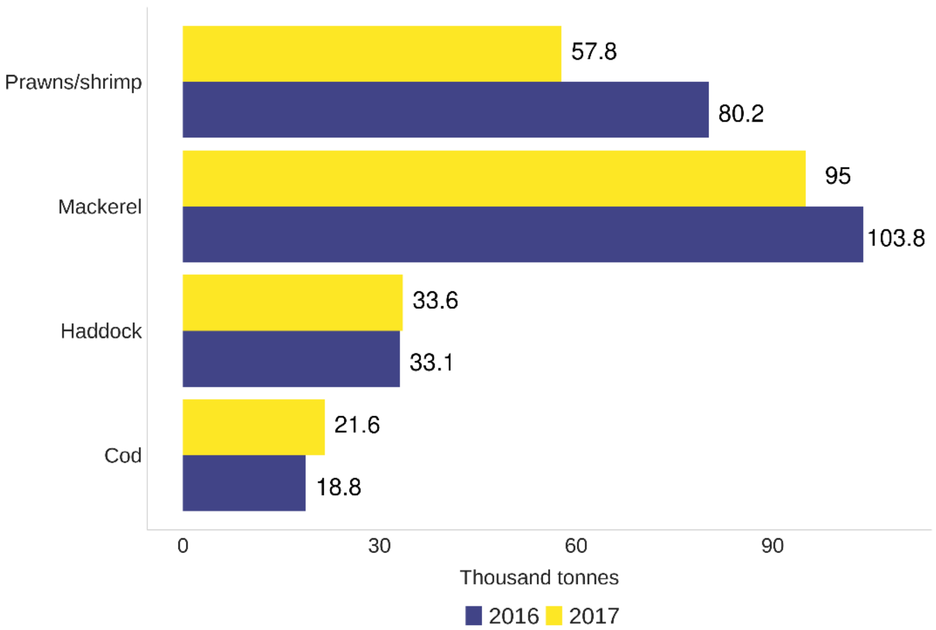
Figure 2.1.11b: UK fish imports and exports by species 2020



Source: HMRC

The UK relies on imports to meet domestic demand, especially for cod, haddock, tuna, and shrimp and prawns but is a net exporter of herring, mackerel, salmon, nephrops (langoustines), and scallops. Salmon is the only species which is both imported and exported in significant quantities.

Figure 2.1.11c: Domestic production of wild fish native to UK waters



Source: Seafish

Domestic fish yields of four main species fished and consumed in Britain can vary significantly year-to-year, as a snapshot of 2016 and 2017 shows (this data is older than the import and export data, but allows a reasonable comparison). Compared with figure 2.1.11b, showing imports and exports, it is apparent that the UK produces only a small amount of the cod it consumes, and less than half of haddock consumption also. A surplus of mackerel beyond domestic needs is exported, while shrimp and prawns are caught domestically and imported in similar volumes. During the Covid-19 pandemic industry-led initiatives to link buyers with the UK fleet led to an increase in availability of British-caught fish in some supermarkets; sales of (primarily imported) canned and frozen fish increased.

Figure 2.1.11d: UK fish imports by country 2019

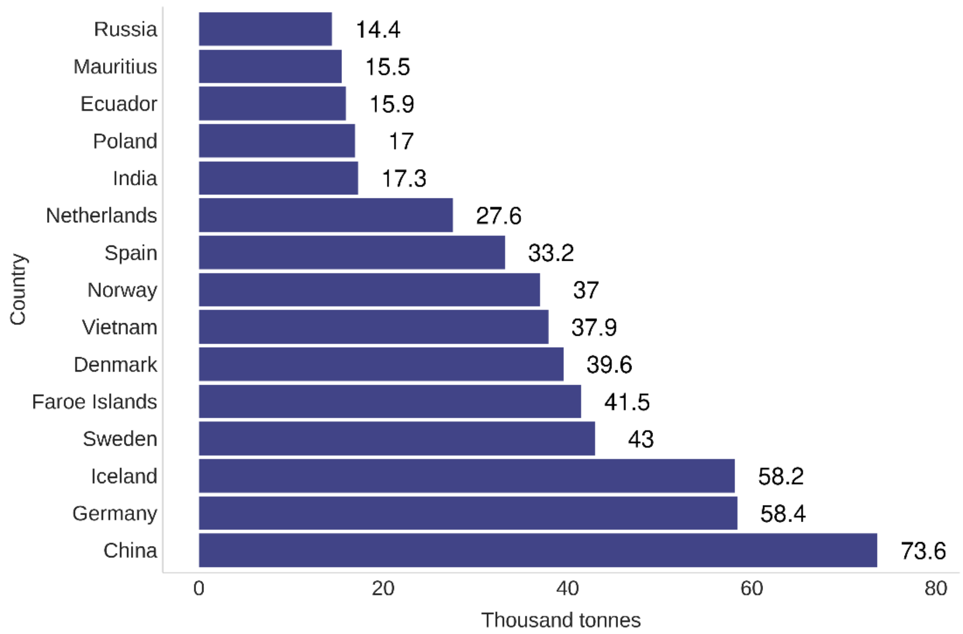
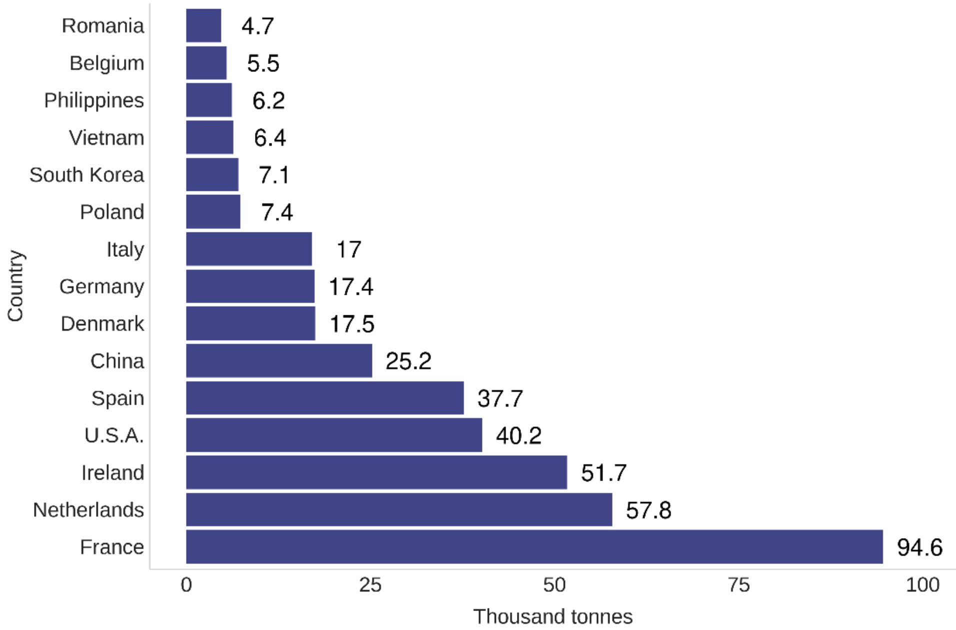


Figure 2.1.11e: UK fish exports by country 2019



Source: HMRC

EU countries are the largest export market, followed by the US and China (a key processing hub), while China and the UK's North Sea neighbours are the main sources of fish imports. A shift in diet to more locally sourced fish and shellfish would make the UK more self-sufficient in marine protein. However, from a food security perspective, having strong trade links and a diversity of supply is beneficial.

Trends

There are risks to fishing and marine sustainability from overfishing. Continuing international management of stocks and quota is necessary – for example, any unilateral increase in quota by other nations has a direct impact on food security for the UK nations who also fish in those sectors. A summary of stock health by species for the UK's main sources is as follows (as of 2017) – note salmon and warm water prawns are primarily farmed, so not included:[51]

- Cod (Iceland, Norway): healthy
- Haddock (UK, Iceland): variable but healthy, with UK stocks now being managed sustainably.
- Skipjack tuna (Mauritius, Ecuador, Seychelles, Philippines, Ghana): healthy and underexploited. Note that other species of tuna (making up about 7% of

[51] Seafish, 'Market insight [redacted]

UK tuna imports) are often overfished, with illegal, unregulated, and unreported catch.

- Cold water prawns (Canada and Greenland): variable stocks but managed stably.
- Mackerel (UK, North Sea nations): stocks good but trend uncertain.

Climate change presents a separate risk. The Climate Change Committee's Independent Assessment of UK Climate Risk projects warming of 0.2-0.4°C per decade to 2100 and beyond in the shallow shelf seas around the UK, particularly in the English Channel and southern North Sea. Warming seas, ocean acidification, and changes in salinity impact the entire marine biosphere and food chain on which commercial fishing depends. Fish farms face separate climate-related risks.

Climate change impacts are projected to include range shifts, decline in fish stock recruitment for species such as cod and herring, and risk of passing critical temperature thresholds for salmonid populations including Atlantic salmon, Arctic charr, and brown trout. Climate change impacts are also likely to impact abundance, distribution, and nutritional quality of prey species, which can indirectly affect commercially valuable fish stocks (for example cod). Climate change impacts can also increase risk and prevalence of pests and pathogens, potentially reducing quality and survivability of targeted fish species. Changing conditions can encourage the presence of invasive species (such as Pacific oysters), creating increased competition for resources for native fisheries.

However, there may also opportunities for increases in warmer water species like mackerel, anchovies, and sardines. Under the Fisheries Act 2020, the UK is committed to fishing within sustainable limits, avoiding wasteful bycatch and supporting marine ecosystems. A climate change objective in the Act aims to encourage management policies to mitigate against the effects of climate change.

Indicator 2.2.1 Essential inputs

Headlines

The cost of inputs varies year to year and is a significant risk to farming economies due to the narrow margins on which they operate – and therefore to food security. Out of £26.7 billion gross agricultural output in 2020, £17.3 billion was spent on 'intermediate consumption' (costs and inputs). In 2020, seeds cost UK farmers £922m, fertilisers £1,147m, energy and fuel £1,290m, pesticides £1,097m, and animal feed £5,586 million. Animal feed is both the most expensive input across the entire sector and the one for which prices fluctuate most.

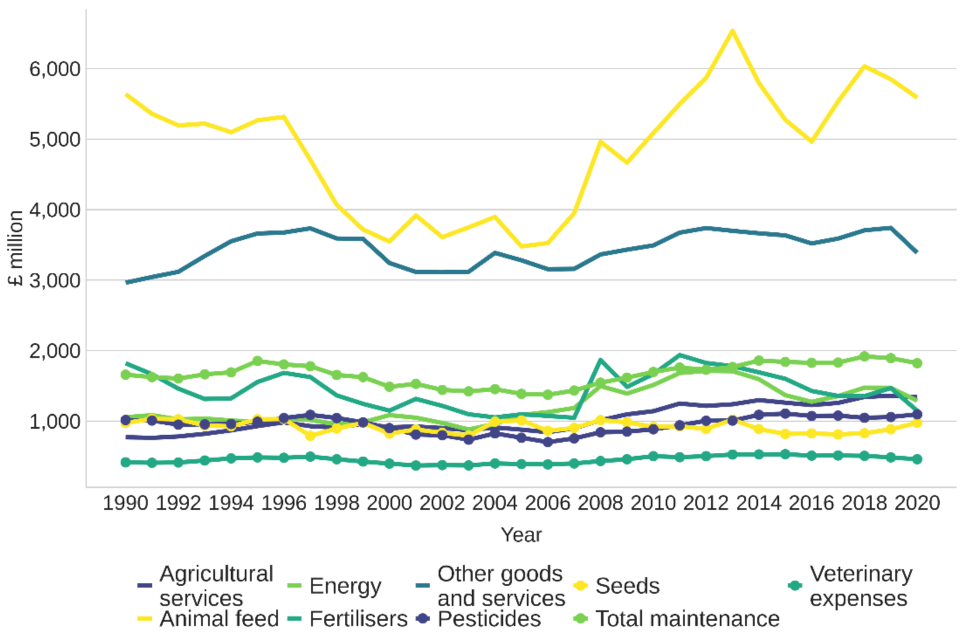
Context and rationale

Production of food requires several essential inputs. For crops these include natural and chemical fertilisers, pesticides, and seeds for crops, vegetables, and pasture leys. Animal feed is required for livestock production, from direct grazing, farm-grown fodder, or through buying in feed. Feed varies in cost and environmental impact from locally grown hay and silage, to UK-grown grain, and to imports of grain and soyameal. These inputs all represent significant costs to farmers. Reducing them while maintaining yields is desirable from an economic and environmental point of view.

Soil and water are the most important inputs of all for primary food production. They have already been discussed in a global context in **Theme 1** and will be further addressed in the **Sustainability and Environment (2.3)** section of this chapter, along with biodiversity-related ecosystem services which are also essential to food production. Labour and energy, two other key inputs, are discussed in **Theme 3**.

Data and assessment

Figure 2.2.1a: UK principal farm costs

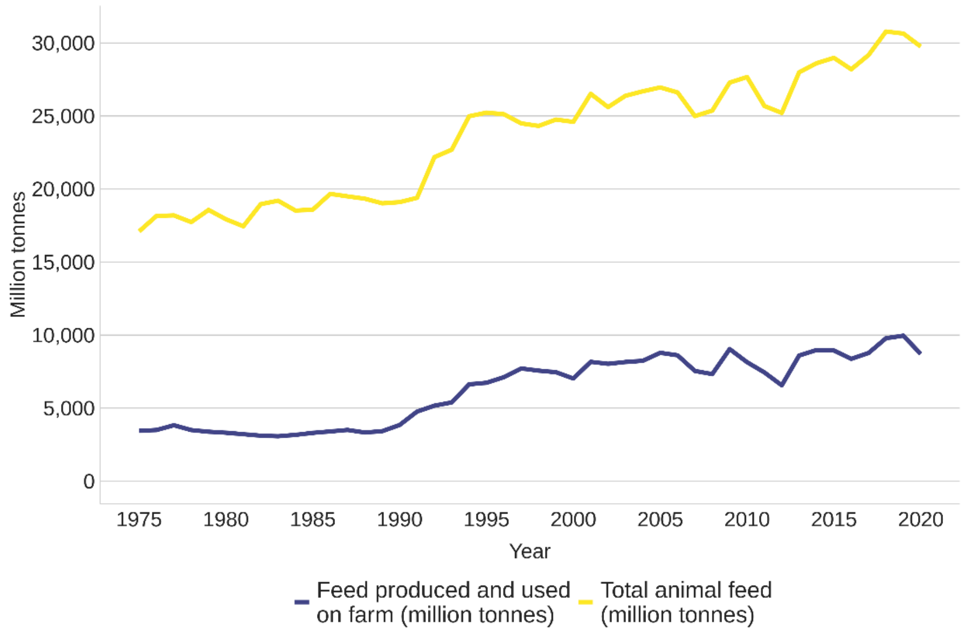


Source: Defra AUK 2020

Animal feed is the single largest input cost for UK agriculture, with 30 million tonnes costing livestock farmers £5.6 billion in 2020. Fertiliser costs were £1.1 billion in 2020, the lowest since 2007 and reflected low oil prices as well as the reduced capacity of farmers to grow wheat in 2020. Fertiliser prices are volatile, being subject to global production and markets and dependent on production inputs like natural gas. Application levels of mineral fertilisers are affected annually by price of fertiliser and crops, crop type, and weather, with oil prices particularly affecting costs. The total cost of agricultural pesticide products was over £1 billion in 2020.

Seeds are another of the main expenses in crop production. Costs in 2020 were abnormally high due to weather conditions preventing autumn sowing and winter crops failing and being resown in spring. Seeds are required for planting crops and re-sowing grassland in rotations and are typically purchased from specialist suppliers (especially for higher value crops). Much of the required vegetable seed is imported, as are some young plants for propagation, for example tomato plants. Seed saving remains a small but important part of the UK's food production and security, varying with production and market demands.

Figure 2.2.1b: UK animal feed



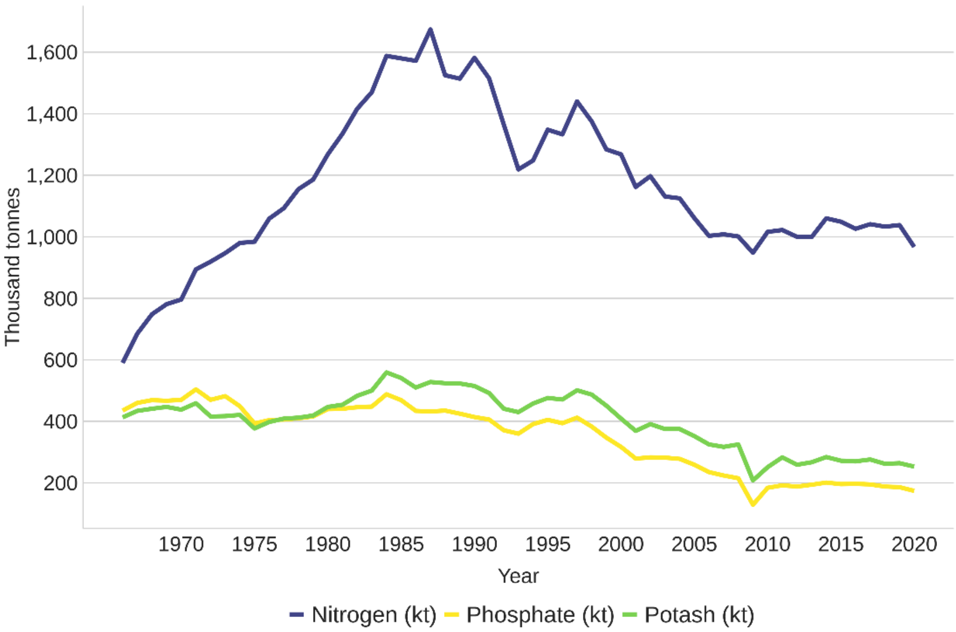
Source: Defra AUK 2020

Animal feed is the most important input for livestock production. It can be grown on farm or bought in as grain, protein crops (for example beans and soya), or grass in the form of hay, silage, or haylage. As highlighted in indicator 2.1.6 on grain production, 11.9 million tonnes, over 60% of UK grain, was used for animal feed in 2020, making up 40% of total animal feed. Dependency on grain is reduced where grazing livestock have access to grassland (including in all-grass systems) and is affected by annual fluctuations in the growth of such forage due to weather and climate.

Total feed use increased in the 1990s and continues to climb, now about 76% higher than in the mid-1970s and 50% higher than the early 1990s and correlates only a little with price changes (for example in 200 to 2008 and 2011 to 2012) – as livestock need feeding regardless of cost. Over the same period most livestock outputs have remained stable, though there has been intensification, for example in milk production, where 24% fewer cows now produce 9% more milk than in 2020. Production of poultry and eggs have also increased. Comparing the 2020 cost of feed (£5.6 billion) with the £13.8 billion combined value of livestock production it is clear that livestock production remains vulnerable to changes in feed prices, for example through competition with energy crops, poor harvests, and global competition for grain. In 2020, £2.5 billion of animal feed was imported, and £1.1 billion exported, about 60% of both with EU countries. This means net dependency on imports is about 25% of total feed cost but actual use of feed imports is closer to 45%.

In terms of land and energy use, there is also an opportunity cost when feeding these calories to animals rather than directly to humans, considering a substantial proportion are cereals and other high protein and energy crops. Reducing their use as feed crops would free up land and resources for other land uses. However, animal feed can play a role in making use of surplus foodstuffs that would otherwise be wasted. There may also be opportunities for novel feedstuffs for animals that could be more efficient, such as insect protein.

Figure 2.2.1c: Fertiliser use in UK agriculture 1966-2020



Source: British Survey of Fertiliser Practice

Plant growth requires three main elements: nitrogen, phosphorous (commonly in the form of phosphate), and potassium (commonly in the form of potash). The use of these elements for agriculture, in the form of fertilisers, peaked in the mid-1980s following a rapid increase in use in the 1960s and 1970s of nitrogen and steady increase of the others. Use of all reduced between 1990 and 2010 but has been fairly steady over the last decade. In 2020, overall fertiliser application rates reduced by an estimated 6.2% due primarily to increased spring sowing, which uses less fertiliser.

Inorganic fertilisers, especially ammonium nitrate for nitrogen, are often imported, so global availability of the key minerals is an important factor, as covered in **Theme 1**. Organic fertilisers (primarily manure) make up just under half of nitrogen applications and are typically sourced on farm in mixed holdings, or from other local sources.[52] Generally speaking, manures are more often used on grassland and inorganic fertilisers on crops.

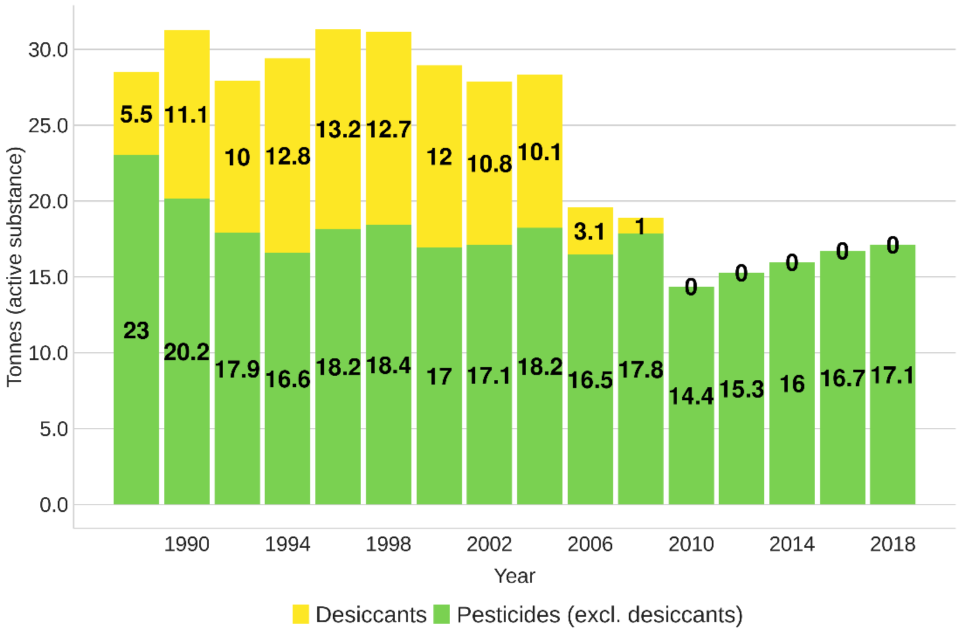
The UK imports roughly 50% of its ammonium nitrate, with 75% of imports for fertiliser use coming from the EU (primarily from Lithuania, Poland, and the Netherlands) and the remaining 25% from Georgia and Russia. If the only UK manufacturer were to close, demand for imports would increase. Dependency on other suppliers like Russia or China is only likely to occur if EU suppliers could not increase their supply to the UK. There are also alternative nitrogen-based fertilisers that could potentially be used. More than 90% of the UK's total Calcium Ammonium Nitrate and Urea Ammonium Nitrate supply is imported from the EU, while only about 40% of Urea arrives from the EU. Urea imports from outside the EU are currently sourced from Algeria, Russia, and Egypt, with supplies also coming from Belarus and Bahrain. Importing ammonium nitrate requires specialist port facilities due to its explosive nature, so an issue at a major port could be challenging (see further discussion of port substitutability in **Theme 3**).

Fertilisers have the potential to cause environmental damage to water and air quality as well as contributing to climate change through nitrous oxide emissions. These effects can be exacerbated and mitigated by application method and rate.

---

[52] Defra, 'Soil nutrient balances UK, 2020', https://www.gov.uk/government/statistics/uk-and-england-soil-nutrient-balances-2020/soil-nutrient-balances-uk-2020-statistics-notice.

Figure 2.2.1d: Pesticide use on cereals, Great Britain and UK



Source: Defra. Figures from 2010 onwards include Northern Ireland, prior to that coverage is GB only. 2018 figure for pesticides does not exclude desiccants.

Pesticides (or 'plant protection products') are used to protect crops from a variety of plant, fungal, and animal pests that can affect yields. Application volume can vary year to year depending primarily on pest, disease, and weed incidence, and is also influenced by the weather at key crop development stages when pesticide applications are most often made. There is significant variation crop to crop, but approximately 90% of pesticides used in agriculture are applied to arable crops.

The weight of pesticides used reduced from 1990 to 2010, largely down to declines in the use of sulphuric acid as a desiccant on potatoes. Since 2010 it has gradually increased, but the weight applied remains lower than pre-2010 levels. Since 1998, when the relevant data collection began, the frequency of pesticide application and the number of active substances applied has increased. For arable crops the average number of spray rounds has increased from 4.8 in 2000 to 6.2 in 2018, with the average number of active substances applied rising from 11.6 to 16.7 over the same period. This translates into increases in the total area treated (which represents the area multiplied by number of treatments made). This is partly driven by greater use of mixtures of products in spray tanks to overcome challenges around resistance.

Pesticides are subject to regulatory controls which may alter the way in which products are permitted to be used (range of crops, frequency, or rate of application). Such changes usually reflect post-registration concerns arising from unforeseen environmental effects (for example the impact of neonicotinoid insecticides on bee behaviour and survival) or operator and consumer exposure.

The use of pesticides can have direct and indirect effects on soil health, water quality, and biodiversity.

Trends

Seed supply is generally resilient in the sense that additional seed can be sourced from stocks held by suppliers. In future, seed that provides resilience to the changing climate will be needed.

Feed volumes used continue to rise steadily while the price per tonne is falling slowly (in real terms). The use of grain and imported soya for livestock feed may questions about the environmental sustainability of this practice, including substantial resource use in the UK and abroad, and a risk of exporting harms.

Changing weather patterns and climate will impact nutrient cycles with implications for fertiliser application patterns. Lower oil prices have made fertilisers cheaper in recent years, but sudden fuel price increases can lead to production halting at short notice, as experienced with gas in autumn 2021 (see **Theme 3**).

Tensions between environmental protection and crop yields are likely to increase as climate change fuels warmer and damper conditions that are more likely to encourage disease and pests, like potato blight and peach-potato aphids. Climate change will also likely change pesticide use and impacts through changing temperatures and rainfall patterns.

Indicator 2.2.2 Agriculture and supply chain waste

Headlines

Food waste in agriculture and in the supply chain is an economic and environmental loss, as well as being a factor in understanding overall domestic production and efficiency, and therefore food security. It represents unnecessary land and resource use, millions of tonnes of carbon emissions, and billions of pounds of wasted value.

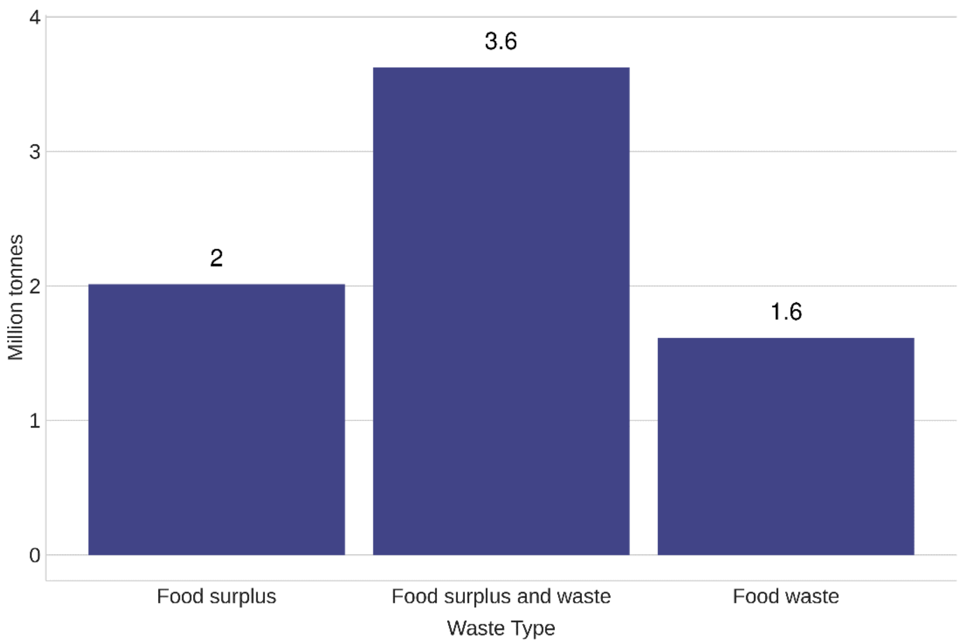
Estimated annual combined surplus and waste in primary production is 3.6 million tonnes (Mt), 6-7% of total harvest. Waste post-farm gate is estimated at 9.5Mt, of which 7.7Mt is in households and hospitality and 1.8Mt in manufacturing and retail. These figures compare to around 43Mt of food purchased for consumption in the UK.

Context and rationale

The Waste and Resources Action Programme (WRAP) is a charity established in 2000 which works on reducing food, clothing, and packaging waste, recycling, and improving the entire lifecycle of food consumed in the UK. WRAP monitors food waste throughout the supply chain and has produced several reports on which the main indicators here are based. It should be noted that whilst the UK evidence base on food waste has been recognised as one of the strongest in the world, there remain significant uncertainties associated with the data. The quality of data varies by sector, in order of robustness from households and retail (both relatively accurate), to manufacture and hospitality and food service (relatively weak) and primary production (weak, and partly modelled using non-UK data).[53]

Data and assessment

Figure 2.2.2a: Central estimate for annual food waste and surplus in UK primary production in 2020

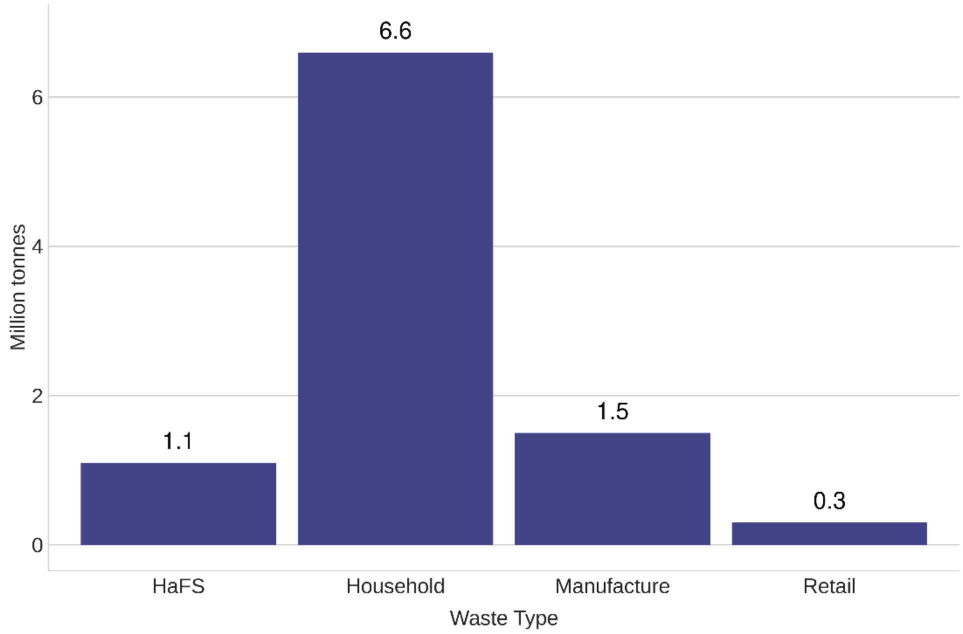


[53] Further information on progress in reducing food waste and details on interventions with that aim, as well as water use and other issues, can be found on the WRAP website, for example on UK food surplus and waste [redacted]

Source: WRAP: Food waste in primary production in the UK

Surplus and waste in primary production compares to approximately 55 million tonnes total UK food production in 2020, making it about 6-7% of production. A distinction is made between food waste (1.6Mt) and surplus food (2Mt), which rather than reaching its intended market is instead redistributed, becomes animal feed or goes into bio-based materials. Food waste in primary production is hard to estimate, and there is no definitive data. WRAP's estimates are based on applying the 'best available data' from comparable geographies around the world to UK production quantities. As a result, there is a wide possible range, from 2.2Mt to 5.0Mt. Based on the central estimate of 3.6Mt, up to £1.2 billion value of food is lost, of which part is recovered in sales for animal feed.

Figure 2.2.2b: Post farmgate food waste arising in the UK in 2018 by sector



Source: WRAP: Food surplus and waste in the UK

The 9.5Mt of food wasted annually post-farmgate compares to 43Mt of food purchased for consumption in the UK, and has a value estimated at over £19 billion, primarily in household waste. However, only 70% of that was intended for consumption, with 30% the 'inedible parts' (fruit and vegetable peelings etc). Between farm and fork, 1.5Mt are wasted in manufacture (0.7Mt of which is 'inedible parts'), 1.1Mt in hospitality and food service (HaFS), and 0.3Mt in retail. Around 0.7Mt of food surplus from manufacturing, retail, and hospitality and food service is either redistributed via charitable and commercial routes or diverted to produce animal feed (up about 10% since 2015).[54]

Trends

Since 2007, there have been large-scale interventions aimed at reducing food waste across supply chains and households in the UK. WRAP estimates that this may have contributed to a reduction in post farmgate total food waste between 2007 and 2018 of around 15% (1.7Mt). Total post farmgate food waste in the UK was 476,000 tonnes lower in 2018 compared to 2015 which equates to a 4.8% reduction (10Mt down to 9.5Mt). This can be partly attributed to consumer campaigns like WRAP's 'Love Food Hate Waste' and the UK Food Waste Reduction Roadmap (aimed at businesses), along with better labelling and storage guidance, and also more widespread food waste collections from councils.[55] Food waste in manufacturing reduced by around 395,000 tonnes between 2011 and 2018 (an approximate 20% reduction, from around 1.9Mt), whilst levels of food waste reported by retailers were around 290,000 tonnes in 2009 compared to 259,000 tonnes in 2020.

The UK has a commitment to UN Sustainable Development Goal 12.3 and the Courtauld Commitment 2030 to reduce per capita food system waste by 50% by 2030 (alongside targets on greenhouse gas emissions and water use).[56] Compared to the 2007 baseline, total per capita food waste had reduced by 20% by 2018, and 27% if 'inedible parts' are excluded. Climate change could have an impact, with extreme weather events, pests, diseases, and warmer temperatures all risks for increased food waste in production and the supply chain, unless adaptations are put in place.

Indicator 2.2.3 Household food waste

Headlines

Average waste of four key products was generally around 20% between 2018 and 2021. This fell sharply at the outset of the COVID-19 pandemic, with improved food management behaviours leading to a significant reduction in self-reported

---

[54] WRAP, 'Surplus food redistribution in the UK 2015 to 2020', [redacted]

household food waste in 2020. These positive changes, however, have started to decline with people returning to a pre-pandemic lifestyle, and food waste levels have increased again in 2021 to pre-pandemic levels.

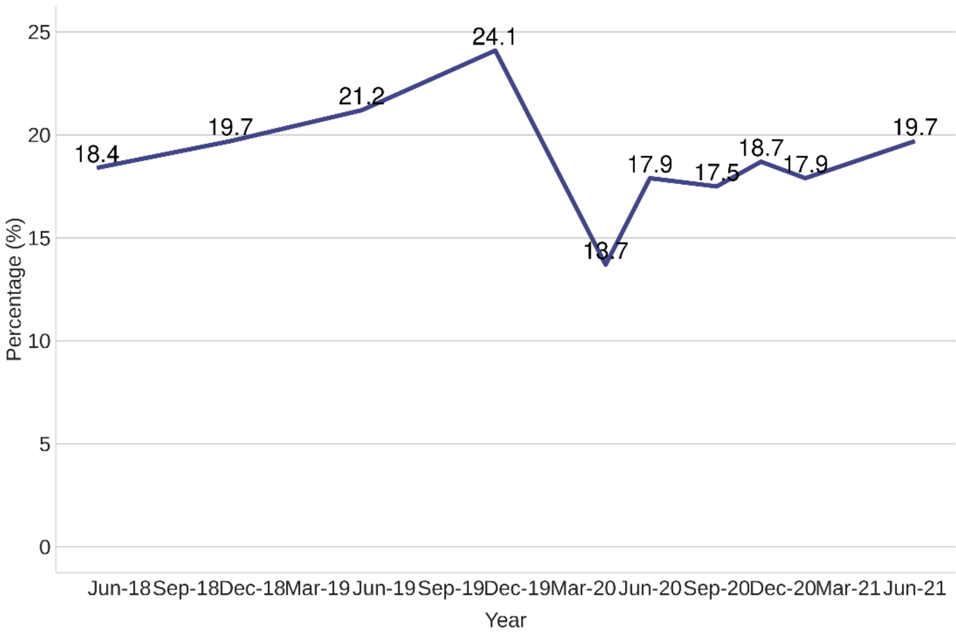
Context and rationale

WRAP estimates that in 2018, total annual food waste across the UK reached 9.5 million tonnes. The highest contributor to this total by weight were UK households, with 70% of post-farmgate waste arising in the home.

There are various approaches to measuring household food waste. For the purposes of this report, statistics have been chosen that are frequently updated to make tracking changes easier. The WRAP research used here estimates that bread, chicken, milk, and potatoes are some of the products most likely to be wasted, and therefore asked consumers to estimate the percentage that was thrown away uneaten of these four products following the last time they purchased each item.

Data and Assessment

Figure 2.2.3a: Estimated UK percentage of bread, chicken, milk, and potatoes wasted



Source: WRAP food waste trends survey 2021[57]

There was a 10% decrease in reported levels of food waste, from almost a quarter (24.1%) of four key products in November 2019 to 13.7% in April 2020. This was mainly due to improved food management behaviours adopted during lockdown. Levels of food waste then rebounded to some degree but remained consistently below pre-lockdown levels across 2020. Self-reported food waste in June 2021 is now back in line with the levels recorded in 2018. It remains below the results for 2019 but shows a return to pre-pandemic levels.

Trends

WRAP's research in 2020 provided important insights into was how well UK households responded to the pandemic by adopting positive food management behaviours. The decline in food waste in 2020 indicates how important it is to foster and maintain behavioural change to reduce food waste in the long-term. The gradual increase in food waste observed in 2021 could be an indication that returning to a pre-pandemic lifestyle, where people spend more time outside the house and experience higher levels of time pressure, has a negative influence on behaviours and waste levels.

WRAP also produces more in-depth research into household food waste but at a less frequent rate than the self-reported household levels presented in this report. Based on their data, there has been an overall 31% per capita reduction in edible household food waste with the majority of the reduction having occurred between 2007 and 2010.[58]

Indicator 2.3.1 Sustainable agriculture

Headlines

Sustainable production methods ensure the UK's long term food security by protecting the natural capital embedded in healthy soil, water, and biodiverse ecosystems. Food security rests ultimately not on maximising domestic production (which is market driven), but on making best use of land types which vary in quality and potential uses. Balancing and integrating food production with

---

[57] WRAP, 'Food waste trends survey', [redacted]

[redacted]

environmental factors supports efficient and sustainable land use without offshoring harms associated with lower production standards. Following the UK’s departure from the EU, new government incentives are being developed or considered across the four UK nations to support sustainable production.

Context and Rationale

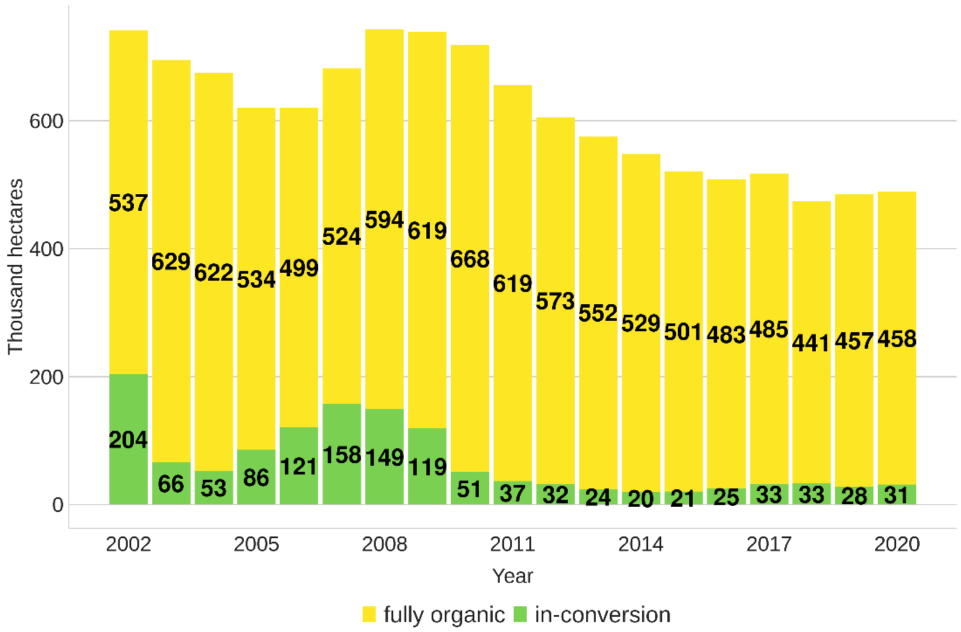
Food production does not happen in isolation from society or the environment. Farming can damage soil, air, and water, drive species loss and contribute to climate change, all of which threaten the current and future productivity and sustainability of agriculture, and therefore food security itself. On the other hand, good farming practices can reduce or reverse these harms, encourage biodiversity, and capture carbon all while producing healthy food.

Agricultural policy is devolved across the four UK nations. Following the UK’s departure from the EU, the UK governments are able to set their own agricultural support schemes. The Scottish Government is currently consulting on a future policy, and the Welsh Government plans to launch a Sustainable Farming Scheme in 2025. In England, Defra has announced three new environmental land management schemes to pay farmers for land management and environmental services. The environmental impacts of these schemes may also affect productivity and Defra is investigating different methodologies to assess these. Future Food Security Reports will aim to show the effect these schemes have on food security.

Organic farming is in broad terms an indicator for current environment-orientated food production in the UK. Other systems such as no and low-till farming, agroecology, and agroforestry also contribute towards balancing sustainability and food production. Organic farming practices do not allow the application of chemical fertilisers or pesticides, or the routine feeding of antibiotics to animals, and they also have high standards for animal welfare. Consequently, productivity tends to be lower than in conventional systems. One of the core principles of organic farming is that by good land management, such as crop rotation, environmental harms can be reduced and soil health improved, offering greater sustainability in the long run.

Data and Assessment

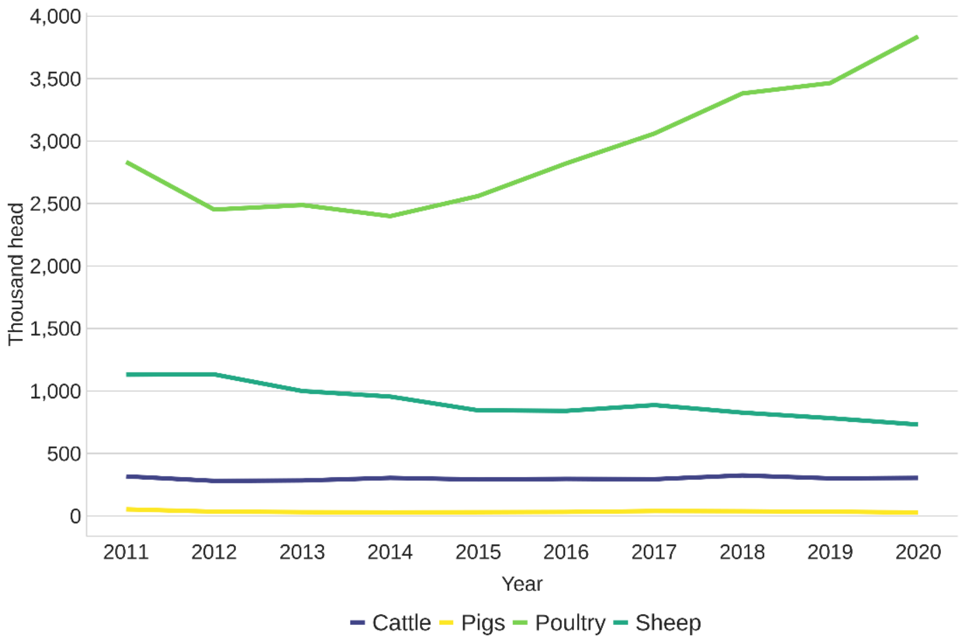
Figure 2.3.1a: UK area of land in-conversion and fully organic



Source: Organic certification bodies collated by Defra statistics

In 2020, organically farmed land represented 2.8% of total UK farmed area, at a little under 500,000 hectares. Organically farmed land has declined from a peak in 2008, but risen slightly again since 2018, while the number of organic processors and producers continues to fall, now down over 25% since 2008. These trends seem to indicate movement towards fewer farmers managing larger areas of land, mirroring trends across agriculture.

Figure 2.3.1b: UK organic livestock numbers



Source: Defra AUK 2020

AUK data also shows that permanent pasture (grassland) is by far the biggest proportion of organic land at 62%, followed by temporary pasture (for example grass-clover leys in crop rotations) at 20% and cereals at 9%. The high proportion of grassland indicates that grazing livestock remain significant for organic producers. However, steady declines in sheep numbers may demonstrate the wider economic challenges of farming on marginal land, while an increase in poultry has been fuelled by massive growth in laying hens, presumably the result of consumer demand for organic eggs.

Trends

Total land area allocated to organic farming peaked in the 2000s and has declined slightly since, perhaps partly due to tougher economic times since 2008. With new environmental land management schemes promising alternative rewards for balancing productivity with environmental benefits, sustainable production in the UK is likely to grow in scale and importance.

Indicator 2.3.2 UK soil health

Headlines

Estimates suggest soil degradation, erosion, and compaction result in losses of about £1.2 billion each year and reduce the capacity of UK soils to produce food.

Context and Rationale

Soil health is essential to the long-term security of food production globally and in the UK, and the Climate Change Committee has also identified it as one of the key concerns for climate change. Soil health is affected by several factors, including structure, water retention, soil organic matter, mineral content, and damage through erosion, compaction, and contamination. There is some data available, but the challenge of covering it graphically reflects the difficulties of adequately representing the complexity of soil health with any single indicator, and the great variety of soil types in the UK. Consequently, this section relies on qualitative analysis.

Data and Assessment

Two soil health factors tracked by Defra are soil nitrogen and phosphorus levels, which have remained broadly stable over the last ten years at around 90kg/hectare and 6kg/hectare respectively.[59] Indicators on nitrogen and phosphorus levels in soil are useful for judging optimum fertiliser application rates but have little to say about soil health more generally.

Soil erosion reduces productive capacity and causes nutrient loss, as well as off-site environmental harms such as water pollution. Improving soil organic matter can benefit long term soil health and sustainable productivity. For example, with some cereals, planting early in the autumn to establish soil cover reduces soil erosion risk while increasing yields.

It has been estimated that soil degradation costs England and Wales £1.2 billion per year and that intensive agriculture has already caused arable soils to lose 40% to 60% of their organic carbon. Soil erosion in England and Wales is lower than many other countries, but it is estimated that 2 million hectares are still at risk. Around 3.9 million hectares are at risk of soil compaction in England and Wales – nearly twice the total area of Wales – with a potential yield penalty of

---

[59] Defra, 'Soil nutrient balances UK 2020', https://www.gov.uk/government/statistics/uk-and-england-soil-nutrient-balances-2020/soil-nutrient-balances-uk-2020-statistics-notice.

£163 million every year; the risk is highest on clay soils during wet periods.[60] Similar impacts have been recorded in Scotland.[61]

Soil health is perhaps the single most important factor for future domestic food production. It is hoped that future editions of the UK Food Security Report will cover soil health with quantitative data as well as qualitative analysis, as filling this data gap will be important for understanding future food security.

Trends

Soil health in the UK is an extensive and costly problem, but without proper indicators it is difficult to determine the speed and direction of change. Climate is a key factor in soil formation and processes, and severe degradation of soil would have long-term, potentially irreversible, implications considering the critical importance of soil for protecting the environment and providing high quality farmland. Conversely, well-planned mitigation activities around soil management have the potential to contribute to climate adaptation through, for example, increased soil organic matter and water holding capacity, contributing to 'sustainable intensification'.

Indicator 2.3.3 Climate change impacts on yields

Headlines

Climate change and emissions pose significant risks to production and food security. As a consequence of unusual weather patterns associated with climate change, wheat yields in 2018 were 7% below the 2016 to 2020 average, and in 2020 were 17% below that average. Ozone in the low atmosphere has a separate, ongoing effect on yields; total economic losses for wheat, potato, and oilseed rape in the UK caused by damage due to ozone may have been over £185 million in 2018, with more than 97% of losses occurring in England.

---

[60] Environment Agency, 'State of the Environment: Soils', https://www.gov.uk/government/publications/state-of-the-environment/summary-state-of-the-environment-soil.

[61] CREW (Scotland's centre of expertise for waters), 'Effect of Soil Structure and Field Drainage on Water Quality and Flood Risk', [redacted]

Context and Rationale

As the UK Climate Risk Independent Assessment (CCRA3) sets out in Chapter 3 of the Technical Report, agriculture is highly dependent on climate, affecting the productivity and viability of crops and livestock.[62] Weather and climate variations affect both utilised land area and yields. The effects of heat, cold, wetness, and drought can have positive effects on production, but most of the consequences of a changing climate are negative.

Longer growing seasons and warmer temperatures may have some positive effects for particular crops and regions, but overall risk magnitude is assessed to increase from medium at present to high in future. Increased climate exposure (including heat stress, drought risk, and wetness-related risks) is modifying productive capacity and will continue to do so in future in line with the degrees of warming experienced. The severity of risk to agriculture from climate change could further increase if mitigation efforts are ineffective in preventing non-linear threshold effects and 'tipping points' in global systems.

A separate consequence of polluting emissions is an increase of ozone in the troposphere (the low atmosphere, including at ground level). Ozone is not directly emitted but is formed in the atmosphere by the action of sunlight on ozone precursors (nitrogen oxides, volatile organic compounds (VOCs), methane, and carbon monoxide). With the exception of VOCs, ozone precursor emissions are dominantly human-caused, resulting especially from industrial activity.[63] While important for absorbing ultra-violet radiation in the high atmosphere, ozone at ground level is harmful to human and plant life and is calculated to have a significant effect on crop yields.

Data and Assessment

The CCRA3 provides examples of productivity in years with unusual climatic features. The 5-year average for UK wheat yields in 2016 to 2020 was 8.4 tonnes per hectare, but a hot, dry summer in 2018 (7.8 tonnes per hectare) and a very wet winter and dry spring in 2020 (7 tonnes per hectare and 40% down compared with 2019), resulted in significant yield losses. By contrast, 2015 and 2019 had above average UK wheat yields, demonstrating volatility from year to year. The hot, dry summer of 2018 also affected other crops, with carrot yields down 25% to 30% and onion yields down 40% on a normal year, whilst potato yields were down on average 20% in England and Wales. Climate sensitivity can also affect the

---

[62] UK Climate Risk Independent Assessment, 'Technical Report: Chapter 3: Natural Environment and Assets', [redacted].

quality of produce, with consequences for food security. For example, weather conditions prior to harvest can impact the quality of milling flour and its protein content. Changes in temperature and humidity can also exacerbate problems with pests, diseases, and heat stress, as set out in the next case study.

On the positive side, warmer temperatures may open opportunities for new crops, and a reduction in the frequency of frost days across the UK has benefits for both arable agriculture and horticulture, through reduced incidence of frost damage for vulnerable crops. However, many tree species and other crops need a period of cold weather to produce a good crop every year, and therefore suffer from a lack of proper cold temperatures over winter.

Beyond unusual temperatures, rainfall and drought, the consequences of climate change also include increased risk of wildfires, flooding, coastal erosion, and high winds. All of these can have severe impacts on agricultural production in affected areas.

A report for the UK Centre for Ecology and Hydrology calculates that the ozone impact on crops in 2018 reduced UK wheat production by 5.5%, amounting to a production loss of 800,000 tonnes with an economic value of approximately £125 million (at average prices for 2018).[64] The highest production losses were indicated for eastern and southern counties of England, particularly Cambridgeshire, Essex, Suffolk and Lincolnshire, and parts of Hampshire, Wiltshire and Dorset. It also reduced UK potato yield by 6.5%, resulting in a loss of 305,000 tonnes of potato tubers worth £50 million, with the highest production losses in parts of North Yorkshire, Cambridgeshire, Hertfordshire and Bedfordshire. Ozone reduced UK oilseed rape production by 1.9% in 2018, amounting to 39,000 tonnes of lost production, worth £11 million; the highest production losses were predicted for central England.

Ozone also affects other plants, reducing flower numbers in perennial grassland by 10%, annual total biomass increment in perennial grassland in the UK by 2.7%, and annual biomass increment in managed broadleaf woodland by 7.3%. These impacts could affect overall biodiversity, and livestock and biomass yields, with consequences for land use.

Trends

Climate change poses a risk to UK food production already, and this risk will grow substantially over the next 30 to 60 years. Minimising the extent of global warming

---

[64] Centre for Ecology and Hydrology, 'NECD Reporting 2020 – Quantifying and mapping exceedances of ozone flux-based critical levels for vegetation in the UK in 2018', forthcoming, https://uk-air.defra.gov.uk/library/, pages 4 to 5.

and addressing the risks it poses to food production are both essential to future food security. Ozone causes yield loss every year, particularly in Southern and Eastern England.

Case Study 2.1 Climate change: farming impacts and risks[65]

Understanding how the climate is projected to change across the UK during the 21st century is vital for UK agriculture, food security, and commercial food sectors. Plants, animals, and soils are affected by the weather through variations in temperature, rainfall, and humidity. Climate-related impacts may occur through gradual change, or as a result of more rapid changes triggered by extreme weather events such as drought and flood.

The UK climate is changing, average temperatures have increased, and seasonal rainfall is highly variable. To understand how the climate may change in the future, the UK Climate Projections (UKCP18) use a range of climate models to provide probabilistic simulations of UK climate to the end of the 21st century in a high concentration climate scenario known as RCP 8.5.

How might temperature change in the future?

From the UKCP18 data, all areas of the UK are projected to experience warming, particularly in the summer, which could have implications for growing season duration, crop yield, and quality. Regional projections for 2061 to 2080, using the RCP 8.5 scenario, show greater warming in Southern England compared to northern regions of the UK.

Warmer temperatures will increase the occurrence of heat stress, which can impact livestock productivity, fertility, welfare, and mortality. The area of greatest risk for thermal heat stress in dairy cattle now and in the future is South West England. Other key areas of high future risk and large risk increases include Northern Ireland, Wales, the Midlands, North West England and North West

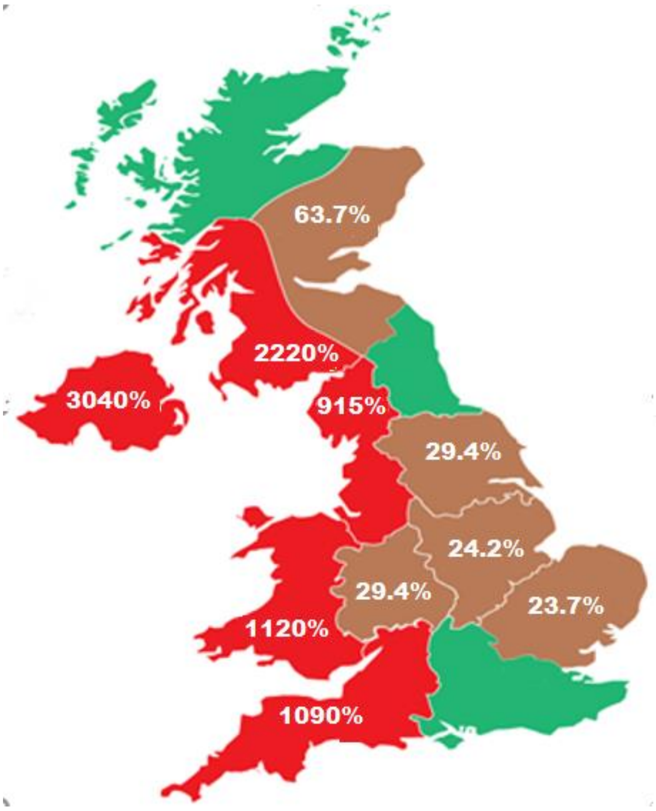
[65] Met Office Hadley Centre Climate Programme 2018 to 2021, Developed from Joanna Jones, Edward Pope, Debbie Hemming, Freya Garry, James Bacon and Jemma Davie, 'Future climate risk to UK agriculture from compound events',
[redacted]

Scotland. Risk of thermal heat stress in dairy cattle is projected to increase by over 1000% in South West England, the region with the most dairy cattle.

Warmer temperatures can also encourage fungal diseases such as potato blight (in combination with higher relative humidity), and other pests and pathogens, including the peach-potato aphid (*Myzus persicae*) which is a risk to over 400 plant species, including potatoes and sugar beet.

The Met Office is currently researching how increasing future temperatures may impact different livestock types, combined with changes in grass productivity.

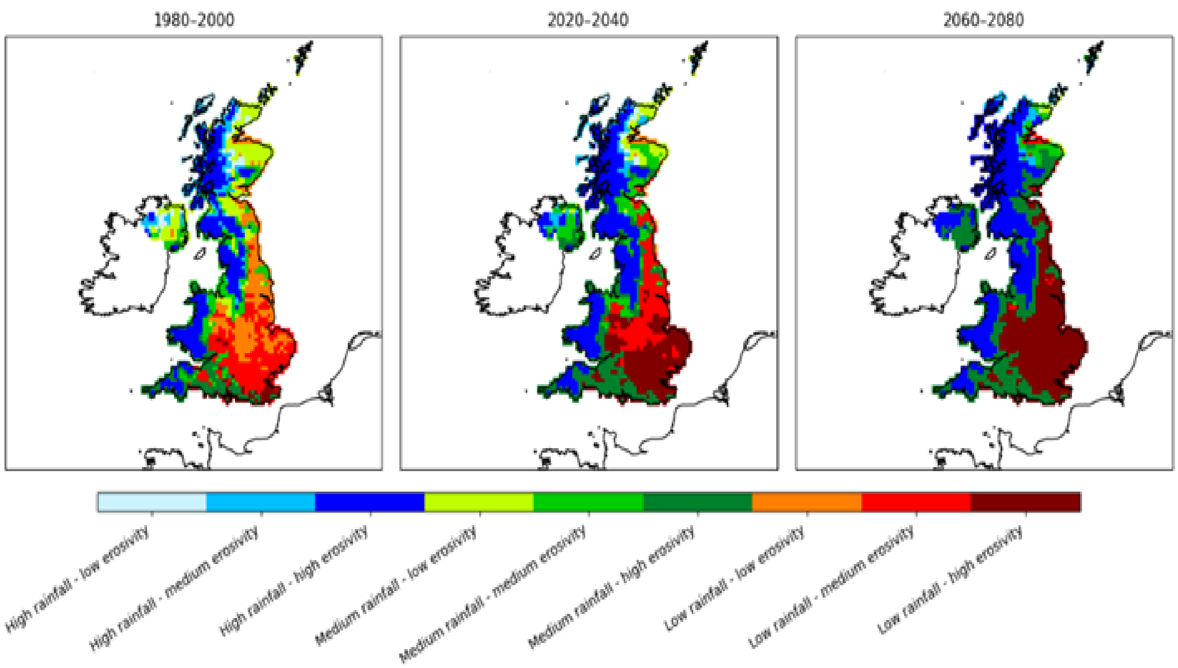
Figure 2.1a: Increases in risk for future climate (2051 to 2070) compared with current climate (1998 to 2017) for thermal heat stress in cattle (red) and potato blight (brown).



Risks to soils from changes in UK rainfall

Understanding climate impacts on soil erosion is vital for ensuring a sustainable and resilient food system. Using the UKCP18 climate simulations, the Met Office looked at the potential future impacts of climate change on soil erosion risk through changes to rainfall erosivity.

Figure 2.1b: Categorisation of erosion risk using mean annual precipitation totals and annual mean erosion values derived from hourly precipitation data for the UKCP18 convection permitting models. Regions with low rainfall-high erosivity density and high rainfall-high erosivity density are considered at the greatest risk of erosion.



Rainfall erosivity is the measure of rainfall total and intensity, and is one of five main predictors that can be used to describe soil loss rates. To identify regions at risk of soil erosion, information on present-day soil erodibility is combined with rainfall erosivity.

The study looked at rainfall total and erosivity across the UK for three time periods (1980 to 2000, 2020 to 2040, and 2060 to 2080) in a high concentration climate scenario (RCP8.5). Key findings include:

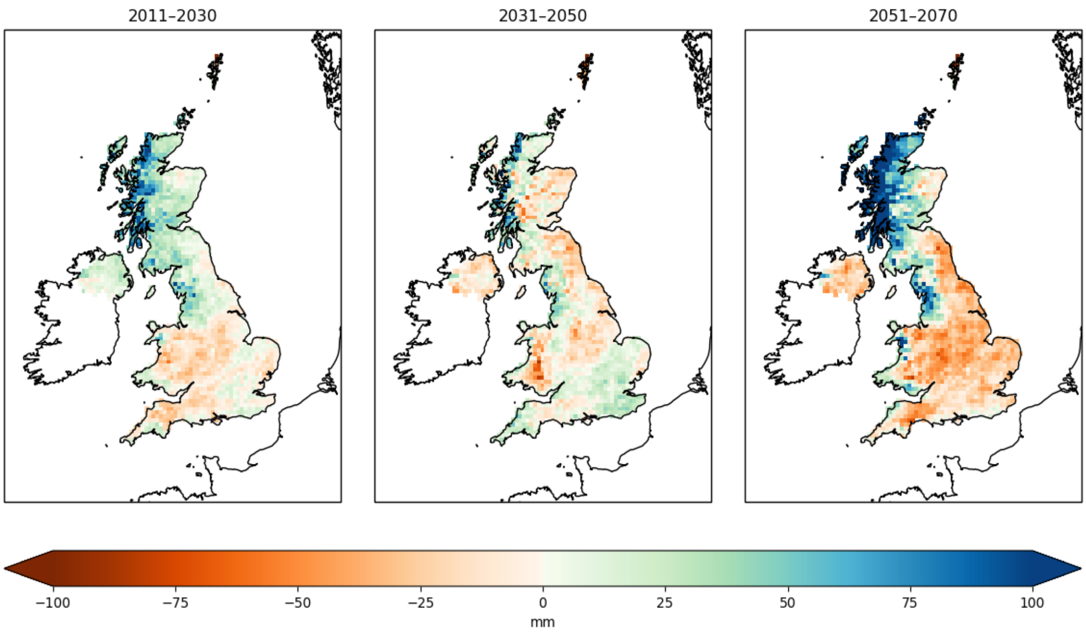
- Large projected increases in areas of relatively high erosion risk and potential soil degradation across South and East England.
- By 2060 to 2080, regions considered at the greatest risk of soil erosion, due to rainfall, included the Midlands, East Anglia, and the Yorkshire coastline.
- Combined with the soil erodibility data, a large area of Southern England is at risk of increased rates of soil erosion.

Potential impacts: Arable farming in East Anglia is likely to be adversely affected by soil erosion, due to the entire region being considered at relatively high risk of erosion by 2060 to 2080. The results shown in the figure below only consider meteorological factors, and further work is needed to incorporate land cover and land management practices for a comprehensive assessment of erosion risk.

How might seasonal and spatial rainfall patterns change in the future?

Rainfall is the largest source of water for growing grass and crops in the UK. Changes in rainfall patterns can impact water storage, plant productivity, and cause soil erosion and waterlogging. Using data from UKCP18, the Met Office looked at how annual rainfall across the UK may change in the future. As highlighted in the figure below, by 2051 to 2070 average 12-month rainfall accumulations are projected to increase across North West England, Scotland, and coastal regions around Wales. In contrast, rainfall accumulations across the rest of England and Wales are projected to decrease. Annual rainfall variability is projected to increase with greater potential for both extremely high and low national rainfall totals. South-central England and North West Scotland are projected to experience the greatest annual rainfall variability, which may require changes in water management.

Figure 2.1c: Difference in average 1-year rainfall accumulations (measured in mm) compared to baseline period (1991–2010) under RCP8.5, using bias corrected UKCP18 convection-permitting climate model projections.



Risks to UK agricultural areas from drought

Seasonal drought can lead to significant reductions in crop yield and there is currently a 3% chance per year that at least 80% of the UK wheat area could experience drought. Wheat varieties that are tolerant to a range of weather conditions, such as flooding and drought, may need to be considered in the future.

Recent Met Office research used UKCP18 simulations to assess the future impact of drought in the UK, focusing on the period 2041 to 2070. Key findings include:

- Winters are projected to be slightly wetter, on average, while all other seasons are projected to be typically drier, particularly June to September.
- During the summer months, the South East showed the greatest increase in severe drought conditions.
- Between April and October drought conditions are more likely, suggesting that a changing climate will affect water availability during the UK's main crop growing season.

Indicator 2.3.5 Environmental impacts of agriculture

Headlines

Agriculture is impacted by the environment and climate change, but it also affects them in turn. The UK has environmental standards and targets relating to water quality, meeting Net Zero, and biodiversity, all of which continue to be areas where agriculture has a negative impact on the environment.

Context and Rationale

As well as soil health (discussed at **Indicator 2.3.2**), agriculture also has an impact on water, air, and living things.

In some areas an abundance of water falls and flows, whereas in other areas it is a scarce and valuable resource and is abstracted for agricultural use. As a percentage of total water abstraction this is tiny (around 1% in England), but this abstraction is highly regionally and seasonally concentrated and represents a substantial burden in some areas, particularly in summer months. Furthermore, agriculture can have a negative effect on water bodies that provide other vital services, especially through pollution caused by soil and fertiliser run-off.

The farming sector is a significant source of greenhouse gases, such as methane and nitrous oxide from livestock and fertilisers. Carbon dioxide emissions are largely caused by farm vehicles and machinery and can also result from poor soil management.

Biodiversity is an important indicator for understanding the overall sustainability of food production, fisheries, and farming practices in the UK. Good biodiversity also provides important ecosystem services to agriculture. Biodiversity is difficult to measure, so Defra has tended to rely on the long-standing Farmland Bird Index, which tracks the numbers of 19 bird species: 7 'generalist' species that thrive in many environments, and 12 ‘specialist’ birds which rely heavily on farmland habitats. Birds sit at the top of the food chain and reflect the diversity and availability of insect and plant species; however, they directly show only a part of the biodiversity picture, and do not in themselves provide ecosystem services to agriculture.

Data and Assessment

WRAP’s 2019 progress report on the Courtauld 2025 Water Ambition notes that 14% of rivers are over-abstracted and nearly a quarter of rivers in England are at risk from unsustainable water abstraction; a similar proportion of aquifers are classed as in ‘poor quantitative status’.[66] The same study asserts that 86% of rivers do not meet good ecological status and over 50% of England’s freshwater and wetland species have declined since 1970.

For water availability, the UK is vulnerable to drought and flooding. The 2018 drought severely affected harvests, resulting in costly alternatives such as sourcing onions from New Zealand to fill supply gaps. UKCP18 show projected patterns of hotter, drier summers and a risk of more frequent and intense periods of aridity, which will have an impact on water availability for agriculture and food production. Building resilience reduces risk but could also have positive effects. For example, WRAP estimates that better water management could boost crop production by 20% globally.

Agriculture contributes to the pollution of water bodies through run-off and soil absorption of fertilisers and manure nutrients, pesticides, sediments, and faecal bacteria. High nutrient concentrations damage aquatic ecosystems and must be removed from drinking water, which is expensive. The same WRAP report estimates that it costs approximately £1.2 billion each year to remove pollutants from water so that it is safe to drink. At the same time, soils and nutrients are lost into watercourses through diffuse pollution. It has been estimated that agriculture accounts for around 61% of the total nitrogen in river water in England and Wales and around 28% of the total phosphorus load in river water in Great Britain. Diffuse water pollution from agriculture and rural land use has been directly attributed to 28% of failures to meet Water Framework Directive (WFD) standards in England.[67] This is monitored separately across the four nations.[68]

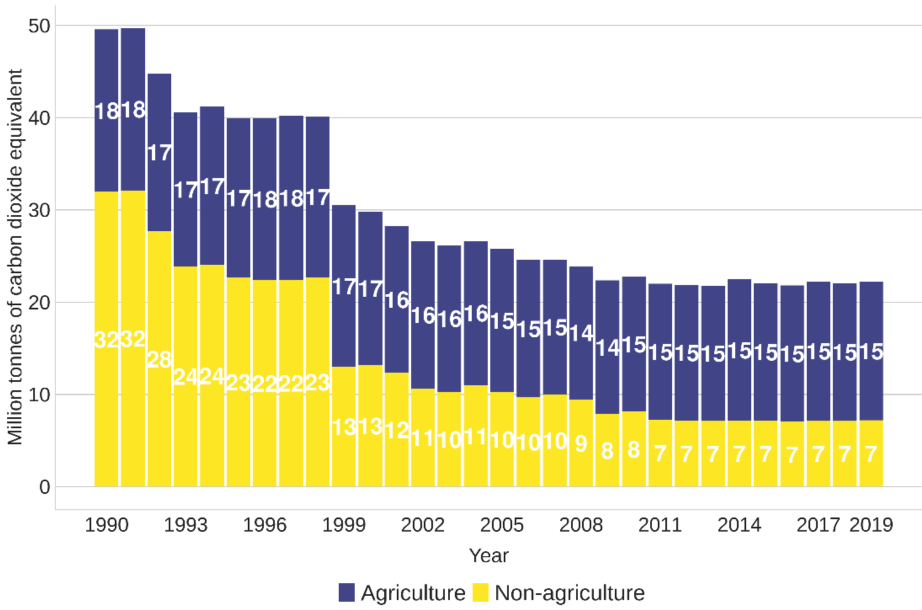
---

66 WRAP, ‘Working together to protect critical water resources,
[redacted]

67 Parliamentary Office of Science and Technology, ‘Diffuse pollution of water by agriculture’
[redacted]

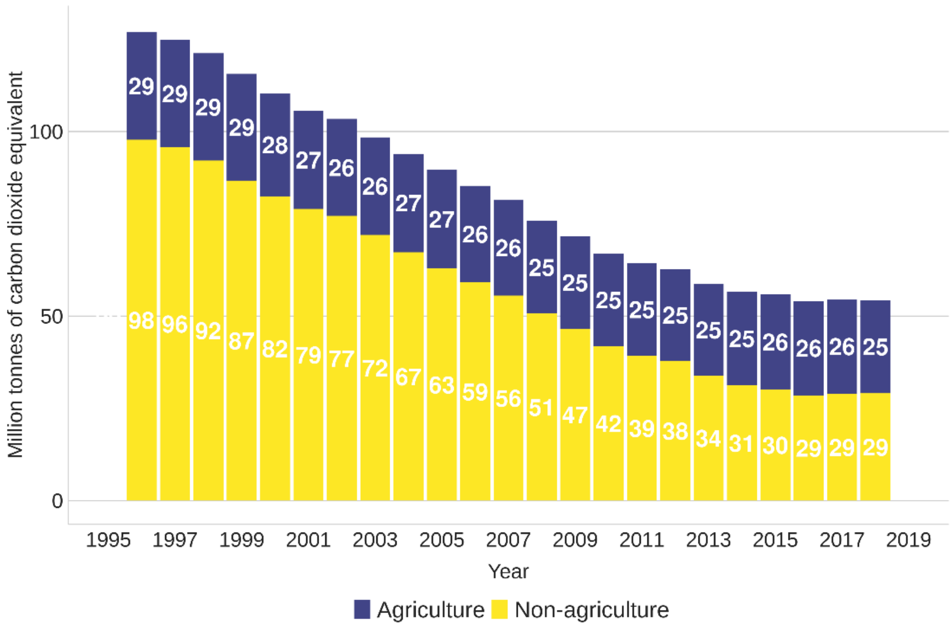
68 Environment Agency, ‘2021 River Basin Management Plan: Nitrates’, https://consult.environment-agency.gov.uk/++preview++/environment-and-business/challenges-

Figure 2.3.5a: UK nitrous oxide emissions



Source: Defra AUK 2020 (Department for Business, Energy and Industrial Strategy)

Figure2.3.5b: UK methane emissions



[redacted]AERA, 'Nitrates Directive', https://www.daera-ni.gov.uk/articles/nitrates-directive.

Source: Defra AUK 2020 (Department for Business, Energy and Industrial Strategy)

Agriculture accounted for about 11% of total greenhouse emissions in the UK in 2019, with agricultural emissions 13% lower than in 1990. This was primarily the result of reduced livestock numbers following BSE and foot and mouth outbreaks in the 1990s and early 2000s, and have not reduced significantly since 2008. A recent WRAP report estimates that total UK food system emissions are equivalent to 35% of UK territorial emissions; over a third of food system emissions are from production overseas.[69]

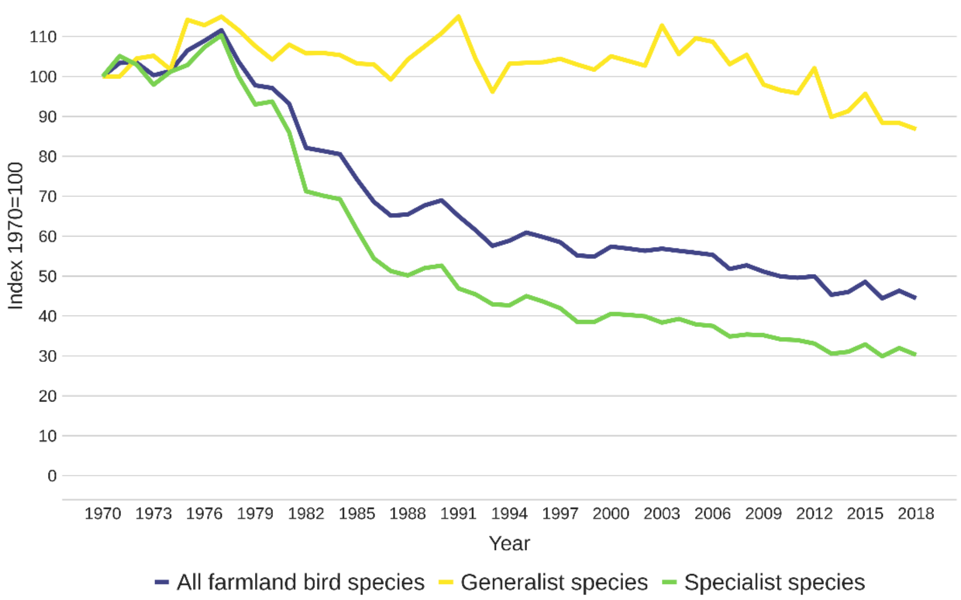
Agricultural emissions of nitrous oxide and methane declined through the 1990s and 2000s and have remained fairly stable since. The majority of nitrous oxide emissions from agriculture result from manure management and application of organic and mineral fertilisers to land, and have fallen with lower fertiliser application rates. The majority of methane emissions come from enteric ruminant digestion in livestock, which has fallen and then remained level just as livestock numbers have. There is research underway to investigate the link between ruminant diet and emissions to see if food additives like Bovaer 3-NOP or dietary supplements such as seaweed might help mitigate methane emissions. Even between systems producing the same outputs (like beef or dairy), greenhouse gas emissions vary greatly, and average emissions are not necessarily that informative. A nuanced, full lifecycle approach to policy on agriculture and greenhouse gases is required to understand the complexities.

It is also important to consider greenhouse gases in a global context to ensure the UK does not export emissions (and other environmental harms) to other parts of the world by replacing domestic production with imports from more environmentally damaging systems.

[69] WRAP, 'UK Food System GHG Emissions', [redacted]

Note: An index number is a statistical measure that reflects a price or quantity compared with a standard or base value. The base usually equals 100 and the index number is usually expressed as 100 times the ratio to the base value. For example, if a bird population in 1980 was twice as large as it was in 1970, its index number would be 200 relative to 1970.

Figure 2.3.5c: UK farmland bird index



Source: Defra AUK 2020 (BTO/RSPB)

Data is limited, but from farmland bird numbers it appears that biodiversity on UK farms may have fallen to about 30% of what it was in 1970. There was a sharp decline in farmland birds during the 1970s and 1980s as farming became more intensive. The decline has continued more gradually ever since and remains concerning. The ‘specialist’ species like corn buntings and yellowhammers are the better measure for understanding the impacts of farming on biodiversity as they rely most heavily on farm habitats, whereas ‘generalists’ like wood pigeons thrive in a variety of habitats. While birds are only a part of the biodiversity picture, their reliance on the food chain below them makes them a proxy indicator for plant, mammal, and insect biodiversity.

Biodiversity is key to stable farming systems. The right plants in the right place can reduce nutrient leeching, and a healthy ecosystem with insects like spiders, beetles, and earwigs can reduce pesticide use. Warmer temperatures and excess or reduced water availability has an impact on species and habitats; climate modelling and analysis of 402 species in England found that 36% were at risk of range loss and 41% may expand their range in future. This can be aggravated through agriculture and food production driving land use change, habitat loss, and fragmentation. Between 2010 and 2018, 58 recorded non-native species have become established in the UK. Though some (like the tree bumblebee) can have positive effects, overall these are one of the top 5 threats to England's natural environment, with estimates of the economic cost at around £1.3bn per annum.[70] Farming practices and global supply chains have accelerated their spread.

A fuller view of biodiversity indicators, including pollinators, marine environment, non-native species, and many others can be found in a new report on UK biodiversity indicators by the Joint Nature Conservation Committee.[71]

Trends

Water health and abstraction are both expensive societal costs, and important issues for agriculture to address for a sustainable, food-secure future. WRAP is working towards the Courtauld 2030 Water Ambition to improve water quality and availability through sustainable water management; a progress report on a series of UK (and international) case studies on water use can be found in the 2021 annual report.[72]

Greenhouse gas emissions from agriculture have reduced overall since 1990, but have not changed in recent years. The newly published Net Zero Strategy sets out areas where innovation and emerging technologies may support the sector in adapting to climate change, and also discusses alternative proteins (Chapter 3, sections 22 and 33).[73] WRAP's Courtauld Commitment 2030 aims to reduce UK food system greenhouse gas emissions by 50% by 2030 (alongside targets on water and waste).[74]

The continued decline of farmland birds shows that the agricultural intensification which accelerated in the 1970s continues to harm the UK's biodiversity and, consequently, ability to produce food sustainably and in symbiosis with nature. A changing climate also increases the threat to specific species and ecosystem services through spread of new pests, pathogens, and invasive non-native species. Farming and food production can exacerbate these risks but could also play a major role in supporting the UK's natural ecosystems, delivering mutual benefits to biodiversity and society.

---

70 UK Climate Risk Independent Assessment, 'Technical Report: Chapter 3: Natural Environment and [redacted]/, pages 24 and 47 to 48.
71 JNCC, 'UK Biodiversity Indicators 2021 Revised', https://jncc.gov.uk/our-work/uk-biodiversity-indicators-2021/.
72 WRAP, Courtauld Commitment Annual Report 2021, [redacted]
73 BEIS, 'Net Zero Strategy: Build Back Greener', https://www.gov.uk/government/publications/net-zero-strategy.
74 WRAP, 'Courtauld Commitment 2030', [redacted].

Theme 3: Food Supply Chain Resilience

This chapter of the UK Food Security Report looks at food security in terms of key infrastructure underlying the supply chain. Sourcing and supplying food to consumers in the UK is dependent on a complex and interacting web of systems. The theme considers how efficient and resilient systems are to transport, store, manufacture, and sell food on its path from commodity to consumers. It describes the potential threats and vulnerabilities to the sophisticated 'just-in-time' supply chains underlying the modern food system and how industry and government collaborate to prepare for and respond to issues.

In terms of this theme, food security means a supply chain that is consistently able to deliver adequate quantities of food, both through preparing for disruption and having the capacity and flexibility to respond effectively to unexpected problems. A resilient supply chain is robust and resilient, possessing an ability to recover from disruption and which can re-orientate to alternate outcomes when necessary.

Key Messages

- The UK is resilient to potential shocks in the food supply chain. Supply systems, which are owned and operated by the private sector, are adaptable and flexible in responding to problems. Government monitors risks and works with industry to respond to emerging issues and maintain supply chains.
- Notable risks to the supply chain stem from its dependence upon other critical sectors including energy, transportation, borders, labour, key inputs (chemicals, additives and ingredients), and data communications. In addition, the threat of cyber-attack to UK businesses, including those in the agri-food sector, is significant and growing.
- The food and drink sector's dependency on energy has marginally declined thanks to increased energy efficiency, whereas demand for energy in the agricultural sector has remained stable in the last 20 years.
- Both EU and non-EU food imports, via all modes of transport, are well spread across a number of ports of entry, with no port having a dominant share. There is, however, a reliance upon the Short Strait for some food products, including fruit and vegetables (62% of fruit and vegetable imports arrive from the EU via the Short Strait), meats (43%), and dairy (41%). Only simultaneous disruption to several ports would be serious enough to have a material effect on UK food supply.
- Securing sufficient labour at appropriate skill levels presents additional issues for the agriculture and food sectors. This includes short-term challenges, mainly due to high levels of absenteeism caused by coronavirus (COVID-19), and the longer-term challenges of filling vacancies across the agri-food sector.

- A number of pressures in recent years, including the COVID-19 pandemic widely impacted the UK food supply chain. However, it also demonstrated the resilience held within supply chains, through an effective industry-led response, supported by government, to apply key mitigations to uphold continuity in the food supply chain.

The UK's food supply chain is a highly complex system. It encompasses:

- primary producers (for example, farming, fishing)
- food manufacturing (for example, factories, process plants, mills, refineries, production plans)
- logistics (for example, storage, distribution centres, transportation, ports)
- wholesale and retail (for example, wholesalers, supermarkets, local businesses)
- food services (for example, restaurants, cafes and caterers).

The importance of the UK food supply chain cannot be overestimated. Food is one of 13 Critical National Infrastructure (CNI) sectors in the UK. CNI sectors are "those facilities, systems, sites, information, people, networks and processes necessary for a country to function and upon which daily life depends".[75] Every element of the supply chain, from food manufacturing to retailers, relies on physical infrastructure (buildings, vehicles, machines, power and data connections); digital infrastructure (the digital technologies that provide the cyber foundation for information technology and operations); human infrastructure (the skilled people who work in the supply chain and their working relationships with each other) and economic infrastructure (the system of finance, contracts and agreements that allow businesses to make money and operate productively.) Problems arising anywhere in this system can cause disruption to the supply of food.

In the UK the underlying infrastructure of the supply chain is owned and operated by private industry. The agri-food sector holds the capability, levers, and expertise to respond to potential disruptions.

Food supply policy including risks relating to resilience and security is devolved to each national administration. National Security and Counter Terrorism (CT) policy is a specific reservation under the Home Affairs heading. As lead departments for food as a CNI sector, Defra and the Food Standards Agency (FSA) manage those risks specifically relating to National Security and CT across the UK government. However, the role of government is an indirect one; to plan for and coordinate responses and intervene only where necessary to ensure the continuity of supply.

[75] CPNI, 'Critical National Infrastructure' (2021), https://www.cpni.gov.uk/critical-national-infrastructure-0

Energy and other critical resource inputs

All stages of the food supply chain, including production, processing, packaging, distribution, transport, retailing and the consumption of food itself, are dependent on their use of energy, other key inputs, and the functioning of critical interconnected systems. Fluctuations in the energy market also affect the prices of commodities or key inputs such as carbon dioxide (CO_2). These fluctuations can therefore affect the economic viability of food businesses.

Over the last 20 years, energy demands for UK agriculture have remained consistent whilst demand for energy from the food and beverage sector has declined in the same period, indicating increased energy efficiency. This reduces the risk posed to businesses by disruption to energy supply or price shocks, but the sector remains reliant on energy sources, which can be volatile. The source of risks to the supply of electricity, natural gas, and petroleum products varies, with the most significant current risks being a reliance on imported natural gas.

Disruptions to major power networks in August 2019 highlighted the challenge of energy supply for the food system. Though the power disconnection itself was relatively short-lived, the knock-on impacts to other services were significant. This event demonstrated the need for essential service providers, including those in the food sector, to have robust business continuity plans in place for disruptive events such as power outages.

Certain goods critical to the functioning of the food supply chain are known as ‘key inputs’ and their supply is monitored by government. Although the provision of these goods is industry led, government supports industry in developing plans and mitigations to ensure continuity of supply.

Key inputs in the food supply chain are diverse and interface with an array of different markets. Challenges to access for these key inputs can come from a range of sources and causes. As an example, disruptions to CO_2 supply occurred both in 2018 (as a result of unexpected maintenance and operational challenges for fertiliser plants) and 2021 (as a result of complex economic factors ultimately caused by an increase in the price of natural gas). Where necessary, government can make targeted interventions to support continuity of supply, and over the longer-term, work with industry to build resilience.

Transport and logistics

The transport sector plays a strategic role in connecting the UK food supply chain. It links UK ports, farms, food manufacturers, retailers, food service providers, and consumers. It is essential to the import and export of food. Food is primarily transported by sea, road and rail, and recent challenges related to the COVID-19 pandemic and the UK's departure from the EU have made clear just how reliant the food supply chain is upon the transport sector.

The UK food supply chain is dependent upon just-in-time logistics systems, which allow the transportation of all food within short timeframes and as close as possible to when it is needed. For fruit, vegetables, and other items with a short shelf life, this allows food to be as fresh as possible and avoids food waste. These transportation systems are highly efficient, regular, and predictable, and allow consumers to have widespread access to food on supermarket shelves.

Just-in-time supply chains are sensitive to disruption to transport, particularly in road freight. Overall delay times on the Strategic Road Network, responsible for two thirds of all freight, have increased over the last five years.

Ports of entry to the UK are particularly important links in the just-in-time supply chain. As a nation the UK imports 46% of the food it consumes. Having a diverse range of international supply sources provides greater flexibility and makes food supply more resilient in the event of disruption. Equally, diversity in these access points provides flexibility and greater resilience in response to disruptions.

Around a quarter of the UK's food imports pass through the Short Strait (Dover and the Channel Tunnel), and short-life products from the EU are highly reliant on these routes. 62% of fruit and vegetable imports from the EU arrive via the Short Strait, 43% of meats and 41% of dairy imports. Food and beverage imports are otherwise spread across a number of ports of entry, with no one port dominating.

Despite diversity of entry for the most part, UK ports are also subject to a variety of risks that may be geographically correlated, such as tidal surges on the East Coast. The impact of any disruption to ports would depend on the length and scale of the disruption, as well as the ability to find alternative points of entry in the timescales required. A further consideration is the dependency of the UK on the resilience and regulatory approach of ports, especially in the EU. For example, imports can be severely disrupted by border closures. Border issues may have different dynamics and affect freight differently. During the COVID-19 pandemic, the UK experienced two border closures, neither of which caused serious supply issues.

Labour and skills dependency

Throughout the supply chain, people are vital. In growing and harvesting, transporting goods, food manufacturing, and in retail of finished food products, the agri-food workforce employs 4.1 million people and represents 13% of Great Britain's employment. The continuity of food supply is dependent upon securing sufficient labour with skills necessary to carry out specialised tasks.

The types of roles across the agri-food sector are vast. They include skilled and highly skilled roles – including, for example, engineers, butchers, supervisors, auditors, and veterinary nurses. The agri-food sector is also highly reliant upon roles classified as 'low-skilled'. These roles are often labour intensive and common in the agriculture and hospitality sectors.

There are challenges securing sufficient labour across the agri-food chain. These challenges are both short-term and longer-term and interact with the wider challenges facing the UK economy, posing a threat to food supply resilience. They include dependency on agricultural seasonal workers and other skilled food chain labour from the EU along with the continued impact of COVID-19 on the workforce.

Food retail and wholesale

Diversity is essential to food security, not only in terms of trade in agri-food commodities, but also within the domestic supply chain which consists of retailers, food manufacturers, wholesalers, and food service operations. If one major supply chain or company were to fail, for example due to economic failure, cyber-attack, or power failure, there could be a significant impact on availability of, and access to, food, if other parts of the supply chain were not able to help to fill the gap.

The size and diversity of the UK food retail and wholesale sector provides economic resilience. The greatest risk is in the retail sector, where the five biggest retailers have 60% of market share between them. The size and diversity of the food supply chain allows flexibility when an agri-food business fails, however the COVID-19 pandemic has placed pressure on all parts of the food supply chain – especially in the wholesale sector. The closure of the hospitality sector due to COVID-19 and other lockdown impacts resulted in financial distress across significant parts of the wholesale market. However, despite these pressures the wholesale sector maintained financial viability and food supply was not compromised.

Consumer behaviour

The UK's just-in-time food supply chain relies on balancing supply with consumers' demand. Consumer behaviour can cause sudden demand shocks and impact the effectiveness of the food supply chain. Given the UK's history of secure food supply, consumer shocks resulting from stockpiling are rare. However, during disruption caused by the COVID-19 pandemic, industry proved effective in responding to increased demand, with government taking a supporting role. Consumer behaviour was characterised by a moderate increase in the amount of food purchased and in the number of shop visits made, rather than indiscriminate 'panic buying'.

Cyber threats

The risk of cyber-attack to UK businesses is significant and continues to grow. It presents a threat to all CNI sectors. The nature of cyber-attacks means that they are varied and that attackers can adapt their approaches to their targets.

While the UK food supply chain has not been subject to significant attack, disruptions have been recorded in other areas of the globe with implications for their food security. Given the interconnectedness of the global food supply chain attacks elsewhere potentially also pose risks for UK food supply.

Indicator 3.1.1 Business resilience and response

Headline

The food supply chain is entirely owned and operated by private business, which is adaptable and flexible in responding to problems. Government monitors risks and works with industry to respond to emerging issues and maintain supply chains. A number of pressures in recent years, including the unprecedented stress of the COVID-19 pandemic, have threatened supply chains, but industry response, with government support, has succeeded in maintaining overall supply.

Context and Rationale

The threats which can impact the continuity of the UK food supply chain are diverse. The most significant risk of disruption lies in the agri-food sector's reliance upon other critical sectors, for example energy and transport. Disruption experienced in one sector could put food supply chain continuity at risk. Given the wide range of potential shocks and disruptions that might occur within the agri-food chain – whether affecting energy, labour, data communications, raw materials (known as key inputs), or transport – government and industry need to be confident that adequate continuity and contingency planning is in place to mitigate against these risks.

The capability, levers, and expertise to respond to disruption lie with the agri-food industry, which is experienced in dealing with scenarios that can affect food supply disruption. Government's role is to support and enable an industry-led response. This includes extensive and ongoing engagement to support industry in preparedness for, and response to, potential food supply chain disruptions.

Defra, other UK government departments, and the devolved administrations routinely identify, prepare, and respond to risks of national significance. This includes contributing to the National Security Risk Assessment, a classified and scientifically rigorous cross-government assessment of the most serious threats facing the UK and its interests overseas.[76] The National Risk Register (NRR) provides public information on the most significant risks that could occur in the next two years, and which could have a wide range of impacts on the UK.

The COVID-19 case study illustrates how the UK government, devolved administrations and industry collaborated effectively to mitigate against the risks of COVID-19. It also highlights the need for both industry and government to continue business continuity planning.

This indicator remains qualitative due to the commercial confidentiality of the agri-food sector.

Data and Assessment

The COVID-19 pandemic response demonstrated that the UK has a resilient food supply chain and a food industry which is good at responding to disruptions. Government actions, such as the temporary relaxation of UK Competition Law, supported industry in working collaboratively to minimise disruption, establish alternative supply routes and suppliers, and accommodate pressures in the supply chain.

The risks to the UK food supply chain from COVID-19 in 2020 were complex and unprecedented. The impacts were highly interrelated across the food supply chain and required a combination of mitigation measures to safeguard future continuity of supply. It is therefore difficult to identify the effectiveness of each individual mitigation measure, as it was the diversity of these actions which allowed product availability to steadily improve from late March 2020. It is clear that close collaboration between UK government, the devolved administrations and industry was critical to the effectiveness of the COVID-19 response.

Defra and the devolved administrations have continued to develop mitigations in response to evolving risks and issues associated with COVID-19. For example, in anticipation of border congestion in January 2021, government developed the Expedited Return Scheme (ERS) which allowed the prioritisation of empty food vehicles travelling from the UK to the EU through the Kent Traffic Management System. This allowed food vehicles to restock and return to the UK with fresh

---

[76] Cabinet Office, 'National Risk Register 2020' (2020), https://www.gov.uk/government/publications/national-risk-register-2020, p. 5.

supplies. The ERS did not need to be activated and congestion issues were managed at the border.

In recent years the agri-food sector has experienced significant challenges not limited to COVID-19. This has included although is not limited to; the March 2021 disruptions to global supply chains in the Suez Canal; shortages of key inputs such as CO2; and labour and skill shortfalls in critical sectors. Although consumer choice may have been temporarily affected by these risks, the agri-food sector has ensured that there has not been an overall food shortage within the UK's supply chain.

Case Study 3.1 COVID-19 response

Overview

The COVID-19 pandemic widely impacted the UK food supply chain. The government played a supportive role, utilising well-established ways of working with the food industry. This support enabled an industry-led response that met the demand placed on it.

Background

This case study reflects the UK's response to COVID-19 across the agri-food sector at the start of the pandemic and the months that followed. Interventions differed in some ways across England, Scotland, Wales, and Northern Ireland. COVID-19 and its impacts still present risks to the UK's food supply despite the resilience of industry.

At the beginning of the crisis, early in 2020, risks to the UK's food supply began to materialise. These included:

- An upsurge in demand for certain products due to increased consumer purchasing. This represented a demand shock and led to temporary shortages of mainly non-food products, partly caused by a perception of potential shortages in the food supply chain.
- Increased staff absences due to rates of COVID-19 and requirements to self-isolate.
- Social distancing requirements meant businesses needed to adapt ways of working to maintain operability within their sectors, reducing capacity.
- Financial difficulties in food sector businesses, particularly due to closures of some sectors, for example, in hospitality.
- Minor international trade disruption and quotas leading to some temporary shortages of products.

- Difficulties for those classified as ‘vulnerable’ (financially vulnerable/shielded/elderly) in accessing food throughout the lockdown stages.

Discussion

Defra worked closely and quickly with the food sector, other government departments, and the devolved administrations to understand key issues and develop interventions to ensure food supply to the UK population. A number of government measures were put in place to maintain food supply chain resilience.

Stakeholder Engagement

Stakeholder forums were used to maintain regular communication between industry, government departments and the devolved administrations. These included:

- **The Food Chain Emergency Liaison Group (FCELG)**: Defra’s long-established food industry sector working group for resilience and security issues. The group formally met regularly to identify and mitigate potential risks to food supply and interdependent sectors. The group also met in emergencies to act as a conduit between the food industry, UK government, and the devolved administrations. The FCELG has since been replaced by the Food Supply Resilience Planning Group, focusing on planning for medium- to longer- term risks to the food supply chain.
- **Food Resilience Industry Forum (FRIF)**: a bespoke forum which was established at the start of the COVID-19 pandemic to support the logistical and technical operations of food supply across the UK food supply chain.
- **Sector specific industry meetings** aimed at providing effective communication between food sectors and government.
- **The Scottish Government’s Food Sector Resilience Group**: specific to Scottish stakeholders, but similar to FCELG and FRIF, with regular ministerial involvement. A Scottish Public Sector Food Forum was also established.

Temporary measures introduced by industry

- **Communications to the public –** government worked closely with retailers to develop and share messaging that aimed to help consumers understand the resilient nature of the supply chains and the impacts of their own actions.
- **Item limits on high demand goods (food and non-food) –** to allow time for restocking of popular products.
- **Specific shopping slots allocated for vulnerable groups and key workers both online and in person –** to ensure access to food.
- **Social distancing measures for public and staff –** to safeguard individuals from COVID-19 infection.

- **Enhanced cleaning measures –** to mitigate against the spreading of COVID-19**.**

Temporary measures introduced by government

Defra and wider government introduced a number of temporary mitigation measures:

- **Extended delivery and drivers' hours** – relaxing regulations on delivery times and driver regulations to allow a higher frequency of deliveries to and from stores.
- **Relaxation to UK Competition Law** – two separate exclusion orders (the Competition Act 1998 (Groceries) (Public Policy Exclusion) Order 2020) allowed grocery retailers and their suppliers (directly or indirectly) to collaborate effectively to prepare for and, if required, respond to potential disruption only in the instance that it related to specified 'qualifying activities'. This allowed more open discussion on areas such as stock levels, item limits, and store hours. A temporary relaxation to UK competition law was also made specifically for the dairy sector to allow further collaboration in the supply chain.
- **Relaxation of the plastic bag fee** for minimum contact between deliveries and more time-efficient deliveries.
- **Labelling easements** to allow for minor deviations on labels.
- **The Pick for Britain campaign and website** - a collaboration with industry to ensure sufficient seasonal labour for domestic food production.
- **Food parcels for shielded groups** - to ensure the clinically vulnerable had access to food during lockdown.
- **Government support for businesses** experiencing increased costs and disrupted cash flow as a result of COVID-19. This included the Coronavirus Job Retention Scheme, the Coronavirus Business Interruption Loan Schemes for small and large businesses (CBILS/CLBILS) and the Bounce Back Scheme for small and medium enterprises (SMEs)
- **The Trade Credit (TCI) Reinsurance Scheme** which provided £10bn of guarantees on business-to-business transactions currently supported by TCI, backdated to April 2020 and running to 31 December 2020.
- **Legislation supporting information sharing agreements** between industry and government. Defra included provisions in the **Coronavirus Act (2020)** which allowed government powers to obtain information from industry if necessary in a disruption. However, these provisions were not brought into effect due to the continued collaborative relationship between industry and government.

- **Adding essential food items to the Category 1 (CAT 1) goods list during COVID-19 response** - to allow inclusion in mitigations where appropriate, such as prioritisation on commercial freight and access to hauliers.

Trends

The government will continue to review threats and risks as part of its responsibilities to food as a Critical National Infrastructure (CNI) sector. The risks exposed through the COVID-19 pandemic and transition planning for EU Exit have highlighted the significance of business continuity planning within industry and helped inform risk mitigation as part of their operations. Government intelligence suggests that broadly, industry continues to prioritise business continuity planning where possible. However, this is more likely to be possible for larger agri-food companies than for small and medium-sized enterprises (SMEs).

Indicator 3.1.2 Energy dependency in the food sector

Headline

The food supply chain is highly dependent upon the energy sector and vulnerable to both short-term supply disruption and medium-term energy price fluctuations. Demand for energy from the food and beverage sector has declined in the last 20 years, reflecting increased energy efficiency, but the sector remains reliant on imported natural gas. Demand has remained consistent for the agriculture sector for the past 20 years.

Context and rationale

The food supply chain depends directly and indirectly upon energy through its reliance upon common energy sources such as electricity, natural gas, and petroleum products. This dependency is evident across the supply chain, through production, processing, packaging, distribution, transport, retailing and consumption of food itself. Energy security is vital to the functioning of the whole economy. The food supply chain has high energy demands and is vulnerable to disruptions to energy supply or changes in energy prices. Capturing the energy intensity of the food supply chain is complex because it spans several sectors not all of which are purely food related. If the UK's energy supply is not secure, the food supply chain will be vulnerable to disruptions.

Fluctuations in the energy market may affect the prices of commodities or key inputs such as carbon dioxide (CO2), and thus the economic viability of food businesses. Oil prices represent one of the most important drivers of change in global food commodity prices. Consumer prices also depend on wider factors including agri-food import prices, domestic agricultural prices, domestic labour and manufacturing costs, and Sterling exchange rates.

The UK meets its energy needs through production and trade. In 2020, total energy net import dependency was 28% of primary supply. This was 7.2 percentage points lower than 2019 and the lowest level since 2009, largely a result of lower demand during the COVID-19 pandemic.

For oil, import dependency varies by product. The UK is a net exporter of petrol meaning all demand could be met through indigenous production alone in the event of disruption. In 2020, the UK met close to 60 percent of road diesel demand through indigenous production. The UK imports diesel from a large number of sources which increases security of supply. The UK is self-sufficient in the production of gas oil (red diesel) which is commonly used by agricultural vehicles.

In recent years around half of natural gas demand was met through indigenous production, in 2020 this was 54%. The remainder is met through imports via pipelines and of liquefied natural gas (LNG). In 2020, a third of supply was met through imports from Norway. The UK has a large number of other import sources which increases security of supply.

A small proportion of UK electricity supply is provided by imports. In 2020, net imports accounted for 5.4% of supply. Whilst domestic generation capacity is sufficient to meet UK needs, interconnectors can provide additional flexibility and reduce costs. Northern Ireland and the Republic of Ireland have a single electricity market, by which electricity can flow freely across borders, balancing the market for the whole island of Ireland.

The Department for Business, Energy and Industrial Strategy (BEIS) is the lead UK Government Department for the risk of major power disruption. BEIS works closely with the Cabinet Office and other government departments to ensure that appropriate preparedness and mitigation measures are in place so that impacts from energy supply disruption are minimised.

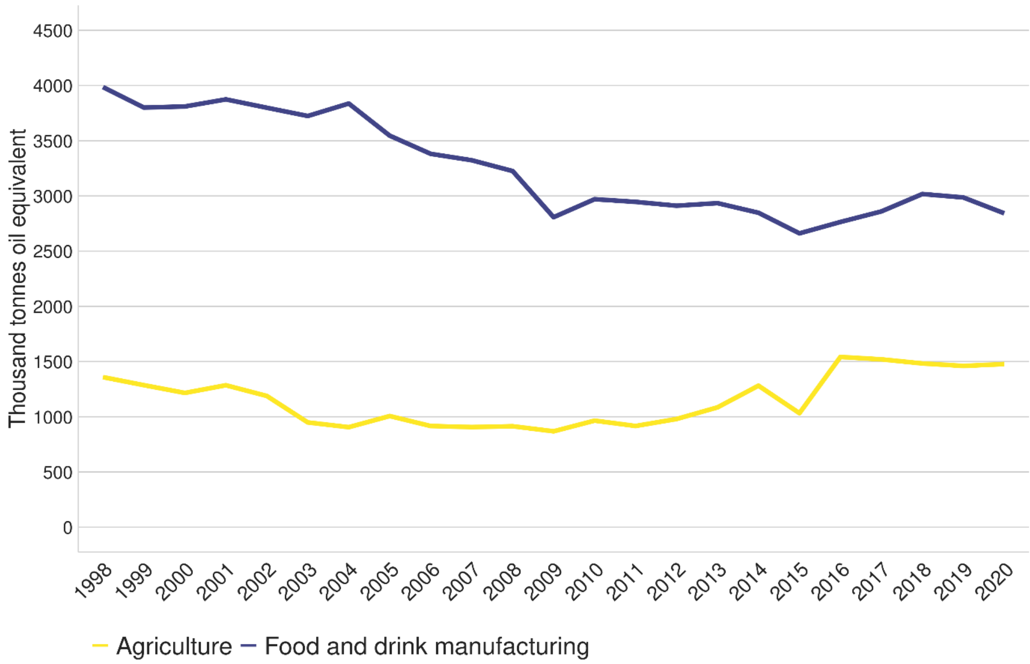
This indicator includes data collected from BEIS through the Digest of UK Energy Statistics (DUKES) to illustrate energy demand in the food and drink manufacturing and agriculture sectors. A case study is provided on the major power disruption which took place on Friday 9 August 2019.

Data and assessment

Indicator: Aggregate energy demand for agriculture and food and drink manufacturing

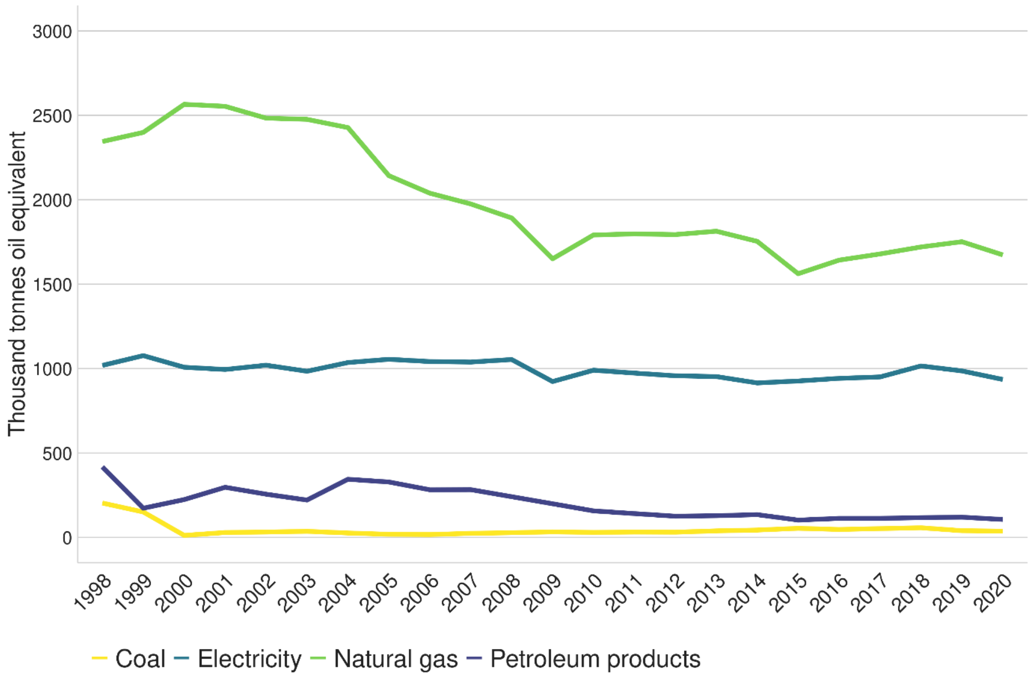
Sources: DUKES

Figure 3.1.2a: Aggregate energy demand for agriculture and food and drink manufacturing.



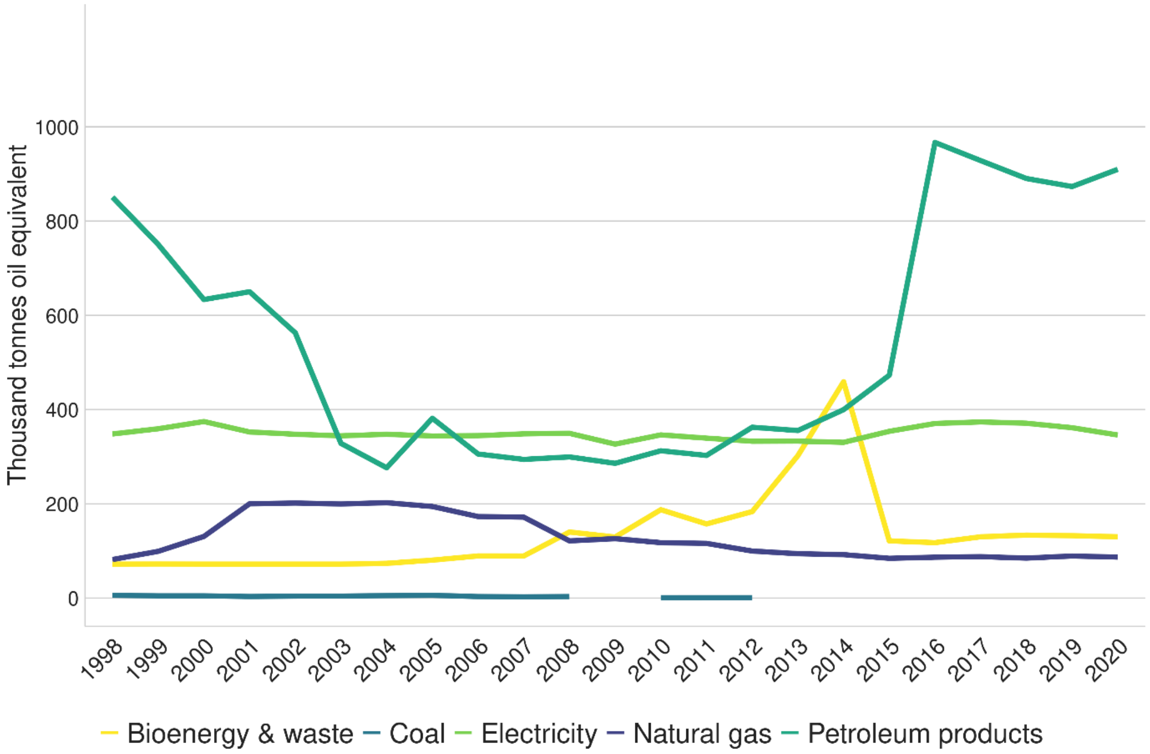
In 2020, natural gas accounted for close to 60% of demand in the food and drink manufacturing sector, whilst electricity accounted for a third. Although minimal, demand for energy from bioenergy and waste has increased in recent years in line with substantial growth in renewable energy production. Continuing this trend in line with Net Zero targets may be challenging for manufacturing processes that use high temperature heat sources for which electricity is less effective than gas/petroleum products.

Figure 3.1.2b: Energy demand by energy type in the food and drink manufacturing sector.



Overall total demand for energy by the food and drink manufacturing sector has remained stable in the last 20 years. Natural gas meets 60% of energy needs followed by electricity at a third.

Figure 3.1.2c: Energy demand by energy type in the agriculture sector.



Demand for energy in the agricultural sector shows an increase in 2016, which is somewhat explained by methodological updates. This includes apparent increased demand for petroleum products from 2015, in fact due to a change in method of estimating sector demand for oil products, and a peak in bioenergy and waste in 2013-14.[77] To note, further revisions and back casting were delayed due to COVID-19 and will likely be published in 2022.

Petroleum products play an important role in the agricultural sector, meeting more than 60% of energy needs. Within the DUKES balance this largely consists of burning oil, used for drying of crops and heating, and gas oil (commonly known as red diesel) used to power non-road machinery (NRMM). In addition, a small amount of propane is used, mainly for heating (most commonly on poultry farms). Indirect agricultural demand for energy inputs such as fertiliser are not captured within this sector of the balance, but in demand for energy by the chemical industry.

The drop off in demand for coal is in line with reducing coal demand across the board.

---

[77] BEIS, ‘Change to method of estimating sector demand for oil products’ (2019), https://www.gov.uk/government/publications/energy-trends-june-2019-special-feature-article-change-to-method-of-estimating-sector-demand-for-oil-products

Trends

In absolute terms, energy used in food and drink manufacturing has generally been declining over the last 20 years (more significantly on a per capita basis), reflecting increased energy efficiency. For agriculture, energy use has been more stable, with a slight upward trend between 2016 and 2020. Energy use in agriculture is also likely to be impacted by other inputs such as fertiliser, which is not reflected here.

Case Study 3.2 9 August 2019 Power Outage: Food Sector Impact

Overview

On Friday 9 August 2019, over 1 million customers were affected by a major power disruption that occurred across England, Wales, and some parts of Scotland. Though the power disconnection itself was relatively short lived - as all customers were restored - the knock-on impacts to other services were significant. This event demonstrated the need for essential service providers, including those in the food sector, to have robust business continuity plans in place for disruptive events such as power outages.

Background

The 9 August power disruption was triggered by a lightning strike to an overhead transmission line and the near simultaneous loss of a number of generators. The loss of generation caused an imbalance between the amount of electricity being generated and the amount of electricity being used by businesses and the public. This triggered an automatic protection system (known as Low Frequency Demand Disconnection) which had the effect of disconnecting over 1 million customers to address the imbalance and protect the electricity network from a total shut down.

Although all customers were restored within 45 minutes, a number of sites and services were impacted including:

- Rail – 371 cancelled services, 220 part cancelled services and 870 delayed trains; some signalling assets were also affected. Major delays extended into Sunday 11 August.
- Hospitals – 4 hospitals automatically switched to their back-up generators.
- Water Treatment – 3,000 customers experienced a reduction in water pressure and 1 water treatment plant needed to switch to its back-up generator.

- Airports – 2 airports automatically switched to their back-up generators.

Discussion

The majority of these services were not disconnected by the Low Frequency Demand Disconnection Scheme. Instead, the service disruptions were caused by protection systems under the control of individual essential service operators, which reacted to the disturbance on the electricity network.

A number of investigations were carried out by the impacted industries to better understand why internal safety systems reacted to the frequency and voltage fluctuations in the way that they did and whether any mitigations are available. For example, the rail industry took proactive steps to assess why some trains stopped operating when the frequency on the power network dropped. Several engineering and incident response solutions were introduced to ensure resilience to future potential power disruptions. These are set out in the Office of Rail and Road's report on the rail disruption.[78]

Impacts were further exacerbated by the ineffectiveness of essential services' business continuity plans. Guidance developed by the Energy Emergency Executive Committee (E3C) was developed and cascaded to operators of essential services to ensure their preparedness and resilience to a range of possible power disruption scenarios. The E3C includes industry, regulators, UK government and devolved administrations who work together to build resilience in energy supplies

Whilst the power outage did not have a large impact on the food sector - no disruptions were reported across the food production, distribution or sale - this event illustrates the importance of adequate preparation and planning for power disruptions, to minimise any disruption to customers and the public.

---

[78] Office of Rail and Road, 'Report following railway power disruption on 9 August 2019, (2020) https://www.orr.gov.uk/media/10752

Indicator 3.1.3 Transport dependency in the UK

Headline

The functioning of the food supply chain depends on an efficient transport network, especially the road network. Just in time supply chains are sensitive to disruption to transport, particularly in road freight. Overall delay times on the Strategic Road Network, responsible for two thirds of all freight, have increased over the last five years.

Context and rationale

The transport sector plays a strategic role in connecting the UK food supply chain. It links UK ports, farms, factories, retailers, food service providers, and consumers. It is essential to the import and export of food. Food is primarily transported by sea, road and rail. Food products were the most common commodity imported by UK-registered heavy goods vehicles in 2020, with 1.2 million tonnes imported, accounting for 35% of all imports.[79,80]

The UK food supply chain is dependent upon the use of 'just-in-time' logistics, which allow the transportation of food within short timeframes and as close as possible to when it is needed. For fruit, vegetables and other items with a short shelf life, this allows food to be as fresh as possible and avoids food waste. These transportation systems are highly efficient, regular, and predictable, and allow consumers to have widespread access to food on supermarket shelves. Food security disruption could however occur if the continuity of the transportation system was compromised. The reasons for transport disruption could include, for example, border delays, extreme weather events, flooding or any other accidental or malicious disruption affecting multiple points of the transportation network. As a result of the just-in-time approach, retailers do not usually hold substantial stock on-site, meaning that the supply chain is sensitive to sudden increases in demand and disruption is likely to be felt relatively quickly. However, on such occasions, the UK is unlikely to experience an overall shortage of food, though some products may experience temporary disruptions. On such occasions products in short supply may be able to be sourced from alternative suppliers.

---

[79] 35% includes food products, beverages and tobacco.
[80] DFT, 'International Road Freight Statistics', (2021) https://www.gov.uk/government/statistics/road-freight-statistics-2020

The COVID-19 pandemic and the challenges related to EU Exit have illustrated how reliant the food supply chain is upon the transport sector. During the pandemic, despite shocks to the food system, food supply was maintained with only temporary disruptions. Although there are ongoing recruitment and retention challenges of Heavy Goods Vehicle (HGV) drivers which has caused significant challenges within the transport sector. Certain areas of the UK, in particular remote and island communities, are more vulnerable to disruption occurring in the transport system due to the length and complexity of their supply lines. EU Exit has also created new challenges for supply of food to Northern Ireland, which has in general a more complex supply chain due to the greater distances and ferry connections needed to ship goods from Great Britain.

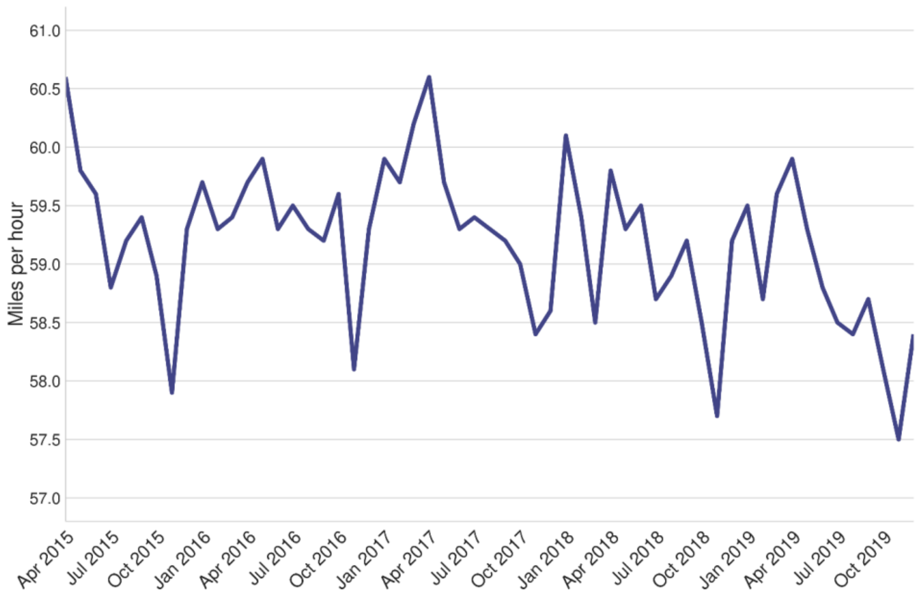
As all food is transported at least part of the way via road, this indicator looks at the Road Congestion and Travel Time Statistics collected by the Department for Transport (DFT) which cover the Strategic Road Network (SRN) in England. The SRN is the most heavily used part of the national road network covering motorways and major A roads, and carries a third of all traffic and two-thirds of all freight. Delay indicators are only available for the SRN in England. However, as a high proportion of food to all parts of the UK travels through England, this indicator is relevant to the food supply of the entire UK.

Data and Assessment

Indicator: Road Congestion and Travel Time Statistics

Sources: Strategic Road Network

Figure 3.1.3a: Average speed on the Strategic Road Network (SRN).

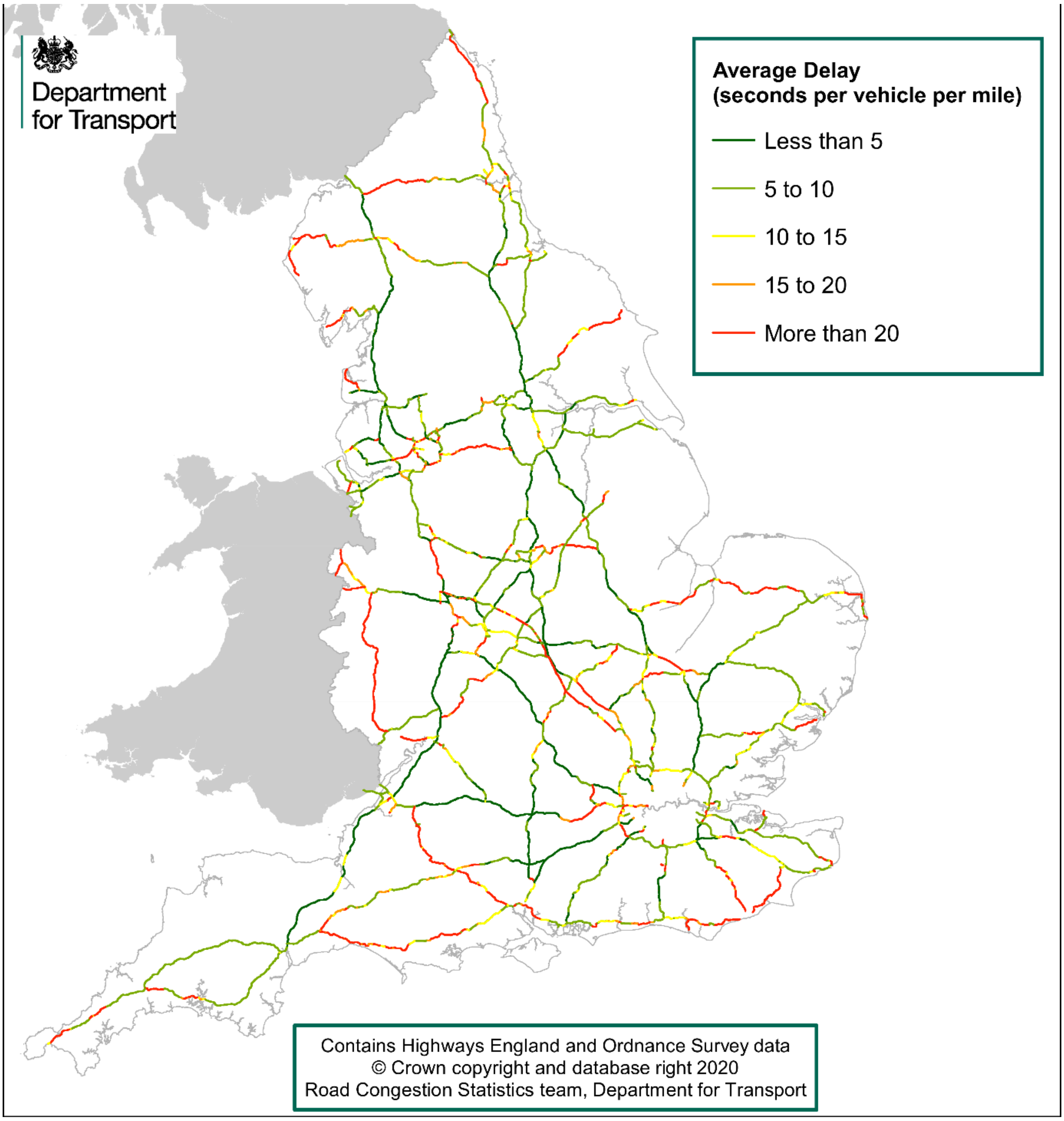


This indicator only includes data up to the end of 2019 as from March 2020 the average speed increased due to there being fewer vehicles on the road during the first COVID-19 lockdown. The DFT has published a report on the impact of the pandemic on travel time measures, including estimates of what average speeds would have been in 2020 without coronavirus impacts.[81]

The average monthly speed on the Strategic Road Network in England varied between 57 and 61 miles per hour from 2015 to 2019. Each year the month with the slowest average speed is November, while April often has the highest. There is seasonality within the congestion data, with higher speeds experienced around April and slower speeds in November, after the clocks change. This change causes a slight increase to average delays which might be due to darker mornings causing people to get up later, therefore increasing the number of people using the roads during peak times. In April, when the clocks go forward, the average delay is slightly lower, which could be attributed to people getting up earlier with the lighter mornings, decreasing the number of vehicles on the roads during peak times. This seasonality is generally incorporated into planning by hauliers and other logistics businesses.

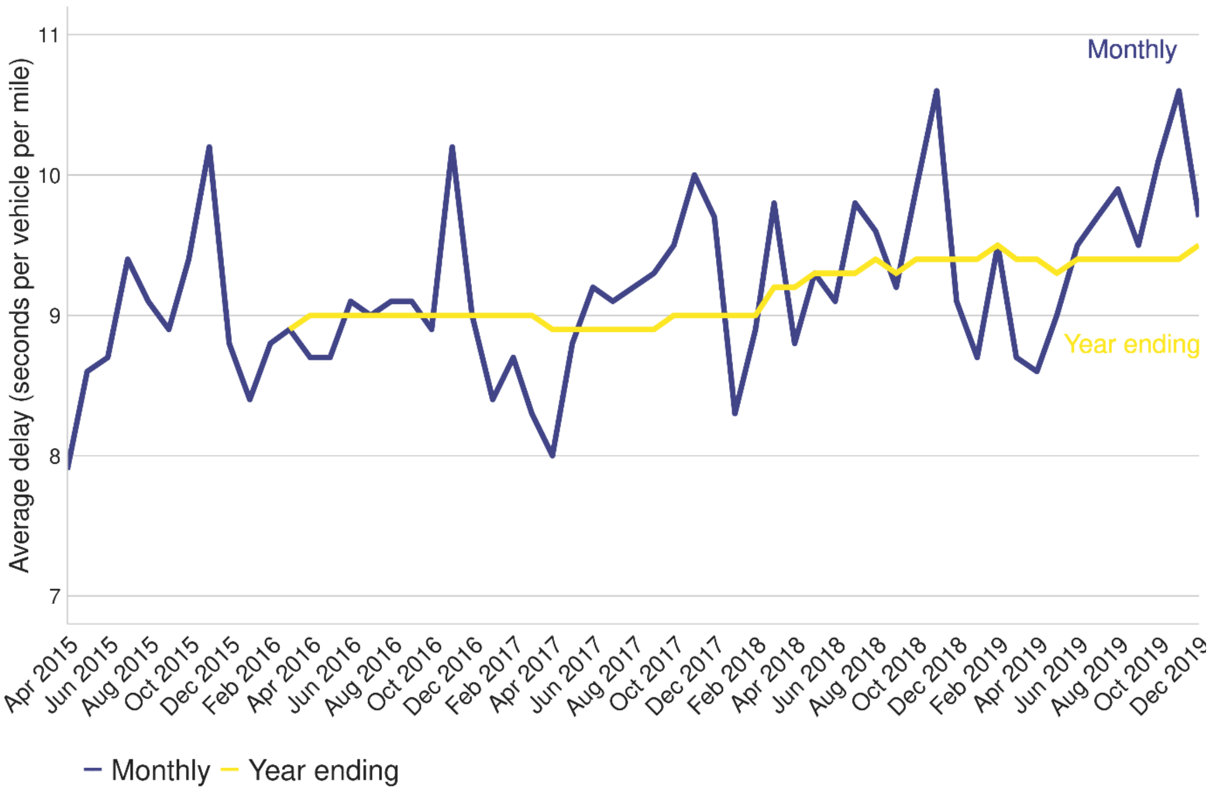
[81] DFT, 'Impact of the coronavirus (COVID-19) pandemic on travel time measures' (2020), https://www.gov.uk/government/statistics/travel-time-measures-for-the-strategic-road-network-and-local-a-roads-july-2019-to-june-2020/impact-of-the-coronavirus-covid-19-pandemic-on-travel-time-measures.

Figure 3.1.3b: Average delay on the Strategic Road Network (SRN) in England, 2019.



The average delay on individual main carriageway links was less than 10 seconds across England in 2019. Around major cities, the delay was approximately 20 seconds per vehicle per mile (spvpm). This could be due to the high demand on the network around them, relative to their capacity. The roads with the greatest year-on-year increases in delay also tended to have the greatest decreases in average speed. These were primarily in areas with ongoing roadworks, implemented as part of the Road Investment Strategy (RIS).

Figure 3.1.3c: Average delay on the Strategic Road Network (SRN).



For 2019, the average delay on the SRN was estimated to be 9.5 seconds per vehicle per mile (spvpm) compared to speed limits. This is 0.9% higher compared to 2018, which means on average there were more delays in 2019 than 2018. 2019 is used as a reference year because the travel restrictions under COVID-19 in 2020 affected traffic flow in a way that was atypical.

Since 2016, there has been a gradual increase in the average delay on the SRN in England, although the number of vehicles travelling on it over that time has increased at a greater rate.

Average speeds on the SRN have decreased slightly by 0.5 miles per hour (1% decrease) since 2016, while in the same period average delays have increased by 0.5 spvpm (5% increase).

Overall, continuity of the SRN system is expected to be maintained. There has been a slight worsening in average delay times which can be explained by the decrease in average speeds due to roadworks. However, in the past 5 years there have been no significant disruptions to just-in-time supply chains, suggesting high food security for food already within the UK.

Trends

In absolute terms there has been a slight increase in average delay times on the SRN, although this is not significant. It will be important to monitor any changes resulting from structural breaks caused by COVID-19 and the UK's exit from the EU. Longitudinal evaluation of the SRN will be needed to determine its resilience.

The road freight sector has been impacted by a reduction in the number of drivers. An estimated 268,000 people were employed as HGV drivers between July 2020 and June 2021. This is 39,000 fewer than the year ending June 2019, and 53,000 fewer than the peak of 321,000 HGV drivers during the year ending June 2017.[82] The UK government is taking action to address this shortage.[83] This includes attracting drivers back to the industry by investing £32.5 million to improve facilities across the country, to investing £17 million to create new HGV Skills Bootcamps to train up to 5,000 more people to become HGV drivers in England.

Indicator 3.1.4 Points of entry in the UK

Headline

Food imports from the EU, particularly short shelf-life goods, are concentrated on the Short Strait (Dover and the Channel Tunnel). The risks of this concentration are discussed in **Indicator 3.1.5.** Imports are otherwise spread across a number of ports of entry, with no one port dominating non-EU imports.

Context and Rationale

The UK's points of entry are the places where goods enter the country from abroad. Food from overseas, as well as animal feed and fertiliser inputs for domestic agriculture, enter the country through these international gateways. The following analysis focuses mainly on UK seaports, which are the most important of those gateways. The Channel Tunnel and airports (particularly Heathrow) handle the remainder of the UK's food imports, around 15% of the total.

---

[82] Office for National Statistics (ONS), 'Fall in HGV drivers largest among middle-aged workers' (2021) https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/fallinhgvdriverslargestamongmiddleagedworkers/2021-10-19

[83] UK Government, 'HGV driver shortage: UK government response', (2021) www.gov.uk/government/topical-events/hgv-driver-shortage-uk-government-response.

Understanding the spread of imports across the UK's ports helps to identify key infrastructures such as port facilities, roads and railways which connect those ports to the food supply chain. Food security could be compromised where risks are not spread between a sufficient number of ports, or where there is a lack of flexibility to switch between suitable ports, should the need arise.

UK ports are also subject to a variety of risks that may be geographically correlated, such as tidal surges on the East Coast. The impact of any disruption to ports would depend on the length and scale of the disruption, as well as the ability to find alternative points of entry in the timescales required.

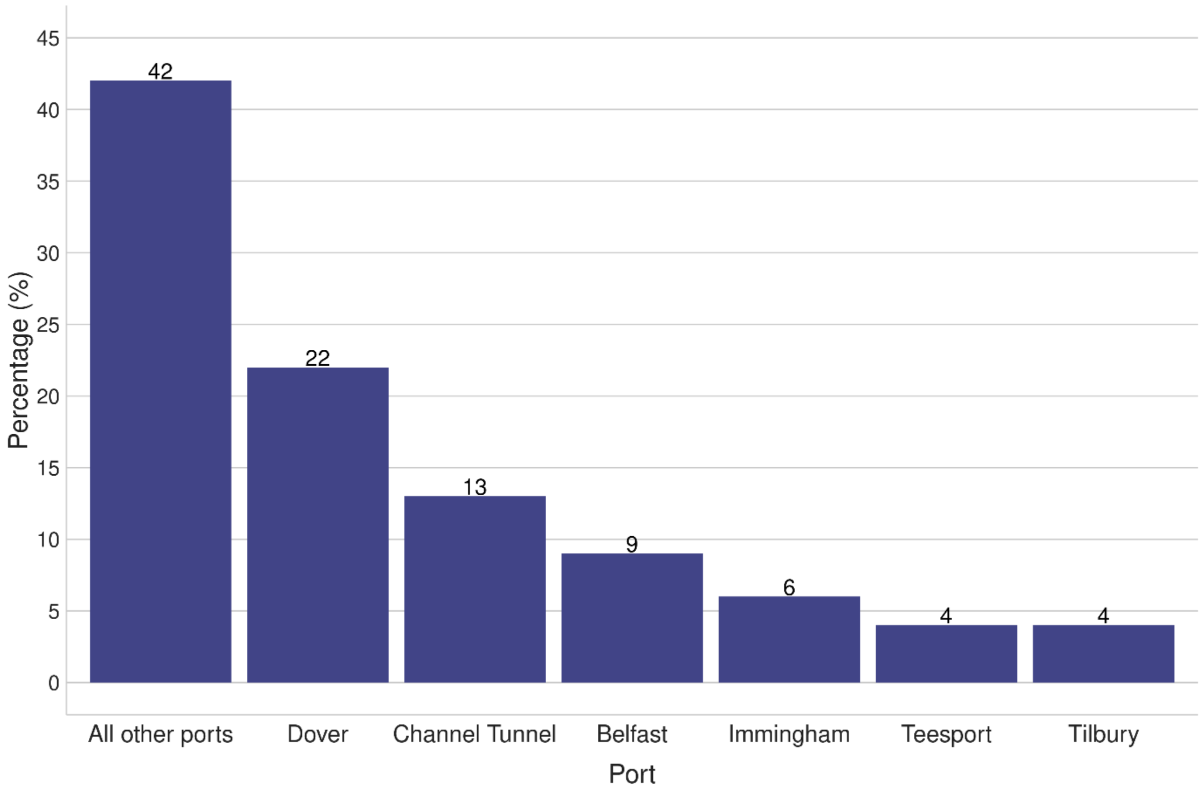
A further consideration is the dependency of the UK on the resilience and regulatory approach of ports in the EU from which the bulk of UK imports depart. This varies between countries like France, Spain, and the Netherlands, and affects the ease with which goods flow to the UK.

Data and Assessment

Indicator: Percentage share of UK food imports by port and mode of transport

Source: A report by Baker P, PRB associates (2020), commissioned by Defra

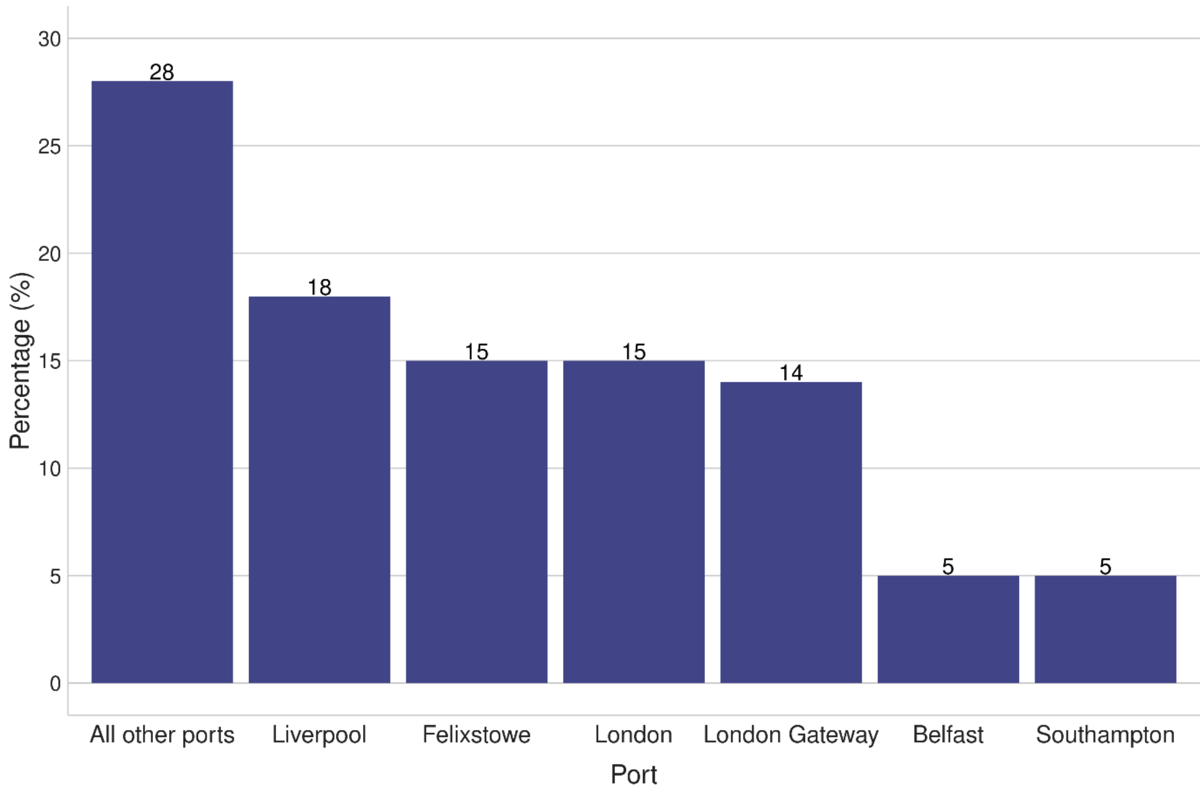
Figure 3.1.4a: Percentage share of UK food imports by port (EU countries, 2018).



The graph above shows the main ports used for UK food imports from the EU in 2018. The top six ports responsible for EU imports account for 58% of total shipments. The port of Dover represents the biggest source of EU food imports, at

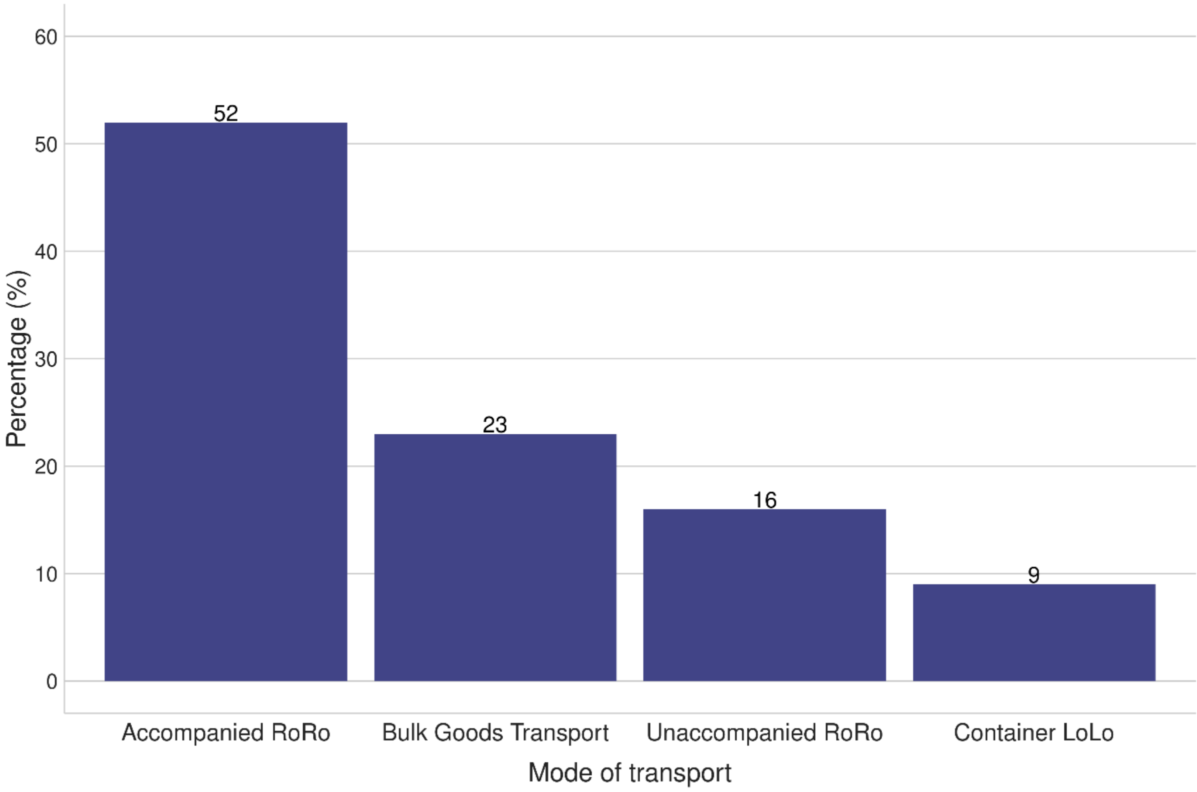
22% of the total. In 2018, the UK imported 28 million tonnes of food products from the EU.

Figure 3.1.4b: Percentage share of UK food imports by port (non-EU countries, 2018).



Non-EU imports are more concentrated within the top 6 ports. The graph above shows that the top 6 ports account for 72% of non-EU imports, with Liverpool the biggest source of shipments, at 18%. In 2018, a total of 11.3 million tonnes of food products were imported from non-EU countries.

**Figure 3.1.4c: Percentage share of UK food imports by mode of transport (EU countries,
2018)**



Although equivalent data is not available for non-EU countries, the graph above demonstrates the split of UK imports from EU countries by mode of transport. Accompanied 'roll on roll off' (RoRo) accounts for just over half of EU imports, at 52% of the total. This is when freight is carried in trailers attached to a road goods vehicle, on sea-going vessels fitted with ramps for discharging without the use of cranes. The next most significant is Bulk Good Transport, accounting for 23% of the total and involving the import of agricultural commodities, such as sugar and grain. Unaccompanied RoRo (freight carried on unattached trailer) and container 'load on load off' (LoLo) (cargo carried in 20-foot and 40-foot containers) account for the remaining quarter of food imports from the EU between them.

In aggregate, both EU and non-EU food imports, via all modes of transport, are well spread across a number of ports of entry, with no port having a dominant share. Only simultaneous disruption to several ports would be serious enough to have an overall effect on UK food supply.

There are clusters of ports used for handling food import traffic, for instance in the South East and North East regions. Their geographical proximity suggests that they could share some risks of disruption from extreme events such as coastal flooding. A tidal surge on the east coast could have a concurrent impact across multiple key ports in the UK and on the European mainland. Government, ports, and many businesses have plans to reroute goods to other ports in this event, but the combined effect of rerouting all east coast traffic would likely cause delays and congestion at other ports.[84] The just-in-time nature of the supply chain makes it vulnerable to this kind of disruption, with the greatest impact on availability of fresh produce.

However, the resilience of port infrastructure is not solely a matter of having a range of ports to potentially divert to. Alternative ports must have the correct protocols, staffing capacity and suitable infrastructure to receive food imports and different cargo types. A port's capacity and configuration govern both the types and sizes of sea-going vessels that can be received, and therefore the types and quantity of food cargo that can be discharged there. Currently, there is a data gap at both the individual port and UK level, to allow for an accurate assessment of the ease with which food import traffic can be switched between ports in the event of disruption. This is an area which could be considered for future Food Security Reports.

Trends

There has not been a significant change in the diversification of EU and non-EU food imports in recent years. It will be important to monitor any changes resulting from the UK's exit from the EU, or any new developments in port capacity, such as the planned Poole-Tangier route.

Indicator 3.1.5 Food imports via Short Strait

Headlines

There is a degree of reliance on the Short Strait import routes for some food products, especially perishable goods such as fresh fruit and vegetables. In the event of disruption to the Short Strait, it is expected that the use of alternative points of entry could decrease the impact to food supply.

Context & Rationale

The Short Strait routes refer to the ferry connections between the port of Dover and Calais and Dunkirk, and the Channel Tunnel railway connection between Folkestone and Calais. The Short Strait routes are the shortest routes from Dover to continental Europe, and offer advantages in time, cost, and frequency of

[84] Achuthan and others, 'Resilience of the food supply to port flooding on east coast' (2015), http://randd.defra.gov.uk/Document.aspx?Document=13179_SynthesisReport.pdf.

services. The short journey times are particularly important for the transport of goods with a short shelf life, such as fresh fruit and vegetables.

Given the perishability of many food products and the just-in-time basis of the food supply chain, food importers have increasingly used these routes through shipping in accompanied trailers. An over-reliance on the Short Strait routes could mean that an issue with one or both of them could significantly disrupt the supply of some imported food products.

It is estimated that 36% (10 million tonnes) of food imports from the EU arrived via the Short Strait in 2018, which equates to around 25% of total UK food imports. Given that around half of the food consumed in the UK is imported, it can be estimated that around 12.5% of food consumed in the UK is being imported via the Short Strait.

Data and Assessment

Indicator – Breakdown of the Short Strait food imports from the EU

Source: - The source of all the data in this section is a report by Baker P, PRB associates (2020), commissioned by Defra

Figure 3.1.5a: Percentage breakdown of the Short Strait food imports from the EU

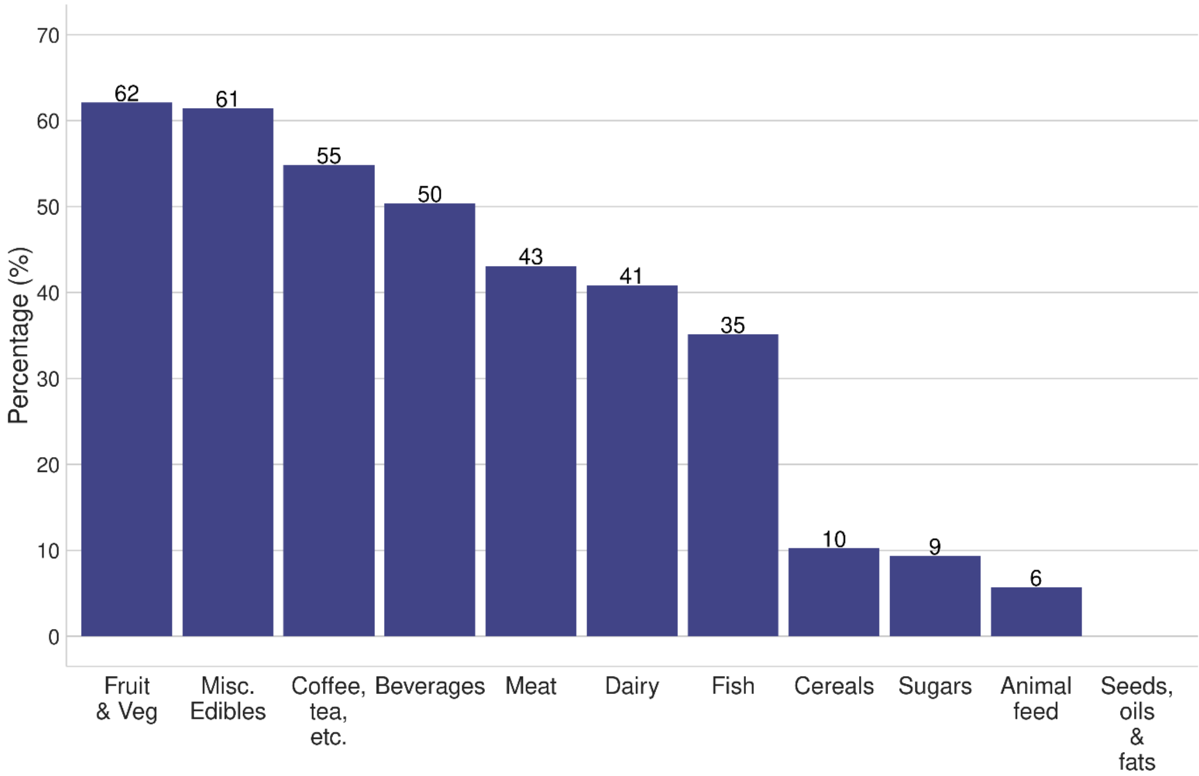
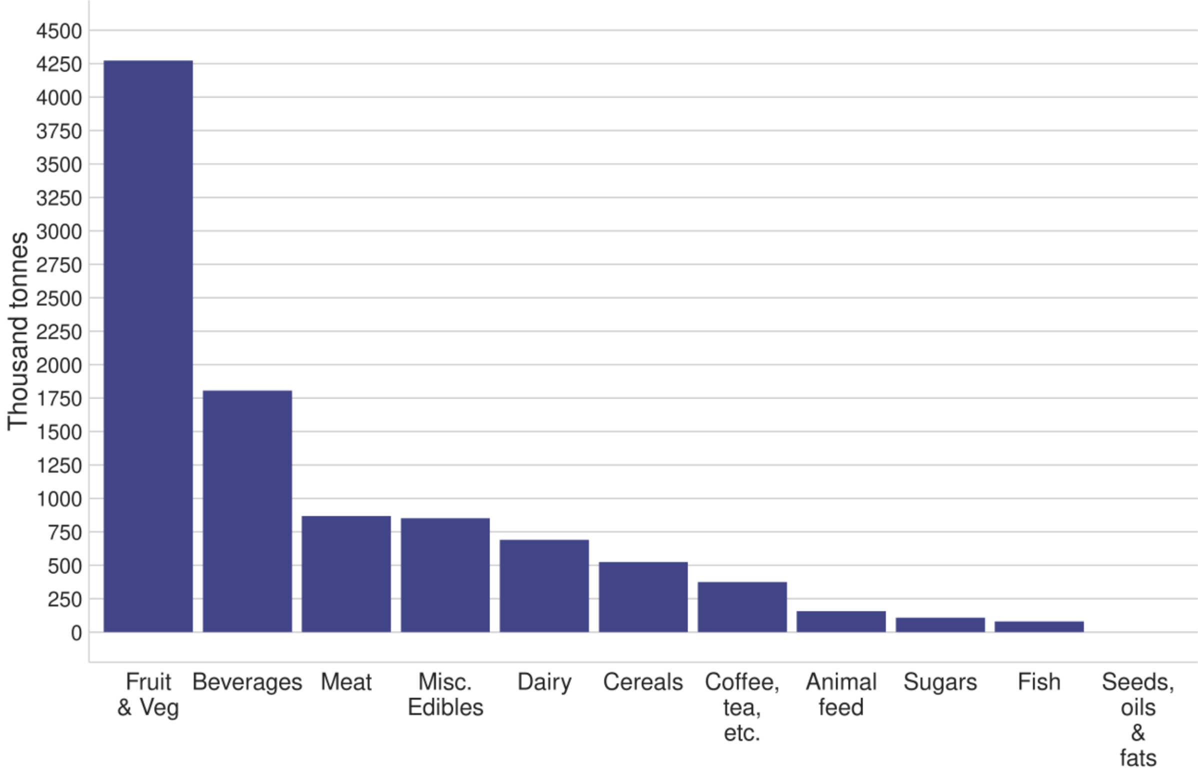


Figure 3.1.5b: Breakdown (in tonnes) of the Short Strait food imports from the EU.



The graph above presents volumes data on the breakdown of food imports from the EU and their corresponding shares of total food imports from the EU in 2018. The UK is reliant on the Short Strait for certain food groups, in particular: fruit and vegetables (62% of fruit and vegetables imported from the EU arrive via the Short Strait), meats (43%) and dairy (41%). Of the total EU food products imported via the Short Strait, it is estimated that 44% are fruit and vegetables, 19% are beverages, 9% are meats, and 9% are dairy.

In addition, there are 0.3 million tonnes of non-EU food imports that arrive via the port of Dover. Of those imports, 98% are "Edible fruit and nuts; peel of citrus fruits or melons."

There is some reliance on Short Strait routes for food imports of certain products, there is potential for these imports to be redirected to other ports on the south and east coasts of England in the event of disruption at Dover and the Channel Tunnel.

Examples of ports that may be suitable for this substitution include Harwich, Portsmouth, Immingham, Hull, and Killingholme. The ability of these ports to take on additional shipments at potentially short notice will be determined by factors including:

- current utilisation levels
- competing demand for spare capacity from other sectors
- having the relevant infrastructure
- trained inspection staff in place to accommodate increased traffic flows

- the ability of industry to reconfigure their supply chains.

Finding extra capacity could present significant challenges given the volumes involved. In an ordinary week, around 36,000 trailers use the Short Strait crossings, compared to 20,000 trailers on the North Sea and Western Channel routes, all of which are much longer sailings. The port of Dover handled 1.07 million imports of road goods vehicles in 2020, while Harwich, Portsmouth, Immingham, Hull and Killingholme handled 220,000 combined.

Trends

There has not been a significant change in the level of reliance on the Short Strait routes in recent years, but the UK's exit from the EU could affect this in the future.

Indicator 3.1.6 Border closures

Headlines

Border closures intended to control disease have the potential to threaten food imports. Border issues may have different dynamics and affect freight differently. The below case studies draw on two border closures experienced during the COVID-19 pandemic; one imposed on the UK by France, and the other imposed by the UK on Southern Africa and South America, neither of which caused serious supply issues.

Context & Rationale

Border closures are the decision taken by a country to close its borders to people or goods entering from elsewhere. Border closures limiting the travel of people were used by the UK and other nations during the COVID-19 pandemic to limit the spread of the virus.

Border closures pose a risk to the food supply chain as the UK imports around 45% of the food it consumes. Consequently, border closures can cause temporary disruptions to the supply of certain food items, particularly fresh products from the EU as these often arrive via road accompanied by a driver. Freight which arrives unaccompanied is less susceptible to the impact of a border closure that prevents hauliers from entering the UK. This is because no single person is accompanying the food between countries. The container with the food inside is loaded onto a ship and then collected by another driver at the destination port.

Although disruption to certain foodstuffs may occur, border closures are unlikely to be a threat to overall food security as the UK's food supply is diverse. In addition, accurate data, real-time intelligence sharing, and cross-government collaboration bolster the capacity of both government and industry to respond to border closures. However, delays to shipments of fresh food can lead to shortages on shelves due to the just-in-time supply chain, and economic losses through spoilage. This section will include two case studies on the French-imposed border closure in December 2020, and the UK imposed border closures for Southern Africa and South American countries in January 2021.

Case Study 3.3 French Border Closure, December 2020

Overview:

In December 2020, France closed its border with the UK as a consequence of the Alpha variant of COVID-19 circulating amongst the UK population. France banned the entry of people, including accompanied freight (both sea and air), from the UK at 23:00 Sunday, 20 December for 48 hours.

Travel bans were also imposed on the UK by other countries, including the Netherlands, Belgium, and Italy, though these restrictions did not include accompanied freight.

Background:

The border closure was a threat to the UK's food supply due to the volume of food imports that come from or through France to the UK, and because of the lack of warning, which gave the UK little time to respond.

The UK imports many food items directly from France, such as 13.4% of cheese imports, 32.4% of yoghurt imports, 27.6% of apple imports, and 19.4% of bread, crispbread, and savoury imports. France accounts for 9.1% of the UK's total food imports.

The France - UK route is also important for food imports from other EU nations. Many of these imports arrive accompanied, so the total ban on both people and accompanied freight posed a significant threat to the UK food supply.

This manifested in two ways. Firstly, hauliers transporting food were unable to travel to the UK from France. Secondly, hauliers were stuck in the UK and unable to return to mainland Europe to pick up more food.

Discussion

Despite the potential threat, no serious disruption to the supply of food into the UK occurred. The interruption was relatively short-lived, with the ban on accompanied freight lasting only 48 hours. Many businesses had sufficient stockpiles to mitigate this disruption to supply for this period.

French officials ended the restrictions after the UK government set up prioritised COVID-19 testing sites for hauliers, who could then return to France if they tested negative. Although the UK has a significant dependence on France-to-UK shipping lanes for its food imports, there are a number of other important routes such as from Rotterdam in the Netherlands, as well as domestic production.

The availability of data regarding UK imports of food and other key inputs in the food supply chain was significant in this situation. The government always had the evidence required to make informed decisions about the next steps. The availability of communicable and up-to-date trade data is crucial in combatting such instances of disruption.

Case Study 3.4 UK-Imposed Border Closures (southern Africa; South America), January 2021

Overview

In January 2021, the UK government imposed border closures due to the presence of COVID-19 variants in several countries. The first border closure was with South Africa in early January. It prevented aircraft travelling directly from South Africa to England, as well as a ban on entry for travellers who had been in or transited through South Africa in the previous 10 days. Equivalent restrictions were imposed on all southern African countries.

In mid-January a second border closure of the same nature was imposed, this time with Brazil and other South American countries.

Background

These border closures mirrored the French border closure in that only unaccompanied freight was permitted into the UK. As this travel ban impacted included over 20 countries, it posed a significant threat to food supply.

Discussion

Although direct flights were prevented from arriving in the UK, the arrival of unaccompanied ships continued. Many of the food items imported from southern Africa and South America such as bananas and grapes travel unaccompanied on ships, so the travel bans did not disrupt their supply.

The risk to food supply was further reduced because food imports from both regions remain relatively low in comparison to Europe. The three biggest suppliers, Brazil, South Africa, and Argentina, only account for 1.7%, 1.6% and 1.5% of the UK's total food imports respectively.

Combining Defra's trade data with an understanding of how food imports are transported, the government was able to impose travel bans without impacting the UK's food supply. It is crucial that the government continues to gather up-to-date data in this area so that difficult decisions can be made efficiently and confidently.

Foreign-imposed border closures do not occur in a vacuum. Vulnerabilities that might normally be of minimal concern can be amplified in the context of a major incident. The French border closure occurred concurrently with two producers of a critical ingredient closing their UK production sites. In this instance, the supply of that ingredient was not severely disrupted but it is vital that the government tracks all such threats to the UK's food supply, through live monitoring of issues as well as engaging with various stakeholders.

The UK imposed border closure was not inconsequential, but the impact on food supply was small, and the impact on food security was virtually non-existent.

Trends

The UK has experienced an increased number of border closures due to the COVID-19 pandemic. Whilst it is difficult to predict future incidents of border closures, the food supply chain has illustrated its resilience in responding to such disruptions.

Indicator 3.1.7 Key inputs to the food supply chain resilience

Headline

Certain goods are critical to the functioning of the food supply chain. Although the supply of these goods is industry led, government monitors the supply of these key inputs and supports industry in developing plans and mitigations to ensure continuity of supply. Where necessary, government is able to make targeted interventions to maintain supplies.

Context & Rationale

Key inputs are those chemicals, ingredients and additives used in the production, supply, and storage of essential food items. Essential food items are products that are recommended for a nutritionally balanced diet in line with the Eatwell Guide (for example cheese, fresh meat, bread).[85]

Key inputs include all inputs from farm to fork, with products as diverse as fertilisers and chilled meats. In manufacturing, sodium hydroxide (NaOH) is a key input as it is a cleaning agent necessary for the safe and hygienic manufacturing of food. Other examples of key inputs include ammonium nitrate (fertiliser), ethylene glycol (refrigerant), wheat flour (ingredient), tinplate (packaging), potable water, and fresh fruit and vegetables (ingredient).

Key inputs in the food supply chain are diverse and interface with an array of different markets. The same input could have a myriad of uses within the industry and therefore be vulnerable to several shocks in the system. An example of this is carbon dioxide (CO2) which is produced, in one instance, as a by-product of ammonium nitrate and used in the meat and drinks manufacturing and packaging industries.

Therefore, contingency planning is essential to ensure that industry and the government are prepared to respond to different shocks to the system. In general, key inputs are resilient to the most common disruptions.

The significance of key inputs to the food supply chain was highlighted during the summer of 2018 when there was a shortage of CO2. This incident revealed that for the government to have a comprehensive understanding of the food supply chain, it was crucial to map hidden inputs like CO2. Since then, government has gained foresight into the vulnerabilities in the supply of key inputs. Yet the 2021 shortage of CO2 has demonstrated that disruptions to key inputs are still a genuine possibility.

The causes of disruption to key inputs are diverse. They include border or transport disruption, company closures, shortages of HGV drivers or shortages of products required to produce the key input.

---

[85] PHE, 'Eatwell Guide', https://www.gov.uk/government/publications/the-eatwell-guide.

A ‘perfect storm’ of incidents like this can seriously disrupt the supply of key inputs, so it is important that government maps and monitors them. The initial work undertaken following the CO_2 shortages in 2018, coupled with the work done when the UK left the EU, ensured that the government was in a good position to understand the potential vulnerabilities in the supply of key inputs into the food supply chain during the first wave of COVID-19.

Data and Assessment

The government plays an active role in engaging with the agri-food sector to develop industry-led mitigations. This includes providing advice on substitution and seeking alternative supplier routes to mitigate against shortages of key inputs. If disruption did occur, depending on the severity, and where industry mitigations were not possible (e.g., alternative supplier, substitution, reasonable production adjustment), the government would consider appropriate levers on a case-by-case basis and work with the relevant departments to alleviate the impact. This could include regulatory easements, laying legislation to relax food production or labelling regulations, competition law exclusions or prioritising critical products in freight transport into the UK.

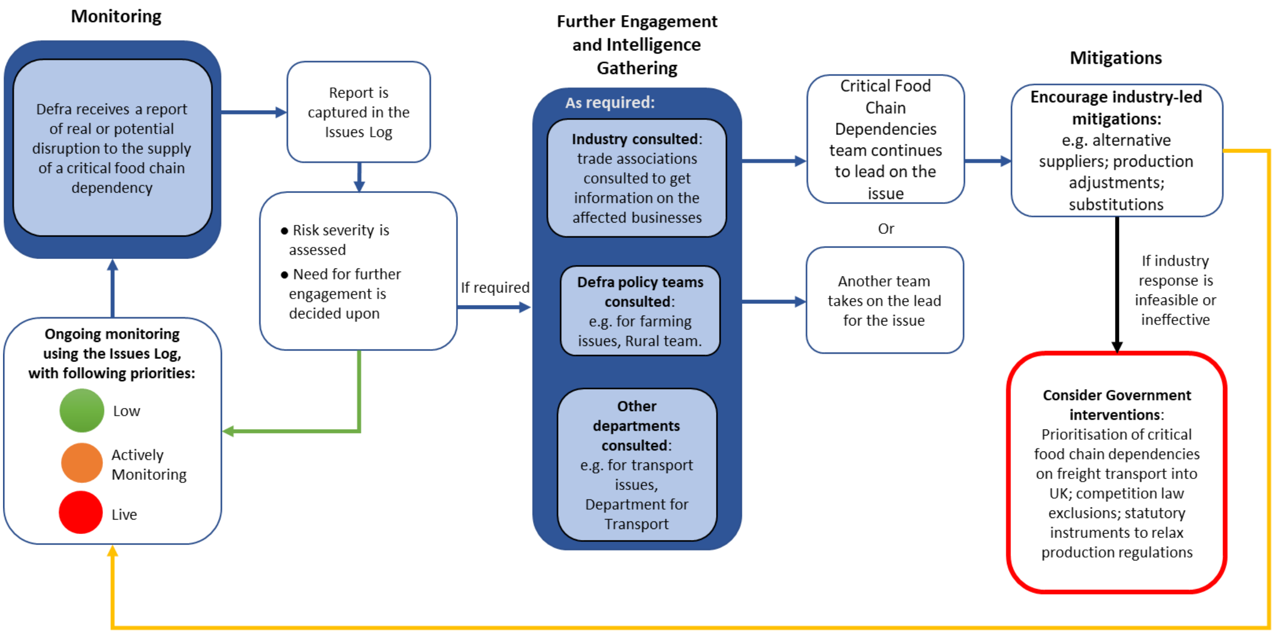
An example of these mitigations is Government Secured Freight Capacity (GSFC), a legacy mitigation that was put in place to reduce disruption in a no-deal scenario to ensure a smooth movement of key input goods (known as Category 1 or CAT1 goods) into the UK through reserved freight capacity.

Within Defra, some industries produce certain CAT1 goods. This includes the food sector which is dependent on key inputs such as raw materials, refrigerants and additives (for example thiamine used in flour fortification). This intervention was used to support the flow of key inputs into the food supply chain. On the date it was stood down in June 2021, GSFC had never been used during the period of live monitoring of disruption to key inputs into the food chain. This is a reflection of the work done by Defra to anticipate a possible disruption in January 2021. Additionally, Defra’s role within the Capacity Management Centre (CMC) – the operation centre that ran GSFC – was highly successful in managing and resolving any potential issues without needing further progress into GSFC.

The government, and in particular Defra, conducts research into key inputs into the food supply chain and actively monitors their supply. Intelligence on supply of key inputs is shared across government departments (for example BEIS and the Department for Health and Social Care (DHSC)) and with industry, especially during instances of increased potential for disruption. This collaboration is vital for ensuring government has a clear view of threats to the food supply chain.

Collaboration was particularly important in the context of EU Exit and the COVID-19 pandemic, which had the potential to place stress on the supply of key inputs as a result of consumer-driven demand shocks, border closures, absenteeism, and delays at ports. In addition, regular horizon scanning for signals of change which might impact the supply of key inputs in the medium-term and long-term is undertaken by government.

Figure 3.1.7a: How Defra monitors the supply of key inputs into the food chain



The aim of research into key inputs is two-pronged. Firstly, the research helps government understand the importance of any particular key input to the food supply chain. Secondly, it identifies vulnerabilities in the supply chain of each key input. The research is centred on five broad characteristics:

1. **Supplier** – including major supplying companies; major supplying countries.
2. **Transport** – including lorry type; ship type; accompanied vs. unaccompanied; driver qualifications required.
3. **Supply Chain** – including supply chain type; points of entry.
4. **Production** –including process automation; dependence on migrant labour.
5. **Food Technology** – including importance for essential food items; shelf life; stockpiles; substitutability.

The government also considers cross-sectoral demand for key inputs to aid prioritisation, as well as environmental questions such as the sustainability of their production.

Overall, such work continues to provide insight into food chain key inputs to understand their importance to the food supply chain and the vulnerabilities which might exist in their supply. This has afforded government a clearer, more detailed understanding of the food supply chain and has strengthened the capacity of Defra to plan for, and ultimately mitigate, potential threats to the UK's food supply. The response to the carbon dioxide shortage illustrated government's role in coordinating an industry response to a short-term supply issue.

The government's work in preparation for leaving the EU and during COVID-19 has helped to increase knowledge of the supply of key inputs into the food supply chain. Within this, government has developed clear mitigations aimed at supporting industry should there be disruption to a key input.

Case Study 3.5 Carbon Dioxide (CO2) Shortage 2018

Overview

In June 2018 the agri-food sector experienced a shortage of carbon dioxide (CO2) due to several concurrent factors.

Background

Carbon dioxide is used extensively in the food supply chain, including in supply, storage, as a stunning gas in slaughterhouses, in the packaging of perishable foods, the carbonation of soft and alcoholic beverages, the refrigeration of food, and the refining of sugar.

The factors contributing to the shortage of carbon dioxide included:

- CO2is a by-product of ammonium nitrate fertiliser production, so low fertiliser prices across Europe affected the commercial viability of CO2 production.
- Several UK and EU manufacturers capitalised on the opportunity to shut plants for maintenance works.
- This coincided with high summer temperatures which created problems at some plants, made liquefying CO2 more difficult, and led to unforeseen failures in restarting plants.
- High temperatures and the 2018 FIFA World Cup also raised demand for carbonated beverages. With low CO2 stocks, tight supply in continental Europe, and restrictions on sources of supply, many UK suppliers and manufacturers defaulted on contracts to supply CO2.

The response was led by industry and supported by the UK government.

Discussion:

The Food Chain Emergency Liaison Group (FCELG) was used as a forum for obtaining a detailed view of the UK and European situation, exploring industry use of carbon dioxide and its alternatives, as well as for industry-supplier discussions. Government maintained awareness of emerging concerns and issues for the food and farming sectors, and concerns about their CO2 stock levels. Through established industry liaison, government understood that industry was assessing the viability of electric stunning and exploring alternatives to CO2in packaging.

The pig and poultry sectors were identified as particularly vulnerable to interrupted CO2 supply due to its use for stunning before slaughter. The Food Standards Agency (FSA) worked to establish practical steps to keep abattoirs running.

Measures were quickly implemented such as the authorisation by the FSA of electric stun facilities and the use of CO2alternatives at key sites. Staff working hours at plants were extended where required and a risk assessment was issued to businesses with technical advice on CO2 and gas substitutes for packaging.

Defra also shared intelligence with key government departments, including BEIS and the Cabinet Office (CO), in order to maintain an overview of the UK's available CO2 supply.

Although some product lines were impacted by the shortages, the government's close relationship with industry, alongside collaborative intel sharing across government, ensured that no serious food supply issues occurred.

The incident brought to light the vulnerabilities in the supply of CO2. This encouraged industry to put in place mitigations, such as increased storage capacity, and also motivated government to conduct research into the supply chain of CO2, and subsequently many other key inputs into the food chain.

Trends

There is a risk of disruption and government will continue to monitor the key inputs into the food supply chain and, where required, work with industry in cases of disruption.

Indicator 3.1.8 Consumer behaviour

Headline

Consumer behaviour can cause sudden demand shocks. During recent disruption caused by the COVID-19 pandemic, industry proved effective in responding to increased demand, with government taking a supporting role. Consumer behaviour was characterised by a moderate increase in the amount of food purchased and in the number of shop visits made, rather than indiscriminate ‘panic buying’. Consumer behaviour was characterised by a moderate increase in the amount of food purchased and in the number of shop visits made, rather than indiscriminate ‘panic buying’.

Context and rationale

Consumer purchasing behaviours are the actions taken by consumers to purchase food, drink, and groceries. Consumer purchasing behaviours are complex and widely studied.[86] Most purchasing decisions are habitual and are reliant on unconscious biases, rules of thumb, and social and cultural norms. A range of factors can shape what consumers choose to buy, and how often, such as:

- shopping priorities such as price or convenience
- personal and household taste/preferences
- advertisement and marketing
- availability
- public messaging
- food concerns such as safety issues
- values such as concern for animal welfare or sustainability

Stockpiling

The decision to stockpile food is an adaptation made by consumers when there is an anticipation that there will be disruption in food supply, a food shortage, or price increases. If this is perceived to be a likely event, then these may be rational behaviours for the individual, especially for consumers concerned with affordability or people with limited access to food shops.

In response to perceived risk to supply consumers can exhibit a range of stockpiling purchasing behaviours. These can range from considered purchasing, whereby consumers add a little more to their baskets, through to bulk buying, where consumers buy significantly more than they would of one item or more in either one or multiple trips, to more extreme behaviours such as looting. These can range from considered purchasing, whereby consumers add a little more to their baskets, through to bulk buying, where consumers buy significantly more than they would usually, to more extreme behaviours such as looting.

[86] d'Angelo and others, [redacted]

For the purposes of this report, stockpiling behaviour is defined as when individuals build up a reserve stock of goods over a period of time to mitigate against the loss of not having that product at a later date.

An individual’s assessment of whether a risk to food supply is credible is based on the information available to them. This information can take many forms, such as an official government response, media or news content, and also public discourse (such as social media discussion) and the behaviour of others. Depending on the perceived severity of the risk, consumer adaptation strategies sit on a spectrum from normal purchasing behaviour through to stockpiling, then to the more extreme behaviours of panic buying and looting.

Having (access to) more information does not necessarily always lead to a return of normal shopping behaviours. Any additional information, particularly sensationalist coverage on traditional and social media, can risk increasing the visibility of the issue, making it more plausible, thus creating an increased perception of risk and feeding into the overall stockpiling cycle.

Industry is effective in responding to fluctuations in demand including planned (such as Christmas and Easter) and unplanned events (for example, people stockpiling bread and milk during bad weather events). More severe shortages due to sustained consumer demand shocks or ‘buying’ may require additional interventions by industry, such as item purchasing limits, with government playing a supportive role. More severe shortages, due to sustained consumer demand shocks or ‘panic buying’, may require additional interventions by industry, such as item purchasing limits, with government playing a supportive role.

Demand spikes can exacerbate shortages of products and increase the pressure on supply chains, making it more challenging to manage stock through supply. Changes in consumer behaviour can cause potential impacts such as product shortages. Even incremental shifts in food purchasing behaviours at the population level can have significant impacts on just-in-time supply chains.

Data and Assessment

Behaviours driving purchasing spikes in a crisis are often reported in the media as irrational responses to perceived supply disruption. However, evidence suggests that the majority of consumer behaviour observed during March and April 2020 was not indiscriminate ‘panic buying’ to bulk buy goods, but a more moderate increase in purchasing in response to perceived supply uncertainty.

The cumulative effect of these small changes in shopping behaviours can play a significant role in disrupting just-in-time supply chains which are finely tuned to ‘normal’ consumer purchasing patterns. This disruption led to availability and supply issues which presented as empty shelves or reduced product range in shops. This was picked up by conventional and social media. Headlines about empty shelves further exacerbated consumer uncertainty and fed into the perception of shortages, which likely led to consumers continuing to purchase more than they normally would. There is a risk of headlines creating a real demand issue from a perceived one.

The strength and speed of this episode was unprecedented. Future (potential) episodes would likely benefit from more effective and earlier coordination with industry, to enable more impactful joined up communications. Response to potential future episodes would benefit from more effective and earlier coordination with industry, to enable more impactful joined up communications. Industry reported that the logistical interventions government made at speed were helpful and would likely need to be enacted again in a similar situation. Increases in purchasing during the COVID-19 pandemic have been the only food related demand shock observed in recent years, although other demand spikes have been observed such as fuel in the autumn of 2020. Future purchasing spikes are likely to be caused by shocks in the food supply chain, but there is the potential for media coverage or rumour to cause demand shocks without any actual supply issue. This is likely to be exacerbated if consumer confidence in the supply chain is low. Both government and industry worked collaboratively in response to consumer behaviour during COVID-19 and are well placed to respond to any future disruptions.

Case Study 3.6 Consumer behaviour in the 2020 lockdown

Overview

The COVID-19 pandemic resulted in a series of sudden changes in consumer purchasing behaviours with two clear phases, effectively separated by the imposition of the hard lockdown on 23 March 2020:

- **Pre-Lockdown:** Starting in late February a fast-rising sense of urgency to secure hygiene supplies swiftly followed by demand for food and other consumables to last a period of potential disruption to supply.
- **Post-Lockdown:** a focus on securing household needs safely, observing and adapting to social distancing measures in a much more closely controlled retail environment.

In both phases a key shopper priority was to establish and maintain a higher level of household resilience than normal. These shopping changes had several significant impacts within the food and consumer goods industry over the spring and early summer of 2020.

Background

COVID-19 tested the UK food supply system perhaps more than any other time in over 70 years. Businesses across the food supply chain had to adjust rapidly to greatly increased consumer demand as the nation came to terms with national lockdown and the closure of businesses, schools, and the hospitality sector. Businesses across the food supply chain had to adjust rapidly to greatly increased consumer demand as the UK came to terms with national lockdown and the closure of businesses, schools, and the hospitality sector. As a result, people were spending more time at home and eating out less.

However, despite a challenging start, the food industry showed its resilience as it continued to function throughout and provide an essential service.

COVID-19 changed lifestyles, as it altered the frequency, volume and the way people bought their food. Understanding how behavioural changes impacted food availability will help government and industry better respond to a future crisis.

Discussion

What was the problem?

Increases in COVID-19 cases and a general expectation that the government would impose some limitations on movements and socialising, and close schools created a degree of uncertainty amongst consumers as to how they may be able acquire food in the short-term. This uncertainty was compounded by events in other countries which were reporting that consumers were stockpiling food drinks and household goods. To mitigate the perceived risk of being unable to acquire food due to lockdown restrictions, quarantine measures, or the stockpiling behaviours of others, UK consumers rationally increased purchasing.

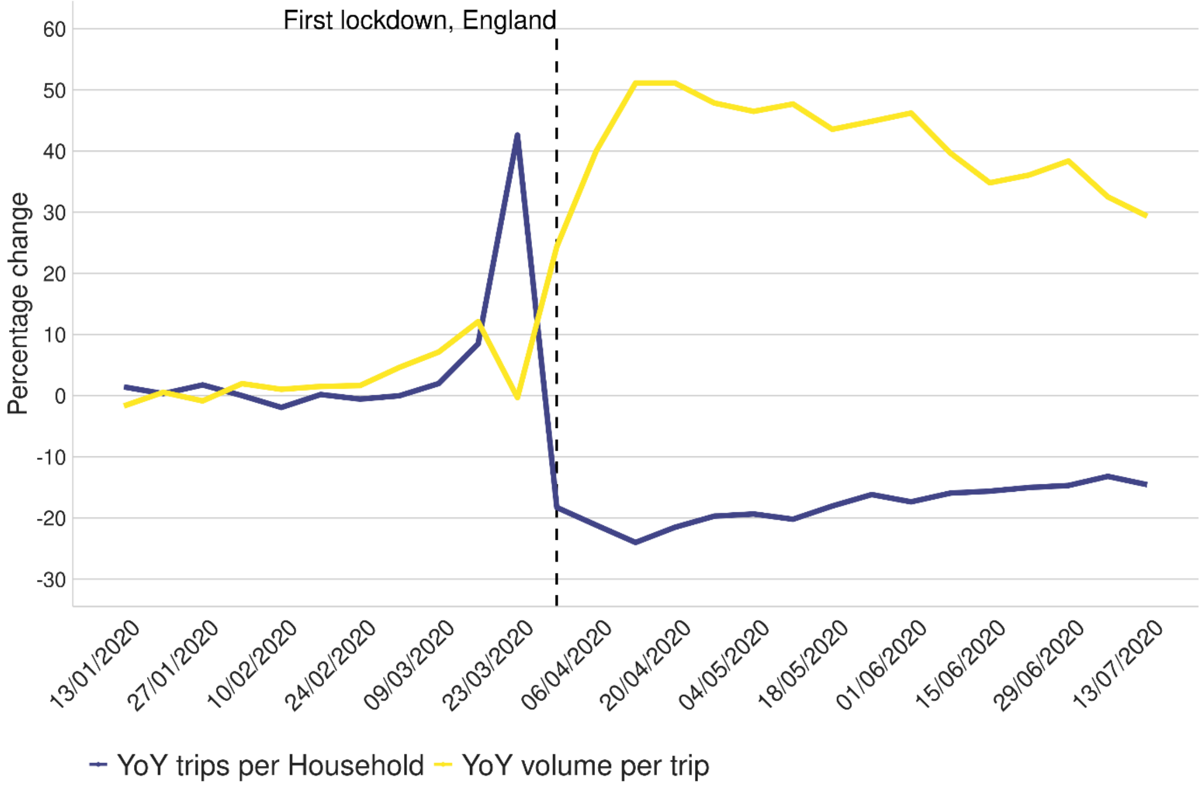
What was the scale of the challenge?

Immediately prior to the implementation of a nationwide lockdown on 23 March 2020 there was a substantive increase in the volume of food purchased compared to the same week in 2019.

This increase was seen in three main ways;

1) From mid-February there was a slight increase in the amount of food consumers were purchasing every time they visited the shops
2) An increase in the frequency of trips consumers were making to the shops
3) A slight increase in the range of products going into consumer baskets, particularly long-life products, and staples. This reflected the fact that consumers were spending more time eating at home.

Figure 3.6a: Consumer purchasing behaviours pre and post lockdown (Kantar, Worldpanel FMCG, England, Wales, and Scotland): percentage change in year on year trips per household and year on year purchased volume per trip. Further information on the methodology can be found in the appendix.



Bulk buyers (for example people buying substantially more than they would normally do in a single trip) were actually in the minority. Data on consumer purchasing patterns did not reflect the media narrative of consumers engaging in indiscriminate ‘panic buying’. To some degree consumers exhibited a rational increase in visits to the shop to acquire the food and drink products they wanted in the face of uncertain circumstances. When this incremental purchasing behaviour was replicated at the population level it created an unprecedented surge in demand over a short period of time which led to product availability issues**.**

When lockdown began, consumer purchasing behaviours underwent a dramatic transformation (see figure 3.1.8a). The number of shopping trips per week fell while the amount of food purchased per trip increased. This behaviour was likely due to consumers minimising time spent in shops. Retailers just-in-time supply chains struggled initially to replenish the goods on shelves in the face of this sudden shift in consumer purchasing behaviours.

What actions were taken to resolve the issue?

Supply chains were able to adapt to the changes in consumer purchasing patterns swiftly and availability of products largely recovered by June. There were longer term availability issues with some specific items, such as flour and eggs which were key ingredients in the large increase in home baking which occurred during the lockdown in March to June 2020.

Many of the measures implemented to mitigate impacts of accelerated consumer purchases did not require direct government intervention. Retailers implemented item limits on specific items to stabilise supply and removed a large proportion of promotions including multi-buy offers and quantity discounts.

Retailers suggested that the relaxation of elements of competition law enabled them to coordinate on setting item limits and store opening hours. Additionally, government interventions to allow for additional supplies to be delivered outside of normal delivery hours helped with the push to fill shelves, such as relaxing planning rules for night-time store deliveries and driver hour limits.

Close and frequent communication between retailers, supply chain businesses and government was critical in ensuring these interventions were implemented effectively. The UK governments have multiple forums for engagement with the food retail sector and these were employed throughout the disruption.

It is not clear from evidence which factors and mitigating actions were most significant in ending the demand shock. The pandemic caused a general trend towards fewer, larger shopping trips. Supermarkets were able to readjust to ensure supply was stabilised through government-supported mitigations and setting item limits in place, which may have renewed consumer confidence. It may also be that consumers who had filled their cupboards felt less at risk and returned to their previous purchasing habits.

Trends

Increases in purchasing during the COVID-19 pandemic have been the only food related demand shock in recent years, although demand spikes have been observed such as fuel in the autumn of 2020. Future purchasing spikes are likely to be caused by shocks in the food supply chain, but there is the potential for media coverage or rumour to cause demand shocks without any actual supply issue. This is likely to be exacerbated if consumer confidence in the supply chain is low. Both government and industry worked collaboratively in response to consumer behaviour during COVID-19 and are well placed to respond to any future disruptions.

Indicator 3.1.9 Labour and skills dependency

Headline

The food supply chain is dependent on a large workforce and specific labour skills. There are challenges securing sufficient labour and skill levels across the agri-food chain, which pose a threat to resilience.

Context and rationale

The agri-food workforce employs 4.1 million people, covering 13% of Great Britain's employment[87] and is critical to the resilience of the UK food sector. The continuity of food supply is dependent upon securing sufficient labour levels and the skills necessary to carry out specialised tasks. This is true for all levels of the food supply chain, from farming production and processing, manufacturing, logistics and retail, right through to transportation of goods. The food supply chain is also reliant upon sufficient labour levels and skills in those sectors upon which it depends, such as energy and transport. Government holds limited quantitative data for labour on a subsector-by-subsector basis. This section includes employment data and supportive qualitative evidence.

The types of roles across the agri-food sector are vast. They include skilled and highly skilled roles – including for example engineers, butchers, supervisors, auditors and veterinary nurses.[88] The increasing use of digitisation, robotics and automation requires highly qualified staff to maintain and operate such technologies. The specialised skills required for these roles, which often require degrees and postgraduate qualifications, can make recruitment of staff more difficult.

The agri-food sector is also highly reliant upon roles classified as 'low-skilled'. These roles are often labour intensive and common in the agriculture and hospitality sectors.

A key feature of labour within the agri-food chain is the reliance on migrant labour from both EU and non-EU countries. It is estimated that the number of non-UK

---

[87] Defra, 'Food statistics in your pocket' (2020), https://www.gov.uk/government/statistics/food-statistics-pocketbook/food-statistics-in-your-pocket-summary.
[88] UKVA, 'Skilled worker visa: eligible occupations and codes' (2021), https://www.gov.uk/government/publications/skilled-worker-visa-eligible-occupations/skilled-worker-visa-eligible-occupations-and-codes.

nationals working in the UK is approximately 3.7 million, with approximately 1.5 million non-EU nationals working in the UK.[89]

There are both short-term and longer-term challenges in recruiting across the agri-food sector, which has faced difficulty in securing sufficient labour in recent years. The COVID-19 pandemic caused a shock in the supply chain. The impact of COVID-19 infection rates and requirements for people to self-isolate led to elevated absence rates across the food industry and other interdependent sectors at various points since the start of the pandemic. COVID-19 has also presented logistical challenges for foreign nationals wishing to work in the UK.

At the same time, the introduction of the new points-based immigration system at the end of the transition period has meant it is more difficult for sectors to recruit workers from overseas. Under the points-based immigration system there is no general route for low-skilled workers to enter the UK on a working visa. This has presented challenges in securing labour for parts for the agricultural sector, which in recent history has relied upon EU labour to fill low skilled roles, for example in the meat processing and fruit and vegetable sectors.

A key labour mitigation is the Seasonal Workers Pilot. The Pilot opened in 2019 and is designed to test the effectiveness of the immigration system at supporting UK growers during peak production periods, whilst maintaining robust immigration control. The Pilot also provides a valuable source of labour for the fruit and vegetable growers of the UK, helping to ensure the food security of the country.

The Seasonal Workers Pilot operates in the edible horticulture sector, to support farmers growing UK fruit and vegetables. This is the sector of agriculture which has the highest dependency on seasonal labour and ensures food supply chains in the UK are maintained. Of those granted a Seasonal Worker visa in the year ending September 2021, 18,019 or 73% were Ukrainian nationals. Eastern European nationalities make up most grants in the Seasonal Worker visa, with the next highest grants being to Russian (1,862, 8%), Belarusian (853, 3%) and Moldovan (706, 3%).

Some sectors also have longstanding challenges in securing the appropriate labour levels and acquiring the right skills for their sector. This can include negative perceptions of roles within the agri-food sector. For example, the farming sector roles can be physically demanding and often in rural locations which may limit the labour available. Further, the Food and Drink Federation has estimated over the next ten years, 25% of the food and drink manufacturing workforce is due to retire, with up to a third of the workforce set to reach retirement age by 2033 to

[89] ONS, 'Labour Force Survey' (2021) https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/august2021.

2035.[90] Similar recruitment and retention problems are experienced in roles such as heavy goods vehicle drivers and warehouse operatives in distribution centres. For example, an estimated 268,000 people were employed as HGV drivers between July 2020 and June 2021. This is 39,000 fewer than the year ending June 2019, and 53,000 fewer than the peak of 321,000 HGV drivers during the year ending June 2017.[91] Further, some roles are highly skilled and therefore the number of individuals available to fill specific roles may be limited. This is particularly the case for dairy and meat sectors and areas where specialist engineers and technicians are required.

The impacts of labour and skills shortages will vary between each sub-sector and business type in the food supply chain. Larger companies may have more flexibility to manage higher absence rates due to their ability to move staff around, whereas small and medium-sized enterprises (SMEs) may have limited capacity to develop contingency plans for sudden increases in absence rates. The 'just-in-time' nature of the supply chain may also add additional strain when quickly adapting to smaller workforces.

Defra relies on a collaborative relationship with industry to effectively respond to disruption. In particular, government is dependent on information from industry which allows it to develop an overall assessment of the implications 'on the ground'. This in turn informs the industry response as well as a proportionate and effective cross-government response.

Data and Assessment

Figure 3.1.9a: Agri-food sector employees and self-employed farmers 2020 (millions, percentage).

Indicator: – Employment levels of people in agri-food sector over time

Source: – Agriculture in the UK 2021 (AUK)

---

90 Food and Drink Sector Council, 'Preparing for a changing workforce: a drink and supply chain approach to skills', (2019), [redacted]

91 ONS, 'Fall in HGV drivers largest among middle-aged workers' (2021), https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/fallinhgvdriverslargestamongmiddleagedworkers/2021-10-19.

Figure 3.1.9a: Agri-food sector employees and self-employed farmers 2020 (millions, percentage).

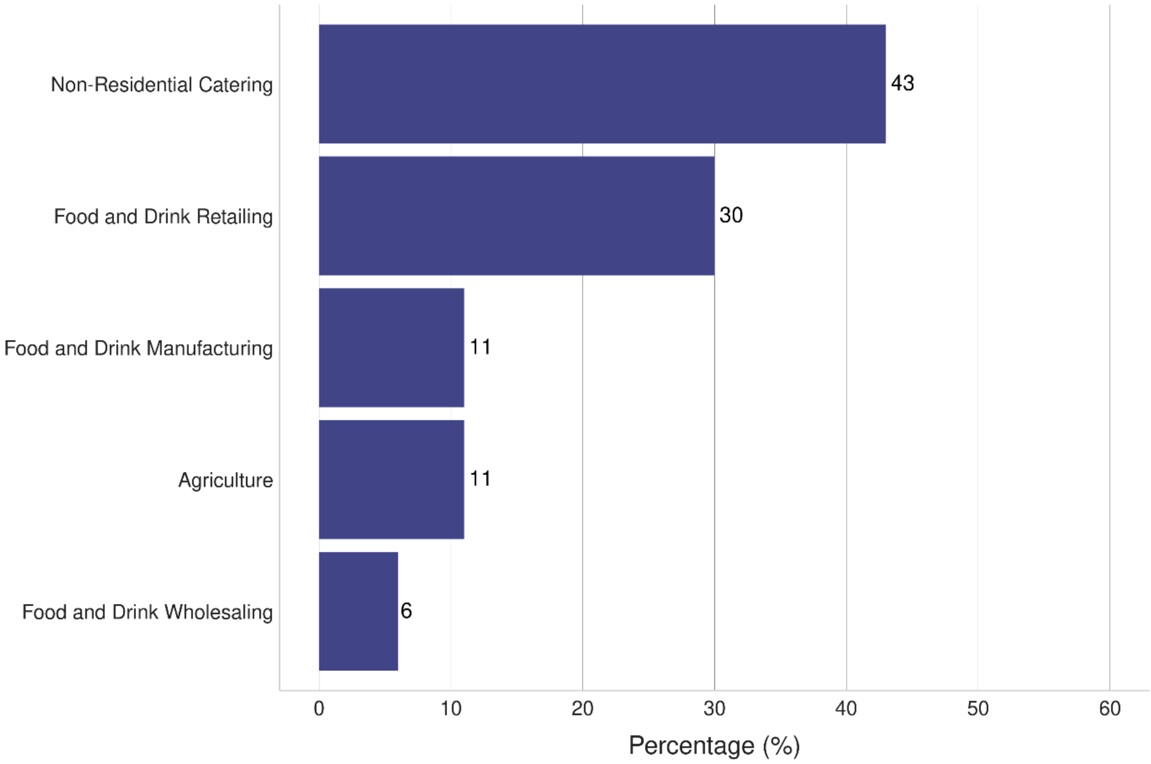
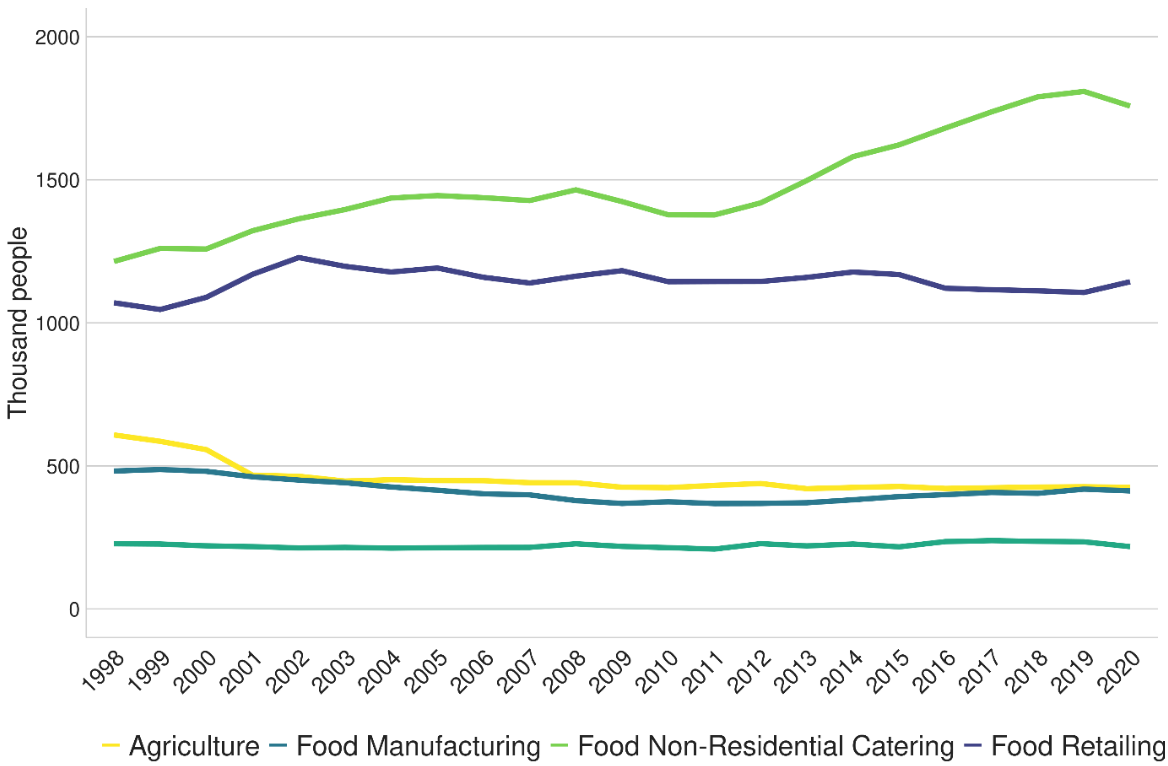


Figure 3.1.9b: Agri-food sector employees and self-employed farmers over time (thousands).



The agri-food sector is one of the most significant employers in the UK. In the fourth quarter of 2020, the agri-food sector employed 4 million people, or 13% of all employees in Great Britain.[92]

In the twelve months to December 2020, employment in the agri-food sector decreased by 1.0%. Employment in 2020 fell in wholesaling (7.1%), non-residential catering (2.8%), manufacturing (1.4%), and agriculture (0.6%). Employment in 2020 rose only in retailing, by 3.4%. Employment across the whole economy decreased by 1.0% over the same period. The COVID-19 pandemic clearly meant that this was an unusual time, and the partial closure of the hospitality sector (with knock on impacts for wholesale and retail) for periods during this year probably accounts for these figures.

Over a longer period, employment in the agri-food sector has risen 9.7% since 2000. Changes in each of the sectors since that time show that employment in agriculture, manufacturing and wholesaling reduced by 24%, 14% and 1.2% respectively, while non-residential catering and retailing increased by 40% and 5% respectively.

In recent years the agri-food sector has been highly reliant on labour from abroad for specific tasks. For example, Defra estimates that up until the last two years 99% of seasonal workers in the horticultural sector came from outside the UK each season. In the short term, there have been challenges in securing sufficient labour levels and the necessary skills since the start of the COVID-19 pandemic. This is due to high levels of staff absenteeism from COVID-19 infection and the requirement to self-isolate. There remain longer term challenges in recruiting for vacancies in specific sectors in both high and low skilled roles.

The impacts of labour and skills shortages will vary between each sub-sector. However, it is unlikely that there would ever be an overall shortage of food due to a lack of labour levels and skills. In exceptional circumstances in times of reduced capacity this could result in reduced supply availability and choice of some agri-food products, in particular fresh produce. Further, any impacts to one sector could provide knock-on implications to other parts of the food supply chain.

Although the risks associated with labour and skills shortages can add additional strain, the agri-food sector is experienced in responding to disruptions within the food supply chain.

---

[92] Defra, [redacted]', p. 17.

Trends

Employment numbers across the agri-food sector have remained stable for over 20 years. The non-residential catering sector saw a gradual increase in years leading up to 2019. The data in this report does not cover 2021 and therefore it cannot account for any further changes in employment rates due to the COVID-19 pandemic.

Indicator 3.2.1 Cyber threat in the food supply chain

Headline

The threat of cyber-attack to UK businesses, including those in the agri-food sector, is significant and growing. A cyber-attack can affect any part of the food supply chain and other sectors which the food sector depends upon.

Context and Rationale

The risk of cyber-attack to UK businesses is significant and continues to grow. It presents a threat to Critical National Infrastructure (CNI) sectors, which includes food and broader areas which the food supply chain depends upon, such as energy, transport, and water. The nature of cyber-attacks means that they are varied and that attackers can adapt their approaches to their targets. It can range from high volume, opportunistic attacks where technical expertise is bought, not learned, to highly sophisticated and persistent threats involving bespoke malware designed to compromise specific targets.[93]

As with any other industry sectors, agri-food businesses are vulnerable to cyber-attacks. Potential scenarios which could be experienced by UK businesses include:

- Espionage: Infiltrating organisations' corporate and financial systems with the intention of learning and pre-positioning for future attacks.
- Hacktivist attacks: Company website defacement, or forcing a website offline through a distributed denial of service (DDOS) attack, which could cause reputational damage.
- Ransomware: Attacks via 'ransomware' where data is made inaccessible to the victim, or systems made inoperable, until a ransom is paid.

---

[93] NCSC, 'The Cyber Threat to UK Business', 2017. https://www.ncsc.gov.uk/report/cyber-threat-uk-business

- Phishing: the theft of personal data (staff and/or consumers), corporate data and/or intellectual property or trick staff into making erroneous decisions (for example visiting websites that host malware) and financial transactions (such as sending money to hoax suppliers).
- Other criminality: Attacks on manufacturing plants and industrial control systems.
- Insider Threat: A motivated insider with requisite knowledge of cyber systems could increase the likelihood of a successful cyber-attack. A cyber incident could also result from a lack of employee cyber education or due diligence in following safe procedures.

The specific risks and probable impact associated with cyber-attack varies for different actors within the food supply chain. However, there are specific behaviours which can increase a business's vulnerability to cyber-attack. These include, but are not limited to, weak overall internet or IT security measures, poor password policies, failure to keep software up to date, poor system monitoring, and inadequate access controls. These lack of security measures considerably increase the risk of a cyber-attack taking place.

The overall impact to food supply would depend upon the nature of the cyber-attack and its location within the agri-food chain or other relevant sectors such as energy, transport, or water. The impact could influence the production capability of individual businesses, though it is unlikely to affect the overall food supply chain. For example, any impact to computer systems for logistics businesses could cause some disruption, but its impacts would be limited due to the diversity of logistical companies in the UK.

The National Cyber Security Centre (NCSC) is the UK government's technical authority for cyber security in the UK. It takes a leading role in providing guidance and advice on cyber security for UK organisations. Responsibility for mitigating the risk of cyber-attack rests with industry. Defra and the NCSC work with industry and trade bodies to promote proportionate cyber security measures.

The NCSC produces extensive guidance documents to help mitigate against the risk of cyber-attacks. The NCSC website has a list of 46 different topics related to cyber-security, from ransomware passwords best practice to remote working. All these articles can be found on their website. More broadly, Defra and the FSA jointly sponsor publicly available guidance aimed to build resilience from cyber-attack in agri-food businesses. This guidance is known as PAS 96.

Case Study 3.7 Cyber threat to USA meat company

Overview

In June 2021 the world's largest meat packer, José Batista Sobrinh (JBS), experienced a ransomware attack, with servers affected in North America and Australia. The breach forced the company to pause operations at the majority of its meat plants in the USA, causing concerns about potential meat shortages and animal welfare issues.

Background

JBS has more than 150 plants in 15 countries, employing over 150,000 employees worldwide. Its customers include supermarkets and fast-food chains such as McDonalds.

A ransomware attack is when attackers breach a victim's network and encrypt it. Data is almost always stolen prior to encryption. The attackers then offer to decrypt the victim's network in return for a ransom payment, and threaten to leak the stolen data on the dark web if no payment is made.

Discussion

On 30 May 2021, JBS USA's IT systems were infected by a sophisticated ransomware attack, and the company suspended all affected IT systems as a result. IT systems are essential in modern meat processing plants as they are used extensively throughout the production process. The company believed this ransomware attack, the largest known attack on a food manufacturer, originated from a criminal gang.

This breach forced the company to suspend operations at nearly all its plants in the USA, as the plants were unable to complete even basic tasks, like weighing poultry, sharpening knives, and clocking in employees. The breach also affected the company's operations in Australia, though on a smaller scale.

Although the company did eventually restore its operations back to full capacity on 8 June 2021 (10 days of disruption) through the help of the authorities and third-party experts, they still paid a ransom of £7.8m via Bitcoin to the attackers to decrypt their network and in response to threats to leak the data. Paying the ransom relied on the promises of criminals, and gave no guarantee that the attackers would not leak the data or attack again in future.

Although the attack did not have any noticeable impact on food security in the USA or the UK, this case study has been highlighted to show the potential risks cyber threats can pose food manufactures in the future.

In a sector which is increasingly becoming more dependent on technology, it is difficult to be immune to cyber-attack, but companies can put measures in place to reduce the risk and limit damage once it does occur. The NCSC has produced a number of guidance documents for businesses to plan ahead for future potential attacks. They have listed some recommended standards which companies can voluntarily adopt.

At the time of writing there have been no major cyber-attacks on a UK based food manufacturer. This could reflect the highly resilient nature of the food supply chain as 66% of all businesses have a formalised incident response process. In the event of minor attacks 89% of UK food businesses managed to restore operations within 24 hours.

Assessment

The risk of a cyber-attack is not limited specifically to the food industry, and cyber-attacks on other businesses can cause indirect disruption to individual food businesses. For example, in July 2021 a ransomware attack on the US IT firm Kaseya caused Swedish Coop supermarkets to close (NCSC, 2021). To date there have been no serious incidents in which a cyber-attack on a food business has created widespread disruption to the UK food supply chain.

Defra, the FSA, and the NCSC have been working with major food businesses to promote awareness of sensible and proportionate cyber security measures throughout supply chains including SMEs.

Trends

The threat of cybercrime is growing with attacks becoming increasingly sophisticated. It is essential that industry takes the precautions necessary to help respond to future cyber-attacks and understands the implications should a cyber-attack happen in another sector upon which they rely.

Indicator 3.2.2 Diversity of food retailers

Headline

The size and diversity of the food retail sector provides resilience. If an individual company fails, others can maintain the UK's food supply. No one company has overwhelming market share, although the majority of food retail is concentrated in a small number of supermarket companies. The resilience of the sector was illustrated during the COVID-19 response.

Context and Rationale

Diversity is essential to security, not only in terms of trade in agri-food commodities, but also within the domestic supply chain, which consists of retailers, food manufacturers, wholesalers, and food service operations. High concentrations in specific parts of the food chain may make the chain more vulnerable to temporary supply shortages, which could be exacerbated by increased consumer purchasing. If one major supply chain or company were to fail, for example due to economic failure, cyber-attack, or power failure, there could be a significant impact on availability and access of food, if other chains were not able to help to fill the gap. In the UK, this is an unlikely scenario due to the size and diversity of the agri-food sector, which gives flexibility in case any one sector or company should fail. The greatest risk is in the retail sector, where the five biggest retailers have 60% of market share between them. If one closed, there would be short-term disruption and an additional burden on the supply chains of the other four. This indicator considers the market share of retailers in the UK.

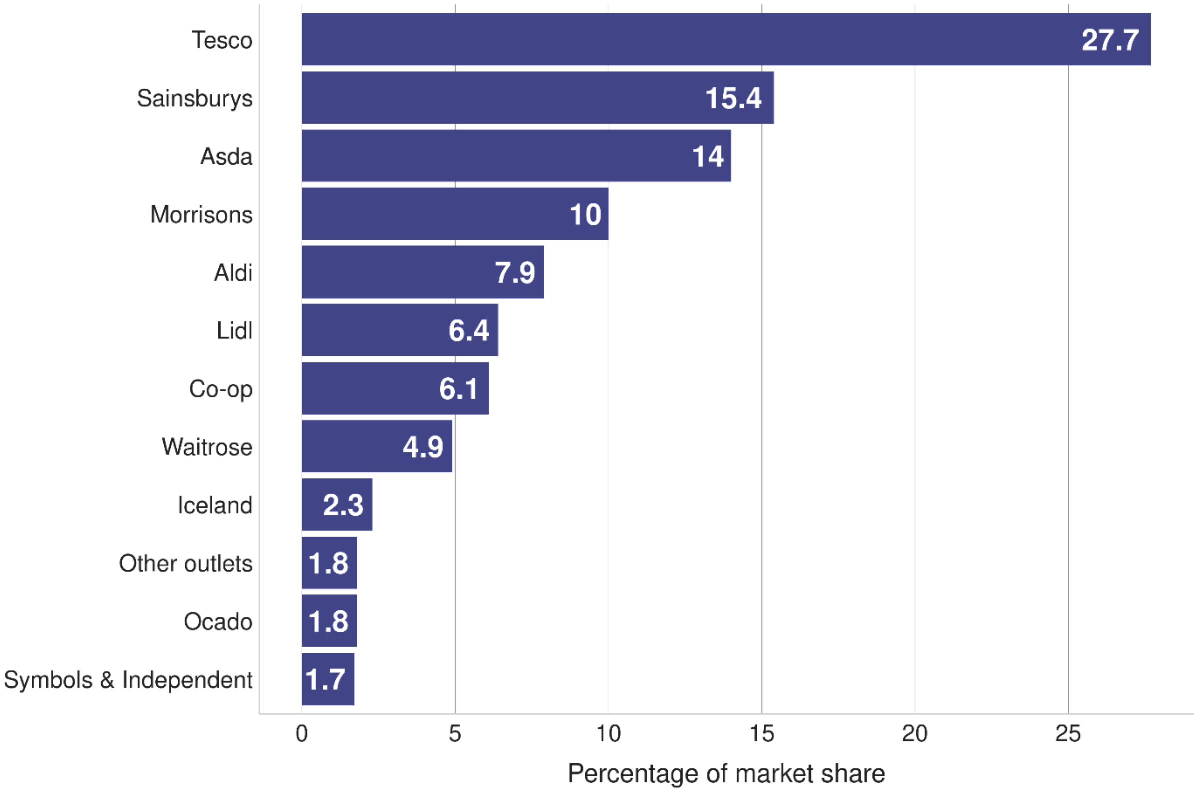
Data and Assessment

Indicator: Diversity within the food industry

Source: Kantar[94]

[94] Kantar, 'Grocery Market Share', [redacted]

Figure 3.2.2a: Food and drink retailer market share, Great Britain (12 weeks ending 31 October 2021).



The fact that the UK has several large retail and wholesaling operations suggests a reasonable balance between economies of scale and diversity. Larger companies can enhance resilience in the supply chain through having greater resources and infrastructure to respond flexibly to shocks in the food supply chain. However, small and medium size enterprises, through their adaptability and flexibility, to the diversity of supply and consumer choice.

Trends

The combined market share of food and non-alcoholic drinks of the largest four food and drink retailers accounted for about two thirds of the overall market in 2021. Tesco commanded the largest market share at just over a quarter. The most marked trend in the retail landscape since 2011 has been the rise of the ‘discounters’, notably Aldi and Lidl, whose market share has increased from around 2% each in 2011 to around 8% and 6% respectively. This has generally been at the cost of the biggest four retailers. The COVID-19 pandemic had an immediate and marked effect on internet sales: in the 12 months to March 2020 internet sales of food accounted for around 5% of all retailing on average, in the following 12 months to March 2021 this was 11%. It is not clear that this is a permanent shift but as of October 2021 this proportion has shown no signs of moving back to pre-pandemic levels.[95]

Indicator 3.2.3 Economic resilience in the food supply chain

Headline

The wholesale sector experienced significant financial pressure due to the closure of the hospitality and public sector food sectors during the COVID-19 pandemic. However, despite these pressures the wholesale sector maintained financial viability and food supply was not compromised.

Context and rationale

The size and diversity of the food supply chain allows flexibility when an agri-food business fails, as identified in **Indicator 3.2.2**. The COVID-19 pandemic placed increased pressures on all parts of the food supply chain. This included some sectors experiencing complete or partial closures, such as those in hospitality and in public sector food. These closures also had knock-on economic impacts for other parts of the food supply chain, including the wholesale sector. The closure of the hospitality sector due to COVID-19 and other lockdown impacts resulted in financial distress across significant parts of the wholesale sector. Due to commercial sensitivity quantitative statistics are unavailable for this indicator. A case study is therefore included which outlines the financial threats faced by the wholesale sector due to partial or full closure of the hospitality and public sector food sectors during the COVID-19 pandemic.

Case study: COVID-19 impacts upon Wholesale Sector

Source: Defra

---

[95] ONS, 'Online Retail', https://www.ons.gov.uk/businessindustryandtrade/retailindustry/bulletins/retailsales/october2021#online-retail.

Case Study 3.8 COVID-19 impacts upon the Wholesale sector

Overview

Retail wholesalers provide stock to retail customers such as convenience stores. Foodservice wholesalers supply customers, such as caterers, restaurants, hotels, and schools. Retail wholesalers maintained stable demand throughout the pandemic.

Public sector food contracts are fulfilled primarily by foodservice wholesalers. The closure of the hospitality sector due to COVID-19 and other lockdown impacts resulted in financial distress across significant parts of the foodservice wholesale sector.

While wholesalers were eligible for some limited non-sector specific support, they did not benefit to the same extent as the hospitality sector they support.

Despite this financial distress, the food service wholesale sector continued to service public sector food contracts, ensuring people in schools, care homes, nursing homes, prisons, and hospitals continued to be fed throughout the COVID-19 response.

Background

Food and drink wholesalers act as intermediaries throughout the food supply chain, with foodservice wholesalers serving both private hospitality contracts and public sector food contracts. The foodservice wholesale sector operates on low profit margins, and the national lockdown in spring 2020 led to a drop of 40% in food service orders without corresponding reductions in businesses' fixed costs. The foodservice wholesale market is dominated by five firms, which account for around 80% of industry revenues; public sector food is most reliant on larger suppliers, for whom hospitality typically makes up a large proportion of revenue.

Discussion

The cumulative impact of COVID-19 measures resulted in financial distress for foodservice wholesalers who supply public sector food. Impact on provision of food to the public sector posed a food supply challenge for significant and also highly vulnerable parts of the population.

Throughout the pandemic, Defra officials worked closely with the wholesale industry via the Federation of Wholesale Distributers, a dedicated Task and Finish Group, extensive bilateral engagement, and a monthly Defra Wholesale survey. This allowed Defra to assess the scale of the problem and monitor risks to the sector, and in turn to public sector food supply. Defra shared this intelligence and broader expertise of food supply chain issues with lead government departments responsible for public sector food (DfE, DHSC, MoJ, MoD) This helped to support their contingency planning. Defra also re-established the Public Sector Food Working Group with Cabinet Office. This working group helped to share risks and issues relating to public sector food provision between departments and with devolved administrations.

The Governments of Scotland, Wales and Northern Ireland brought in a number of measures to support wholesalers:

- The Scottish Government launched a £5 million bespoke wholesale Food and Drink Resilience Fund. Providing grants for foodservice wholesalers suffering hardships as a result of COVID-19. The fund was targeted at any SME wholesalers selling food and drink to the hospitality and/or public sector.

- The Welsh Government launched two schemes that could benefit wholesalers supplying hospitality and public sector food: a grant of £5,000 to supply chain businesses whose turnover has been impacted by more than 40% due to the Covid-19 restrictions; and a sector-specific fund for supply chain businesses whose turnover has been impacted by more than 60%, dependent on turnover and employee numbers.

The Northern Ireland Executive offered businesses required to close due to restrictions, including wholesalers, a one-off grant of up to £4,800, depending on business size and length of restrictions.

Assessment

Although there was financial distress across the wholesale sector due to the drop-off in demand from hospitality, the greatest risk of business failure was confined to small and medium-sized foodservice wholesale businesses who are typically engaged with small and medium-sized care homes. Such failures would not affect overall UK food supply to the public sector given the saturation in the sector and the highly competitive market but did pose a risk of short-term shortages for customers. Any failure of these companies would have been managed through re-letting of contracts to competitors.

Theme 4: Food Security at Household Level

This chapter of the UK Food Security Report looks at food security in terms of whether households can consistently afford and access sufficient healthy and nutritious food. It discusses the affordability of food and drink, in real terms and compared to other living costs, and trends in the cost of healthy foods. It looks at physical access to food shops, measures of household food security across the UK, and government schemes to support households to access food. It also looks at the landscape and use of food aid in the UK.

In terms of this theme, food security refers to people in the UK having physical and economic access to sufficient healthy food at all times.

Key messages

- Data on household food security indicates that 92% of households regarded themselves as being food secure in the financial year 2019 to 2020.
- In the last decade, food and non-alcoholic drinks have, on average, become cheaper compared to other goods and services. However, affordability needs to be understood in the wider context of overall household expenditure. Housing and transport make up the largest share of spend for the average UK household, and both categories have seen increases in their share in the last decade.
- Access to food shops in England is for the most part adequate, with at least 84% of the population in every region able to reach a shop by public transport or walking within 15 minutes.

Understanding household food security

There are various complex factors that determine whether a household is food secure. At a high level, household food security can be broken down into affordability, access, utilisation, and stability. Affordability, access, and utilisation provide three key links in the chain, or tests, for households to get food on their plates. Simply, these are whether they can fill shopping bags, pay for them, and prepare nutritious meals. Stability is determined by the consistency with which the previous three tests are met.

Affordability

The relative affordability of food indicates whether a household has the financial means to meet their nutritional requirements. The ability to afford food is linked to overall pressures on the household budget. Across all households in the UK, food and non-alcoholic drink is the fourth most significant household expenditure after housing, transport, and recreation and culture. Between 2009 and the financial year ending (FYE) March 2020, across all households in the UK, real terms expenditure on food increased by 3.9%, compared to 13.4% for housing and 4.7% for transport. Compared to the EU, UK consumers spend a lower proportion of their household budgets on food and non-alcoholic drink, around 10% against an EU average of 16%. It is important to remember that some of these household expenditures can be considered non-discretionary, meaning that it is difficult for a household to cut back on spending. Changes in these non-discretionary costs could squeeze household food budgets.

Food price pressures do not seem to be adversely impacting household food security. In the last ten years, food prices overall have fallen in real terms, but there are variations between food groups. Vegetables (including potatoes), milk, cheese and eggs have all become cheaper in real terms. Fruit prices have increased faster than inflation, meaning they cost more in real terms than ten years ago. Growth in average weekly household expenditure for housing, transport, and recreation and culture suggests that the pressure these categories are exerting on the household budget are, on average, more significant than food.

Not all households are equal in this regard. The poorest 20% of households, for whom income has decreased since 2017, spend a higher proportion of their income on food and are thus more impacted by changes in food prices. The proportion of household income spent on food by UK households in each income bracket has remained broadly consistent in the last decade.

Access

Physical access to buy healthy, nutritious food is necessary for food security. Households must have ease of physical access to food shops or affordable food delivery to meet their nutritional requirements.

Data on travel time is currently only available for England. In the regions of England with the lowest access to food shops, over 95% of the population can reach a food shop within 30 minutes without needing a car, and over 84% within 15 minutes. Access to food shops is not equal across regions, with fewer people able to access a food shop quickly without a car in more rural regions. It is also important to note that currently it is not possible to assess the cost and selection of food that is available to consumers in their nearest food shop. Advances in the availability of online grocery shopping across the UK have the potential to alleviate some of the difficulties regarding physical access to food shops. It is likely that the switch to more online grocery shopping might become permanent amongst certain consumers, with the potential for more businesses to offer these services. Trends over time and the impacts of the COVID-19 pandemic are not currently available but will be tracked in future UK Food Security Reports.

Utilisation

Even if affordability and access needs are met, the ability and opportunity to prepare food within households is also important to food security. There are many factors that can prevent people from doing so, including disabilities, lack of infrastructure to store and prepare food, the energy costs of cooking, and lack of skills or time to cook. Measuring the prevalence of these factors is currently very challenging, and there is a lack of sufficient evidence to produce a representative picture across the UK.

According to the most recent data for all UK households in the Family Resources Survey for FYE 2020, 92% of households in the UK reported they were food secure. However, 8% reported being food insecure, and of this, 4% reported low food security and another 4% very low food security. Food insecurity is not evenly spread across society, with age, disability, ethnicity, and geographical location all factors affecting household food security. Trends in this data, including the impacts of the COVID-19 pandemic, will be monitored in future UK Food Security Reports. This report focuses mainly on measuring affordability and access as these factors have the most consistent indicators.

The wider context of household food security

Household food security is not evenly spread across society. For those households in the UK less able to afford food, support schemes exist which provide food aid or otherwise help with food security.

Two of the main government support schemes for households on low incomes are free school meals and the Healthy Start (in England, Wales, and Northern Ireland) and Best Start Foods (in Scotland) schemes. Eligibility for, and uptake of, these schemes provides useful indicators for the wider household food security picture.

Healthy Start vouchers are a scheme in England, Wales, and Northern Ireland to support people on low incomes to access pre-natal vitamins, infant milk formula, and healthy food for young children. In Scotland an equivalent Best Start Foods scheme launched in August 2019. The take-up rate of the Healthy Start voucher scheme was relatively stable between 2019 and 2021. The number of people who can apply for the scheme, known as the eligibility rates, have increased in England, Wales, and Northern Ireland when data from early 2019 is compared with August 2021. These increases are likely linked to COVID-19 and its impacts on the financial situation of households.

Eligibility rates for free school meals have been stable across the UK in recent years, with Wales and England seeing an increase from 2018 due to the introduction of Universal Credit and its transitional protection. Data for England and Wales, however, shows that more pupils became eligible for free school meals between January 2020 and January 2021. This is likely due to COVID-19 impacting households' financial situation as well as the continuing Universal Credit transitional protection measures, which have extended eligibility to more pupils.

Eligibility rates are also expected to increase in Scotland in the coming years due to the staggered expansion of universal free school meals for Primary 4 pupils in August 2021, Primary 5 pupils in January 2022, and all primary school children in August 2022.

Where households struggle to afford food, direct food aid is provided by many different types of organisations, including registered charities, places of worship, community organisations, schools, hospitals, and commercial and social enterprises. These are commonly referred to collectively as 'food banks'. Due to the great diversity of food aid provision, there is no comprehensive record of the number of organisations providing food aid in the UK. Government data is limited regarding the number of individuals or households receiving food aid, how much they might have received and over what period.

Outside the home, public food procurement impacts almost 24% of the population in England and is an important lever to promote a healthy, sustainable food system. The government sets both buying and nutrition standards for food procurement by public bodies.

Indicator 4.1.1 Food expenditure growth compared to other household spending growth

Headline

Across all households in the UK, food and non-alcoholic drink is the fourth most significant household expenditure after housing, transport, and recreation and culture. Between 2009 and 2020, across all households in the UK, real terms expenditure on food increased by 3.9%, compared to 13.4% for housing and 4.7% for transport.

Context and Rationale

Households' ability to afford food is linked to overall pressures on the household budget. This indicator puts food expenditure in the wider context of other household spending to illustrate how growth in other household spending categories may impact the budget available to spend on food.

Other essential expenditures from the household budget include housing, fuel and power, household goods and services, and transport. Some of these expenditures such as electricity and gas bills are considered non-discretionary, meaning that it is difficult for a household to cut back on spending. Price increases in these categories, therefore, can reduce the available food budget. For food, consumers may be able to adjust the money they spend by buying less of a certain product, by switching to cheaper products within a food grouping, or by reducing the consumption of luxury food items or treats. For some households, it could also mean that people might rely on food aid or miss meals if they cannot afford to buy enough food.

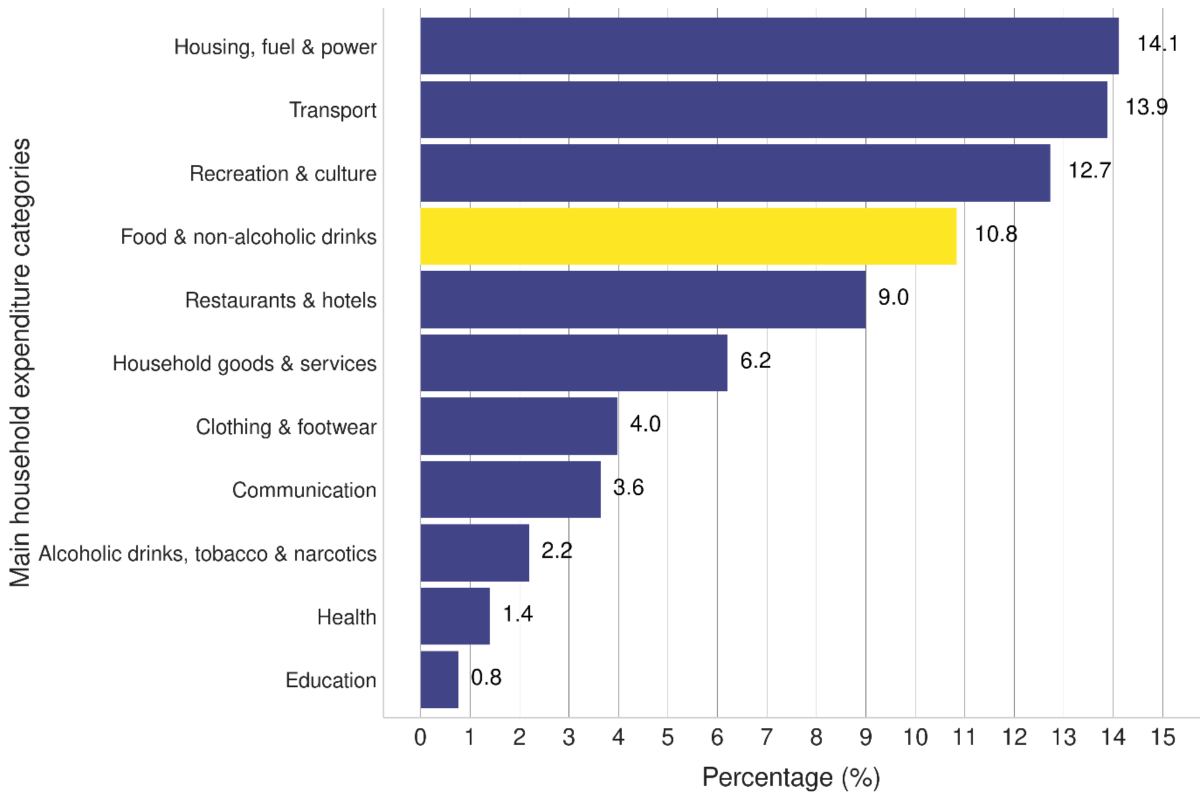
The data used in this indicator represents the average household in the UK. It is important to note that within a household there may be differences at the individual level that are not captured in this data.

Data and Assessment

Data: Contributions to household expenditure growth by Classification of Individual Consumption According to Purpose (COICOP) category over time

Source: ONS Family Spending in the UK

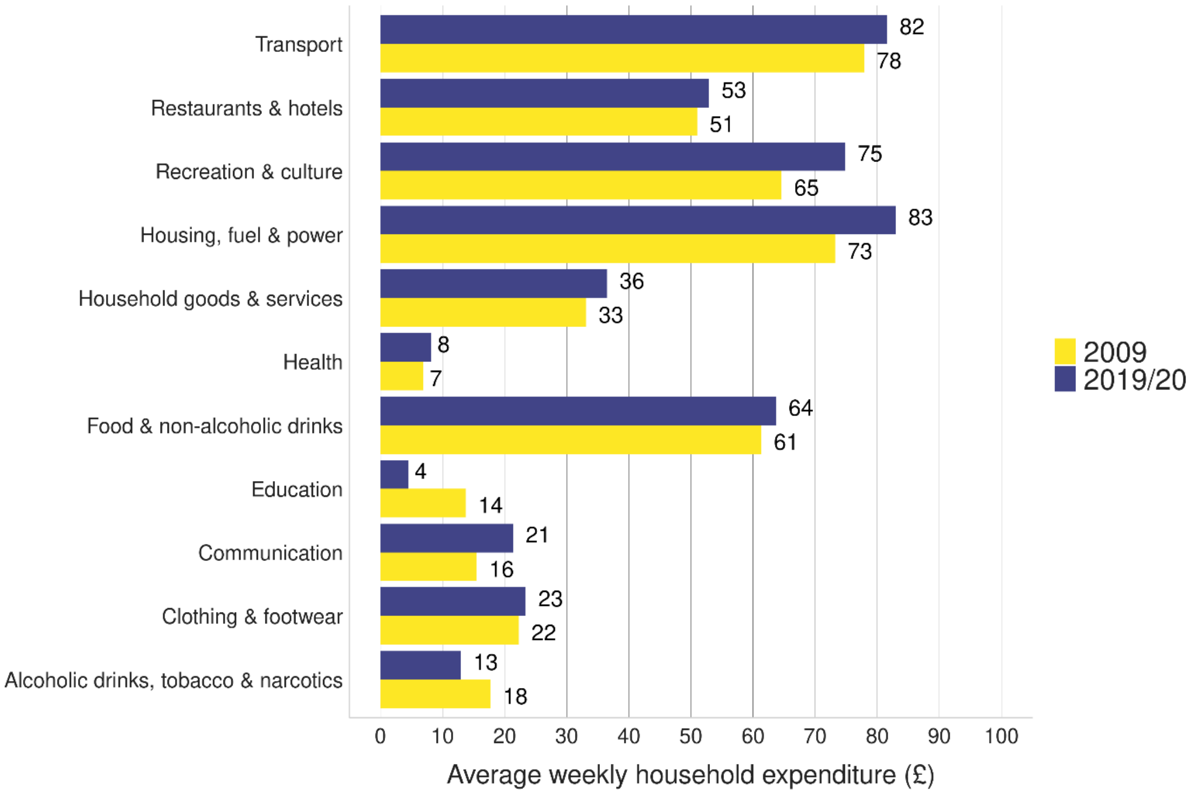
Figure 4.1.1a: Average share of spend in all households FYE 2020



In FYE 2020, the average weekly household expenditure in the UK was £588, down slightly, but not significantly, from FYE 2019 when it was £603 (adjusted for inflation).

In FYE 2020, housing, which does not include mortgage interest or council tax, was the largest expenditure in the average UK household at 14.1%, followed by transport at 13.9%, recreation and culture at 12.7%, and food and non-alcoholic drinks at 10.8%.

Figure 4.1.1b: Actual average weekly household expenditure in 2009 and FYE 2020 (real terms)



Between 2009 and FYE 2020, the increase in total weekly expenditure was 4.8%, from £561 to £588. In the 10-year period covered by the data, housing increased by 13.4% (from £73 per week per household to £83) and transport by 4.7% (from £78 to £82). Recreation and culture expenditure increased by 15.8% (from £65 to £75) and food expenditure increased by 3.9% (from £61 to £64). Apparent increases in communication expenditure were partly due to changes in the Office for National Statistics (ONS) questionnaire. Households reported a decrease in weekly expenditure on education and alcoholic drinks between 2009 and FYE 2020, although education was only 0.8% and alcoholic drinks 2.2% of total expenditure in FYE 2020.

Trends

The growth in average weekly household expenditure for housing, transport, and recreation and culture suggests that the pressure these categories are exerting on the household budget is, on average, more significant than food. Housing and transport are largely non-discretionary expenditures, meaning that households have less control over reducing these expenses. With food being a non-discretionary expense, some households may choose to ‘trade down’ by switching to cheaper products of the same type or buying less of certain types of food to save money.

Based on data from FYE 2020, the ONS calculated that in those 12 months UK households spent an average of £187 per week on activities that were largely prevented during the lockdown of 2020 due to COVID-19 restrictions. These activities included going on holiday, dining out, and travelling. These potential savings, however, were not equally accessible to all households. Younger households, those who are renting, and those living in London spend proportionally more on essentials and relatively little on goods and services that were unavailable under lockdown compared to average households. This could have limited their ability to cut back on spending if their income decreased. Some companies, including mortgage providers and gas, electricity, and water suppliers, offered payment holidays on regular bills. The ONS estimates that 40% of household spending on essentials could have been subject to a payment holiday, equivalent to £177 per week. Any payment holidays, however, were temporary and money saved would need to be paid back.[96]

Food prices can be impacted by a range of factors, including international food commodity and oil prices, exchange rates, transportation, domestic agricultural prices, and labour costs. Significant increases in these areas create upward pressures on UK consumer food prices.

Food retailers generally compete on price and may absorb temporary cost rises. This means that very significant increases to consumer food prices in the UK are not expected unless sustained and significant upwards pressure is created by one or, more likely, multiple major price drivers. If that happens, households on lower incomes within the UK are more affected by food price increases as they tend to spend a larger proportion of their household expenditure on food products. This is discussed in more detail in **Indicator 4.1.2**.

Indicator 4.1.2 Low-income households' share of spending on food

Headline

The poorest 20% of households spend a higher proportion of their income on food and are thus more exposed to changes in food prices. Incomes for the bottom 20% of households have decreased since 2016 to 2017. The proportion of household income spent on food has remained broadly consistent in the last decade for all UK

[96] ONS, 'More than one-fifth of usual household spending has been largely prevented during lockdown' (2020), https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/articles/morethanonefifthofusualhouseholdspendinghasbeenlargelypreventedduringlockdown/2020-06-11.

households, including the bottom 20%. Between 2014 and 2020, food prices in real terms were on a downward trend, meaning that food has become cheaper compared to previous years.

Context and Rationale

The purpose of this indicator is to measure the burden that spend on food places on the household budget for low-income households. The data in this indicator looks at the share of the household budget spent on food purchased to consume at home.

Food tends to account for a greater percentage of household spend for low-income households compared to higher income households. Comparing against all households shows the greater effects food price rises may have on low-income households. Low income is one of many factors that can make someone vulnerable to food insecurity. In the context of this report, low-income households are identified as those within the lowest 20% of households by equivalised disposable income, a measure of household income that accounts for differences in household size and composition.

According to the Office for National Statistics (ONS), between 1957 and 2017 the share of household expenditure spent on food halved. This partly reflects larger incomes, smaller households, and a greater choice of products at different price points.[97] UK households devote a lower share of their spending to food and non-alcoholic drinks compared to households elsewhere in Europe, and particularly in developing countries. For instance, for the average UK household, 10.8% of spend went on food and non-alcoholic drinks in FYE 2020,[98] whereas in EU households, 13.0% of consumption expenditure went towards food and non-alcoholic drinks on average in 2019.[99]

Data and Assessment

Indicator: Spending on food purchased for home consumption as a percentage of total spending, by all households and low-income households

Source: ONS Family Spending, 2019 to 2020 and ONS Consumer Price Inflation

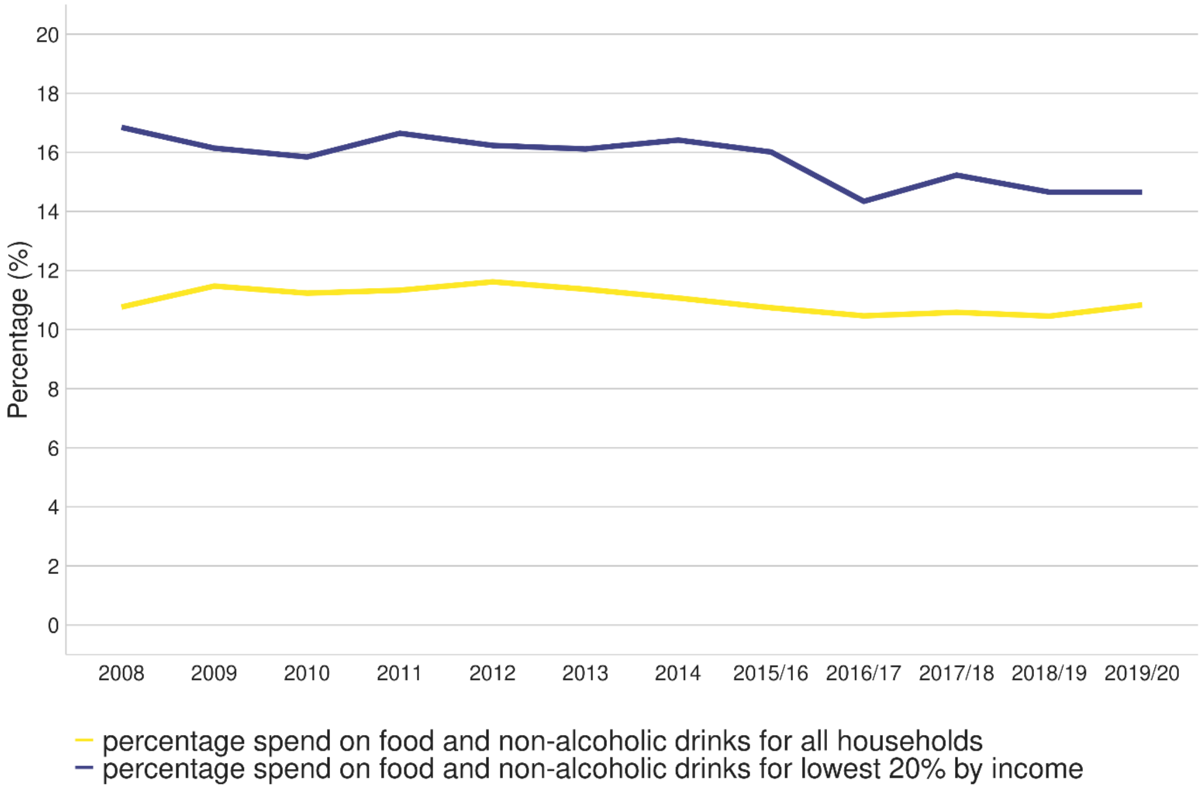
---

97 AHDB, 'Why UK consumers spend 8% of their money on food' (2020), [redacted]

98 ONS, 'Family Spending in the UK 2019 to 2020', https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/bulletins/familyspendingintheuk/april2019tomarch2020.

99 Eurostat, 'Household expenditure in 2019', [redacted]

Figure 4.1.2a: Average spend on food and non-alcoholic drinks, percentage of total spending by low-income and all households, 2008 to FYE 2020



The data compares the percentage of the average weekly household expenditure that is being spent on food and non-alcoholic drinks, for all households and for households in the lowest quintile (bottom 20%) by equivalised disposable income. This is expenditure, not income, so does not account for money that households have put away in savings.

In the period since 2008, households in the lowest quintile by income (bottom 20%) have spent between 14% and 17% of their household expenditure on food and non-alcoholic drinks, while the average household has spent between 10% and 12%. Since 2008, there has been a gradual decrease in food expenditure, as a percentage, for both the lowest 20% by income and for all households.

Figure 4.1.2b: Changes in the food price index (real terms prices) 2010 to October 2021

Figure 4.1.2b is included in this indicator to support the overall assessment of the trends in household spend on food. Real terms prices are adjusted for the effects of overall inflation, which makes it possible to measure the actual change in food and non-alcoholic drinks prices and not just an increase because of overall inflation. From a peak in February 2014, food prices fell continually until October 2016. Prices fluctuated between 2016 and 2019, before falling steadily from May 2020 onwards.[100]

[100] ONS, 'Consumer price inflation, UK: October 2021', https://www.ons.gov.uk/economy/inflationandpriceindices/bulletins/consumerpriceinflation/october2021.

Figure 4.1.2c: Year on year percentage change in income, before housing costs, by quintile median and overall population median (pounds per week equivalised in 2019/20 prices)

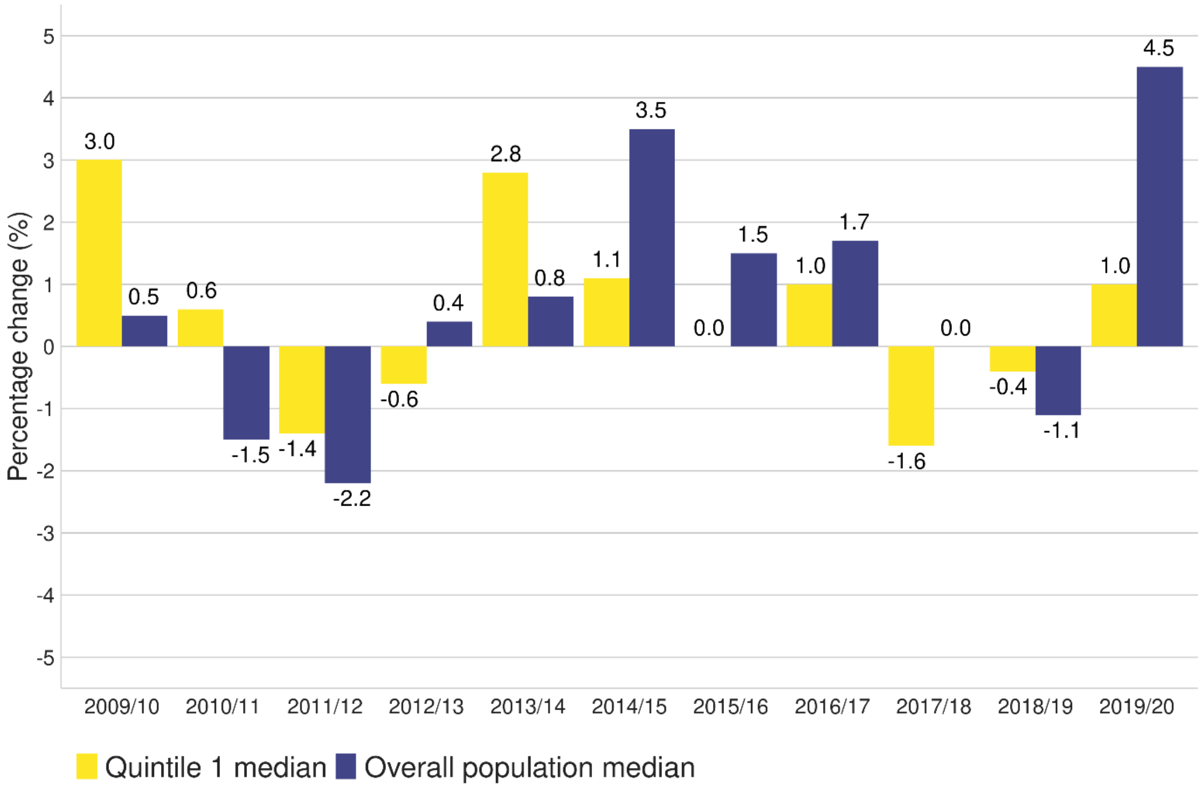


Figure 4.1.2c shows income before housing costs by quintile and overall population medians (equivalised in real terms). This is not the average, but the medians of the income quintiles. These figures have been deflated to FYE 2020 prices and take account of household composition. The sample size is about 20,000. Another data source on income is from ONS' Average Household Income publication, on the median equivalised disposable household income of individuals by income quintile, published as pounds per year. It has a sample of about 17,000 households, but 5,000 households before 2019. The data is from the Living Costs and Food Survey (and Survey on Living Costs from 2019), which is also the data source used in the expenditure data in Figure 4.1.2a.

In FYE 2020 the median income before housing costs in the UK was £547 per week. From FYE 2017 to FYE 2020 income in the bottom quintile fell by 1.1%, to £264 per week, while for the top quintile income grew by 3.9%, to £1,070 per week. In the 10 years from FYE 2010 to FYE 2020, the median income before housing costs for the overall population rose by 7.7%, while the bottom quintile has seen income rise by 2.4% and the top quintile has seen a 2.3% rise in income. Since 2000 median incomes for all households have risen by 25%.

Data from ONS's Average Household Income analysis also show that in the last 3 years the income of households on low incomes has decreased while the income of households on high income has increased. This dataset shows the median equivalised disposable household income of individuals by income quintile.

Between FYE 2017 and FYE 2020, the median disposable income of households in the bottom quintile fell by 11.1% while for all individuals it grew by 0.3%. In the 10 years from FYE 2010 to FYE 2020 median disposable household income in the bottom quintile fell by 2.7%, and in the top quintile it grew by 2.9%. The average disposable income for all individuals in the UK over the same 10-year period has grown 6.9%.

The GSS income and earnings coherence work plan was published on 14 October 2021.[101] It has been produced collaboratively by three government departments: ONS, Department for Work and Pensions (DWP) and HM Revenue and Customs (HMRC). This work plan recognises the recommendation from the Office for Statistics Regulation to improve the accessibility of language and guidance, and is working to ensure that government publications provide a coherent description of the income and earnings landscape with an action to explore the feasibility of producing a single set of cross-sectional household income estimates.[102]

There is a published, and soon to be updated, guide to sources of data on income and earnings which outlines the different data sources and outputs that feed into the analysis of income and earnings within the UK.[103] It explains important information for each data source, including what data are available and the sources' main uses, strengths and limitations. This guidance sets out that the Living Costs and Food Survey is the primary source of household expenditure data and can be used to carry out joint analysis of income and expenditure; and the Family Resources Survey and Households Below Average Income series is the foremost source of data and information about household income, income poverty and inequality and is used for the analysis of low income by researchers and the government.[104]

For this report on Food Security, the Living Costs and Food Survey has been used for analysis looking at expenditure on food and the direct relationship between this expenditure and household incomes; with the Households Below Average Income series used when reporting on trends in household income and analysis of low incomes.

---

[101] Government Statistical Service, 'Income and earnings statistics', https://gss.civilservice.gov.uk/user-facing-pages/income-and-earnings-statistics/.
[102] Office for Statistics Regulation, 'Review of Income-based poverty statistics', https://osr.statisticsauthority.gov.uk/publication/review-of-income-based-poverty-statistics/.
[103] ONS, 'A guide to sources of data on income and earnings', https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/methodologies/aguidetosourcesofdataonearningsandincome.
[104] DWP, 'Family Resources Survey', https://www.gov.uk/government/statistics/family-resources-survey-financial-year-2019-to-2020/family-resources-survey-financial-year-2019-to-2020; Households Below Average Income: financial year 2020', https://www.gov.uk/government/statistics/households-below-average-income-for-financial-years-ending-1995-to-2020.

Trends

Household spend on food as part of their total budget has remained fairly constant since 2010 for average households and low-income households. Between 2010 and 2020, real terms food prices decreased, so that to buy the same food in 2020 cost less than in 2010. Since 2010 median income in real terms for low-income households (bottom quintile) has increased by 2.4% meaning that low-income households have more money to spend.

Low-income households saw their income fall by 1.1% between FYE 2017 and FYE 2020 in contrast to the average household whose income has increased by 4.9% since FYE 2017. With a decrease in income alongside the percentage spent on food having remained the same, the poorest households could have had a diminished budget available for food since FYE 2017.

Indicator 4.1.3 Price changes of main food groups

Headline

Since 2011, food prices overall have fallen in real terms. This has varied by food groups. Vegetables (including potatoes), milk, cheese and eggs, and meat have all become cheaper in real terms. Fruit prices have increased faster than overall inflation, meaning they have become more expensive in real terms than ten years ago.

Context and Rationale

The aim of this indicator is to monitor trends in the affordability of a healthy diet to provide a measure of consumers' nutritional food security. The Consumer Prices Index including Owner Occupiers' Housing costs (CPIH) food groups that are analysed in this indicator serve as a proxy for some of the main foods recommended by government for a healthy diet and look at vegetables including potatoes, fruit, milk, cheese, and eggs, fish, meat, and bread and cereals.

Food price increases can affect consumers' purchasing behaviour. Price rises may mean that consumers either 'trade down' by switching to cheaper products of the same type, buy less of a type of food, or spend more money for the same product. The evidence of the extent to which food price rises affect dietary habits is limited. Nevertheless, tracking the real term prices of key food groups for a healthy diet is still a useful tool to understand some of the factors affecting consumers' ability to follow a healthy diet.

Providing guidance on a healthy diet is complex and will often need to account for an individual's circumstances. The Eatwell Guide depicts a diet based on five food groups and shows the proportions of foods from each food group that are needed to obtain the wide range of nutrients required to stay healthy.[105] For this report, several foods from some of the larger segments of the Eatwell Guide have been selected to track their affordability. It should be noted that there are differences between the composition of the five food groups the Eatwell Guide uses, and the CPIH food groups used in this report due to different categorisation.

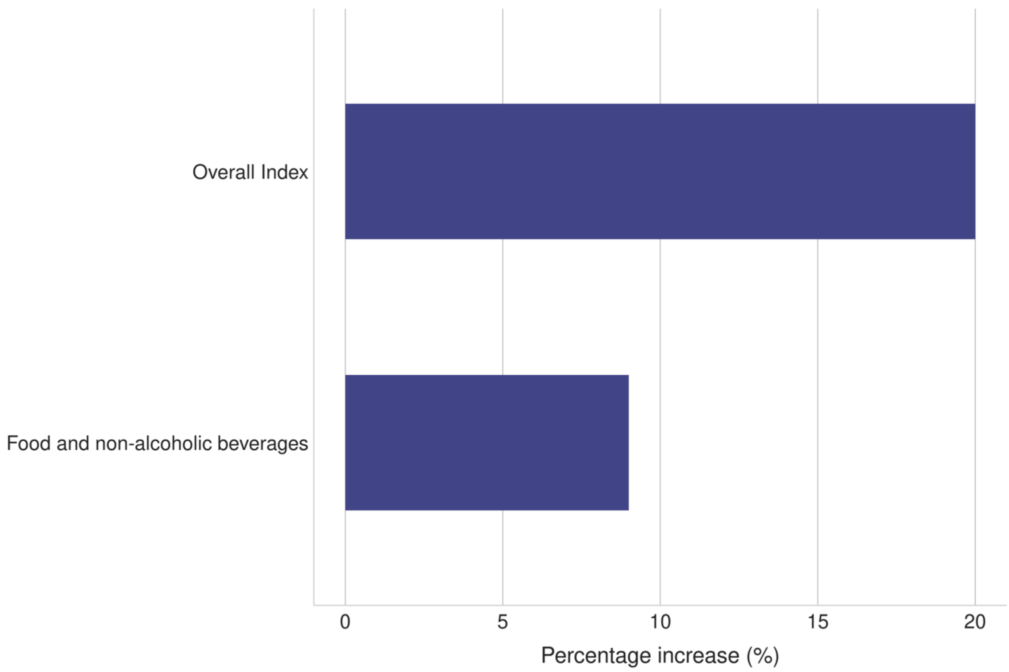
The Consumer Price Index (CPI) is a measure of consumer price inflation produced to international standards and in line with European regulations. The CPI is the inflation measure used in the government's target for inflation. The CPIH is the most comprehensive measure of inflation. It extends the CPI to include a measure of the costs associated with owning, maintaining, and living in one's own home, known as Owner Occupiers' Housing Costs (OOH), along with Council Tax. Both are significant expenses for many households and are not included in the CPI.

Data and Assessment

Indicator: Index of real terms food prices for vegetables, fruit, fish, meat, bread and cereals, and milk, cheese, and eggs.

Data: Office for National Statistics, CPIH

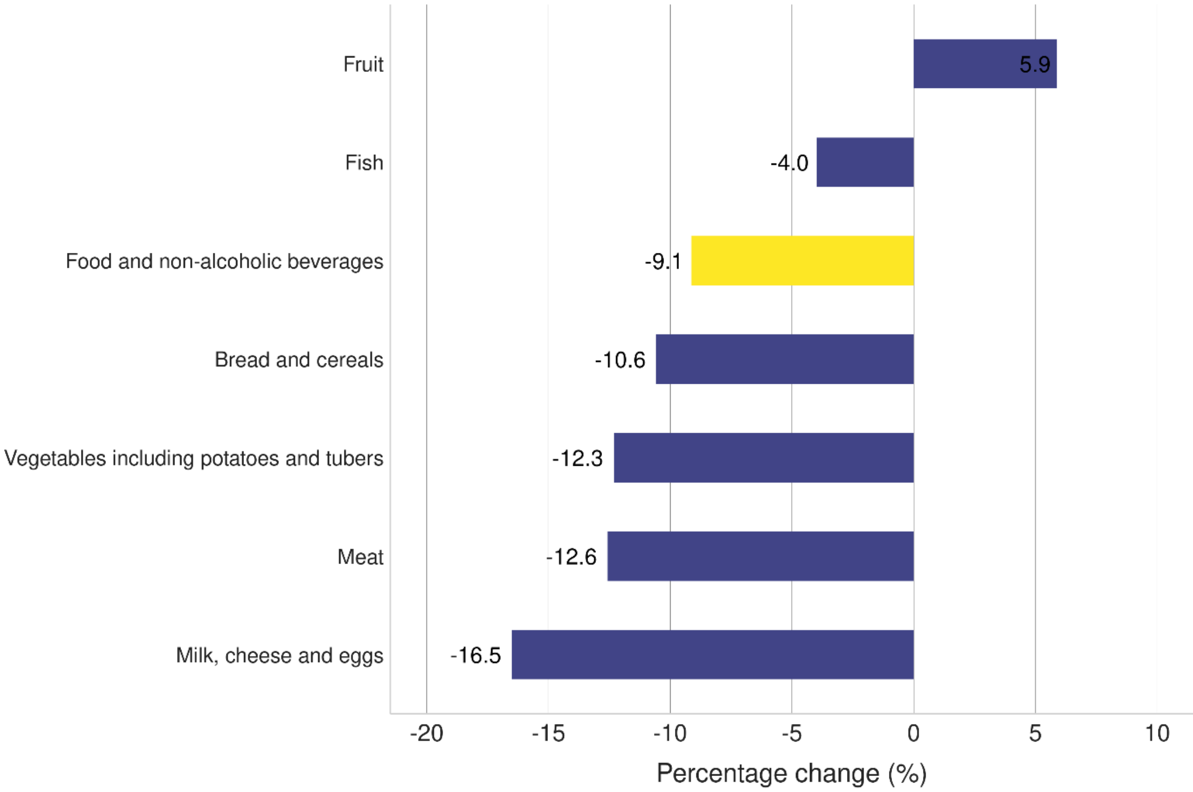
Figure 4.1.3a: Percentage change in prices between October 2011 and October 2021, overall CPIH and food and non-alcoholic beverages



[105] PHE, 'Eatwell Guide', https://www.gov.uk/government/publications/the-eatwell-guide.

The overall CPIH rose 20% between October 2011 and October 2021. Food and non-alcoholic beverages rose 9% in the same period.

Figure 4.1.3b: Percentage change in real terms prices between October 2011 and October 2021, food product classes



Food and non-alcoholic drink prices have decreased in real terms between October 2011 and October 2021. Within food categories, most prices have decreased in real terms in this period. Milk, cheese, and eggs have decreased the most at 16.5%, followed by meat at 12.6% and vegetables (including potatoes and tubers) at 12.3%. CPIH for fruit (fresh and preserved) is the only food category that has increased in the 10-year period, by 5.9%.

Trends

Prices for all main food categories except fruit have fallen in real terms in the last 10 years, as food prices have grown more slowly than the overall CPIH. The increase in fruit prices is above that for food and non-alcoholic drinks. There could be consequences for health, as government recommends that individuals consume at least five portions of fruit and vegetables a day, making up a third of what an individual should eat. While fruit juice can also be a substitute for raw fruit, usually at a lower price, consumption should be limited to no more than 150ml a day.

Food prices are determined by various factors. For fruit in particular, poor harvests, a fall in Sterling exchange rates, or transport disruptions leading to fresh fruit being spoilt, can have an impact on consumer prices. The UK imports most of its fruit from the EU, South America, and Africa. Any issues arising in these regions as well as further down the supply chain may affect fruit prices in future. It is not clear whether the increase in fruit prices since 2011 has been driven by increased consumer preferences for imported out-of-season fruit.

Indicator 4.1.4 Household food security

Headline

According to government data from FYE 2020, 92% of households in the UK regarded themselves as food secure. 8% regarded themselves as food insecure; of this, 4% reported low food security and another 4% had very low food security. Food insecurity is not evenly spread across society, with age, disability, ethnicity, and geographical location all factors affecting household food security.

Context and Rationale

In March 2021, food security data for all UK households was published in the 'Family Resources Survey: financial year 2019 to 2020' for the first time, covering the period of April 2019 to March 2020. This surveys whether heads of households have sufficient food to facilitate an active and healthy lifestyle.

The person with the most responsibility for buying and preparing food in the household (head of household) is asked to assess their overall household food security within the last 30 days by answering a series of questions. The limitations of this indicator mean that information about individual experiences of food insecurity within the household is not available, nor can it directly measure hunger. Instead, the indicator illustrates the financial situation of households and how that affects their access to food. The broad structure and sequence of the questions is the same as those used internationally, including by the United States Department of Agriculture, enabling international comparisons. Although the Food Standard Agency's (FSA) Food and You 2 survey uses the same ten questions as the Family Resources Survey, it is worth noting that the results between the surveys may differ due to the FSA asking these questions about a longer period of 12 months.[106]

---

[106] FSA, 'Food and You 2', https://www.food.gov.uk/research/food-and-you-2.

The 30-day reference period used in the Family Resources Survey may have some limitations in that it can provide only a snapshot of food insecurity at a given time.[107] Nevertheless, this indicator primarily uses data from the Family Resources Survey, as the sample size is bigger compared to the FSA's Food and You 2 survey. Additionally, the Family Resources Survey covers the whole of the UK, whereas the Food and You 2 survey only covers England, Wales, and Northern Ireland.

While the intention is to use the Family Resources Survey data as the only source for future iterations of the UKFSR, for this report, data from the FSA's Food and You 2 survey has been included. This is because the FSA's data covers the latter half of 2020, providing some understanding of the impacts the COVID-19 pandemic has had on household food security. The differences between the Family Resources Survey and Food and You 2 are outlined in more detail below.

Data and Assessment

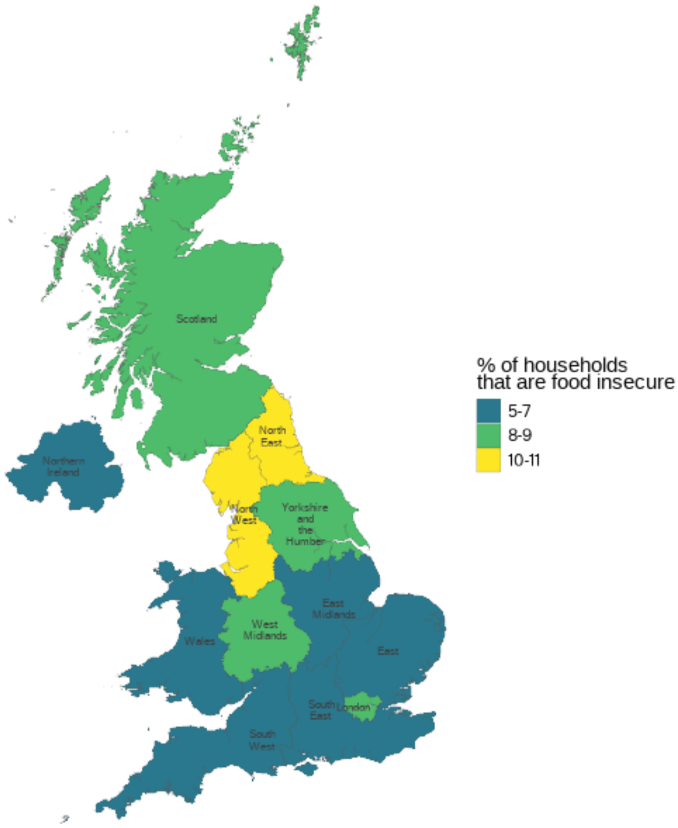
Indicator: Household food security status of all households, FYE 2020, UK

Source: Department for Work and Pensions, Family Resources Survey

Note: A summary of the scoring of food security categories and definitions in the Family Resources Survey can be found in the **Appendix** of this report.

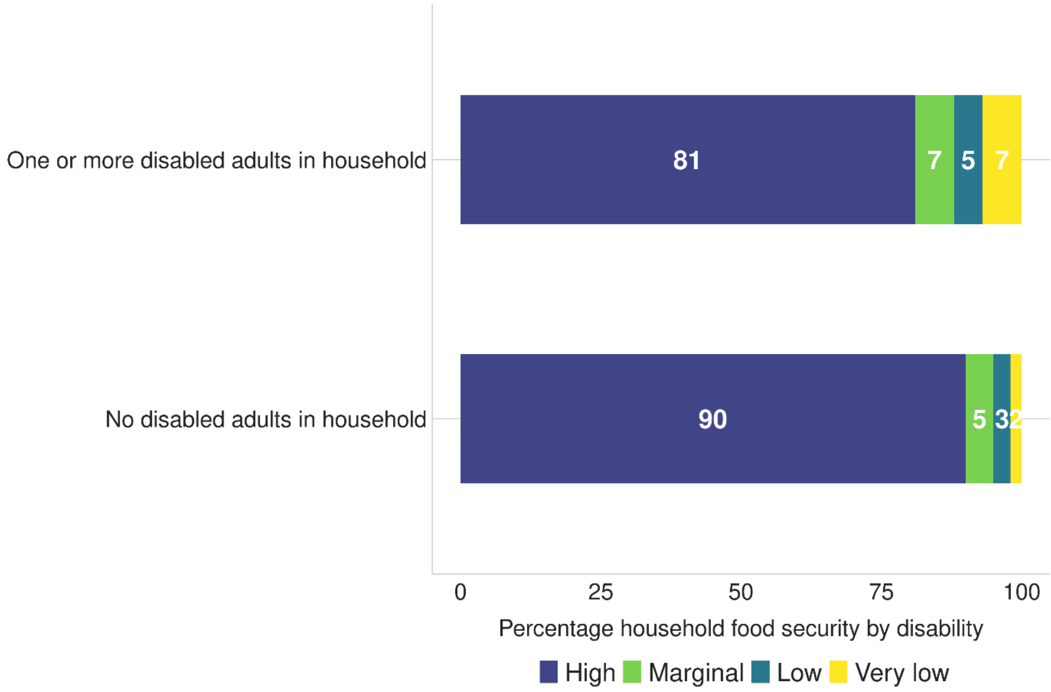
[107] ENUF, 'Food insecurity measurement on the Family Resources Survey' (2019),
[redacted]

Figure 4.1.4a: Household food security by region , FYE 2020



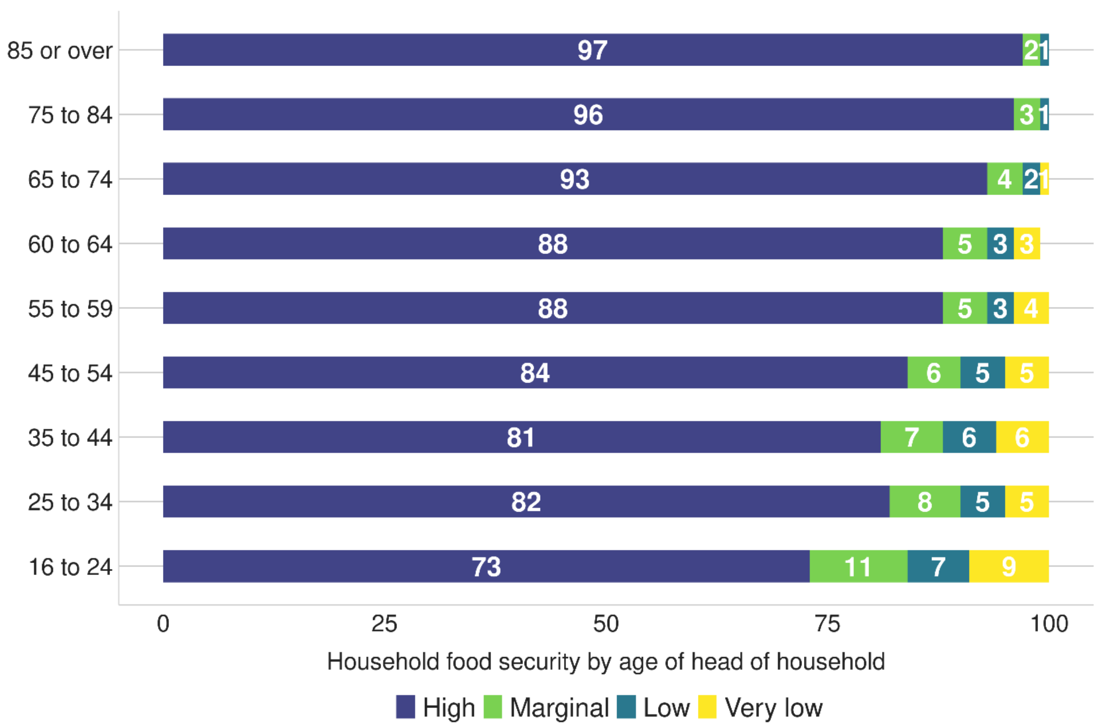
There were regional differences for household food security levels. The North East and North West of England had the lowest levels of food security, at 89% and 90% respectively. The East of England had the highest food security with 95% of households being food secure, and the South East and South West at 94%. Levels of household food security in the four countries of the UK were all similar, with Wales and Northern Ireland at 93% and Scotland and England at 92%.

Figure 4.1.4b: Household food security by disability, FYE 2020



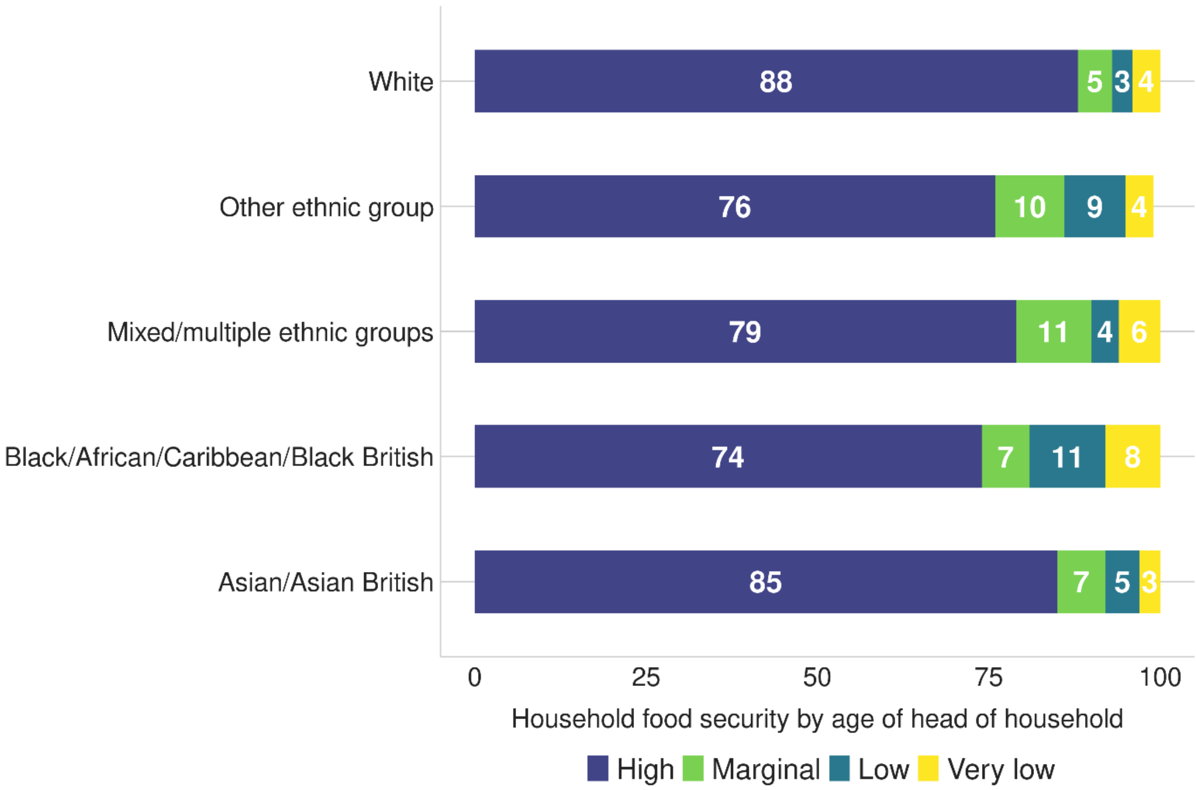
88% of households with one or more disabled people were food secure, compared to 95% of households without any disabled people living in them. In households with disabled people, 7% had very low food security, while only 2% did in households without any disabled people.

Figure 4.1.4c: Household food security by age of head of household, FYE 2020



Households where the head is younger were less likely to be food secure than households with older heads of household. 15% of households where the head of household was aged 16 to 24 were food insecure, while only 1% of households with an 85-year-old or over as head of household were food insecure. As the age of the head of household increased, so too did the likelihood that the household was food secure, apart from where the head of household was aged 35-44, where there was a slight decrease in food security.

Figure 4.1.4d: Household food security by ethnicity of head of household, FYE 2020



Heads of households who are White were most likely to be food secure, with 93% being food secure compared to 81% of Black/African/Caribbean/Black British heads of households. 8% of Black heads of households had very low food security, compared to 4% of those whose ethnicity is White. 92% of households headed by an Asian/British Asian person were food secure. Within that category, those headed by an Indian person had the highest food security of all groups, with 95% food secure.

While not displayed in the graphs above, there are further factors that influence a household's food security. Households with gross incomes of less than £200 per week (7% of households) were the least likely to be food secure (74% high food security, 7% marginal). In comparison, those with gross incomes of £1,000 or more per week (26% of households) were the most likely to be food secure (96% high, 3% marginal).

The composition of the household also played an important role. Households with children (81% high food security; 8% marginal) were less likely to be food secure than households with no children (89% high; 5% marginal). In addition, single-adult households with children were more likely to be food insecure than households with two or more adults and children. Households receiving state support have differing levels of food security, depending on the type of support they receive. In general, households receiving income-related benefits had 64% high and 11% marginal food security.

Food and You 2 The data on household food security contained in the Family Resources Survey report spans FYE 2020, and thus has only limited overlap with the COVID-19 pandemic. As discussed earlier, the FSA's Food and You 2 surveys used the same 10 questions as the Family Resources Survey but asked about a 12-month period in England, Wales, and Northern Ireland only. Data was collected between July and October 2020 for Wave 1, and between November 2020 and January 2021 for Wave 2, allowing more insight into the impacts of the COVID-19 pandemic.

For Wave 1, 84% of respondents were classified as food secure (72% high, 12% marginal) and 16% were classified as food insecure (9% low, 7% very low). 32% of households with an income below £19,000 experienced food insecurity compared to households earning more than £32,000, where food insecurity levels ranged between 4% and 10%. Age was also an important factor; younger adults, particularly 16 to 24-year-olds, had higher food insecurity levels (16% low, 9% very low) compared to older adults, for instance 55 to 64-year-olds (6% low, 5% very low). Households with a child were also more likely to report food insecurity. 77% of households with children reported that they were food secure compared to 88% of households without children. In addition, food insecurity was more likely to be reported by respondents who were long term unemployed or had never worked (44%) compared to those in most occupational groups (range 11-26%).[108]

Overall household food security levels in Wave 2 were similar to Wave 1, where 84% of respondents were classified as food secure (73% high, 11% marginal), and 16% of respondents were classified as food insecure (8% low, 7% very low). Similarly, income levels, age, the presence of children in the household, and the employment status influenced food security levels.[109]

Trends

Due to the limited data around household food insecurity and not being able to directly compare the Family Resources Survey results with the Food and You 2 results, it is difficult to give a long-term analysis of any trends. The data indicates, however, that age, disability, ethnicity, regions, income, family composition, and benefits status play a role in the level of household food security.

---

[108] FSA, 'Food and You 2: Wave 1 Key Findings' (2021), https://www.food.gov.uk/sites/default/files/media/document/fy2-wave-1-report-_key-findings_1.pdf.
[109] FSA, 'Food and You 2: Wave 2 Key Findings' (2021), https://www.food.gov.uk/sites/default/files/media/document/fy2-w2-key-findings_review_final_0.pdf.

Indicator 4.1.5 Access to food shops in England

Headline

Household food security depends on physical access to food shops. In the regions of England with the lowest access to food shops, over 95% of the population can reach a food shop within 30 minutes without needing a car, and over 84% within 15 minutes. Data on the issue is currently only available for England. Access to food shops is not equal across regions, with percentages being lower in more rural areas. Trends towards increased use of online shopping and deliveries, and the impacts of the COVID-19 pandemic, are not currently available but will be tracked in future Food Security Reports.

Context and Rationale

Household food security does not only depend on food affordability, but also on the ability of consumers to physically access food shops. Potentially vulnerable are those households without access to a car or means of private transport as well as less mobile individuals such as disabled people or the elderly. Travel distances are higher in rural areas, which typically have a more dispersed population.

What this data does not show is the cost and selection of food available to consumers in their nearest food shop. Groceries at convenience shops can be more expensive than in larger supermarkets, resulting in higher food costs for a household. Some food shops may also have a smaller selection of food, which could limit consumers' choice and ability to meet all their nutritional requirements.

The growing number and scope of online grocery shopping services across the UK have the potential to alleviate some of the difficulties of physical accessibility of food shops. During the COVID-19 pandemic, there was significant demand for online delivery services across the major supermarket chains. Retailers reacted quickly to increase capacity of both delivery services and click and collect services to meet this demand. To support particularly vulnerable groups, government worked closely with retailers to enable priority access to online groceries. There are, however, some barriers to accessing these services, particularly amongst low-income households, disabled people, and the elderly. Some households cannot afford digital devices, meet the minimum spend or the delivery charges required by some retailers, or might not have the necessary skills to access these digital services. In addition, some areas have lower digital connectivity levels.

It is likely that the switch to more online grocery shopping might become permanent amongst certain consumers, and that there is the potential for further businesses to offer these services.

Data and Assessment

Indicator: The number and percentage of households within 15 or 30 minutes of a food shop by public transport/walking

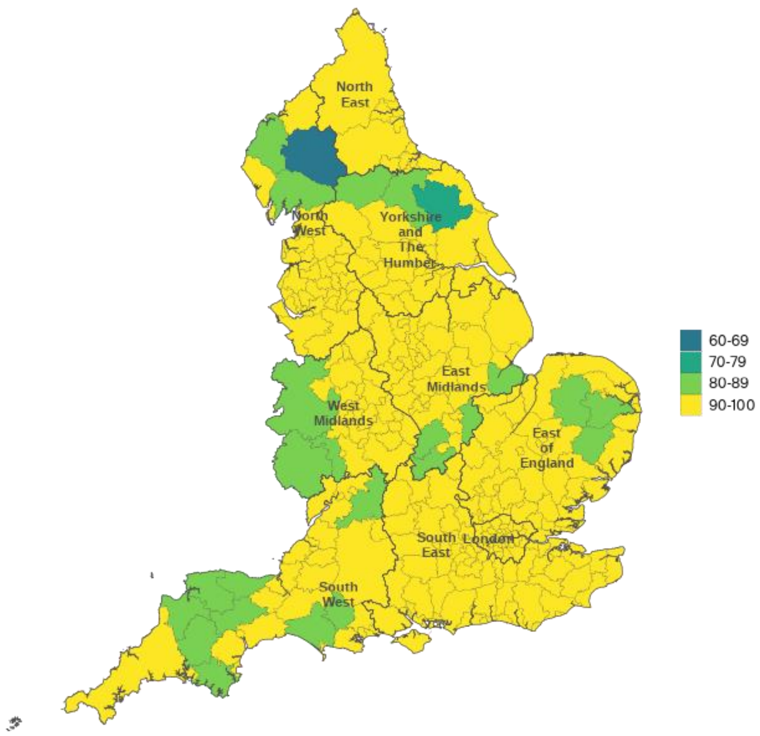
Source: Department for Transport (DfT), 2019, England only

Note: This indicator contains data on England only. The Welsh and Scottish Governments and the Northern Ireland Executive do not regularly collect data on this information. Food shops are defined here as grocery shops, supermarkets, or convenience shops.

The transportation mode ‘public transport and walking’ used in this data set means that travellers will likely need to walk between their origin and destination and the transport network. For some short journeys, it may be quicker for travellers to walk directly to their destination, rather than using public transport at all. Therefore, public transport and walking results are combined.

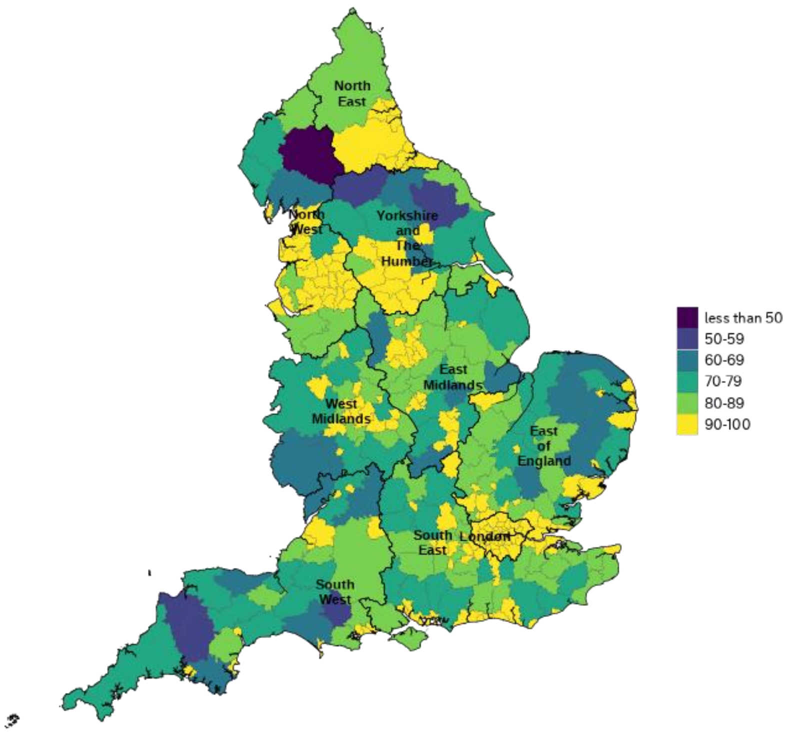
The data shows the percentage of people who can reach a food shop in 30 minutes or 15 minutes by public transport or by walking. The focus lies on this type of transport in favour of cycling or driving as not every household has access to a car or a bicycle, the other modes of transport covered by the DfT data set.

Figure 4.1.5a: Percentage of population in England within 30 minutes of a food shop by public transport or walking, 2019



In all regions taken as a whole, over 95% of the population could reach a food shop in 30 minutes. London has the highest rate at 100% reaching a food shop in 30 minutes, while the South West has the lowest rate at 95.8%. Across England, and at Local Authority level within the regions, there are only a few areas where access within 30 minutes was available to less than 90%: local authorities covering parts of North Yorkshire and Cumbria, parts of the East Midlands, the Welsh border area in the West Midlands, and the rural areas in Devon covering Exmoor and Dartmoor.

Figure 4.1.5b: Percentage of population in England within 15 minutes of a food shop by public transport or walking, 2019



In all regions 84% of the population could reach a food shop in 15 minutes. London has the highest rate at 99.0% in 15 minutes, with the South West having the lowest rate at 84.2% for 15 minutes. It should be noted that the South West also has the highest proportion of their population living in rural areas at 31.6%, while London has the lowest at 0.2%.

At this level, urban centres and population-dense areas are more clearly discernible. There are more parts of England where 70% or less of the population are within 15 minutes of a food store, containing around 1 million households. The remote rural area covering North Yorkshire and Cumbria is more clearly defined.

Trends

This indicator illustrates that accessibility of food shops is not a major issue for most of the population even if they do not have access to a car.

Due to changes in DfT's data collection, the earliest comparable data set for this indicator is from 2015. Between 2015 and 2019, there were not any marked changes in the accessibility of food shops.

Urban areas already have a high saturation of food shops. Opening new shops in rural areas might not be financially viable due to lower customer numbers. Expansion in, and changes to, online grocery offers, such as changes to minimum spend and delivery charges, could improve accessibility rates further. To measure the effect that online grocery shopping has on household food security, a new indicator may be considered for the next iteration of the UK Food Security Report.

While this report does not contain data on food shop accessibility in the devolved administrations (DAs), some research for Northern Ireland suggests low-income households in rural areas may experience food insecurity differently compared to low-income households in urban areas. With rural areas having reduced access to services such as public transport and retail options compared to urban areas, the effects of food poverty can be exacerbated.[110]

Poverty Premium

There are various approaches to defining what the poverty premium is, but generally it is understood as the extra costs low-income households incur when buying the same goods and services as high-income households. Some of the main drivers behind the poverty premium are based on low-income households' constrained finances, which prevent them from accessing favourable deals. Other factors include the geography and corresponding infrastructure in the area a household resides in, a household's digital access, as well as market failures where the needs of low-income households are not met. People can pay a poverty premium in many areas, including fuel, financial and banking services, transport, housing, insurance, and groceries. Low-income households paying extra costs for services compared to high-income households exacerbates pre-existing inequalities in these households.[111]

With low-income households already spending a higher percentage of their household budget on food than the average household, it is important to understand whether they also face additional costs. A study undertaken by the Institute for Fiscal Studies (IFS) in 2012, as well as other studies conducted in 2009 and 2010, noted that there was no evidence to suggest that low-income households pay more for food, or that they faced a premium by not being able to buy food in bulk. In fact, they

[110] McClelland, N., 'Putting food poverty in NI on the map' (2019), [redacted]

[111] Davies, S. and others, 'Paying to be poor: Uncovering the scale and nature of the poverty premium' (2016), [redacted]

stated that many households purposefully buy in bulk to pay lower prices.[112] However, the food budget is not the only factor enabling bulk buying. Buying in bulk is contingent on having the facilities to refrigerate or freeze food, and space to store it at ambient temperatures. Access to food shops is more of a challenge for people who do not have such facilities as they must shop more often. Furthermore, those who have limited cooking facilities or who cannot afford to run them may be paying a premium for items such as ready meals.

Geography is an important factor in determining whether low-income households face a poverty premium for groceries. The same IFS report suggests that households living in rural areas without access to a car are more likely to use local shops, where food prices can be higher. More research needs to be done to understand how low-income households without digital access to online food shopping might be impacted financially.

Indicator 4.2.1 Eligibility for Free School Meals

Headline

Eligibility rates for free school meals have been fairly stable across the UK in recent years, with Wales and England seeing an increase from 2018 due to the introduction of Universal Credit and its transitional protection. There was also a further increase between January 2020 and January 2021. This is likely due to COVID-19 impacting households' financial situations as well as the continuing Universal Credit transitional protection measures, which have extended eligibility to more pupils.

Eligibility rates are also expected to increase in Scotland in the coming years due to the staggered expansion of universal free school meals for Primary 4 pupils in August 2021, Primary 5 pupils in January 2022, and all primary school children in August 2022.

Context and Rationale

All four nations in the UK offer the option of free school meals to eligible pupils. Free school meals are intended to support learning and development to ensure that pupils do not miss out on lunch due to financial constraints. To claim free school meals

---

[112] NatCen, 'Advice on the Measurement of the Poverty Premium across UK markets' (2019), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/782513/natcen_report.pdf.

(outside of the infant free school meals available to all households in England and Scotland), either family or pupil must be claiming particular state benefits. Data from the Family Resources Survey shows that households on these benefits all have below average food security status, except for households claiming pension credits.[113] 57% of households on Universal Credit are food secure compared to 92% of all households. Free school meals data provides important context on households with children which have a low food security status.

Other programmes exist to support pupils' food requirements. These include the School Fruit and Vegetable Scheme in England, the School Holiday Enrichment programme in Wales, as well as the School Milk Scheme and Breakfast Club Programmes available across the UK. This report focuses on free school meals, however, as they provide the most substantial daily meal and reach the largest number of pupils.

Data and Assessment

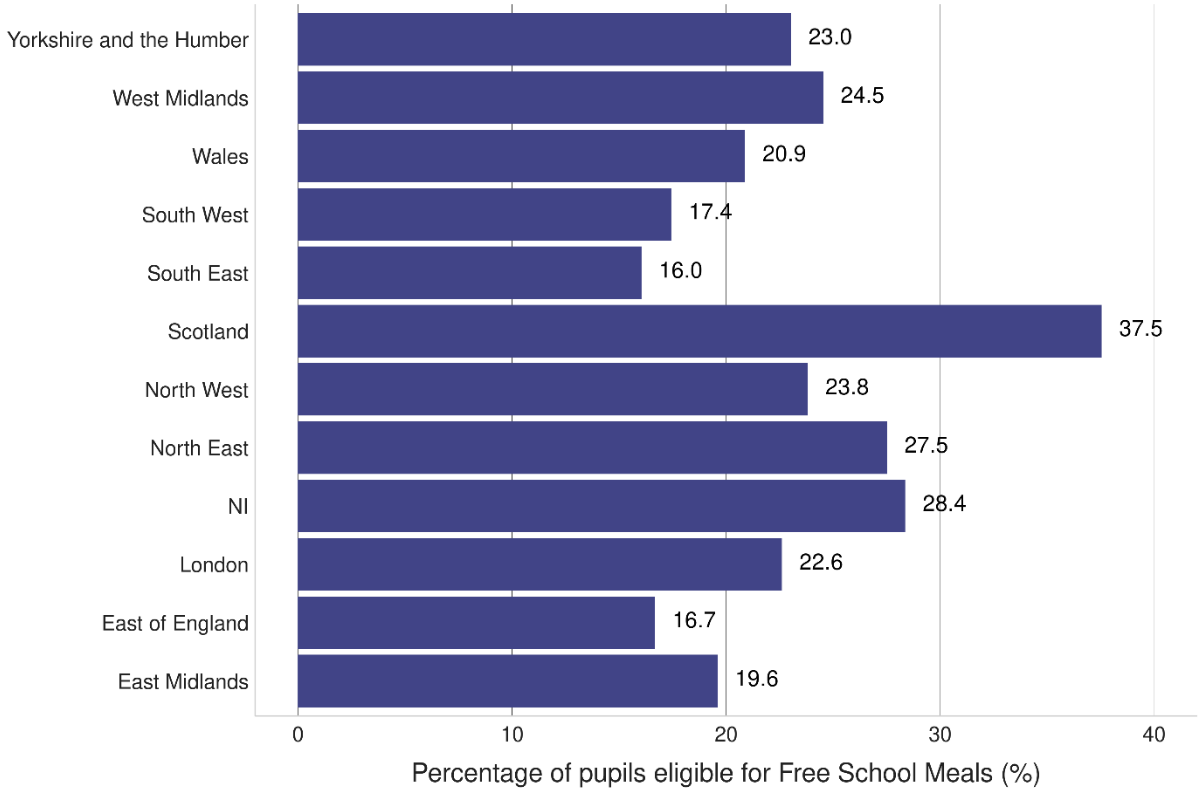
Indicator: Eligibility rates of Free School Meals

Source: Department for Education, Welsh Government, Scottish Government, Northern Ireland Department of Education

Note: The different countries have different eligibility thresholds for Free School Meals. This may impact the levels of eligibility between countries and make direct comparisons between countries more complex.

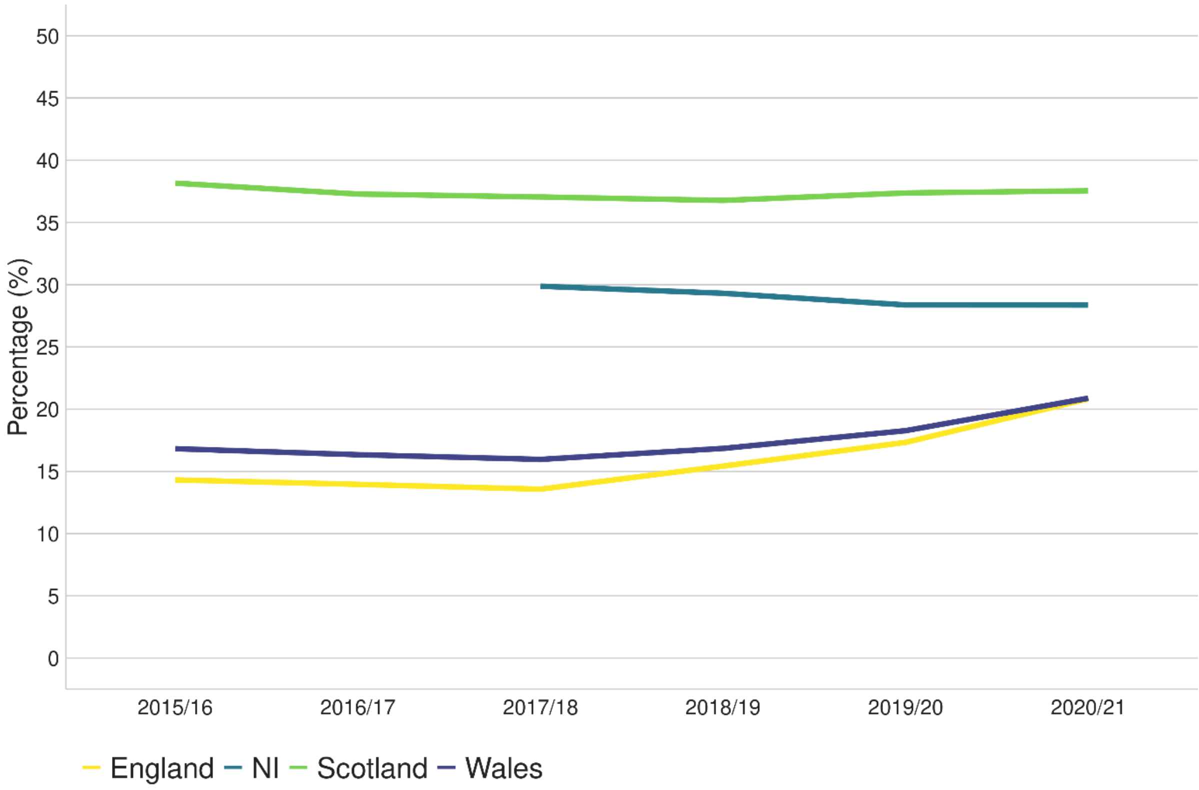
[113] DWP, 'Family Resources Survey', https://www.gov.uk/government/statistics/family-resources-survey-financial-year-2019-to-2020/family-resources-survey-financial-year-2019-to-2020.

Figure 4.2.1a: Percentage of pupils eligible for Free School Meals, UK, 2020/21



In FYE 2021 the region or country with the highest proportion of school children eligible for free school meals is Scotland with 37.5%, although the data for Scotland includes all children in primary 1 to 3. Northern Ireland is the next highest with 28.4%, followed by the North East with 27.5%. The region with the lowest eligibility is the South East at 16.0%, followed by the East of England with 16.7%.

Figure 4.2.1b: Percentage of pupils eligible for Free School Meals, UK, 2015/16 – 2020/21



When looking only at the countries, not regions, Scotland had the highest rate in 2020/21 at 37.5% while England had the lowest rate at 20.8%, very slightly lower than Wales with 20.9%.

In the years for which data is available, Northern Ireland and Scotland have both very slightly decreased in their free school meal eligibility rate. Northern Ireland from 29.9% in 2017/18 to 28.4% in 2020/21 and Scotland from 38.2% in 2015/16 to 37.5% in 2020/21. Wales and England have both increased between 2015/16 and 2020/21, Wales from 16.8% to 20.9% and England from 14.3% to 20.8%.

Trends

The increase in eligibility rates observed for England and Wales from 2018 can be attributed to the introduction of Universal Credit and its transitional protection measures, which have enabled more pupils to stay eligible for free school meals. In April 2018, the criteria used to determine which pupils are eligible for free school meals were updated to reflect the introduction of Universal Credit and the phasing out of other income-based benefits. In England, under the updated criteria, the government estimated in 2018 that by 2022 around 50,000 more pupils would benefit from a free school meal compared to the previous benefits system. From 1 April 2018 in England and 1 April 2019 in Wales, transitional protection was also implemented for those pupils who might otherwise have lost free school meals following the update to the eligibility criteria. This means that any existing pupil who no longer met the eligibility criteria at the point at which Universal Credit was fully rolled out continued to receive free school meals until the end of their current phase of education.

Although trends in eligibility rates have been stable across the UK for the last few years, there have been recent increases that are likely linked to COVID-19 impacts on households' income and the ongoing Universal Credit transitional protection for England and Wales. Between January 2020, before COVID-19, and January 2021, the percentage of pupils entitled to free school meals has increased in Wales and England, but not in Northern Ireland. In England, it has increased from 17.3% to 20.8% and in Wales from 18.3% to 20.9%.

The Scottish Government's annual Schools Healthy Living Survey Report in 2021 did not provide data on the uptake of free school meals. The annual school meals survey which provides data for this report normally takes place every February, but the schools were closed at this point due to the COVID-19 pandemic. The Scottish Government provided local authorities with funding to provide support in lieu of free school meals to eligible families during all periods of school closures. Monitoring returns from local authorities showed this support was reaching up to 175,000 children and young people.

The uptake rates are expected to increase in Scotland in future years. In addition to children in Primary 1 to 3, all children in Primary 4 became entitled to receive free school lunches in August 2021. Universal provision will be extended to all children in Primary 5 in January 2022 and then to all primary school children in August 2022.

Indicator 4.2.2 Take-up of Healthy Start voucher scheme

Headline

Healthy Start vouchers are a scheme in England, Wales, and Northern Ireland to support people on low incomes to access pre-natal vitamins, infant milk formula, and healthy food for young children. In Scotland an equivalent Best Start Foods scheme launched in August 2019. The take-up rate of the Healthy Start voucher scheme was relatively stable between 2019 and 2021. Eligibility rates have increased in England and Wales, nd decreased in Northern Ireland between early 2019 and summer 2021. These increases are likely linked to COVID-19 and its impacts on the financial situation of households.

Context and Rationale

The Healthy Start voucher scheme is available in England, Wales, and Northern Ireland. In August 2019, Scotland introduced its own scheme called the Best Start Foods scheme. Both schemes are aimed at enabling low-income families with young children, and women during pregnancy, to access healthy food and vitamins. Beneficiaries need to meet certain criteria determined by their income level, stage of pregnancy, and age of their children to be eligible for the schemes. Once qualified, families receive vouchers, or in the case of the Best Start Foods scheme, a prepaid card, which helps them pay towards products such as infant milk formula, milk, fresh, frozen, or tinned fruits and vegetables, fresh or dried pulses, and vitamins. The Healthy Start scheme is in the process of moving towards a card system as well.

Including data on the take-up rate of these schemes amongst eligible households contributes to the wider picture of household food security. Both schemes provide assistance to households that might otherwise struggle to purchase healthy food during the important development stages of young children.

Due to the Best Start Food scheme in Scotland launching in August 2019, February 2019 data for Scotland is not available to include in this indicator.

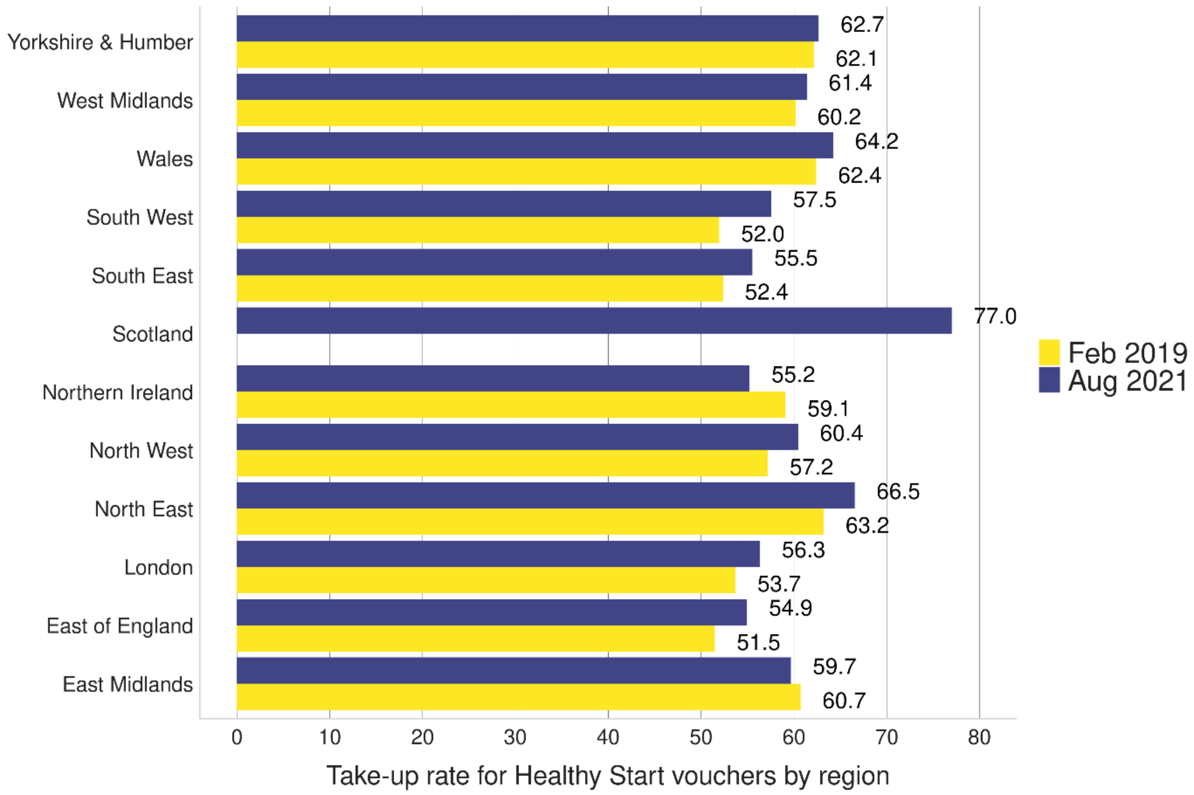
Data and Assessment

Indicator: Take-up rate in the UK

Source: Department of Health and Social Care

Note: The take-up rate shows the percentage of people who have successfully applied for vouchers or payment cards, out of the people who are eligible. This does not mean that the vouchers were spent.

Figure 4.2.2a: Take-up rate for Healthy Start vouchers by region and country, February 2019 and August 2021



In August 2021, the take-up of Healthy Start vouchers (and Best Start payments in Scotland) in the UK was 61.9%, with 376,000 people receiving vouchers or payments. This has increased slightly since February 2019 when the take-up was 57.2%, although this rate did not include Scotland as its scheme did not start until August 2019.

In August 2021 the region with the highest take-up was Scotland, with 77.0% (36,720 people) while in February 2019 it was the North East with 63.2% (16,411 people). Northern Ireland had the lowest take-up rate in 2021 with 56.0% (10,589 people) and East of England did in 2019 with 51.5% (18,670 people).

There has been an increase in the take-up rate in all regions participating in the Healthy Start voucher scheme between 2019 and 2021, except in Northern Ireland which saw a drop from 59.1% to 56.0%. The South West saw the highest increase, rising from a take-up of 52.0% to 59.7%, followed by the East of England which rose from 51.5% to 56.7%.

There has been an increase in the number of people eligible for Healthy Start vouchers and Best Start Food payments in all regions and countries in the UK between February 2019 and August 2021. The highest increase was seen in London at 34.2% while the lowest increase was in Northern Ireland at 12.2%.

Trends

Although the Healthy Start voucher (and Best Start payment) schemes have been available for more than ten years, this report focuses on data from 2019 to 2021 as full data on the total number of people eligible for the scheme was not available prior to 2019. Since 2019, this data has been available, making it possible to draw more meaningful comparisons between different time periods.

While trends have been relatively stable, between February 2019 and August 2021, eligibility in England has increased by 28.8%, in Wales by 18.7%, and in NI by 12.2%. This is likely due to the COVID-19 pandemic and its impacts on households' financial situation.

Case study 4.1 Food Aid

Overview

There is no comprehensive record of the number of organisations providing food aid in the UK. This is because many different types of organisations provide food aid, including registered charities, places of worship, community organisations, schools, hospitals, and commercial and social enterprises. Government data is limited regarding the number of individuals or households receiving food parcels, how many parcels they might have received and over what period. However, DWP has measures in train to improve the official statistics on this subject in the future.

Background

This report defines food banks as organisations that distribute food to those in need. Food banks are seen as emergency crisis provision and are often the last resort for individuals before going hungry. According to the Trussell Trust, 'destitution – and the resulting inability to afford essentials – is the main reason for people needing to use a food bank.'[114]

Food aid is provided by a very broad range of organisations, including registered charities, churches, schools, hospitals, and community centres. Businesses may support these or distribute food directly. Organisations providing food aid proliferated in wealthy countries, including the UK, after the financial crash of 2007 to 2008. Over the COVID-19 pandemic food banks saw an upward shift in demand as social restrictions in 2020 impacted on peoples' lives and livelihoods, and the government

114 Trussell Trust, 'End of year stats', https://[redacted]/.

implemented a range of measures to mitigate them. Third sector aid is not widely available for other non-discretionary living expenses such as housing or transport, making food aid an immediate source of support for people in financial hardship.

The two main charitable food bank organisations in the UK are the Trussell Trust and the Independent Food Aid Network (IFAN). In February 2021, there were over 1,300 Trussell Trust food banks in the UK, in addition to over 1,000 independent food banks. Both have reported increases in the number of food parcels distributed.[115]

Due to the complexity of the food aid landscape, the UK government does not hold data on the precise number of organisations which distribute food aid. Questions related to food aid access have been added to DWP's Family Resources Survey and the results for financial year 2021 to 2022 will be published in 2023. These new questions will assess the number of households accessing food banks within the previous 30 days and will improve government understanding of food aid use and its links to food poverty. This data will be included in future UK Food Security Reports.

Food aid is provided through various means, and to have a thorough understanding of the true scale of the problem requires additional data to fully understand the landscape of food aid and food poverty. Data that DWP are collecting will produce robust official statistics on food bank usage for the first time, and will be an important step forward for the evidence base in this area.

Impact of the COVID-19 pandemic and government response

The COVID-19 pandemic tested the UK's food supply system more than any other time in over 70 years. Businesses across the food supply chain had to adjust rapidly to greatly increased consumer demand. People spent more time at home and ate out less. The overnight closure of many businesses due to lockdown meant that many individuals lost their source of income and had to find alternative ways to feed themselves and their families.

During the period when lives and livelihoods were significantly impacted due to public health restrictions, the government provided significant financial support. As part of its pandemic response, the UK government supported incomes through the Coronavirus Job Retention Scheme ('furlough') with a total of £69.3bn in claims to date, and the Self-Employment Income Support Scheme has paid out over £27bn across all five grants.

In England, £429.1m were given to Local Authorities to provide further support to households struggling with the cost of food and other essentials due to the pandemic. In summer 2020, there was also a £3.5m package of support made available for small food charities through a grant scheme and a further £10m grant assistance

---

[115] House of Commons Library, 'Food Banks in the UK' (2021), [redacted]

made available to FareShare, a national network of charitable food redistributors, to deliver food to the most vulnerable.[116] There was also a package of further support for vulnerable individuals and families during the winter period 2020 to 2021. This package included a further £16m of funding to FareShare to work with local charities and organisations to provide food for those struggling due to the immediate impacts of the pandemic.

In Scotland, amongst wider measures there was £56 million worth of assistance provided in lieu of free school meals to low-income households during school holidays and periods of remote learning. Over £100 million was provided across the Wellbeing, Supporting Communities, and Third Sector Recovery Funds which include supporting a range of food-based activity alongside wider wellbeing action. In 2021 to 2022, the Scottish Government continued to provide assistance in lieu of free school meals to low-income families during the school holidays. In early 2021 the Scottish Government issued a position statement on a human rights approach to tackling food insecurity, and in October 2021 launched a consultation on a national plan to end the need for food banks as a primary response to food insecurity.[117]

In Wales, amongst wider measures an additional £50.7m was allocated to ensure children eligible for free school meals did not go hungry during school holidays. £2m was awarded under the EU Transition Fund to local authorities in Wales to help build resilience in the food aid network. More than 3,000 food boxes were delivered to independent food banks to help meet an increase in demand. The Voluntary Services Emergencies Fund approved £1m for voluntary projects related to food distribution, and £198,000 was allocated to FareShare to support operations which divert good food from going to waste.

Within Northern Ireland, amongst wider measures, £415,000 was allocated to FareShare to increase the supply of food to charities who support those in food poverty.

The Food and You Survey, discussed in **Indicator 4.1.4**, provides a snapshot of the use of food aid in England, Wales, and Northern Ireland between November 2020 and January 2021, at the height of the second wave of the pandemic. Although this currently only offers one data point, the survey results are recognised as an Official Statistics output. Respondents were asked if their household had received a free parcel of food from a food bank or other emergency food provider in the last 12 months. 90% reported that they had not used a food bank or other emergency food provider in the last 12 months, while 7% reported that they had. The 7% of respondents who had received a food parcel from a food bank or other emergency provider were asked how often they had received one in the last 12 months. 26% had

---

116 Fareshare, [redacted]
117 Scottish Government, 'Food insecurity and poverty - United Nations: Scottish Government response', https://www.gov.scot/publications/scottish-government-response-un-food-insecurity-poverty/; 'Ending the need for food banks: a draft national plan', https://consult.gov.scot/housing-and-social-justice/ending-the-need-for-food-banks/.

received a food parcel on only one occasion in the last 12 months, 41% had received a food parcel on more than one occasion but less often than every month, and 6% had received a food parcel every month or more often.

Case Study 4.2 Public Sector Food Procurement in England

Overview

Public food procurement impacts almost 24% of the population in England and is an important lever to promote a healthy, sustainable food system, to support economic growth, and deliver a broad range of social, environmental, and health benefits. Defra is responsible for updating the public sector food procurement standards and ensuring any risk of food supply disruption is mitigated. The Department of Health and Social Care (DHSC) is responsible for the nutrition standards in the government buying standards for food and catering services (GBSF).

Background

The GBSF set mandatory and best practice requirements for procurement of healthier, more sustainable food in the public sector in England. The standards were originally introduced in 2011 as a means of demonstrating leadership and providing clarity around what constitutes sustainable, healthy food and catering procurement. The standards will be consulted upon and updated in early 2022 to maximise the intended social, economic, and environmental impact. This may include reporting on key metrics associated with the objectives of the GBSF, enabling government to benchmark and set targets.

It is currently mandatory for central government departments, their executive agencies, and non-departmental public bodies to comply with the GBSF, along with the NHS, armed forces, and HM Prison and Probation Service. The wider public sector is encouraged to, but not mandated, to comply with the standards. For example, the GBSF is referenced by the School Food Standards.

The public procurement landscape is highly fragmented, and there are a wide range of delivery models. Procurement decisions are devolved to individual organisations, such as government departments and agencies, hospital trusts, and schools. In schools, around 40% of catering is outsourced to private caterers, 40% is under local authority control, with the remaining 20% managed in-house where food is procured directly from wholesalers. Large public sector organisations like NHS trusts, the armed forces, and government departments frequently procure food and catering as part of facilities management contracts. These are commonly delivered by a small number of ‘big players’ in the market. HM Prison and Probation Service has one national contract with a single wholesaler to deliver prison food, alongside two other contracts for additional provisions.

Discussion

Almost 2 billion meals are served in public sector settings each year.[118] Government spend on food is an estimated £2.4bn, which is 5.5% of the UK food service sector turnover. Of the total spend, 29% is in schools, 29% in further and higher education settings, 25% in hospitals and care homes, 11% in the armed forces, 5% in prisons, and 1% in government offices.[119] Food eaten in schools could make up as much as 50% of a child’s diet in termtime, and for some a free school lunch is their only main meal of the day.[120] Improving public sector food buying standards benefits all and has the potential to help close the health gap between those from the lowest and highest income households.

Maintaining a secure food supply

Through engagement and monitoring, Defra gathers relevant industry intelligence related to potential food supply concerns and potential risks. The Department for Education, Ministry of Justice, DHSC, and the Ministry of Defence are responsible for public sector food provision within their respective sectors (for schools, prisons, hospitals, social care providers and the armed forces) and a cross government approach to understanding the risks and issues to public sector food supply is taken. Lead government departments regularly meet with suppliers to understand potential issues. Defra closely monitors and proactively engages with public sector food service providers in the wholesale sector to understand emerging risks.

The economic viability of the food service wholesale sector, notably larger companies, is not considered at risk. Monitoring, however, and close collaboration between government and industry continues following the COVID-19 pandemic.

In the event of food supply disruption, or when risks emerge that may result in disruption, Defra will convene and chair with Cabinet Office a Public Sector Food

---

[118] Defra, ‘National Food Strategy: Independent Review’, https://www.gov.uk/government/publications/national-food-strategy-for-england, page 253.
[119] Defra, ‘A plan for public procurement: food and catering’ (2014), https://www.gov.uk/government/publications/a-plan-for-public-procurement-food-and-catering.

[120] Royston, S. and others, ‘Fair and square: a policy report on the future of free school meals’, The Children’s Society (2012),

https://[redacted], page 12.

Working Group. This group provides a forum for government departments to jointly discuss broader strategic concerns that impact the public sector food supply chain, share intelligence and mitigations. Lead government departments can enact enhanced engagement directly with their suppliers to understand the risk landscape and agree to mitigations such as substitution, menu modifications, and potential relaxation of standards if required.

Theme 5: Food Safety and Consumer Confidence

This chapter of the UK Food Security Report looks at food security in terms of the extent to which consumers are confident in the overall safety and authenticity of the food they eat and the supply chain that delivers it. Public trust in UK food, both in the UK and overseas relies heavily upon confidence in food safety, food standards and confidence in a high-quality food regulatory regime. Without public trust in food safety and standards the UK food supply chain could be undermined. Safe food produced to high standards is integral to food security: it protects public health, reduces the economic and social burden of foodborne disease and food hypersensitivity, and contributes to economic growth and international trade. This theme provides data on the key factors that underpin confidence in the UK food system and risks to this, such as food business compliance with food safety regulation, food safety incidents and recalls, levels of foodborne disease, and activity to disrupt food crime.

Key messages

- The majority of consumers in the UK trust the food they buy and eat to be safe and accurately labelled, when prompted consumers express concern around animal welfare, environmental issues, nutrition, and food production methods.
- Food business compliance with food safety regulation has remained high with slight increases in all four countries of the UK in the past six years, although there is some year-to-year variation.
- Laboratory confirmed reports of pathogens causing foodborne gastrointestinal disease in the UK and the proportional trends in foodborne disease outbreak surveillance data generally remained relatively stable over the period 2015 – 2019.
- Although food safety incident reports have increased since 2010, this is attributable to better detection and higher levels of reporting rather than an increase in risk.

Both safety and consumer confidence in the food system are key to national food security. If there are products which people are not confident in eating, or if doing so actively risks undermining health, this could effectively reduce supply.

The UK nations have a strong regulatory base to ensure the confidence and safety of the UK food supply is maintained. Within this regulatory context it is the responsibility of food businesses to ensure that all food placed on the market is safe, that its quality is what consumers would expect, and that it is not labelled in a false or misleading way. Consumers are responsible for the safe preparation and storage of food in the home and for checking labels to make sure that food is suitable for them to eat.

In the context of assessing UK food security, the effectiveness of the UK's regulatory system for food safety is paramount. Metrics to monitor confidence in the system, indicators to track compliance, challenges which could undermine confidence and realised risks (incidents) help to illustrate this.

Consumer confidence in the food system and its regulation

Confidence in food systems is key to food security. It ensures that physical supplies of food are fully utilised and reduces the risks of consumer demand shocks which may result from product substitution through loss in confidence in some elements of the system. Food regulation is a cornerstone of the maintenance of high standards and confidence in authenticity and safety.

The food system is complex, and its regulation involves multiple bodies. Risks to consumers are varied, including foodborne disease, food allergic reactions or intolerances, risks associated with food crime such as the misrepresentation or adulteration of food and risks arising from mislabelling. Food regulation, and its enforcement, are designed to prevent or reduce these risks. Critical interventions include legislation, enforcement regimes, cross-government and cross-agency working, and partnership working with industry, food sector, and consumer bodies nationally and internationally.

Food and feed safety, including incidents, food poisoning, outbreaks, allergens and intolerances, recalls and risks associated with food crime are regulated by the Food Standards Agency (FSA) in England, Wales, and Northern Ireland, and by Food Standards Scotland (FSS) in Scotland. These independent government departments work with local authorities to enforce food safety regulations and check that standards are being met. The use of the best scientific evidence and analysis available enables effective responses to food incidents and outbreaks. This includes surveillance work to monitor and prevent potential risks to food.

Consumer trust in the FSA and FSS is high. In England, Wales, and Northern Ireland, 78% of consumers who have some knowledge of the FSA trust the FSA to make sure food is safe and what it says it is, and in Scotland 77% of consumers trust FSS. In England, Wales, and Northern Ireland 93% of consumers are confident that the food they buy is safe to eat and 89% are confident the information on food labels is accurate. In Scotland, 68% of consumers trust the information on food labels. In England, Wales, and Northern Ireland consumers report most confidence in farmers (88%) and shops and supermarkets (87%) and least confidence in takeaways (70%) and food delivery services (52%). While time series data is available in Scotland, for consistency trends are not presented due to changes in how data were collected by the FSA in 2020 in the rest of the UK.

Most consumers in England, Wales, and Northern Ireland (88%) report no concerns about the food they eat. When prompted, the most common concerns amongst respondents in England, Wales, and Northern Ireland are the amount of sugar in food (60%), food waste (60%), and animal welfare (57%). When presented with a separate list of issues, respondents in Scotland are most concerned about animal welfare (79%) and the use of pesticides, hormones, steroids, and antibiotics in growing or producing food (77%).

Food business compliance with food safety regulation

It is the responsibility of food businesses to ensure that all food placed on the market is safe. Compliance with food safety regulation is an indicator of good food hygiene practices among those who handle food and is associated with a lower risk to consumers. Across England, Wales and Northern Ireland the percentage of establishments that are found on inspection to be broadly compliant or better with food hygiene law has increased from 89% in 2014/15 to 90.4% in 2019/20. In Scotland, compliance with food hygiene increased from 88% in 2015/16 to 93% in 2020/21, and compliance with food standards has remained high at 99% over the same period. Since 2017/18 food hygiene and food standards inspections in Scotland have been combined into a single food law inspection, and the food law compliance status has increased from 92% in 2017/18 (the first year of the scheme) to 96% in 2020/21.

Food safety incidents, alerts and recalls

A food incident occurs when concerns around the safety or quality of food may require action to protect consumers. Incidents broadly fall into two categories: contamination during food processing, distribution, retail or catering, and environmental pollution such as fires and chemical leaks. Numbers of food safety incidents are not a direct measure of food security. Fluctuations in numbers reflect a diverse range of factors. However, whilst it is unlikely that a food safety incident would cause an overall shortage to food supply, it could impact specific products within the food supply chain and undermine consumer confidence in food safety.

Incidents, food poisoning, outbreaks, allergens and intolerances, recalls and risks associated with food crime, are regulated by the FSA in England, Wales, and Northern Ireland, and by FSS in Scotland. These independent government departments work with local authorities to enforce food safety regulations and check that standards are being met. The use of the best scientific evidence and analysis available enables effective responses to food incidents and outbreaks. This includes surveillance work to monitor and prevent potential risks to food.

The number of food safety incidents reported has increased; much of this is due to better ways of detection and increased voluntary reporting by food businesses and does not necessarily indicate a change in the food and feed safety profile of the UK. The types of incidents that are reported, however, provide an insight into the causes of incidents and the associated risks. These include detection of pathogenic micro-organisms, residues of veterinary medicinal products, chemical contamination, as well as allergens.

The number of food recall notices has remained relatively stable. The number of allergy alerts increased when new legislation required better labelling of allergenic ingredients in 2017 but has remained small: no more than 2 in any of the last 3 years.

Prevalence of foodborne pathogens and outbreak surveillance

For overall food security in the UK, it is important that the food consumed is safe to eat and does not constitute a threat to consumers' health. While not all gastrointestinal infections caused by organisms such as bacteria, viruses, or protozoa, are foodborne, food is an important vehicle of transmission for many gastrointestinal pathogens that cause a substantial public health burden.[121]

The UK Health Security Agency (formerly Public Health England), Public Health Wales (PHW), Public Health Scotland (PHS), and Public Health Agency Northern Ireland (PHA) are the lead agencies responsible for the protection of public health in the four nations. While these executive agencies do not have direct statutory powers to enforce legislation in relation to food safety, they are responsible for the surveillance of infectious gastrointestinal disease, including disease caused by pathogens that pose a food safety risk in the UK. This includes the identification, investigation, and management of foodborne disease outbreaks.

The four most significant bacterial pathogens that may contaminate food are *Campylobacter*, non-typhoidal *Salmonella*, Shiga toxin-producing *E. coli* O157 (STEC O157), and *Listeria monocytogenes*.

Campylobacter sp is the most commonly reported bacterial gastrointestinal (GI) pathogen. Campylobacter reporting showed a marginal overall increasing trend

---

[121] World Health Organisation, 'Estimates of the global burden of foodborne diseases', 2015
[redacted]

from 2015 to 2019, with a peak in reporting of 102.3 cases per 100,000 population in 2018. *Salmonella* is the second most commonly reported bacterial GI pathogen; reporting remained relatively stable during 2015-2019, with a peak of 15.2 cases per 100,000 population in 2018.

STEC O157 and *Listeria monocytogenes* are less commonly reported but reported cases have higher rates of severe illness than *Campylobacter* and *Salmonella.* For both STEC O157 and for *Listeria monocytogenes* there has been a slight decrease in laboratory confirmed reports between 2016 to 2019, although there are some year-to-year fluctuations. For STEC O157 the decrease in reporting rate was from 1.35 to 1.07 per 100,000 population, and for *Listeria monocytogenes* the decrease was from 0.29 to 0.23 per 100,000 population, although low numbers of reported cases complicate interpretation of trends for *L. monocytogenes* infection.

The 2020 foodborne pathogen surveillance data indicators cannot be compared to the data from previous years, as a substantial and sustained reduction in reporting of gastrointestinal pathogens to national surveillance has been observed coinciding with the SARS-CoV-2 (COVID-19) pandemic. The impact is likely multi-factorial and related to the introduction of non-pharmaceutical interventions (NPIs) to control the pandemic, as well as other factors so trend analysis for the data presented in this report should only be considered for 2015 – 2019, with exclusion of 2020 data.

An ‘outbreak’ is defined as an incidence of two or more human cases of the same disease, linked to the same source. Specifically in relation to foodborne disease outbreaks it is where the cases are linked, or are probably linked, to the same food source. In total, the UK public health agencies investigated and reported 276 foodborne disease outbreaks during the period 2015-2020, with nearly 10,000 associated human disease cases. The proportional trends in causative pathogens, hospitalisation rates, associated foods implicated in the outbreak investigations, and outbreak settings remained relatively stable over the period 2015 to 2019 and generally consistent with that seen in the previous decade. However, the implementation of whole genome sequencing since 2015 and the COVID-19 pandemic in 2020 have impacted on this data indicator.

Food Crime

Food crime interventions demonstrate the UK food safety authorities’ ability to receive, assess, and respond to intelligence concerning food crime. The FSS’s Scottish Food Crime and Incidents Unit (SFCIU) and the FSA’s National Food Crime Unit (NFCU) are responsible for tackling food crime in Scotland, and England, Wales, and Northern Ireland respectively.

Disruptions are a recently implemented measure of food crime interventions which stop or reduce the opportunity for food crime offending and in doing so, increase UK food security by ensuring food is safe. Recorded disruptions from the NFCU and successful operations by the SFCIU demonstrate the delivery of activity to stop or reduce the overall scale of food crime across the UK.

The NFCU began recording food crime disruptions in 2020/21. Data shows a steady increase in the number of disruptions recorded through the year attributed to improvements in operational capability and a greater focus on, and awareness of, the full scope of disruption strategies. Overall, NFCU recorded 190 disruptions to food crime, with 52 Pursue disruptions and 138 Prepare, Prevent or Protect disruptions being delivered. The SFCIU was involved in a significant number of investigations during 2020/21 which had various intervention and disruption strands, and are developing an approach to capture the percentage of actionable intelligence that resulted in a positive outcome.

Indicator 5.1.1 Consumer confidence in the food system and its regulation

Headline

Consumer trust in the FSA and FSS is high. Most respondents in England, Wales, and Northern Ireland are confident that the food they buy is safe to eat and that the information on food labels is accurate. In Scotland, the majority of respondents trust the information on food labels. Consumers in England, Wales, and Northern Ireland have more confidence in farmers and shops and supermarkets compared to takeaways and food delivery services

Context and rationale

A loss of consumer trust (either domestic consumers or international trade partners) in food safety can lead to reduced demand and significant economic impacts which in turn can threaten whole sectors of the economy. A fall in consumer confidence can also erode trust in how government and industry communicate risk to the public. Attributes such as safety, sustainability, and authenticity cannot be verified by the consumer at the point of purchase, so consumers must rely on others to communicate this information.

Data and assessment

Indicator: Proportion of consumers reporting confidence in food safety (FSA), proportion of consumers reporting confidence in accuracy of food labelling (FSA and FSS), trust in food regulators (FSA and FSS).

Source: FSA; FSS

Figure 5.1.1a: FSA respondents' confidence that food is safe to eat: Food and You 2, Wave 2 (2021)

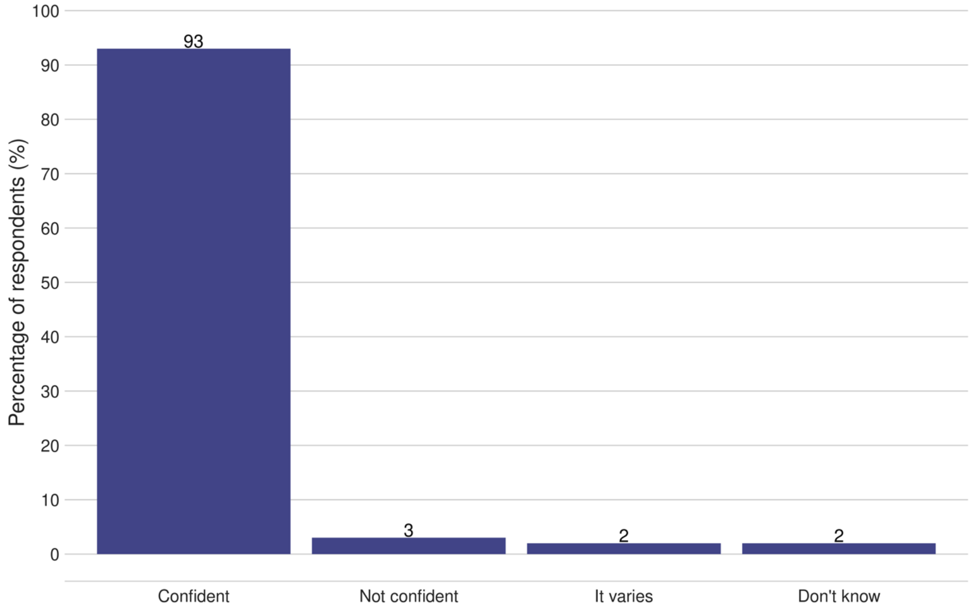


Figure 5.1.1b: FSA respondents' confidence that information on food labels is accurate: Food and You 2, Wave 2 (2021)

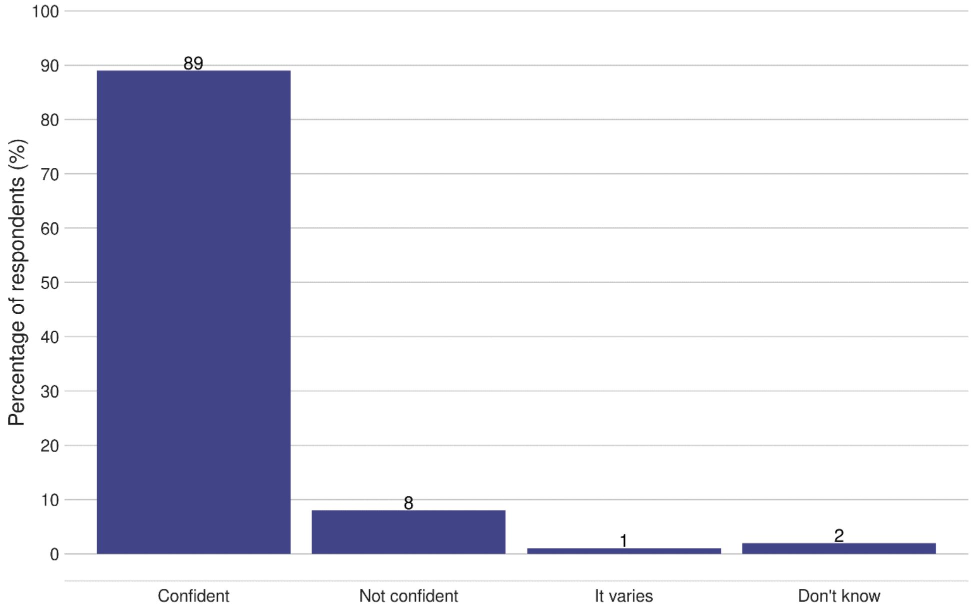
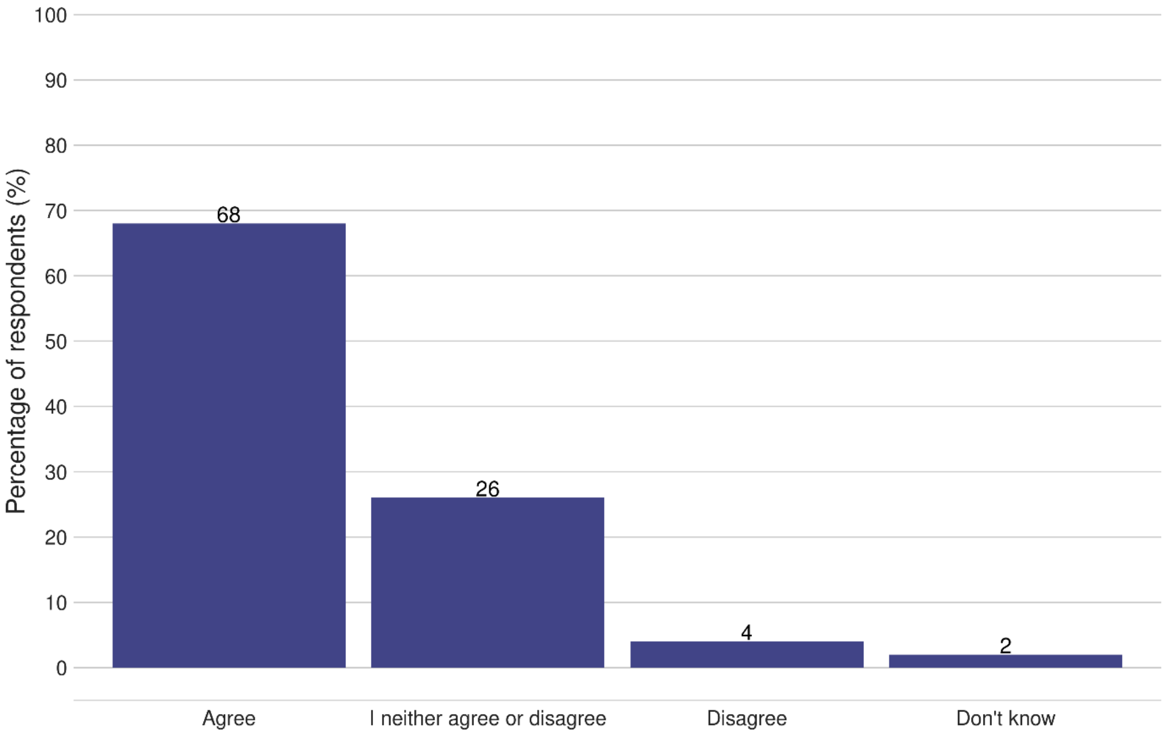


Figure 5.1.1c: FSS respondents' trust in the information on food labels: Consumer Tracker Survey, Wave 11 (2021)



In 2020 to 2021 the majority of respondents (93%) in England, Wales, and Northern Ireland reported that they were confident that the food they buy is safe to eat. 89% of respondents reported that they were confident that the information on food labels, for example, ingredients, nutritional information, country of origin, is accurate. 68% of respondents in Scotland agreed with the statement “I trust the information on food labels” with 4% disagreeing with the statement.

Figure 5.1.1d: FSA respondents' trust in the FSA: Food and You 2, Wave 2 (2021)

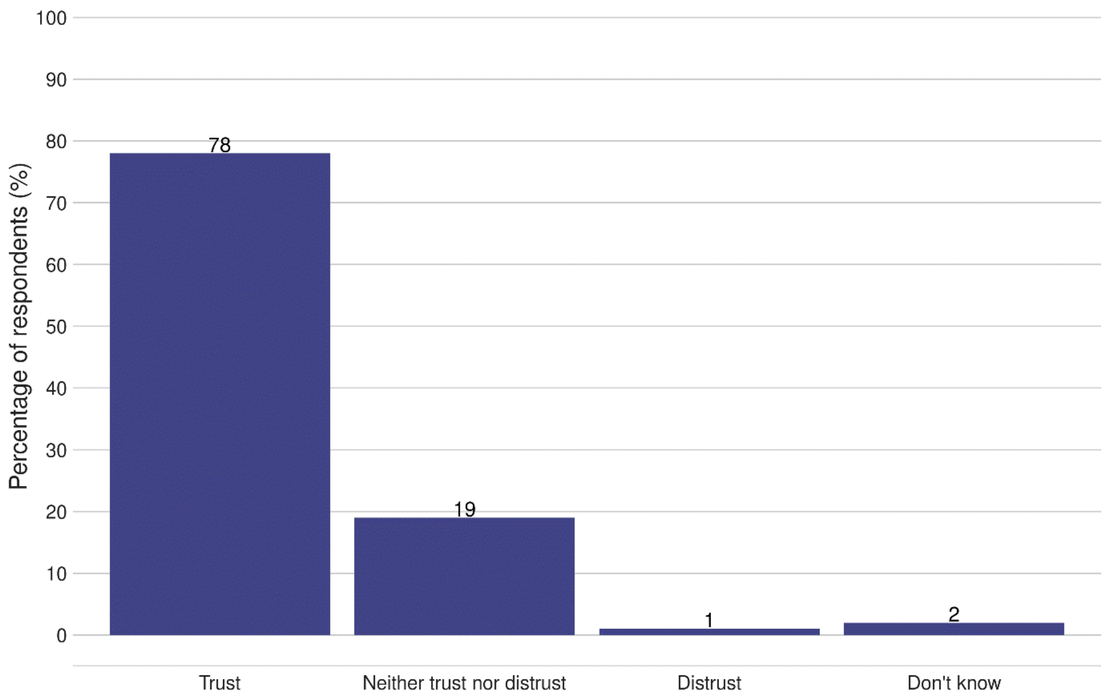
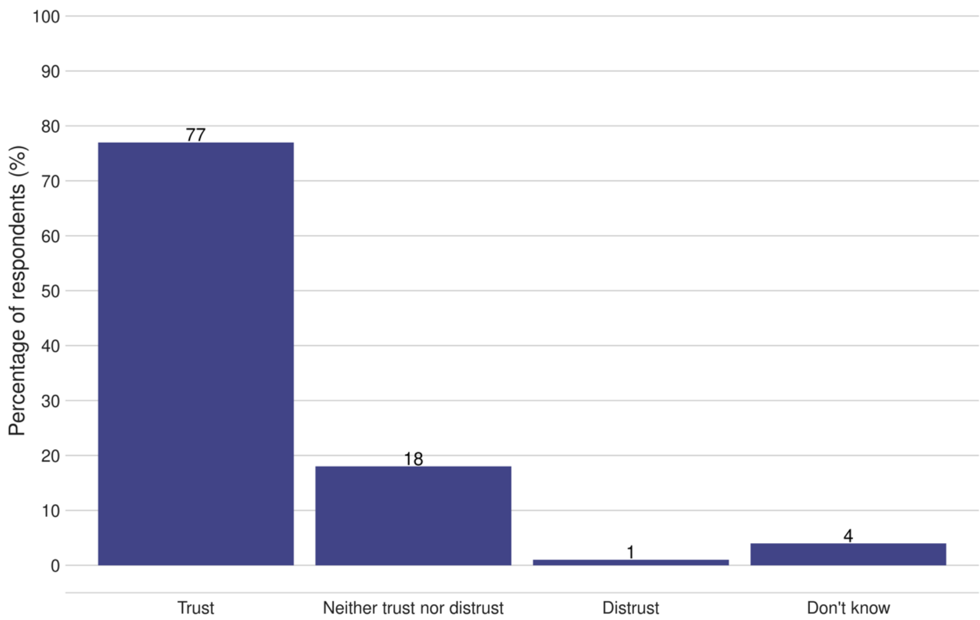


Figure 5.1.1e: FSS respondents' trust in FSS: Consumer Tracker Survey, Wave 11 (2021)



Amongst the sample in England, Wales, and Northern Ireland, 52% knew a lot or a little about the FSA and what it does. Of those consumers who have at least some knowledge of the FSA, trust in the FSA is high with 78% of respondents reporting that they trust the FSA to do its job (that is to make sure that food is safe and what it says it is). 1% of respondents reported that they distrust the FSA. Respondents in Scotland had very similar levels of trust in the FSS with 77% of respondents reporting that they trust FSS and only 1% reporting that they distrust the organisation.

Figure 5.1.1f: FSA respondents' confidence in the food supply chain: Food and You 2, Wave 2 (2021)

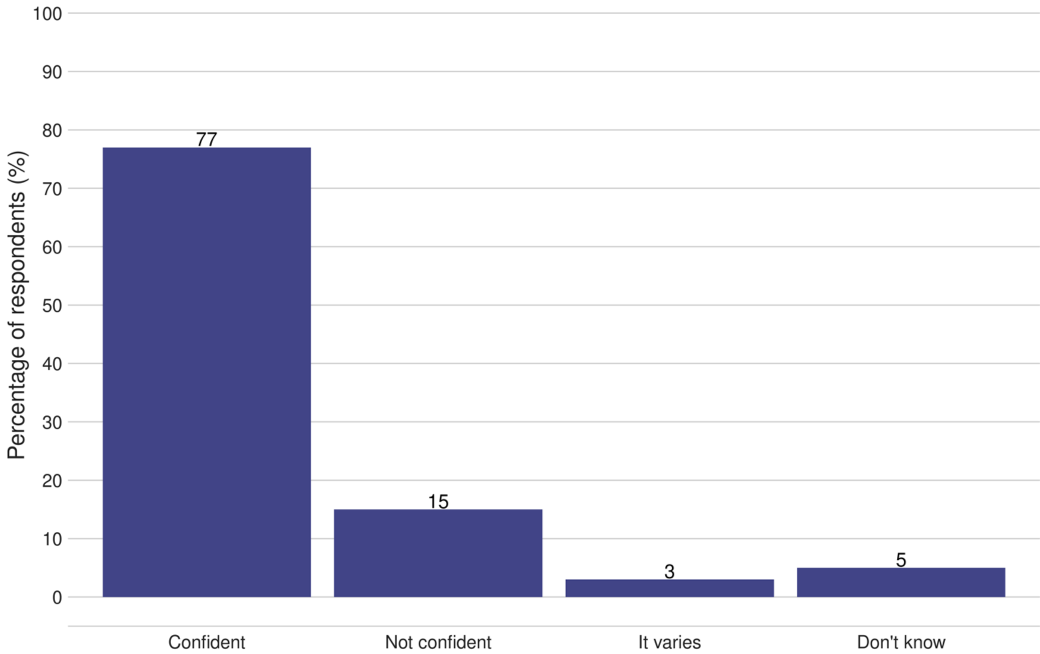
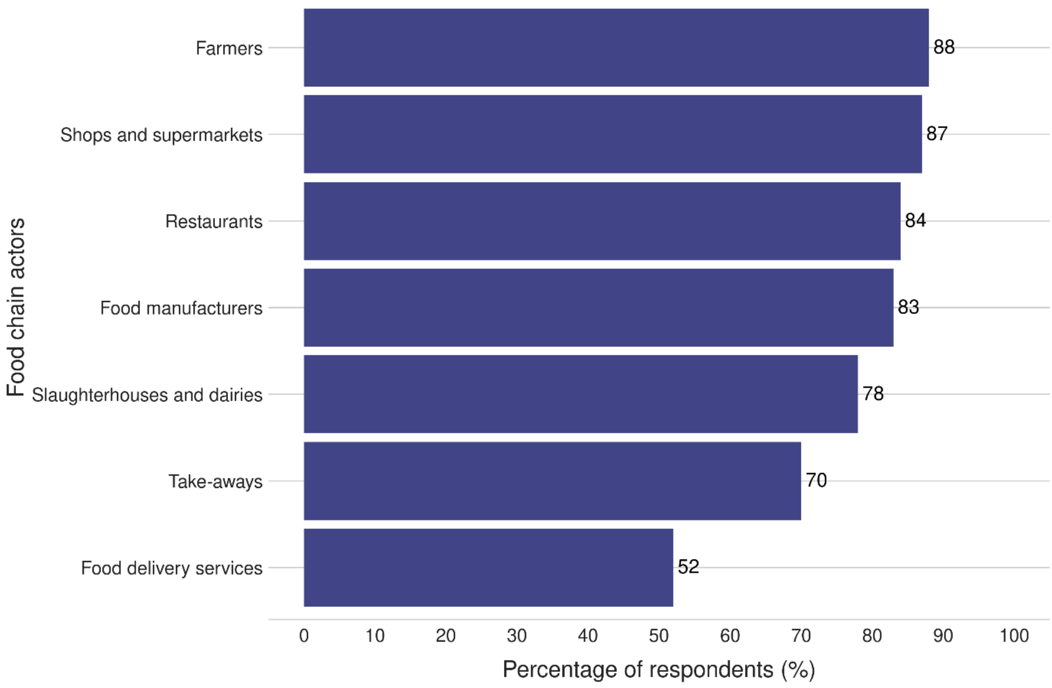


Figure 5.1.1g: FSA respondents' confidence that food supply chain actors ensure food is safe to eat in: Food and You 2, Wave 2 (2021)



Amongst consumers in England, Wales, and Northern Ireland, confidence in the overall food supply chain was high with 77% of respondents reporting that they were confident in the food supply chain. When respondents were asked to indicate how confident they were that key actors involved in the food supply chain ensure that the food they buy is safe to eat, respondents were more likely to report confidence in farmers, shops and supermarkets, restaurants, and food manufacturers compared to takeaways and food delivery services.

Trends

FSA undertook a wholesale review of its Food and You 2 survey methodology in 2020 to enable more frequent and more flexible surveying so robust trend data is not available for this report. However, the high levels of consumer confidence reported are similar to those recorded in the previous surveys.

Time series data is available for Scotland on some of these data, however for consistency these have not been included within this report.

Indicator 5.1.2 Consumer concerns

Headline

Most people in England, Wales, and Northern Ireland report no concerns about the food they eat. When a list of potential concerns are presented, the most common concerns amongst respondents in England, Wales, and Northern Ireland are the amount of sugar in food, food waste, and animal welfare. When presented with a separate list of issues, respondents in Scotland are most concerned about animal welfare and the use of pesticides, hormones, steroids, and antibiotics in growing or producing food.

Context and rationale

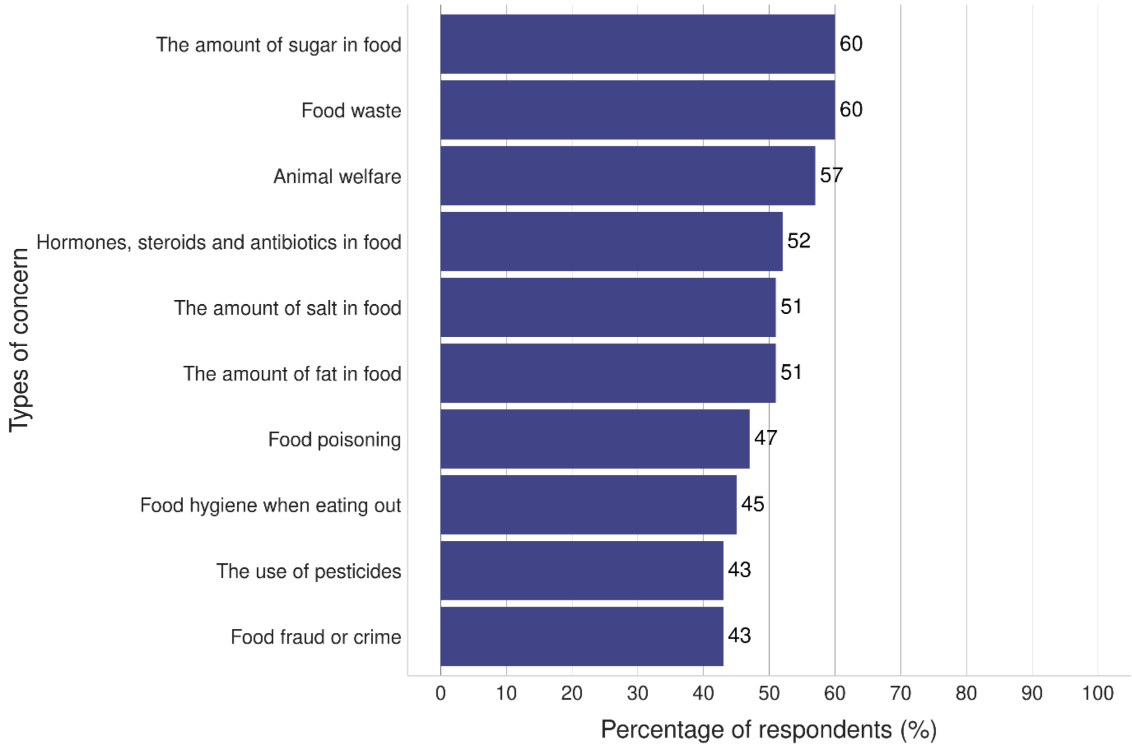
There are many constituent parts of the food system, and consumers may have concerns about one or more of these parts. Understanding which areas of the food system are of most concern to consumers is important for policy development, risk communications and advice, and ensuring consumers can make informed choices about the food and drink they purchase.

Data and assessment

Indicator: Proportion of respondents reporting concern from a list of issues

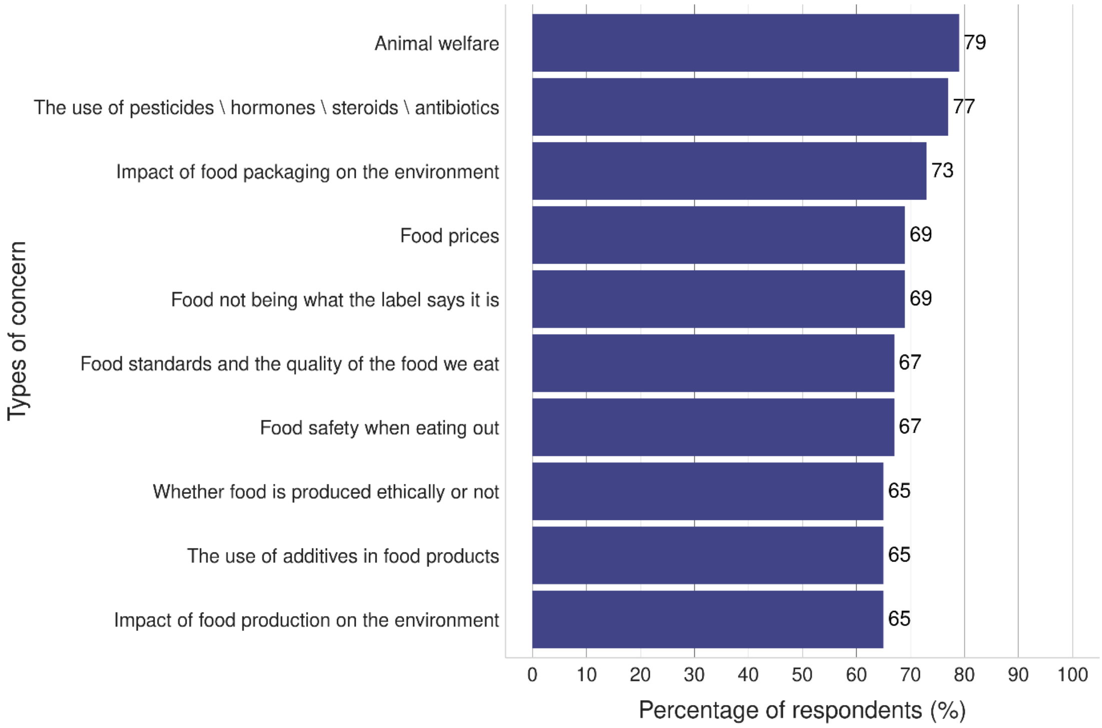
Source: FSA; FSS

Figure 5.1.2a: FSA respondents – ten most common prompted concerns: Food and You 2, Wave 2 (2021)



Most respondents in England, Wales, and Northern Ireland (88%) had no concerns about the food they eat. However, when asked to indicate if they had concerns about a number of food-related issues from a list of given options, the most common concerns amongst consumers in England, Wales, and Northern Ireland were the amount of sugar in food (60%), food waste (60%), and animal welfare (57%). 43% of respondents reported being concerned about food fraud or crime (for example, food not being what the label says it is).

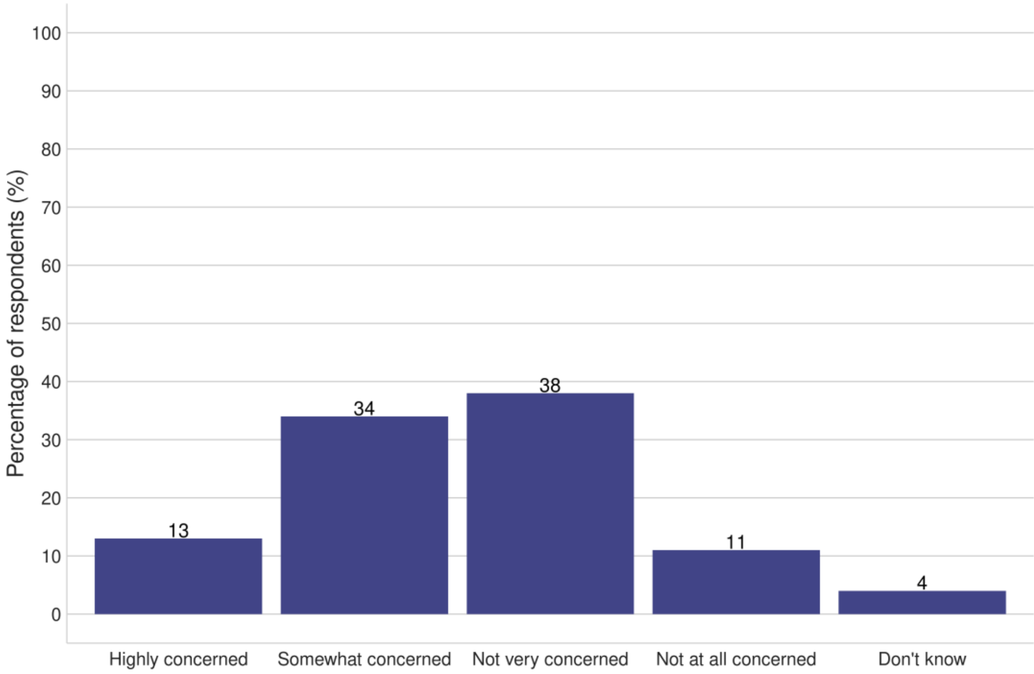
Figure 5.1.2b: FSS respondents – ten most common prompted concerns: Consumer Tracker Survey, Wave 11 (2021)



Animal welfare was the top concern amongst consumers in Scotland, with 79% of respondents in Scotland choosing this. 77% of respondents reported that some food production methods or inputs such as pesticides or antibiotics were also a concern. 69% of respondents were concerned about food not being what the label says it is.

It should be noted that respondents in Scotland would have selected concerns from a different set of survey options compared to respondents in England, Wales, and Northern Ireland as the methods of data collection differ substantially between surveys.

Figure 5.1.2c: FSA respondents' concern about availability of food: Food and You 2, Wave 2 (2021)



Respondents in England, Wales, and Northern Ireland were also asked specifically about the extent to which they were concerned about the availability of a wide variety of food; 13% of respondents were highly concerned, 34% somewhat concerned, 38% not very concerned and 11% not at all concerned.

Trends

FSA undertook a wholesale review of its Food and You 2 survey methodology in 2020 to enable more frequent and more flexible surveying so robust trend data is not available for this report. However, the consumer concerns reported are similar to those recorded in previous surveys.

Time series data is available for Scotland on some of these data, however for consistency these have not been included within this report.

Case Study 5.1 Allergen information on Food Pre-packed for Direct Sale

Overview

Government has a key role to play in setting the regulatory framework to ensure that consumers are provided with the information they need to allow them to make safe food choices.

In 2019, following the death of teenager Natasha Ednan-Laperouse, Defra, the FSA, and FSS reviewed the legal framework for allergen information for food which is pre-packed for direct sale (PPDS). They also consulted on proposed amendments relating to the provision of mandatory information, the form of expression and the presentation of allergen labelling information for PPDS foods.

Background

PPDS is food packaged at the same premises where it is sold or offered to consumers and is also in its packaging before it is ordered or selected.

In the UK, it is estimated that 1% to 2% of adults and 5% to 8% of children have a food allergy. This equates to around 2 million people living in the UK with a food allergy, but this figure does not include those with food intolerances.

There is no cure for food allergies and intolerances. The only way to manage the condition is to avoid food that makes the person ill. Therefore, it is important that consumers are provided with accurate information about allergenic ingredients in products to allow them to make safe food choices.

Discussion

Natasha died as a result of an allergic reaction to sesame in a baguette she had eaten. The inquest into Natasha’s death highlighted that food which is offered to consumers in a package without any allergen information can be dangerous.

During the consultation, consumers were clear that they wanted more information about the food they are eating provided on food labels.

Defra, the FSA, and FSS worked together to introduce the Pre-packed food for Direct Sale Regulations from 1 October 2021. The introduction of this new requirement is supported by online training and guidance.

This will help protect food hypersensitive consumers by requiring potentially life-saving allergen information to be highlighted with an ingredients list with the 14 major allergens emphasised on the label of pre-packed food for direct sale. The change means more food products will now have allergen labelling.

Case Study 5.2 Codex

Overview

The UK is widely respected for its technical expertise and is influential in international standard setting. By working to deliver improved global food standards, the UK supports both global and domestic food safety and security.

Background

The Codex Alimentarius is a collection of internationally adopted food standards and related texts that aims to protect consumer health whilst ensuring the safety, quality, and fairness of international food trade. While voluntary, Codex standards serve in many cases as the basis for national legislation. In 2019, the UK provided £500k to the Codex Trust Fund to support eligible developing countries' participation in Codex. Understanding and participating in the work of Codex means countries benefit from increased food safety, security, and harmonisation with global standards which in turn increases their opportunity to trade internationally.

Discussion

The UK is an influential member of Codex and is widely respected for its technical expertise. Steve Wearne, the FSA Director of International Affairs, was one of three Codex Vice-Chairs from 2017 to 2021 and notably led the work on creating and adopting the current Codex Strategic Plan. Steve Wearne has recently been elected as the new Codex Chairperson and this role will help the UK build stronger relations with all Codex members.

To improve global food standards and protect consumers, the UK will share its expertise as co-chair for new Codex work on food fraud. The work aims to develop guidance to improve risk management activities and the exchange of information between authorities and government agencies related to the prevention of food fraud that may impact the health and safety of the consumer and/or disruption of trade.

The COVID-19 pandemic highlighted more than ever the need for good hygiene practices and the importance of the General Principles of Food Hygiene which is used globally as a benchmark for national hygiene rules. The 'General Principles' serves as the foundation hygiene text. It is cross-referenced with other Codex guidelines and sector and product-specific codes of practice as a means of ensuring that basic food hygiene measures are adopted in the production, processing, and distribution of food commodities along the entire food supply chain.

The UK successfully led the work to update this Codex text when it chaired the working group on the revision of the principles. The key actions for change were to revise the text to clarify the key concepts and terms used and simplify the text. Through the electronic working group and plenary discussions, additional changes were made. This included moving to a risk-based approach to water being fit for its intended purpose and introducing significant text on ‘food safety culture’ within the section on management commitment.

The UK has long recognised the value of food safety culture in determining compliance and influencing behavioural change to improve compliance. In 2012 the FSA developed a Food Safety Culture Diagnostic toolkit for inspectors for local authorities. This was to support the assessment of food safety management during food hygiene official controls, with a particular focus on micro and small businesses.

With the increasing global and national interest in business culture and its relationship with regulation, the FSA decided to look again at food safety culture and its potential role as part of a modernised regulatory system, work on which is ongoing.

Indicator 5.1.3 Food business compliance with food safety regulation

Headline

Across England, Wales and Northern Ireland the percentage of establishments that are found on inspection to be broadly compliant or better with food hygiene law has remained high. In Scotland the compliance status in terms of food hygiene within food business establishments has continued to increase for the same period, and compliance status for food standards has stayed consistent over the period.

Context and Rationale

Compliance with food safety regulation is an indicator of good food hygiene practices among those who handle food. The FSA is responsible for monitoring and reporting on the performance of local authority food law enforcement services in England, Wales, and Northern Ireland. Within Scotland, FSS is responsible for monitoring and reporting on local authority food law enforcement.

Local authorities carry out a range of proactive and reactive interventions at food establishments. Planned checks and interventions, including inspections are carried out in line with the Food Law Codes of Practice in England, Wales, and Northern Ireland.[122] In Scotland planned checks and interventions, including inspections are carried out in line with the Food Law Code of Practice 2019 for food hygiene, at a planned frequency in accordance with a business' risk rating. In England, Wales, and Northern Ireland businesses are rated from A to E, with 'A' being highest risk and 'E' lowest risk. Higher risk businesses receive such interventions more frequently than lower risk ones. The Local Authority Enforcement Monitoring System (LAEMS) was used to collect annual data until 2019/20. For food standards a new delivery model is being developed and is currently being piloted. For this reason, comparable compliance data is not available.

In Scotland, these category descriptors were reversed when FSS started to gradually move from the previous risk rating scheme to the new Food Law Rating System (FLRS) in 2018. Within this E and D premises are the highest risk and A, B and C are lower risk. Until 2017, annual data in Scotland was collected electronically from the LAEMS. However, following the introduction of the Scottish National Database (SND), data was collated electronically from that system.

Compliance data for 2020 to 2021 in England, Wales and Northern Ireland is not available due to the implementation of the local authority Recovery Plan as part of the COVID-19 response. This suspended the LAEMS data collection and has been temporarily replaced with bespoke surveys to monitor progress against the plan. A new system of reporting is under development in England, Wales, and Northern Ireland.

Data and assessment

Indicator: Food business operation compliance status

Source: England, Wales, and Northern Ireland: The Local Authority Enforcement Monitoring System (LAEMS) data; Scotland: The Local Authority Enforcement Monitoring System data and the Scottish National Database (SND).

---

[122] FSA, 'Food and Feed Codex of Practice' (2021), https://www.food.gov.uk/about-us/food-and-feed-codes-of-practice.

In England, Wales and Northern Ireland the FSA tracks the proportion of food establishments that are broadly compliant (equivalent to a Food Hygiene Rating Scheme score of 3 or above).

In Scotland, Food Law (FL) compliance refers to the compliance status under the Food Law Rating Scheme (FLRS), the new risk rating scheme gradually implemented in Scotland in 2018. The compliance categories for the FLRS are A-C. In 2015/16 and 2016/17 the FLRS had not been implemented, therefore there were no FL interventions carried out. Within the former risk rating scheme, which was previously set out in Annex 5 of the Food Law Code of Practice in Scotland, food hygiene (FH) and food standards (FS) compliance categories were E-C for food hygiene and C and B for food standards. Since 2018, new inspection cycles within existing premises and initial inspections in new premises has seen more premises move across to the FLRS risk rating and less premises being inspected under the previous Annex 5 scheme.

While the precise definitions of compliance between Scotland and other three countries are slightly different, both relate to the assessment of an establishment's adherence to food law during an inspection, and so are broadly comparable.

Figure 5.1.3a: Compliance status of inspected food business operators in England, Wales, and Northern Ireland (including unrated establishments).

	2014/15 [123]	2015/16	2016/17	2017/18	2018/19	2019/20 [124]	2020/21
England							
% broadly compliant or better	88.7%	89.2%	89.8%	89.8%	90.4%	90.0%	Not collected
Wales							
% broadly compliant or better	92.1%	92.6%	92.6%	93.5%	93.1%	92.7%	Not collected
Northern Ireland							
% broadly compliant or better	91.5%	93.0%	91.2%	95.4%	94.1%	95.4%	Not collected
Total							
% broadly compliant or better	89.0%	89.5%	90.0%	90.2%	90.7%	90.4%	Not collected

[123] Based on nine months data for Northern Ireland. During 2013/14 preparations were underway for local government reorganisation. In view of this, it was agreed that returns for councils for 2014/15 should be made in advance of the changes becoming effective and would cover the first three quarters of the reporting period.
[124] The 2019/2020 data for England was based on 98% of expected food hygiene returns (all but six returns were received). Wales and Northern Ireland data was for 100% returns received.

Figure 5.1.3b: Compliance Status of premises within Scotland (excluding unrated establishments).

The data within Figure 5.1.3b represents percentage calculations on inspected premises.

Scotland Data: Compliance Status of Food Businesses												
Year	2015/16		2016/17		2017/18		2018/19		2019/20		2020/21	
Compliance Status Food Law (%)	Not collected		Not collected		92		97		97		96	
Compliance Status Annex 5 (%)	FH	FS	FH	FS	FH	FS	FH	FS	FH	FS	FH	FS
	88	99	88	99	89	99	90	99	93	99	93	99

From 2014/15 to 2019/20, the percentage of establishments broadly compliant or better for food hygiene requirements has remained high across all four countries.

Trends

Between 2014/15 and 2019/20 the proportion of food establishments that were ‘broadly compliant’ with food hygiene requirements or better (equivalent to an FHRS rating of 3 or higher) across England, Wales and Northern Ireland has been relatively consistent (89% in 2014/15; 90.4% in 2019/20).

In Scotland the compliance status of food establishments has increased slightly; in 2014/15 food hygiene (FH) compliance status was 88%, this rose to 93% in 2019/20. The food standards (FS) compliance status has stayed consistent. In addition, for FLRS the compliance has increased from 92% in 2017/18 to 96% in 2020/21.

Levels of compliance have been consistently high over the last 6 years. Compliance with food safety and standards regulations is associated with a lower risk to consumers, with higher levels of compliance associated with less risk of foodborne outbreaks and unsatisfactory microbiological samples.[125]

Indicator 5.1.4 Food safety incidents, alerts, and recalls

Headline

The number of food safety incidents reported has increased; much of this is due to better ways of detection and increased voluntary reporting by food businesses and does not necessarily indicate a change in the food and feed safety profile of the UK. The types of incidents that are reported, however, provide an insight into the causes of incidents and the associated risks. These include detection of pathogenic micro-organisms, residues of veterinary medicinal products, chemical contamination, as well as allergens.

The number of food recall notices has remained relatively stable. The number of allergy alerts increased when new legislation required better labelling of allergenic ingredients in 2017.

Context and Rationale

The Food Law Codes of Practice, which cover the UK, outline the definition of a food incident, and the roles and responsibilities of the FSA, FSS, and enforcement authorities for food incidents. The Codes define a ‘food incident’ as “any event where, based on the information available, there are concerns about actual or suspected threats to the safety, quality or integrity of food that could require intervention to protect consumers' interests.” The Feed Law Codes of Practice, which cover the UK, define feed incidents in a similar way.

The number of notified incidents is influenced by several factors such as the introduction of new regulations, consumer trends, advancement in science and technologies, various government led initiatives and increased reporting. Therefore, the data included in this report on the number of incident notifications is only meant to provide an understanding of the number of incidents the FSA and

---

[125] FSA, ‘Evidence of relationship between food business hygiene compliance and measures of food safety (2019), https://www.food.gov.uk/research/research-projects/evidence-of-relationship-between-food-business-hygiene-compliance-and-measures-of-food-safety.

FSS have been made aware of in each Reporting Year. The data is not a clear indicator of any changes in risks to the UK's food security. The break-down of the incidents into various categories, on the other hand, provides an insight into the various hazards or areas of concern that cause food incidents in the UK. The trends in these categories can be a useful indicator to assess where key risks lie.

The FSA and FSS investigate the same incident types but have different categorisation or reporting systems. Incident notifications are categorised according to the potential hazard that is under investigation or that is ultimately of concern. So, where no risk to the safety, quality or integrity of food and feed is identified, the incident may still be classified by the potential issue of concern.

The food, feed and drink supply chains are complex and involve numerous food chain actors from primary producers, to processors, packaging providers and retailers or restaurants. There are multiple points in the supply chain where potential hazards can be detected and communicated to regulators who can then in turn alert consumers.

The FSA and FSS issue alerts to let consumers and food businesses know about problems associated with food, feed, and drink and what action they need to take. These notices and alerts are an important way of communicating to consumers where they need to act and are issued at the FSA's and FSS's earliest opportunity and published online. In addition, point of sale notices are displayed at each of the affected stores for a given time. This is aimed at informing consumers who may have not received the alert through the online platforms.

The alerts indicate a formal response to food safety risks in the food supply chain. The majority of food alerts issued by the FSA and FSS are Product Recall Information Notices and Allergy Alerts (AAs).

A Food Alert for Action (FAFA) is issued to local authorities in cases where a food business operator demonstrates that it cannot or will not adequately recall or withdraw products which fail to meet the safety requirement, and which require specific urgent actions to be taken by local authorities. Very few Food Alerts for Action, which are issued when a food business operator does not adequately comply with safety requirements, have been issued. This indicates that most food business operators comply with the safety requirements laid out in law.

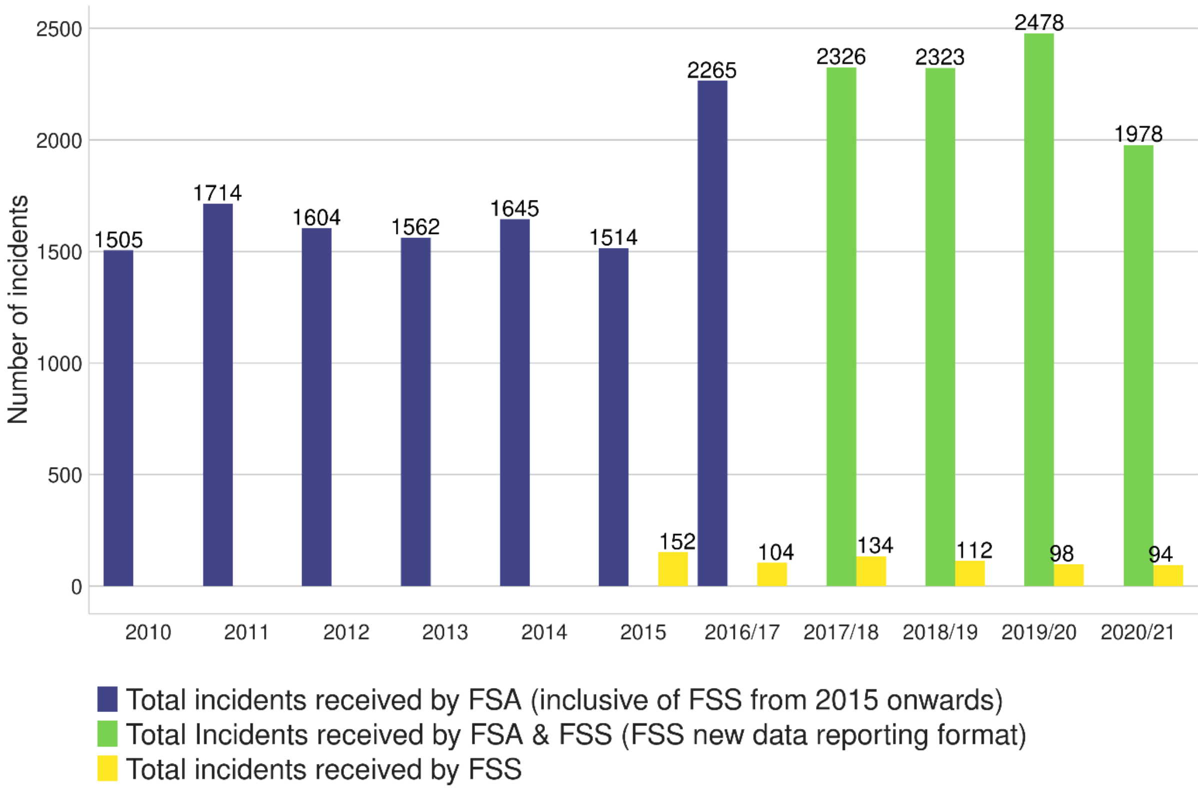
UK food safety bodies are rolling out several incident prevention strategies, the initial focus is the full implementation of the use of root cause analysis (RCA) by industry, enforcement authorities and FSA with analysis and reporting of data; such that root causes can be used to identify themes and underlying trends to help prevent incidents occurring. In addition, strategic surveillance workstreams have developed a number of models based on open and non-open-source data which harness the power of data science to identify emerging risks before they become risks to public health.

Data and assessment

Indicator: Total number of incident notifications received by the FSA and FSS from 2010 to 2021**,** recalls and alerts issued by the FSA and FSS from 2010 to 2021.

Source: FSA and FSS

Figure 5.1.4a: Total number of incident notifications received by the FSA and FSS from 2010 to 2021



In 2017 and 2018, FSS moved to a new data reporting format. Hence, there may be some duplications in the incident figures if the same incident is investigated by both the FSA and FSS.

In 2015 Reporting Year, the 1,514 figure is inclusive of 152 FSS incident notifications. In 2016/2017 Reporting Year, the 2,265 figure is inclusive of 104 FSS incident notifications. From 2017/2018 Reporting Year onwards, there may be some duplications if an incident is investigated by both the FSA and FSS.

Overall, there was a steady rise in incident notifications between 2010 and 2020 with a notable increase in years 2016 to 2017 due to a reporting change, from reporting year to financial year. More broadly, the year-on-year increase can be attributed to several factors including the introduction of new regulations, advancements in technology, science and analytical methods. These have led to better detection and reporting as well as detection of new hazard types including clandestine traveller (stowaways) in food vehicles. The number of notifications received represents how many incidents the FSA and FSS have been made aware of and is not indicative of a change in the UK's food and feed safety profile. Instead, it is more instructive of changes in behaviours, technology, and statutory requirements.

Figure 5.1.4b: FSA breakdown of incidents by category during 2013 to 2021 Reporting Years[126]

	2013	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Biological Origin	477	509	478	504	470	468	531	475
Pathogenic Micro-Organisms	307	348	304	307	376	362	376	350
Non-Pathogenic Micro-Organisms	26	20	35	27	0	4	37	49
Mycotoxins	88	54	58	113	80	87	94	61
Biotoxins (Other)	52	68	56	21	5	6	15	9
Parasitic Infestations	4	0	4	3	9	3	1	0
Bio-contaminants	0	19	21	33	0	6	8	6
Farming Practices	210	251	168	295	324	327	268	242
Residues of Veterinary Medicinal Products	75	210	116	212	218	144	140	114
Pesticide Residues	114	30	41	72	98	177	106	100
Feed Additives	11	9	8	10	7	4	19	27
TSEs (Transmissible Spongiform Encephalopathies)	10	2	3	1	1	2	3	1
Industrial / Chemical	369	290	332	298	123	128	152	109
Heavy Metals	75	74	64	73	39	42	46	43
Migration	29	17	8	14	18	16	33	15
Radiation	4	4	8	3	4	0	1	1
Industrial Contaminants	20	28	63	67	1	4	3	2

[126] FSA (including FSS) breakdown of incidents by category during 2013 to 2014 Reporting Years. From 2015 to 2016-2017 Reporting Years figures include FSA and FSS incidents. From 2017-2018 Reporting Years figures include FSA incident notifications only.

	2013	2014 /15	2015 /16	2016 /17	2017/ 18	2018 /19	2019 /20	2020 /21
Chemical Contamination (Other)	241	167	189	141	61	66	69	48
Other	506	513	757	1168	1408	1400	1527	1152
Allergens	89	140	213	187	260	302	350	187
Adulteration / Fraud	63	62	66	91	18	28	30	12
Labelling Absent / Incomplete / Incorrect	97	69	81	118	160	170	210	155
Genetically Modified Organism / Novel Food	10	9	16	41	64	59	100	54
Food Additives and Flavourings	52	49	35	62	42	43	52	84
Composition	18	46	38	58	100	86	76	89
Foreign Bodies	105	65	97	104	110	104	120	106
Poor or Insufficient Controls	34	25	57	136	287	188	164	91
Organoleptic Aspects	5	9	16	19	5	8	4	0
Packaging Defective / Incorrect	1	5	20	21	10	21	23	6
Environmental Pollutants	n/a[127]	n/a	n/a	n/a	n/a	n/a	n/a	3
Clandestine Detection	n/a	n/a	n/a	n/a	179	198	193	111
CHEMET	n/a	n/a	n/a	n/a	169	181	203	146
Undefined	n/a	n/a	n/a	n/a	n/a	0	0	6
Not Determined / Other	32	34	118	331	4	12	2	26
COVID-19 Outbreaks[128]	0	0	0	0	0	0	0	76
Total	**1562**	**1563**	**1733**	**2265**	**2326**	**2323**	**2478**	**1978**

[127] n/a means data is unavailable for a particular year. This is attributed to a review of incident categories. For example 'Water Quality' incident notifications have been refined and categorised as 'Environmental Pollutants'. This categorisation will capture food incidents resulting from flooding and sewage spillage.

[128] The COVID-19 Outbreak figure reflects the number of notifications logged within the FSA incident management system only. However, we hold additional information on over 200 COVID-19 Outbreaks within a separate record. Other Government Departments and relevant stakeholders also hold additional data on a number of COVID-19 Outbreaks.

This table shows the breakdown of incidents by category reported to the FSA between 2013 and 2021. Overall, there has been a steady increase in incidents with the exception of 2020 to 2021, where a 20% downturn was observed. This downturn is attributed to changes in consumer behaviours, fewer food businesses operating due to the COVID-19 pandemic control procedures and streamlined food production lines. More information on the categories is provided in the appendix.

Figure 5.1.4c: FSS breakdown of incidents by category between 2015 to 2016 and 2020 to 2021

Category	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Allergens	11	8	21	20	18	13
Animal Feed	5	3	7	9	4	4
Chemical	5	1	14	8	10	17
Emergency	4	9	11	6	4	2
Genetically Modified Organism / Novel Food	1	0	0	1	3	5
Illegal Activity	10	5	1	1	3	6
Microbiological	20	23	23	24	27	17
On-farm	12	18	9	6	7	11
Other	3	1	2	3	1	0
Physical	1	1	3	7	7	2
Production Error	3	3	6	7	7	4
Regulatory Breach	11	17	22	17	4	8
Shellfish[129]	66	15	15	3	3	5
Total	**152**	**104**	**134**	**112**	**98**	**94**

[129] FSS amended the way Shellfish incidents are recorded from the 2016 to 2017 Reporting Year. Shellfish incidents are now recorded and investigated when harvesting is known to have taken place.

This table shows the number of incidents by category reported to FSS between 2015 and 2021. Overall, there has been a reduction in the number of incidents recorded by FSS since 2015. The main reason for this is a change in how FSS record their incidents, in particular Shellfish incidents. There are several factors explaining why incidents fluctuate from year to year. These include the introduction of new – or changes to – regulations, advancements in technology, science and analytical methods.

Figure 5.1.4d: Total number of food alerts issued by the UK during 2015/16 to 2020/21 Reporting Years

Led by	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
FSA	166	179	140	190	178	141
FSS	12	26	12	17	8	3
Total	**178**	**205**	**152**	**207**	**186**	**144**

In total, the FSA and FSS issued 144 food alerts during the 2020/21 Reporting Year in comparison to 186 alerts issued in the previous Reporting Year. This represents a 23% decrease when compared to 2019/20. This reduction was primarily driven by the fall in Allergy Alerts.

Figure 5.1.4e: Number of Allergy Alerts issued by the UK during 2015/16 to 2020/21 Reporting Years

Led by	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
FSA	84	98	92	118	106	67
FSS	10	6	1	12	4	3
Total	**94**	**104**	**93**	**130**	**110**	**70**

An Allergy Alert (AA) is issued when the product has been, or is being, recalled from consumers because allergen information on food labels is undeclared or incorrect. The FSA and FSS issued a total of 70 Allergy Alerts during the 2020/21 Reporting Year in comparison to 110 Allergy Alerts issued in the previous Reporting Year. This represents a 36% decrease when compared to 2019/20.

Figure 5.1.4f: Number of Product Recall Information Notices (PRINs) issued by the UK during 2015/16 to 2020/21 Reporting Years.

Led by	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
FSA	80	77	46	72	70	73
FSS	1	14	9	5	4	0
Total	**81**	**91**	**55**	**77**	**74**	**73**

A Product Recall Information Notice (PRIN) will be issued when the product has been, or is being, recalled from the final consumer. The FSA and FSS issued a total of 73 Product Recall Information Notices during 2020/21, much the same as in the previous year (74).

Figure 5.1.4g: Number of Food Alert for Action (FAFA) issued by the UK during 2015/16 to 2020/21 Reporting Years

Led by	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
FSA	2	4	1	1	2	1
FSS	1	6	2	0	0	0
Total	**3**	**10**	**3**	**1**	**2**	**1**

A Food Alert for Action (FAFA) is issued when intervention by enforcement authorities is required. These notices and alerts are often issued in conjunction with a product withdrawal or recall. While the number of recall notices issued has remained stable, very few FAFAs have been issued.

Trends

The number of incidents recorded in any given year can be affected by many factors including new consumer trends, legislative changes, technological and scientific developments, the amount of testing performed, and even the weather. There is a steady year on year increase in incidents from 2013 onwards with the exception of 2020/21 where there was a 20% downturn caused by the pandemic driving changes in consumer behaviour; the streamlining of food production lines; fewer food businesses operating and a reduction in the complexity of the product ranges on offer. The number of incidents reported has now increased following the easing of the national lockdown and is returning to near pre-pandemic levels.

The FSA and FSS highlighted the benefits of Root Cause Analysis (RCA) in food, feed, and outbreak investigations in communications to the enforcement community, and have since committed to the use of RCA as a mechanism for working with industry to prevent incidents.

Between 2015 and 2017, FSS saw an increase in relation to their on-farm incidents. As a result, FSS carried out an incident prevention initiative which involved working with partners to produce a leaflet providing guidance on how farmers could help avoid on-farm incidents. This initiative started at the beginning of 2017 and has helped to reduce the number of on-farm incidents in this category.

There was a rise in the detection of allergen incidents resulting from incorrectly labelled packaging after the implementation of the new Food Information for Consumers Regulation (FICR) in 2014, though changes in dietary trends and international supply chains may also be partially attributable to the observed increases.

Between June 2016 and June 2021, the FSA was notified of 11 allergen related deaths and 11 food related allergic reactions. Notifications from members of the public related to allergies and/or intolerances are referred to the local enforcing authority in the first instance. During the same period, FSS were notified of seven food related allergic reactions.

The reduction of AAs issued in recent years may be partially attributed to:

- High-profile cases resulting in heightened media coverage, leading to greater emphasis on allergen control by food business operators
- Increased allergen awareness campaigns, including by the FSA and FSS
- Impact of Food Information to Consumers Regulation, resulting in greater awareness and allergen risk assessments by food business operators.

Almost all the incidents in the 'Industrial/Chemical' group related to fires which resulted in some potential chemical contamination incident. From 2017/18 Reporting Year onwards, a dedicated CHEMET (Chemical Meteorology) category was introduced for such incidents.

Additionally, each year the FSA runs a Coordinated Food Standards Sampling Programme. This sets different priorities for enforcement authority risk-based sampling and surveillance. The levels of investigation may influence the numbers and types of incidents identified. FSS co-ordinates its own Local Authority Sampling Grants Programme which is designed to take account of UK food standards priorities in addition to areas of particular interest to Scotland.

Finally, during the COVID-19 pandemic, data indicates a downturn of 20% and 4% in the number of incident notifications received by the FSA and FSS respectively. This may reflect fewer food businesses trading over the pandemic and fewer new products coming to the market, as well as a reduction in the complexity of the product ranges offered during this period, and a reduction in local authority inspections. The number of incidents being reported has increased as the national lockdown eased and has now returned to normal level.

Case Study 5.3 Product recalls instigated by malicious tampering with retail consumer products

Overview

In 2019, the FSA and FSS worked with UK law enforcement agencies and Public Health England (PHE) in response to an attempt to blackmail a high-profile supermarket company based in the UK. Prompt responsive action to the threat, including notification to the public by both the FSA and FSS, saw the supermarket company voluntarily recall 182,000 jars of baby food. Direct harm to consumers was avoided, and the impact on wider consumer confidence in the food supply chain was estimated to be at a low level.

Background

The FSA was initially notified by UK law enforcement agencies in October 2019 that a blackmail demand had been received by a supermarket company, threatening the contamination of baby food products from a food producer ('Company 1'), and that the matter was under investigation with those agencies. Subsequently, the FSA and FSS were notified by UK law enforcement agencies in December 2019 that a complaint had been received by the supermarket company of sharp pieces of metal having been discovered in a jar of baby food purchased in a store in Scotland by a consumer, while feeding their baby. Another jar of contaminated baby food was reported to the police having been purchased from a store in the North West of England.

In light of the first discovered tampered product, a voluntary product recall of 8 varieties within the specific baby food range sold by the supermarket company was undertaken as a precautionary measure following close co-operation and discussion between the companies and agencies. A Product Recall Information Notice to the public to highlight the recall was undertaken by both the FSA and FSS.

A further threat was received by the retailer in January 2020 in relation to jars of baby food produced by a second food company ('Company 2'). Neither the retailer nor producer had received complaints, and the threat did not specify locations or product lines. A voluntary recall of 15 varieties within the baby food range was again undertaken as a precautionary measure and the FSA and FSS issued a Product Recall Information Notice to the public to highlight the recall.

Following a successful investigation and prosecution by co-operating UK law enforcement agencies, in what became the UK's largest ever blackmail investigation, the offender was convicted of offences related to this incident as well as other offences. In October 2020, the offender received a sentence of 14 years in prison, including an 11-year sentence in relation to this incident. There are no known cases of injury associated with the incident.

Discussion

The Food Law Code of Practice issued by both FSS and the FSA to competent authorities responsible for the delivery of official food controls and other official activities defines 'malicious tampering' as the deliberate contamination of food by terrorist activity, or with a view to blackmail or extortion. Arrangements for dealing with malicious tampering incidents have been established between the FSA, FSS, and appropriate law enforcement agencies throughout the UK.

If there is a suspected or confirmed safety or quality problem with a food product that means it should not be sold, then it can be 'withdrawn' (taken off the shelves before the product reaches the consumer) and/or 'recalled' (when customers are asked to return the product). The FSA and FSS issue Product Recall Information Notices to let consumers and other stakeholders know about hazards associated with food and/or feed. All alerts published by the FSA and FSS are sent to the local authorities and other stakeholder groups to inform them. In some cases, a Food Alert for Action is issued. This provides local authorities with details of specific action to be taken on behalf of consumers.

The potential for criminal behaviour of this nature to affect the health and wellbeing of consumers directly is obvious, and it also presents a serious risk of harm to food businesses such as retailers and the food industry in general through loss of consumer confidence in the security of the food supply chain. In this particular incident, a careful assessment of the risks presented by the threats identified that while the impact for the wider general public might be considered low, it could be high for the individuals that might be affected by products that had been tampered with. This precautionary principle informed the strategies and contingencies which emerged from the close co-operation between the companies and agencies responding to the incident.

In total, the supermarket company voluntarily recalled 42,000 jars of Company 1's baby food and 140,000 jars of Company 2's baby food, which will have had substantial costs for the companies involved. Against those costs, however, the reported level of consumer concern detected following the recalling of the products and the notification of the recalls by the FSA and FSS appears to have been low. The risk of a wider loss of consumer confidence may well have been mitigated by the prompt responsive action taken as well as the successful subsequent prosecution of the offender.

Additionally, the press coverage of the criminal trial identified that the reporting of at least one of the tampered products to the police was prompted by the first product recall and the value of such action might also be seen in that outcome.

Indicator 5.1.5 Prevalence of foodborne pathogens

Headline

During the period 2015 to 2020, *Campylobacter* continued to be the most frequently reported bacterial pathogen causing infectious gastrointestinal disease in the UK. *Campylobacter* reporting showed a marginal overall increasing trend from 2015 to 2019, while *Salmonella* case reporting remained relatively stable. A decreasing trend in reports of Shiga toxin-producing E. coli (STEC) O157 has been observed since 2016 and, although reported case numbers are low, reports of *Listeria monocytogenes* infection have also declined marginally since 2016. The COVID-19 pandemic had variable impacts on the reporting of case numbers of these four bacterial pathogens in 2020.

Context and Rationale

The UKHSA, PHW, PHS and PHA are responsible for the surveillance of infectious diseases, including gastrointestinal pathogens that cause foodborne disease. Laboratory testing data and epidemiological information on each reported case is recorded in national surveillance databases and case management systems. The aim is to monitor trends in reporting of gastrointestinal pathogens, changes in disease epidemiology and to detect new and/or emerging disease threats, including foodborne disease outbreaks, so that timely and appropriate action to protect public health can be taken.

For overall food security in the UK it is important that the food consumed is safe to eat and does not constitute a threat to consumers' health. While not all gastrointestinal infections caused by organisms such as bacteria, viruses or protozoa are foodborne, food is an important vehicle of transmission for many gastrointestinal pathogens that cause a substantial public health burden.[130] Food poisoning leading to diarrhoea and vomiting as well as other more serious health problems, such as haemolytic uraemic syndrome (HUS).[131] Guillain-Barré

[130] World Health Organisation, 'Estimates of the global burden of foodborne diseases' (2015), https://www.who.int/publications/i/item/9789241565165.
[131] Byrne, L., and others, 'The epidemiology, microbiology and clinical impact of Shiga toxin-producing Escherichia coli in England, 2009-2012', Epidemiology and Infection, 143(16) (2015), pages 3475 to 3487.

syndrome, irritable bowel syndrome),[132] and reactive arthritis,[133] can result in significant negative impacts on both individuals and society as a whole. Published estimates suggest that around one in four people in the UK suffers an episode of infectious gastrointestinal disease each year and foodborne disease in England and Wales results in costs of around £9.1 billion per year to the NHS, the economy and individuals).[134]

There are many gastrointestinal pathogens and microbial contaminants that have a food safety impact. However, four major bacterial pathogens are considered priority pathogens for national surveillance due to the substantial implications for food safety in the UK: *Campylobacter*, non-typhoidal *Salmonella*, STEC O157, and *L. monocytogenes*. This indicator focusses on these pathogens. *Campylobacter* causes a high disease burden because of the considerable numbers of cases reported at a population level each year. *Salmonella* causes the second highest burden in terms of reported numbers of disease cases, with the highest reporting rate seen in children under the age of 10; a population group which is at higher risk of more severe clinical disease. STEC O157 causes gastrointestinal disease with potentially severe complications, especially in children under the age of 5, such as development of HUS.[135] Llisteriosis can have severe health consequences in people who are immunosuppressed or have underlying health conditions, people over the age of 60, pregnant women and new-born babies (typically through infection during pregnancy). Although annual reports of cases of *L. monocytogenes* are relatively small compared to other foodborne pathogens, listeriosis has a high mortality rate (20% to 30%).[136]

No disease surveillance system is perfect and there are both surveillance biases and under-ascertainment of infectious gastrointestinal disease, further information

---

[132] McCarthy, N. and J. Giesecke, 'Incidence of Guillain-Barre syndrome following infection with Campylobacter jejuni', American Journal of Epidemiology 153(6) (2001), pages 610 to 614; Neal, K.R., L. Barker, and R.C. Spiller, 'Prognosis in post-infective irritable bowel syndrome: a six year follow up study', Gut 51(3) (2002), pages 410 to 413.

[133] Dworkin, M.S., and others, 'Reactive arthritis and Reiter's syndrome following an outbreak of gastroenteritis caused by Salmonella enteritidis' Clinical Infectious Diseases 33(7) (2001), pages 1010 to 1014.

[134] FSA, 'The second study of infectious intestinal disease in the community (IID2 Study)', (2016), https://www.food.gov.uk/research/research-projects/the-second-study-of-infectious-intestinal-disease-in-the-community-iid2-study; FSA, 'The Burden of Foodborne Disease in the UK 2018', 2020, https://www.food.gov.uk/research/research-projects/the-burden-of-foodborne-disease-in-the-uk-2018.

[135] Adams, N. and others, 'Sociodemographic and clinical factors for paediatric typical haemolytic uraemic syndrome: retrospective cohort study', British Medical Journal Paediatrics Open 3 (1) (2019).

[136] PHE, 'Listeriosis in England and Wales' (2021), https://www.gov.uk/government/publications/listeria-monocytogenes-surveillance-reports/listeriosis-in-england-and-wales-summary-for-2018; Scobie, A. and others, 'Mortality risk factors for listeriosis - a 10 year review of non-pregnancy associated cases in England 2006-2015', Journal of Infection 78 (3) (2019), pages 208 to 214.

on which is included in the annex to this report.[137] Additionally, it is important to note that the surveillance indicators for 2020 were adversely impacted by the COVID-19 pandemic so the 2020 surveillance data cannot be compared to the data from previous years.

Data and assessment

Indicator: Reported infections of *Campylobacter*, non-typhoidal *Salmonella species (sp).,* STEC O157 and *Listeria monocytogenes* in the United Kingdom, 2015 to 2020

Source: Second Generation Surveillance system (SGSS) and Electronic Communication of Surveillance in Scotland (ECOSS).

Figure 5.1.5a: Number of laboratory-confirmed reported infections in the United Kingdom[138], 2015 to 2020

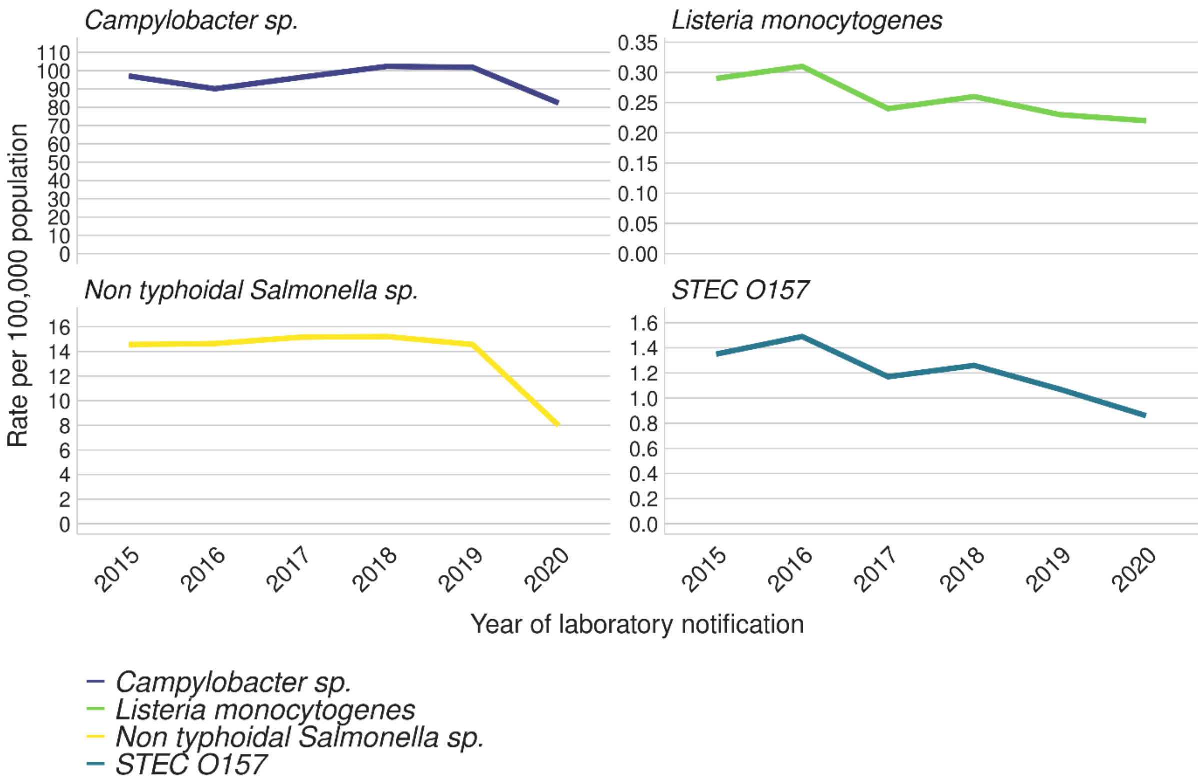
Year	*Campylobacter* sp.	Non-typhoidal *Salmonella* sp.	STEC O157	*Listeria monocytogenes*
2015	63,193	9,479	880	186
2016	58,149	9,610	981	201
2017	63,623	10,010	773	156
2018	67,984	10,107	836	174
2019	68,006	9,724	717	154
2020	54,979	5,329	577	148

Figure 5.1.5b: Rate of reported *Campylobacter* sp., non-typhoidal *Salmonella* sp., STEC O157 and *Listeria monocytogenes* infections per 100,000 population per year in the United Kingdom, 2015 to 2020

[137] FSA, 'The second study of infectious intestinal disease in the community (IID2 Study)' (2016), https://www.food.gov.uk/research/research-projects/the-second-study-of-infectious-intestinal-disease-in-the-community-iid2-study.

[138] Scottish data include serum positive cases and cases that were polymerase chain reaction (PCR) test positive but bacterial culture test negative (pcr+/culture neg). Northern Irish totals for 2019 and 2020 are provisional.

Figure 5.1.5b: Rate of reported Campylobacter sp., non-typhoidal Salmonella sp., STEC O157 and Listeria monocytogenes infections per 100,000 population per year in the United Kingdom, 2015 to 2020



The pathogen with the highest number of reported cases annually across all years from 2015 to 2020 was *Campylobacter.* Case reporting is particularly high in the summer months, with annual peaks usually seen across the months June to August.

Non-typhoidal *Salmonella* was the second most commonly reported pathogen. Peak reporting is usually during the late summer and autumn months.

STEC O157 and *L. monocytogenes* had lower numbers of cases reported, with reporting rate peaks in 2016 of 1.49 cases per 100,000 population for STEC O157 and 0.31 cases per 100,000 population for *L. monocytogenes*.

As illustrated by figure 5.1.5b, the impact of the COVID-19 pandemic on gastrointestinal pathogen reporting rates varied by pathogen. In 2020, there were 5,329 reported salmonellosis cases, a reduction of 45% compared to 2019. *Campylobacter* reporting appeared to be less impacted by the pandemic. Initially there was a substantial reduction in *Campylobacter* reports in April 2020 (between 19% to 33% reduction) but reports had increased to similar levels to those recorded before the COVID-19 pandemic by August 2020 (1% to 7% reduction) and this return to reporting levels seen in previous years was sustained throughout the remainder of 2020 (data not shown) with an overall reduction in reports in 2020 compared to 2019 of 19%.[139] The number of reported cases of STEC O157 fell from an average of 837 cases between 2015 and 2019 to 577 cases in 2020 (overall reduction of 31%). Like *Campylobacter,* there were fewer than expected STEC O157 cases from April 2020 but with levels rising to numbers comparable to the five-year average by August 2020 (data not shown). The reporting rate of *L. monocytogenes* decreased marginally in 2020 (148 cases compared to an average of approximately 170 cases reported in the previous five years, a decrease of 13%).

Trends

After an initial decline in reporting rate between 2015 to 2016, the reporting rate for *Campylobacter* increased from 2017 and reached a peak of 102.33 cases per 100,000 population in 2018. Overall, there has been a marginal but sustained upward trend in *Campylobacter* reports seen over the last decade.

The decreasing trend seen at the start of the decade in reports of *Salmonella* was not sustained in recent years, but case reporting remained lower than pre-2010 levels and relatively stable at approximately 10,000 reports each year until 2020, peaking in 2018 with a reporting rate of 15.21 per 100,000 population.[140]

Reported cases of STEC O157 have shown an overall decreasing trend since 2016. The reason for this decline is unclear, although phage typing indicates a decrease in numbers of one of the most frequently detected types (PT 21/28) (data not shown). In contrast, the number of cases infected with other STEC serogroups (called non-O157 STEC), in particular STEC O26, has been increasing over the last decade (data not shown), likely predominantly due to the increasing number of laboratories implementing enhanced testing methods which enable the detection of all STEC and not just STEC O157.[141] However, a real increase in the number of gastrointestinal infections caused by non-O157 STEC cannot be ruled out and the UK public health agencies are assessing these changes in trends.

---

[139] Ondrikova, N. and others, 'Differential impact of the COVID-19 pandemic on laboratory reporting of norovirus and Campylobacter in England: A modelling approach', PLOS One 16 (8) (2021).
[140] Lane, C. R. and others, 'Salmonella enterica serovar Enteritidis, England and Wales, 1945-2011', Emerging infectious diseases, 20(7), pages 1097 to 1104.
[141] Vishram, B. and others, 'The emerging importance of Shiga toxin-producing Escherichia coli other than serogroup O157 in England', Journal of Medical Microbiology 70 (7) (2021).

Low numbers of reported cases complicate interpretation of trends for *L. monocytogenes* infection. However, the number of reported cases in the UK has declined marginally from 2016 to 2020, following a small increase in 2016.

The 2020 surveillance data indicators 5.1.5a and 5.1.5b cannot be compared to the data from previous years, as an overall substantial and sustained reduction in reporting of gastrointestinal pathogens to national surveillance has been observed coinciding with the COVID-19 pandemic. This may be due to the effects of lockdowns and restrictions on peoples' behaviours, making them less at risk of acquiring certain infections. Examples could include changes in eating out patterns and changes in travel patterns. However, changes in health care seeking behaviours are also likely to have contributed, with fewer people visiting general practitioners and hospitals and having samples taken for testing, as well as changes in laboratory testing practices. Therefore, trend analysis should only be considered for 2015 to 2019, with exclusion of 2020 data.

The significantly lower number of *Salmonella* reports in 2020 was likely driven by multiple reasons, but a marked reduction in number of reports of travel-associated cases due to a reduction in foreign travel during the pandemic was likely to have played a notable role. Travel-associated *Salmonella* in the UK in the pre-pandemic era is estimated to constitute as much as 45% of overall disease burden).[142] Similarly, the reduction in STEC O157 reports reflected a marked reduction in cases reporting foreign travel which normally account for approximately 20% of cases.[143]

The less notable reduction in reports of *L. monocytogenes* throughout 2020 may be due to the fact that reported cases of *Listeria* are typically very unwell and often require hospitalisation, therefore ascertainment is less impacted by a decrease in people visiting their general practitioners and other healthcare settings.

---

[142] Zenner, D. and I. Gillespie, 'Travel-associated Salmonella and Campylobacter gastroenteritis in England: estimation of under-ascertainment through national laboratory surveillance', Journal of Travel Medicine 18 (6) (2011); PHE, 'Travel-associated non typhoidal Salmonella infection in England, Wales and Northern Ireland: 2014' (2017).

[143] Byrne, L. and others, 'The epidemiology, microbiology and clinical impact of Shiga toxin-producing Escherichia coli in England, 2009-2012', Epidemiology and Infection, 143(16) (2015), pages 3475 to 3487.

Indicator 5.1.6 Foodborne disease outbreak surveillance

Headline

In total, the UK public health agencies, together with partner organisations, investigated and reported 276 foodborne disease outbreaks during 2015 to 2020, with nearly 10,000 associated human disease cases. The proportional trends in causative pathogens, hospitalisation rates, associated foods implicated in the outbreak investigations and outbreak settings remained relatively stable over the period 2015 to 2019 and generally consistent with that seen in previous years. However, the implementation of whole genome sequencing since 2015 and the COVID-19 pandemic in 2020 have impacted on this data indicator.

Context and Rationale

The UKHSA, PHW, PHS, and the PHA are the lead organisations responsible for the detection, investigation and management of outbreaks of foodborne disease in the UK, working in partnership with food safety, animal health and local authority colleagues for the implementation of food safety controls (see appendix for further detail).

There are inherent biases which should be considered when assessing the data presented in this indicator. The data derived through systematic national surveillance of foodborne disease outbreaks nonetheless provides an important source of information for foodborne disease trend analysis. This data is used alongside other surveillance indicators for foodborne gastrointestinal pathogens to inform risk assessment and policy development for the protection of UK consumers against risks posed by foodborne disease.

An ‘outbreak’ is defined as an incidence of two or more human cases of the same disease, linked to the same source. Specifically for foodborne outbreaks, the definition usually applied is ‘an incidence, observed under given circumstances, of two or more human cases of the same disease and/or infection, or a situation in which the observed number of human cases exceeds the expected number and where the cases are linked, or are probably linked, to the same food source (including potable water)' (Directive 2003/99/EC).[144]

Public Health Agencies in the UK now routinely perform whole genome sequencing (WGS) for genomic characterisation of several bacterial gastrointestinal pathogens, including *Salmonella* sp., *Listeria monocytogenes, Shigella* sp., *Yersinia* sp. and shigatoxin producing *E. coli* (STEC). The data derived from the systematic national surveillance of foodborne disease outbreaks pre and post the implementation of WGS is not directly comparable.

Data and assessment

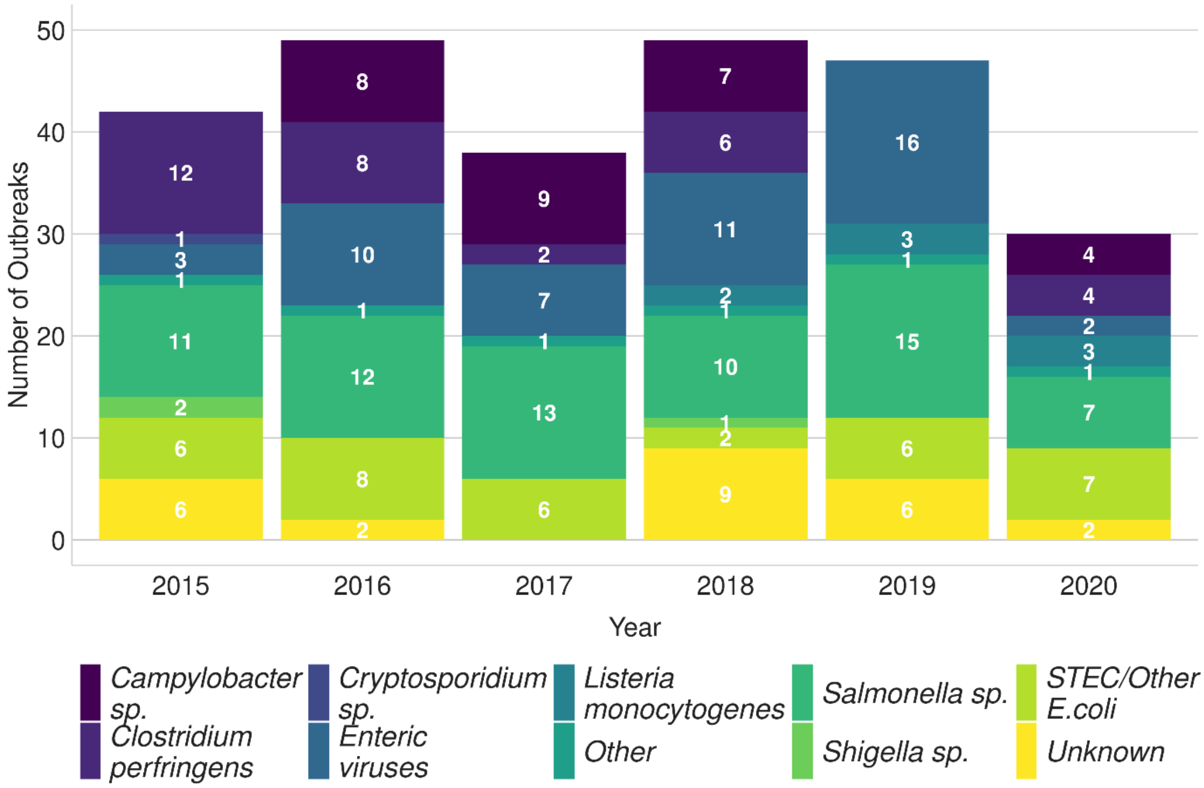
Indicators:

- Number of foodborne outbreaks investigated and reported in the UK and associated number of human cases and hospitalisations 2015 to 2020
- Foodborne disease causative agents and food vehicles implicated in the foodborne outbreaks investigated and reported from 2015 to 2020 and outbreak settings

Source: Electronic Foodborne and non-foodborne outbreak surveillance system (eFOSS) in England and Wales, ObSurv in Scotland and the outbreak surveillance dataset in Northern Ireland

[144] European Union and Council, 'Directive 2003/99 EC of the European Parliament and of the Council of 17 November 2003 on the monitoring of zoonoses and zoonotic agents, Official Journal 325 (2003). [redacted].
.

Figure 5.1.6a: Number of foodborne outbreaks by causative agent investigated and reported to national public health surveillance in the UK, 2015 to 2020



Of the 276 outbreaks reported, 251 outbreaks were investigated where a causative agent was identified between 2015 and 2020. *Salmonella* sp. was the most frequently reported in most years (68 out of 251 outbreaks in total, 27%), with enteric viruses second (49 outbreaks, 20%), followed by *Campylobacter* (42 outbreaks, 17%) and *Clostridium perfringens* (39 outbreaks, 16%). There were between 2 and 8 outbreaks of STEC reported each year during this time period. There were no outbreaks of *Listeria monocytogenes* reported in 2015 and 2016, but 8 outbreaks in total reported between 2017 and 2020.

Table 5.1.6b. Total number of associated human cases and percentage hospitalised (*X%*) associated with foodborne outbreaks reported to national public health surveillance by causative pathogen in UK, 2015 to 2020[145]

Causative agent	2015	2016	2017	2018	2019	2020	Total
Salmonella sp.	**274** *(4%)*	**540** *(4%)*	**688** *(11%)*	**673** *(5%)*	**549** *(7%)*	**732** *(7%)*	**3,456** *(7%)*
Enteric viruses[146]	**210** (*0%)*	**1,407** *(0%)*	**317** *(1%)*	**370** *(0%)*	**476** (*1%)*	**180** (*0%)*	**2,960** *(0%)*
Campylobacter sp.	**190** (*2%)*	**173** *(0%)*	**146** *(6%)*	**140** *(4%)*	**39** *(0%)*	**28** *(4%)*	**716** *(3%)*
Clostridium perfringens	**205** (*1%)*	**163** (*2%)*	**114** (*0%)*	**293** (*0%)*	**141** (*0%)*	**90** (*8%)*	**1,006** (*1%)*
STEC/Other *E. coli*	**106** (*21%)*	**306** (*32%)*	**48** (*25%)*	**55** (*36%)*	**65** (*40%)*	**93** (*32%)*	**673** (*31%)*
Listeria monocytogenes	N/a	N/a	N/a	**17** (*100%)*	**17** (*100%)*	**9** (*100%)*	**43** (*100%)*
Shigella sp.	**17** (*47%)*	N/a	N/a	**34** (*12%)*	N/a	N/a	**51** (*24%)*
Cryptosporidium sp.	**16** *(0%)*	N/a	N/a	N/a	N/a	N/a	**16** *(0%)*
Other[147]	**2** *(0%)*	**23** *(0%)*	**14** *(0%)*	**5** *(60%)*	**13** *(0%)*	**3** *(0%)*	**60** *(5%)*
Unknown[148]	**177** *(0%)*	**15** *(0%)*	N/a	**119** (*1%)*	**140** *(0%)*	**13** *(0%)*	**464** *(0%)*
Total	**1,197** (*4%)*	**2,627** (*5%)*	**1,327** (*7%)*	**1,706** (*5%)*	**1,440** (*6%)*	**1,148** (*9%)*	**9,445** (*6%)*

There were 9,445 cases of foodborne illness reported to be associated with the total 276 outbreaks investigated and reported during 2015 to 2020. The majority of cases (3,456 cases, 37%) were associated with *Salmonella* outbreaks and enteric viruses (2,960 cases, 31%). While just under 6% of the total associated outbreak

---

[145] Hospitalisation data not known for all cases; ascertainment of both cases and hospitalisation varies according to the pathogen, clinical severity and differences in laboratory testing.

[146] Includes foodborne norovirus outbreaks or norovirus outbreaks related to infected food handlers.
[147] 'Other' includes marine biotoxins such as scrombotoxin and okadaic acid as well as other entero-toxin producing bacteria such as *Staphylococcus* or *Bacillus* spp.
[148] Unknown' are outbreaks where a causative agent was not identified as the cause of the disease in the outbreak associated human disease cases.

cases between 2015 and 2020 reported hospitalisation, this varied substantially by pathogen from 0% to 100%.

The effect of routine implementation of WGS for surveillance of bacterial gastrointestinal pathogens has been particularly notable for *Salmonella*. The proportion of all *Salmonella* outbreaks detected at the national level has increased since 2015 from 27% to 67% in 2019, with outbreak associated case numbers per outbreak showing an overall increasing trend (see the appendix for further detail).

Table 5.1.6c. Foodborne outbreaks by food vehicle investigated and reported to national public health surveillance per year, 2015 to 2020 in the UK[149]

Food vehicle	2015	2016	2017	2018	2019	2020	Total
Poultry meat and poultry meat products	12	7	6	5	4	4	38
Composite or mixed foods	6	6	4	5	11	0	32
Other mixed meat/poultry/products	7	5	2	4	2	1	21
Eggs and egg products	3	5	2	2	6	1	19
Beef/bovine meat and products	3	4	2	4	2	2	17
Crustaceans/shellfish/molluscs	1	1	2	6	3	3	16
Fruits and vegetables	0	3	3	3	0	3	12
Dairy	0	1	3	1	1	4	10
Pork meat and products	3	0	2	2	2	0	9
Lamb meat and products	2	0	1	3	2	0	8
Finfish and products	1	0	0	2	0	1	4
Herbs/spices/cereal products/nuts and seeds	0	0	1	1	1	1	4
Potable water	1	0	0	0	0	0	1
Unknown[150]	14	17	10	11	23	10	85
Total	**53**	**49**	**38**	**49**	**57**	**30**	**276**

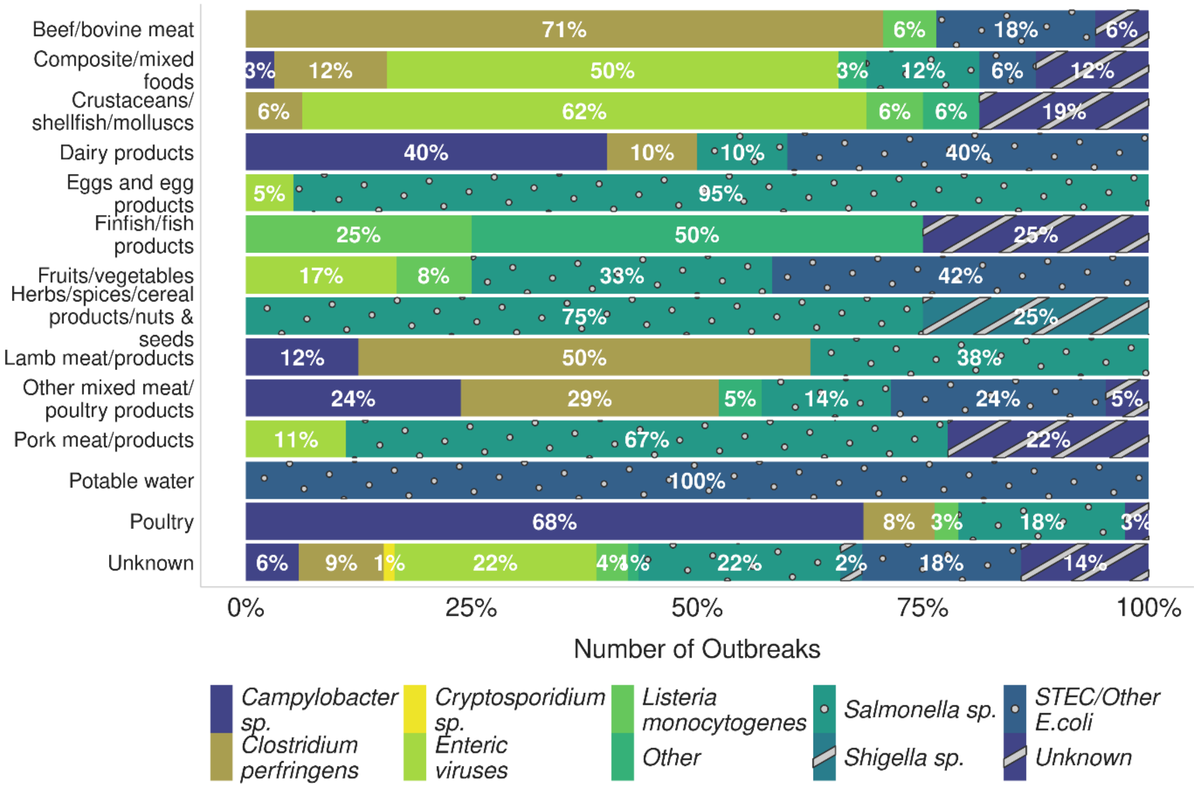
For the 191 outbreaks investigated between 2015 and 2020 with a food vehicle reported as implicated or suspected to be implicated, poultry meat and poultry meat products were most commonly reported as vehicles of infection (38

[149] Not all outbreaks are microbiologically linked to the implicated food vehicle.
[150] Epidemiological investigations may not always be able to identify the food causing the outbreak, and food sampling may not always be undertaken. For those outbreaks where a food vehicle could not be identified, these outbreaks are reported as ‘unknown food vehicle’.

outbreaks, 20%), followed by composite/mixed foods (32 outbreaks, 17%) and other mixed meat/poultry/products (21 outbreaks, 11%).

The overall number of reported outbreaks in 2020 (30 outbreaks) was lower than any other year (2015 to 2019) and 40% lower than the average for this 2015 to 2019 (49 outbreaks). Although the total number of cases (1,148) in 2020 was lower compared to the five-year (2015 to 2019) average (1,659) the percentage hospitalised (9%) was higher than the five-year average (5%).

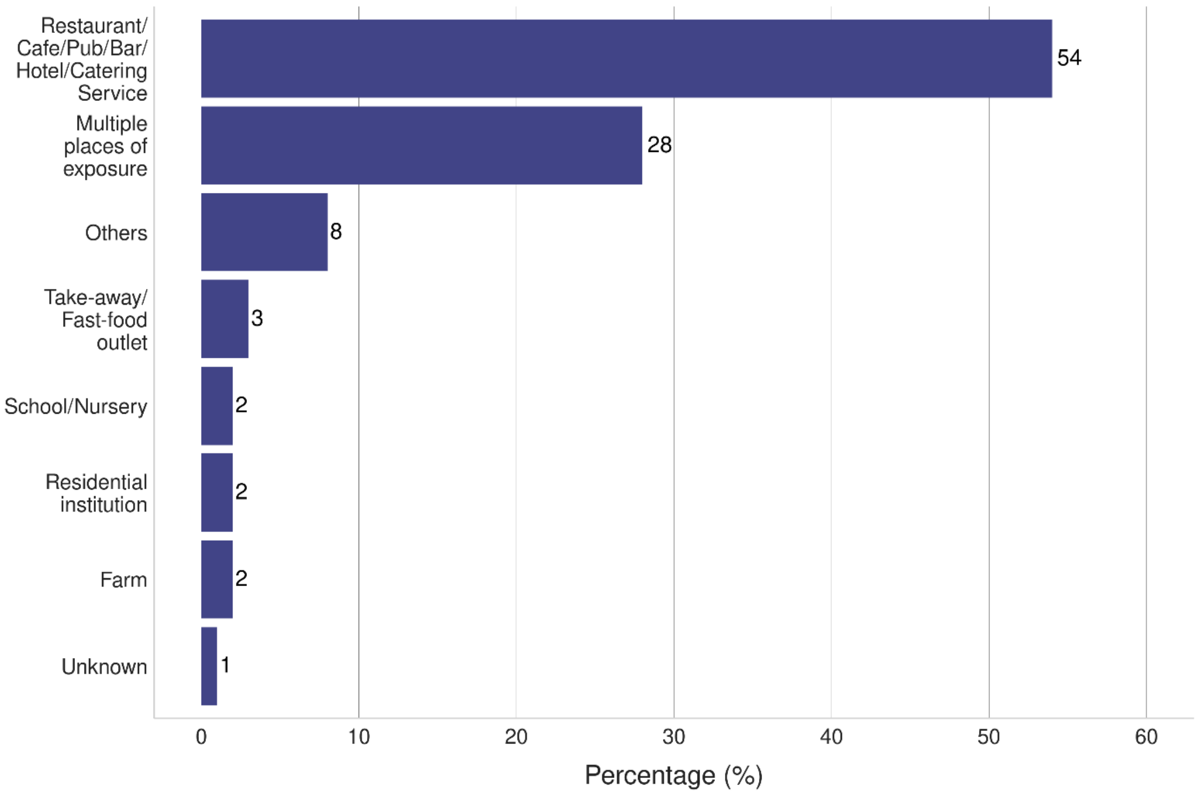
Figure 5.1.6d: Foodborne outbreaks by food vehicle investigated and causative agent reported to national public health surveillance, 2015 to 2020 in the UK



Reported *Campylobacter* outbreaks were predominantly associated with poultry products (implicated as the vehicle in 62% of all reported *Campylobacter* outbreaks with 583 associated outbreak cases), with chicken liver pate/parfait being the most commonly reported vehicle. Eggs and poultry meat products were most commonly implicated in *Salmonella* outbreaks (being the implicated vehicles in 26% and 10% of *Salmonella* outbreaks respectively with a total of 1,089 and 561 associated outbreak cases respectively). Ruminant meat and meat products (lamb and beef) were associated with a total of 28 outbreaks, involving 1,064 associated human cases, nearly half of which (517 cases) were associated with *Salmonella* outbreaks. Beef products were the most commonly reported vehicle in *Clostridium perfringens* outbreaks (implicated as the vehicle in 31% of *C. perfringens* outbreaks with 267 associated outbreak cases). All of the 16 reported outbreaks associated with crustaceans/shellfish/ molluscs were norovirus outbreaks (involving 587 cases).

Outbreaks associated with fruit and/or vegetables were reported as implicated food vehicles in 14% of outbreaks caused by STEC (with 277 associated foodborne illness cases), in 6% of *Salmonella* outbreaks (186 associated cases), in 4% enteric virus outbreaks (93 cases) and 13% *Listeria monocytogenes* outbreaks (12 cases, associated with one outbreak). Outbreaks with dairy products reported as implicated food vehicles were associated with *Campylobacter* and STEC most frequently. The single outbreak reported during this period associated with potable water was an STEC O157 outbreak linked to a private water supply.

Figure 5.1.6e: Percentage of foodborne outbreaks reported by setting, 2015 to 2020[151]



[151] 'Multiple places of exposure' refers to national outbreaks where nationally distributed food vehicle has been consumed in more than one different setting. 'Others' include settings with less than 3 outbreaks reported including, hospital or medical settings, workplace canteens or other undisclosed settings.

By overall reported number and by number of associated outbreak cases, the majority of outbreak investigations reported between 2015 to 2020 were associated with catering settings (54% with specific restaurants/food service establishments and 3% associated with takeaways or fast-food outlets, together contributing 51% of total associated human disease cases). Only 4% of outbreaks were associated with school or other institutional settings. The largest outbreaks (28% of total number of reported outbreaks but constituting 39% of overall number of reported outbreak associated cases), were designated as multiple places of exposure, when a contaminated food product that caused the outbreak is consumed in the home or at multiple locations, including in institutions and multiple different food service establishments. Outbreaks associated with the farm setting were exclusively outbreaks associated with raw drinking milk, caused by *Campylobacter* or STEC O157. There was a significant reduction in the proportion of outbreaks associated with the food service sector in 2020 (6% versus a range of 39% to 67% in previous years).

Trends

The number of foodborne outbreaks reported each year is small but overall, proportionally, the 2015 to 2019 surveillance data demonstrates trends not significantly dissimilar to previous years' data. Several key aspects were generally consistent with some of the long-term trends observed since systematic national surveillance for foodborne outbreaks was first instituted in 1992.[152] There are some notable exceptions. The overall number of outbreaks reported, especially those due to salmonellosis, has declined to levels significantly lower than in the 1990s and 2000s. For *Salmonella*, this is likely due, at least in part, to the implementation of EU wide controls for *Salmonella* in chickens under Regulation (EC) No 2160/2003[153]. There were also several large *Salmonella* Enteritidis outbreaks reported during 2015 - 2020 associated with imported poultry products (ECDC, 2017; ECDC, 2020; ECDC, 2021).[154] This indicates that *Salmonella*

---

152 Gormley, F.J. and others, 'A 17-year review of foodborne outbreaks: describing the continuing decline in England and Wales (1992-2008)', Epidemiology and Infection 139 (5) (2011), pages 688 to 699.

153 European Parliament and Council, 'Regulation (EC) No 2160/2003 of the European Parliament and of the Council of the 17 November 2003 on the control of salmonella and other specified food-borne zoonotic agents (2003), [redacted]

154 European Centre for Disease Prevention and Control: 'Re-emerging multi-country WGS-defined outbreak of *Salmonella* Enteritidis, MLVA type 2-12-7-3-2 and 2-14-7-3-2 (2017), [redacted]'European Food Safety Authority, 2021. Multi-country outbreak of Salmonella Enteritidis sequence type (ST)11 infections linked to

contamination of poultry products at the EU level is still an ongoing public health concern. When considering the data for pathogens subject to routine whole genome sequencing (*Salmonella* sp, STEC, *Listeria monocytogenes* and *Shigella* sp), there has been a year-on-year increase in the proportion of reported national level outbreaks ranging from 26% in 2015 to 94% in 2020 and the average size of outbreaks has steadily increased since 2015, particularly notable for *Salmonella*. Although sporadic campylobacteriosis places a significant health burden on the community, the number of outbreaks investigated and reported does not reflect this burden. This is likely because *Campylobacter* outbreaks are difficult to detect through existing surveillance systems.[155]

The proportion of outbreaks linked specifically to food service establishments remains significant. Outbreaks associated with these settings are most commonly related to and amplified by poor hygiene controls, environmental contamination and cross-contamination in the kitchen. Therefore, continued efforts to improve hygiene and lower the risk of introducing contaminated products and ingredients into food service establishments are needed in order to realize further public health benefits.

There are some notable differences in the 2020 data compared to the data collected from the previous five years. There was a higher overall hospitalisation rate seen in 2020, potentially indicating that during the pandemic less clinically severe cases may not have been identified and associated with foodborne outbreaks. There was also a reduction in the number of *Salmonella*, *Campylobacter*, norovirus and *Cl. Perfringens* outbreaks, likely associated with the COVID-19 pandemic restrictions on the hospitality and catering sector and a notable reduction overall in outbreaks associated with food service settings (see report annex for further detail).

---

poultry products in the EU/EEA and the United Kingdom' (2021), [redacted]; 'European Food Safety Authority, 2020. Multi-country outbreak of Salmonella Enteritidis infections linked to eggs, third update' (2020), [redacted].

155 Pebody, R.G., M.J. Ryan and P.G. Wall, 'Outbreaks of campylobacter infection: rare events for a common pathogen', Communicable Disease Report Review 7 (1997).

Case Study 5.4 *Listeria* outbreak linked to consumption of pre-prepared hospital sandwiches in England

Overview

Listeriosis is a rare disease in the UK, but its clinical severity renders it a public health concern, particularly in the context of clinically vulnerable groups. Identification of *Listeria monocytogenes* from a patient sample is notifiable in England. Public health investigation and follow-up including completion of a questionnaire on what foods individuals who have been diagnosed with listeriosis have eaten prior to illness onset is attempted for all reported cases of listeriosis as an integral part of the enhanced surveillance system for listeriosis in England.

An outbreak of listeriosis in hospitals in England, which caused nine cases and seven deaths, was identified and investigated between May and July 2019 and confirmed to be linked to consumption of pre-prepared sandwiches served to patients in hospitals across England.

The epidemiological, microbiological and food chain investigations, carried out by the multi-disciplinary Incident Management Team (IMT) identified the cause of the outbreak to be contaminated poultry meat used in the production of sandwiches. This was exacerbated by inadequate food safety protocols in hospital catering facilities. Whole genome sequencing confirmed that isolates from all nine cases were closely genetically related and isolates sampled from chicken and other sandwich ingredients had indistinguishable genetic profiles, providing microbiological evidence of the common source of foodborne transmission.

Background

In May 2019, the UKHSA (formerly Public Health England) notified partner agencies of an outbreak detected using analysis of whole genome sequencing data after two patients, with pre-existing medical conditions, contracted listeriosis in the same hospital. Both had overlapping hospital admission dates and had consumed sandwiches whilst in hospital. Between May and June 2019, 9 confirmed cases of listeriosis associated with the outbreak were identified in England in 8 hospitals across 7 NHS Trusts. By the time the outbreak was declared over, 7 patients had died.

An IMT was convened by UKHSA, involving colleagues from UKHSA, local authorities, the FSA and FSS, Public Health Scotland (formerly Health Protection Scotland), Public Health Wales, NHS England, and NHS Scotland.

The individuals diagnosed with listeriosis were interviewed (or family members, where direct interview of the confirmed cases was not possible) to ascertain what foods they had eaten prior to becoming ill and inspection of hospital catering records where available, was carried out as part of the food tracing investigations. This identified that the first three cases had all consumed chicken sandwiches, which the FSA identified to be sourced from a common supplier, which supplied sandwiches to NHS hospitals across Great Britain and were manufactured by one specific business.

In turn, the contamination was traced back to diced chicken which tested positive for *L. monocytogenes* at high levels and whole genome sequencing confirmed that it matched the outbreak strain identified from the cases. Not all cases consumed sandwiches made with the chicken, and some other sandwiches from the same producer were consumed, suggesting that both cross-contamination within the manufacturing environment and a lack of food safety controls in place at the hospitals had contributed to the outbreak.[156]

Discussion

The outbreak posed food safety and public health concerns for vulnerable consumers and patients attending hospitals, and attracted prolonged media and public interest. This risked loss of confidence in hospital food, and particularly sandwiches served in hospital, with pre-prepared sandwiches having been commonly associated with outbreaks of listeriosis in the UK in previous years.

The FSA has a key role as the Central Competent Authority (CCA) in overseeing official food safety controls undertaken by Local Authority (LA) food law enforcement authorities in England, Wales, and Northern Ireland. It is important to understand that, in most cases, enforcement of food law is a direct statutory duty of the competent authority (in this case, the LA).

Following the outbreak, a full cross-government strategic lessons learned exercise was undertaken to identify best practice in the supply chain for NHS food. This also focused on the actions required to prevent future recurrence. The FSA and FSS contributed to a ’root and branch‘ review commissioned by the Secretary of

---

[156] PHE, ‘Investigation into an outbreak of Listeria Monocytogenes infections associated with hospital-provided pre-prepared sandwiches, UK May to July’ (2019) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/937907/2019-05-Listeria-CC8-Outbreak-Report.pdf.

State for Health and Social Care. The subsequent Report of the Independent Review of NHS Food made 8 recommendations for system-level changes to be taken forward by an expert group with representation drawn from across the sector and government.[157] Both the evidence obtained during this specific outbreak and provided by the FSA and FSS contributed to the report which was later published on the FSA's website.

In summary, this outbreak of listeriosis led to a thorough investigation of *what happened* and *why*. To help avoid repetition of the incident, the report recommended that NHS purchasers must have effective mechanisms in place to assure food safety within their supplier base and drive improvements where necessary to ensure all businesses supplying high-risk foods meet the highest standards.

The report recommended that the standards of food-safety audits for high-risk food manufacturers be raised, to give confidence that legal and contractual requirements were being met. It was noted that most NHS trusts used a private company to accredit food suppliers as safe, but they must be aware that third-party accreditation was not a guarantee that a product was safe.

The report also recommended that NHS trusts must recognise their legal obligations as food business operators and ensure effective compliance with robust food safety procedures is achieved across their supply base. These procedures must be clearly understood, properly implemented, and verified to ensure compliance.

Indicator 5.1.7 Food Crime

Headline

Recorded disruptions from the FSA's NFCU and successful operations by the SFCIU help to quantify the successful delivery of activity to stop or reduce the opportunity for food crime offending within the UK food chain. The NFCU began recording food crime disruptions in 2020 to 2021, with a steady increase in the number of disruptions recorded through the year. Increases can be attributed to improvements in operational capability and a greater focus on, and awareness of, the full scope of disruption strategies. While still in an early phase, food crime interventions are an important indicator for the security of UK food, demonstrating

---

[157] DHSC, 'Report of the Independent Review of NHS Hospital Food' (2020), https://www.gov.uk/government/publications/independent-review-of-nhs-hospital-food.

the UK food safety authorities’ ability to receive, assess, and respond to intelligence concerning food crime.

Context and Rationale

Following the horsemeat incident in 2013 that affected consumers in the UK and Europe, government-commissioned reviews recommended the establishment of food crime units to prevent further food crime incidents. As a result, the FSA set up its NFCU, operating in England, Wales, and Northern Ireland, and FSS created the SFCIU.

The Units define food crime as serious fraud and related criminality in food supply chains.[158] Most food crime relates to two broad classes of activity:

- The deliberate inclusion of lower-grade, unsafe or alternative ingredients as edible and marketable.
- The sale of passable food, drink, or feed as a product with greater volume or more desirable attributes.

In many cases, consumers will be unable to identify they have been victims of fraud. However, in some instances, especially when ingredients are misrepresented, they can have significant impacts. These can come from individuals consuming products they avoid due to dietary requirements, religious or cultural observances, and/or allergies which can lead to serious physical harm, or even death. By tracking food crime interventions, it is possible to better articulate where food crime incidents have manifested (and have required some form of response).

The NFCU and SFCIU both follow similar investigative and disruption strategies, 4P and 4D, respectively as detailed below:

[158] FSS, ‘Food Crime Strategic Assessment’ (2020), https://www.foodstandards.gov.scot/publications-and-research/publications/food-crime-strategic-assessment-2020.

NFCU 4P Approach (taken from the Home Office's Serious and Organised Crime Strategy)[159]			
Pursue	Prepare	Protect	Prevent
Deal with offenders through prosecution and disruption	Build capacity and capability to identify and mitigate the impact of food crime	Protect industry and the public from the effects of food crime	Prevent people from committing food crime
SFCIU 4D Approach (taken from the Scottish Government's Serious Organised Crime Strategy)[160]			
Disrupt	Detect	Deter	Divert
Target those committing food crime and related fraudulent activity and identify opportunities to take enforcement action	Identify those involved in food crime and related fraudulent activity using all power available to the organisation, local authorities and partner agencies	To deter individuals involved in food crime and related fraudulent activity through intelligence gathering, investigation, regulatory compliance and surveillance of the supply chain	To divert people from becoming involved in food crime and related fraudulent activity

The NFCU record operational outcomes across the 4P approach as disruptions. These are achieved where the NFCU leads or supports action in response to a food crime threat which has a measurable impact. It is a measure of impact, not the activity or effort to achieve it.

The way this data is recorded and reported may change in coming years, so this indicator might be subject to change in future iterations to reflect these developments.

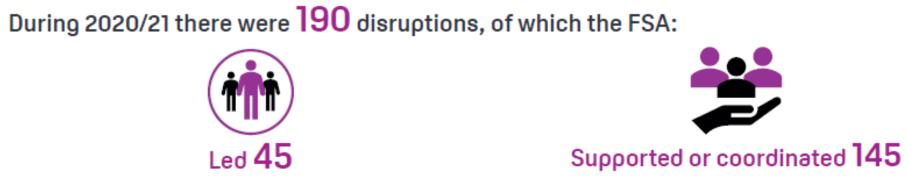
[159] Home Office, 'Serious and Organised Crime Strategy' (2018), https://www.gov.uk/government/publications/serious-and-organised-crime-strategy-2018.
[160] Scottish Government, 'Serious and Organised Crime Strategy (2015), https://www.gov.scot/publications/scotlands-serious-organised-crime-strategy/documents/.

Data and assessment

Indicator: Total number of disruptions recorded by FSA

Source: NFCU

Figure 5.1.7a: Number of disruptions recorded in 2020 to 2021



During 2020 to 2021, the number of disruptions recorded each quarter by the NFCU increased steadily across the year, with 52 Pursue disruptions and 138 Prepare, Prevent or Protect disruptions being delivered overall. This was driven by the NFCU achieving full operating capability, applying greater focus to prepare, prevent, and protect outcomes, and increasing awareness amongst staff with regards to identifying and recording disruptions resulting from their work.

SFCIU was involved in a significant number of investigations during 2020 to 2021 which had various intervention and disruption strands. As part of developing a disruption activity indicator SFCIU are developing an approach to capture the percentage of actionable intelligence that has resulted in a positive outcome.

Trends

Due to limited time series data it is not possible to provide an assessment of the trends, however this will be possible in coming years.

Case Study 5.5 Unlawful processing in the red meat sector

Overview

NFCU worked in partnership with other agencies and authorities to tackle a case of unlawful processing in the red meat sector. This led to the seizure of 5.3 tonnes of meat, which had been prepared in unsanitary conditions and was being sold to consumers online. This case also started the process of considering further policy development in the online food sales space.

Background

Unlawful processing in unregulated premises can lead to unsafe product being placed in the human food chain posing a risk to human health. In addition, this sort of food crime is often linked to other manifestations of food crime, such as livestock theft, document fraud, and misrepresentation. Such practices are damaging to law-abiding food business operators, who comply with the regulatory requirements, both as there are lower costs associated with operating outside of approval, and as the existence of unregulated business could undermine confidence in the UK food industry.

The NFCU worked to support and coordinate a local authority led investigation into a suspected illegal meat supplier. The initial concerns were that the meat was derived from stolen livestock. The subject of the investigation used an identified social media Facebook page as a ‘shop window’ to advertise the product and direct customers on how to buy the meat.

The NFCU worked with the police, local authority food teams, and other partners to co-ordinate activity at the suspect’s premises. On two separate occasions, a total of 5.3 tonnes of meat, roughly translating to three full transit vans, was discovered being prepared in unsanitary conditions rather than a registered and hygienic food preparation environment. It is suspected that a significant amount of meat had already been supplied to consumers in addition to the meat seized.

Whilst initial concerns regarding stolen livestock were not proven in this instance, support from local rural policing partners aided enquiries and produced useful information for the future.

An investigation into identified regulatory offences continues to be led by the local authority, and the NFCU are supporting financial investigation into the subject as a result of this activity.

Discussion

The product was due to be distributed across a large geographical area, spanning the north and south of England, which demonstrates the reach that such interventions can have in protecting consumers across the UK. The FSA’s assessments of potential risk, including details of how and where the meat was produced, resulted in a FAFA notice being issued. FAFAs are issued by the FSA and provide local authorities with details of specific action to be taken on behalf of consumers. In this instance, authorities were asked to contact premises who may have purchased the product and to ensure they were withdrawn from the market and recalled from consumers.

NFCU's support and co-ordination resulted in a significant amount of meat being removed from the market and protected consumers from unsafe meat. Working across teams with both internal and external partners also led to:

- the service of a Remedial Action Notice and Hygiene Emergency Prohibition notice stopping the unlawful business from operating;
- discussions with FSA teams responsible for policy development to ensure any appropriate preventative measures regarding online sales are taken forward;
- applications from the operator of the unregistered food business for appropriate approvals, making their activities visible to the regulators, who can ensure the safety and hygiene of production. This also ensured a potential food business operator was aware of food safety law, further protecting their consumers.

There is still work to be done to increase the understanding and ability to prevent criminality associated with unlawful processing, as well as to understand the demands for products within specific communities in the UK. Strong partnership action such as this has, however, strengthened NFCU knowledge and ability to tackle similar issues in the future, has protected consumers from potential harm, and helped level the playing field for legitimate businesses in this sector.

Case Study 5.6 Operation OPSON and the Food Industry Intelligence Network

Overview

The Food Industry Intelligence Network (FIIN) supported UK Regulators during Operation OPSON VII (2017-18), which focused on illegal treatment of tuna in the supply chain. Information and expertise provided on the supply chain were invaluable in supporting intelligence gathering and enforcement activities in the UK and across Europe. The activity strengthened relations between regulators and FIIN and assisted in outlining the scale of illegal activity from a global perspective.

Background

The FIIN consists of 46 major food businesses active in the UK. They co-operate to share anonymised and aggregated authenticity testing data to enhance their response to potential food crime threats such as product adulteration or misrepresentation, discernible either from regulatory activity and intelligence, or from industry supply chain assurance. UK food standards agencies have signed Information Sharing Agreements (ISAs) with FIIN. This relationship continues to develop and has allowed for the sharing of valuable information including tens of thousands of lines of data each year, contributing to the identification and investigation of food crime, and supporting a number of national operations.

Discussion

The ISA between FIIN and both SFCIU and NFCU has provided a collaborative gateway to share intelligence and data in relation to vulnerabilities across the supply chain. This has supported threat assessment, targeting of authenticity sampling, and general situational awareness. NFCU and SFCIU are also involved in the FIIN's plenary meetings and the development of food fraud awareness training.

Operation OPSON is a yearly Europol/Interpol joint operation focused on counterfeit and substandard food and beverages which is coordinated by SFCIU and NFCU in the UK.

The relationship between the NFCU, SFCIU, and FIIN was particularly effective during OPSON VII which targeted the production and distribution of illegally treated processed tuna. This related to extension of durability dates and use of chemicals and additives to enhance the visual appearance of poorer quality tuna. This issue was a concern at a global level, involving organised crime, and it was suspected that fraudulent product was entering the UK supply chains. This not only defrauds UK businesses and consumers but poses a health risk to consumers from histamine and high levels of chemical and additives injected into the tuna.

Due to the complex nature of the tuna supply chain and sophistication of the fraud, support from FIIN provided an enhanced understanding of these issues and allowed access to experts in this area. These insights provided by FIIN were shared with other agencies and supported a number of significant enquiries across Europe. The specialist knowledge provided from FIIN also assisted in directing the focus of the sampling undertaken in the UK, where a picture on illegal treatments could be developed and patterns drawn from the findings.

Along with sampling and intelligence activity occurring in the UK for the operation, there were more than 51 tonnes of tuna suspected to have been illegally treated seized across Europe.[161] The operation found that the fraud was an established, on-going, and highly organised criminal practice. An assessment by the SFCIU capturing the findings of the operation was presented to the EU Food Fraud Network which included a number of recommendations informed by consultation

---

[161] Europol, 'Operation Opson VII – Analysis Report' (2019), [redacted]

with FIIN. The link between the regulator and industry was key in understanding the threat and vulnerability to consumers and responsible businesses in the UK from criminality within the tuna supply chain, and as part of seeking to develop a preventative approach moving forward.

The fusion of FIIN's insight and expertise and the NFCU's and SFCIU's intelligence and operational co-ordination makes clear the importance of the regulatory relationship with FIIN. The success of the operation highlights the value of similar activities as well as the importance of creating and expanding relationships with other industry bodies as part of a holistic food crime response.

Case Study 5.7 Activities of the Food Authenticity Network and Centres of Expertise

Overview

The Food Authenticity Network (FAN) is helping to build a more resilient, secure, global food supply chain. This is achieved through collating, curating, and raising **awareness of the tools available to check for and mitigate against food fraud, providing an accessible and valuable network for an increasingly global stakeholder community.**

FAN also helps to e**nsure that the UK has access to a resilient network of laboratories by providing fit for purpose testing through the food authenticity Centres of Expertise (CoE) acknowledged on its website.**

FAN now has over 2,600 members from 81 countries and territories. In 2020, it attracted over 21,500 unique users from 133 different countries to its open access website. Its international membership enables sharing of best practice information for the benefit of all stakeholders, helping to raise standards worldwide, whilst showcasing UK global leadership in food authenticity testing and food fraud detection.

Background

The FAN was set-up in July 2015 by LGC (formerly known as Laboratory of the Government Chemist) with funding from Defra, as a response to recommendations in the Elliott Review.[162] The Elliot Review was an independent review into the integrity and assurance of food supply networks that was commissioned following the horsemeat incident in 2013. The report highlighted the need for access to resilient and sustainable laboratory services that use standardised validated approaches. FAN gathers information on food authenticity testing, food fraud mitigation, and food supply chain integrity and disseminates it via its open access website. FAN is led by LGC and funded through a public-private partnership approach.

Discussion

Recognising that no one organisation will be equipped with all the necessary expertise in all methods and techniques used in food authenticity testing and all of the different commodity groups impacted by food fraud, fourteen CoEs covering different disciplines and techniques are acknowledged on the FAN. Following a recent workshop and incident simulation exercise for CoEs, a framework of collaboration is being developed to lay out how a collective technical view can be formulated during an emergency national or international food fraud incident. The framework also considers how laboratory capability and capacity issues could be mitigated during a serious future incident, minimising the impact of such an event on legitimate businesses and consumers.

FAN also undertakes a range of knowledge transfer activities to disseminate best practice information to industry, enforcement, and analysts, through publication of e-seminars and a new programme of quarterly webinars covering topics from allergen risk assessments to fish speciation.

FAN recently collaborated with Mérieux NutriSciences to undertake a detailed assessment of data presented at a webinar in April 2020, which showed a ‘dramatic’ increase in food fraud activity at the beginning of 2020 and attributed this to the COVID-19 pandemic. The assessment found that although the pandemic had increased food fraud vulnerability, there was insufficient evidence of ‘dramatic’ increases in specific COVID-19 related food fraud incidents.

---

[162] Defra and FSA, ‘Elliot review into the integrity and assurance of the food supply networks: final report’ (2014), https://www.gov.uk/government/publications/elliott-review-into-the-integrity-and-assurance-of-food-supply-networks-final-report.

Figure 5.7a: FAN number of unique users by country, 2020[163]

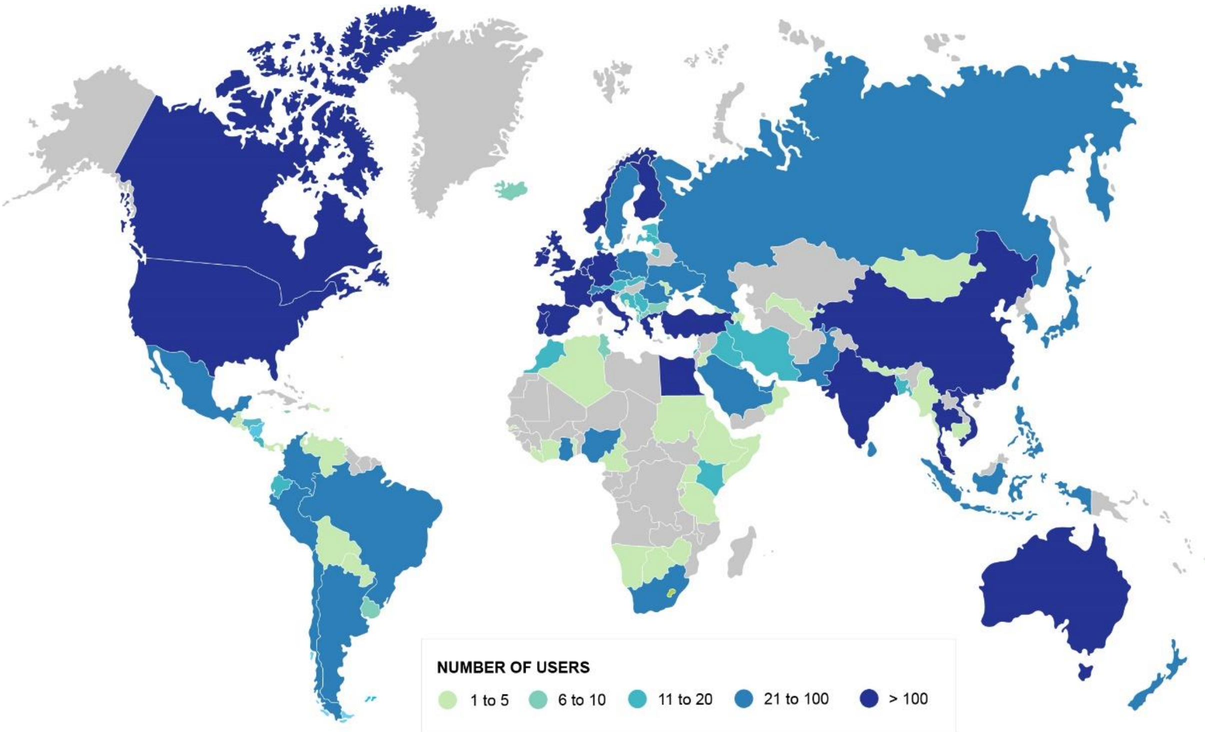
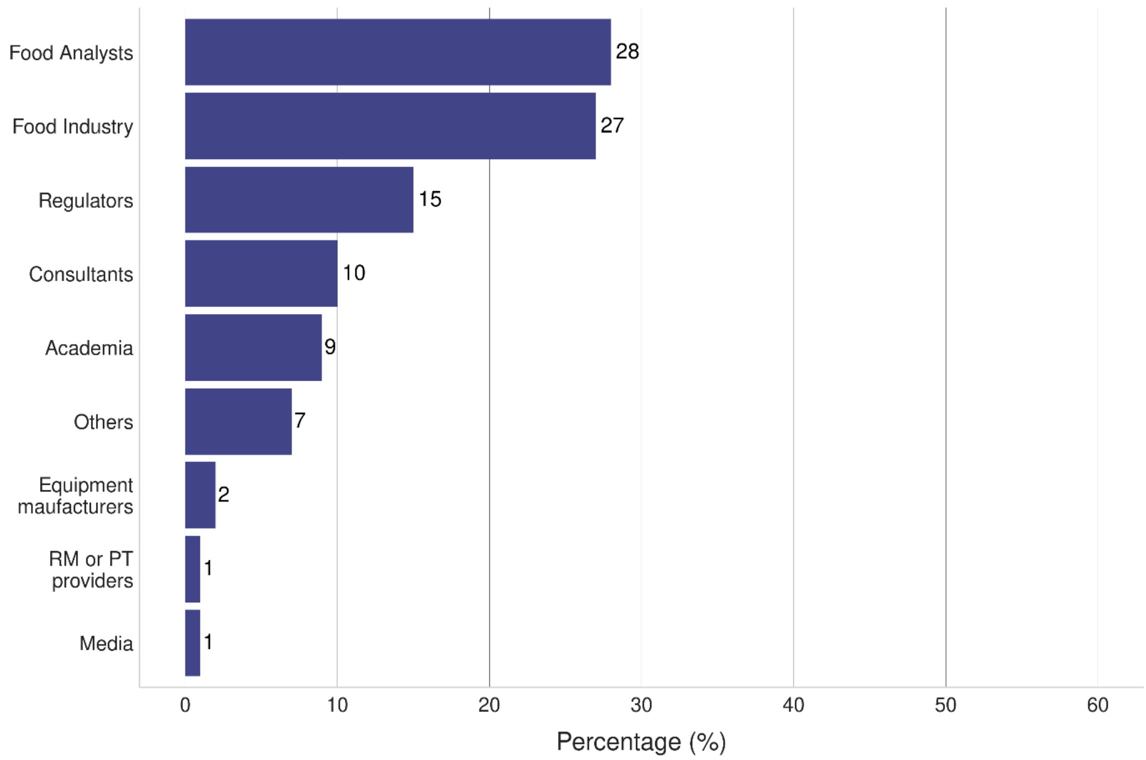


Figure 5.7b: FAN1b – FAN membership by professional category in 2021



[163] FAN, 'What we do', [redacted]

About the UK Food Security Report

The UK Food Security Report sets out an analysis of statistical data relating to food security, examining past, current, and predicted trends relevant to food security to present the best available understanding of food security. It fulfils a duty under Part 2, Chapter 1 (Section 19) of the Agriculture Act 2020 to prepare and lay before Parliament *"a report containing an analysis on statistical data relating to food security in the United Kingdom"*. The first report must be published before Christmas Recess 2021, and subsequent reports must be published at least once every three years thereafter.

It contains statistics for different time periods, but always using latest available data at the time of release. Data comes from surveys run by Defra and from a wide range of other sources including government departments, agencies and commercial organisations, in the UK and internationally.

Associated datasets from this publication are also available. Data are a mixture of National Statistics, Official Statistics and unofficial statistics. Unofficial statistics are used where there are gaps in the evidence base. Further information on National Statistics can be found on the Office for Statistics Regulation website.

Contact and feedback

Enquiries to: foodsecurityreport@defra.gov.uk

You can also contact us via Twitter: @DefraStats

We want to understand the uses that readers make of this new report. To help us ensure that future versions of this report are better for you, please answer our short questionnaire to send us feedback.

Production team: Matt Bardrick, Jasmin Eng, Ros Finney, Luke Hamilton, Jenny Kemp, David Lee, Jeremy Levett, Will Norman, Maria Prokopiou, Andrew Scaife, Chris Silwood, Jonathan Smith, Beth White, Isabella Worth.

We are extremely grateful to the following for their expert contributions and guidance throughout the synthesis of this Report, helping to ensure it delivers a thorough analysis of a robust evidence base:

- Professor Tim Benton, Chatham House
- Dr Tom Breeze, University of Reading
- Professor Bob Doherty, University of York and FixOurFood
- Selvarani Elahi MBE, UK Deputy Government Chemist, LGC
- Dr Pete Falloon, Met Office, Climate Service Lead - Food Farming & Natural Environment
- Alan Hayes, Food Systems and Sustainability Advisor
- Dr John Ingram, University of Oxford
- Professor Peter Jackson, Institute for Sustainable Food, University of Sheffield
- Dr Ian Noble, Mondelez International
- Dr Bill Parker, Head of Technical Programmes, AHDB
- Dr Maddy Power, Wellcome Trust

Appendix

Theme 1 – Global Food Availability

Index numbers used in figures 1.1.1a, 1.1.2a, and 1.1.5f

An index number is statistical measure that reflects a price or quantity compared with a standard or base value. The base usually equals 100 and the index number is usually expressed as 100 times the ratio to the base value. For example, if food production per capita in 2010 was twice as large as its 5-year average between 2014-2019, its index number would be 200 relative to 2014-2019.

Indicator 1.1.2, figure 1.1.2.a

The Organisation for Economic Co-operation and Development (OECD) is made up of Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Israel, Japan, South Korea, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden Switzerland, Turkey, the UK, and the US. MENA refers to Middle East and North Africa.

Theme 3 – Food Supply Chain Resilience

Case study 3.6, figure 3.1.8a

Consumer purchasing behaviours pre and post lockdown (Kantar, Worldpanel FMCG, England, Wales, and Scotland): year on year trips per household and year on year purchased volume per trip.

The Kantar Take Home household panel is made up of 30,000 households that are chosen to be demographically representative of the Great British population, by region of the country, household size, presence of children, and age of main shopper. Socio-economic group is not included in the sample targets but is part of the weightings applied to ensure the survey population is representative of GB. Panellist population targets are obtained from the results of the BARB Establishment Survey and the Office for National Statistics (ONS).

The panel reports on a continuous basis on all Fast Moving Consumer Goods purchases that are brought back into the home, reporting where items were purchased, what was purchased, how much was paid and if a promotion was used.

Theme 4 – Food Security at Household Level

Indicator 4.1.4, figures 4.1.4a-d

Scoring: The categories of ‘high’, ‘marginal’, ‘low’, and ‘very low’ food security are based on the points scored out of the ten questions.

High food security, or a score equal to 0, means the household has no problem, or anxiety about, consistently accessing adequate food.

Marginal food security, or a score of 1 or 2, means the household had problems at times, or anxiety about, accessing adequate food, but the quality, variety, and quantity of their food intake were not substantially reduced.

Low food security, or a score of 3 to 5, means the household reduced the quality, variety, and desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially disrupted.

Very low food security, or a score of 6 to 10, means that at times during the last 30 days, eating patterns of one or more household members were disrupted and food intake reduced because the household lacked money and other resources for food.

Disability - In this dataset, a person is defined as having a disability if they regard themselves as having a long-standing illness, disability, or impairment which causes substantial difficulty with day-to-day activities. Some people classified as disabled and having rights under the Equality Act 2010 are not captured by this definition, such as people with a long-standing illness or disability which is not currently affecting their day-to-day activities.

Ethnicity - The ethnic groups used in the data denote the group to which respondents consider that they belong.

Sample sizes for ‘Gypsy, Traveller or Irish Traveller’ are small. In Northern Ireland, ‘Irish Traveller’ is included in ‘Other ethnic group’ whereas in England, Scotland, and Wales, ‘Gypsy or Irish Traveller’ is included in ‘White’. The group ‘Arab’ is included in ‘Other ethnic group’.

The group ‘Asian/Asian British’ includes ‘Indian’, ‘Pakistani’, ‘Bangladeshi’, ‘Chinese’, and ‘Any other Asian background’.

It is not possible to disaggregate the group ‘Black/African/Caribbean/Black British’ due to differences in data collection of the country specific question.

Theme 5 – Food Safety and Consumer Confidence

Indicators 5.1.1 and 5.1.2

In England, Wales, and Northern Ireland consumer confidence in food and its regulation is measured through Food and You 2, the FSA's flagship survey, which is an Official Statistic. In Scotland consumer confidence is measured through the Food in Scotland Consumer Tracking Survey.

The Food and You 2 survey conducted biannually by the FSA since 2020, measures self-reported consumer knowledge, attitudes, and behaviours related to food safety and other food issues amongst adults (16+ years) in England, Wales, and Northern Ireland.

The survey is primarily carried out online using a methodology known as 'push-to-web'. Fieldwork for Wave 2 was conducted between 20 November 2020 and 21 January 2021. A total of 5,900 adults from 3,955 households across England, Wales and Northern Ireland completed the survey.

The Food in Scotland Consumer Tracking Survey monitors attitudes, knowledge and reported behaviours relating to food amongst a representative sample of Scotland's population, identifying changes over time. The survey is online and 1,016 Scottish adults were surveyed for Wave 11.

Direct comparisons cannot be made between these two data sources due to methodological differences and different time periods covered by the surveys. As such, data are presented separately for England, Wales, and Northern Ireland (combined) and Scotland.

Many of the indicators in this section for FSA findings do not have time series data. This is because the primary source of this data for England, Wales, and Northern Ireland (the FSA's Food & You 2 survey) commenced in 2020 therefore there are not enough waves of data to present a time series or make any assessments regarding trends. FSS's Food in Scotland consumer tracker survey does contain time series data, and future iterations of the UK Food Security Report will include FSA and FSS time series data to presents trends subject to the FSA retaining these questions.

Indicator 5.1.1 Consumer confidence in the food system and its regulation

Figure 5.1.1a FSA respondents – confidence that food is safe to eat: Food and You 2, Wave 2 (2021)

Figure 5.1.1b FSA respondents – confidence that information on food labels is accurate. Food and You 2, Wave 2 (2021)

Question: How confident are you that… A) the food you buy is safe to eat. B) the information on food labels is accurate (for example, ingredients, nutritional information, country of origin, Base= 4814, all respondents. N.B. ‘Very confident’ or ‘Fairly confident’ respondents are referred to as confident.

Figure 5.1.1c FSS respondents – trust in food label information: Food in Scotland Consumer Tracker Survey Wave 11 (2021)

Question: How much do you agree or disagree with each of these statements? I trust the information on food labels, Base = 1016. ‘I definitely agree’ and ‘I tend to agree’ are referred to as ‘Agree’ and ‘I definitely disagree’ and ‘I tend to disagree’ are referred to as disagree.

Figure 5.1.1d FSA respondents – trust in the FSA: Food and You 2, Wave 2 (2021)

Question: How much do you trust or distrust the Food Standards Agency to do its job? Base=3309, all respondents who know a lot or a little about the FSA and what it does. N.B. ‘I trust it a lot’ and ‘I trust it’ referred to as trust.

Figure 5.1.1e FSS respondents – trust in FSS: Food in Scotland Consumer Tracker Survey Wave 11 (2021)

Question: How much do you trust or distrust Food Standards Scotland to do its job? Base= those aware of FSS W11 827. Trust is classed as those who responded ‘I trust it a lot’ and ‘I trust it’. Distrust is classed as those who responded ‘I distrust it’ and ‘I distrust it a lot’

Figure 5.1.1f FSA respondents - Consumer confidence in the food supply chain: Food and You 2, Wave 2 (2021)

Question: How confident are you in the food supply chain? That is all the processes involved in bringing food to your table. Base= 4814, all online respondents and those answering the Eating at Home postal questionnaire. N.B. ‘Very confident’ or ‘Fairly confident’ respondents are referred to as confident.

Figure 5.1.1g FSA respondents – confidence that food supply chain actors ensure food is safe to eat in: Food and You 2, Wave 2 (2021)

Question: How confident are you that... A) Farmers, B) Slaughterhouses and dairies, C) Food manufacturers for example, factories, D) Shops and supermarkets, E) Restaurants, F) Takeaways, G) Food delivery services for example, Just Eat, Deliveroo, Uber Eats…in the UK (and Ireland) ensure the food you buy is safe to eat. Base= 4850, all online respondents and those who completed the Eating Out postal questionnaire.

Indicator 5.1.2 Consumer Concerns

Figure 5.1.2a FSA respondents– ten most common prompted concerns: Food and You 2, Wave 2 (2021)

Question: Do you have concerns about any of the following? Responses : The amount of sugar in food, Food waste, Animal welfare, Hormones, steroids or antibiotics in food, The amount of salt in food, The amount of fat in food, Food poisoning, Food hygiene when eating out, The use of pesticides, Food fraud or crime, The use of additives (for example, preservatives and colouring), Food prices, Genetically modified (GM) foods, Chemical contamination from the environment, Food miles, The number of calories in food, Food allergen information, Cooking safely at home, None of these, Don't know. Base= 3764, all online respondents.

Figure 5.1.2b: FSS respondents – ten most common prompted concerns: Food in Scotland Consumer Tracker Survey Wave 11 (2021)

Question: Please sort each of these issues according to whether or not they cause you concern or do not cause you concern.

Figure 5.1.2c FSA respondents – concern about availability of a wide variety of food: Food and You 2, Wave 2 (2021)

Question: (In England and Wales) Thinking about food today in the UK and Wales, how concerned, if at all, do you feel about each of the following topics? The availability of a wide variety of food: Base = 5900

Question: (In Northern Ireland) Thinking about food today in the UK and Northern Ireland, how concerned, if at all, do you feel about each of the following topics? The availability of a wide variety of food: Base = 5900

Indicator 5.1.4 Food safety incidents, alerts and recalls

Figure 5.1.4b

'Pathogenic Micro-Organisms' incidents relate to suspected, possible, or actual contamination by harmful bacteria, fungi, or viruses. It also includes concerns about measures to control the risk from pathogenic micro-organisms. In contrast, 'Non-Pathogenic Micro-Organisms' incidents primarily relate to fungi or bacteria of a non-pathogenic or unidentified species.

The concern for 'Mycotoxins' and 'Biotoxin (other)' incidents is contamination by toxins produced by living organisms. Mycotoxins such as aflatoxins are produced by certain moulds that grow on crops and other feedstuffs. 'Biotoxin (other)' incidents include algal toxins in shellfish, which are mainly reported as part of the regular monitoring of shellfish beds. ‘Bio-contaminants (other)’ incidents include sewage spills and toxins produced by the degeneration of animal or vegetable material.

‘Residues of Veterinary Medicinal Products’ incidents accounted for most of the notifications in the ‘Farming Practices’ group. This includes those incidents that are routinely reported from the long-standing Statutory Surveillance Programme of residues of veterinary medicines in food producing animals.

Many of the incidents in the ‘Industrial/Chemical’ group relate to ‘Chemical contamination (other)’ notifications. Almost all of such incidents related to fires, which recorded possible risks due to the production of potentially carcinogenic polycyclic aromatic hydrocarbons (PAHs) during combustion. From the 2017/18 Reporting Year onwards, a dedicated CHEMET (Chemical Meteorology) category was introduced for such incidents. ‘Heavy Metal’ incident notifications primarily involve lead and copper poisoning, usually occurring on farm to livestock.

Incident notifications relating to migrant travel were previously recorded in “Not Determined/Other” or “Poor or Insufficient Controls” categories. The 2017/18 Reporting Year saw the introduction of a dedicated ‘Clandestine Travellers’ (stowaways) category to refine the recording of the associated hazard type.

‘Allergens’ incidents concern the undeclared presence of allergens, either as cross-contamination or undeclared ingredients. Labelling issues can include improper health claims, incorrect date labels and misleading food descriptions or usage instructions.

‘Foreign Bodies’ incidents refer to physical contamination notifications, whereby unintended material (e.g., glass, metal, plastic or from an animal origin) is present in the product.

‘Poor or Insufficient Controls’ include incidents resulting from lack of good manufacturing practice such as poor temperature control of perishable foods, undercooking, unhygienic premises, and inadequate documentation.

Furthermore, the ‘Adulteration/Fraud’ category includes counterfeit products; illegal import and export (including irregularities with documentation), and the use of unauthorised premises to produce food. It should be noted the FSA’s National Food Crime Unit use a refined definition when reporting the number of fraud-related incidents. In particular, this would not typically include incidents where there is no or limited evidence of intention to deceive. A similar process exists for the Scottish Food Crime & Incidents unit.

Indicators 5.1.5 and 5.1.6 Foodborne disease

The UK Health Security Agency (UKHSA), Public Health Wales (PHW), Public Health Scotland (PHS) and the Public Health Agency Northern Ireland (PHA) are responsible for the surveillance[164] of pathogens (primarily bacteria, viruses and parasites) that can cause gastrointestinal disease, including diseases related to food poisoning. The public health agencies are also the lead organisations responsible for the detection, investigation and reporting of foodborne disease outbreaks in the UK, working in partnership with food safety, animal health and local authority colleagues. Data presented in this report are derived from laboratory reports of gastrointestinal pathogens from clinical diagnostic laboratories and the systematic surveillance of outbreaks of foodborne disease.

Indicator 5.1.5 Prevalence of foodborne pathogens

While not all gastrointestinal infections are foodborne, food is an important vehicle of transmission (FSA, 2020)[165] for many gastrointestinal pathogens that cause a substantial public health burden (WHO, 2015)[166]. The term "burden of disease" is used to describe the overall cumulative consequences of a defined disease. While *Campylobacter* and *Salmonella* cause the greatest burden of disease in terms of number of reported cases each year, *Listeria monocytogenes* and Shiga toxin-producing E. coli (STEC) O157 cause more severe disease leading to higher rates of hospitalisation and death. There are many other gastrointestinal pathogens and microbial contaminants that have a food safety impact, such as norovirus, hepatitis A, *Cryptosporidium* sp. and *Clostridium* sp. Further information on surveillance indicators for these pathogens is available elsewhere, including on the UKHSA, PHS, PHW and PHA websites and in outbreak reports.

Surveillance based on laboratory confirmed reports of gastrointestinal disease generally starts with a clinical diagnostic sample being taken by a general practitioner (GP) or at a hospital from an individual suffering with gastrointestinal disease symptoms, usually most commonly vomiting and/or diarrhoea. It is mandatory for testing laboratories to notify the public health agencies within 7

---

[164] Surveillance is defined as the systematic collection, analysis and interpretation of data essential to the planning, implementation and evaluation of public health practice, and the timely dissemination of this information for public health action.

[165] FSA, 2020. Foodborne Disease Estimates for the United Kingdom in 2018 https://www.food.gov.uk/sites/default/files/media/document/foodborne-disease-estimates-for-the-united-kingdom-in-2018_0.pdf

[166] World Health Organisation 2015: WHO estimates of the global disease burden of foodborne diseases

days when certain specified pathogens are isolated from human clinical diagnostic samples under Health Protection Regulations[167].

Once a laboratory result is available, this, together with epidemiological information on each case is reported into national surveillance databases and case management systems in each country. For three of the four key bacterial gastrointestinal pathogens, non-typhoidal *Salmonella*, STEC O157 and *Listeria monocytogenes*, the testing laboratory will forward the isolates to the relevant public health agency's National Reference Laboratory for further characterisation by whole genome sequencing (WGS). For *Campylobacter*, currently only a proportion of isolates, usually those associated with outbreaks, are forwarded to the reference laboratories for WGS.

Using these surveillance databases, regional and national public health protection teams throughout the UK analyse the laboratory test results, WGS data and epidemiological data. The aim is to monitor trends in reporting of gastrointestinal pathogens, changes in disease epidemiology and to detect new and/or emerging disease threats, including foodborne disease outbreaks, so that timely and appropriate action to protect public health can be taken.

No disease surveillance system is perfect and there is known under-ascertainment of infectious gastrointestinal disease and for every laboratory confirmed report of gastrointestinal disease made to national surveillance systems, there will be additional unreported cases in the community due to people not seeking healthcare for their illness or samples for laboratory testing not always being taken even when they do. There are various estimates available attempting to quantify the under-reporting of gastrointestinal pathogens. In the UK, the measures used most commonly by the public health and food safety agencies when assessing the burden of infectious gastrointestinal diseases have been derived from a large research study undertaken in 2008-2009 (Tam et al, 2012)[168]. The researchers estimated that for every case of infectious intestinal disease where a sample is taken and tested at a diagnostic laboratory with a confirmed result subsequently reported to national surveillance, there were 147 (95% CI, 136 - 158) community

---

[167] Health Protection (Notification) Regulations 2010 https://www.legislation.gov.uk/uksi/2010/659/contents/made and www.legislation.gov.uk/wsi/2010/1546/contents/made and Public Health etc. (Scotland) Act 2008.

https://www.legislation.gov.uk/asp/2008/5/pdfs/asp_20080005_en.pdf

[168] Tam, C.C., Rodrigues, L.C., Viviani, L., Dodds, J.P., Evans, M.R., Hunter, P.R., Gray, J.J., Letley, L.H., Rait, G., Tompkins, D.S. & O'Brien, S.J. (2012) Longitudinal study of infectious intestinal disease in the UK (IID2 Study): incidence in the community and presenting to general practice. Gut 61(1), 69-77 doi: 10.1136/gut.2011.238386 https://www.food.gov.uk/research/research-projects/the-second-study-of-infectious-intestinal-disease-in-the-community-iid2-study

cases that remained unreported. The extent of under-reporting varies by pathogen. The study established that the ratio of unreported human *Campylobacter* disease to reports to national surveillance is 9.3 to 1 (95% CI 6-14.3), suggesting that in 2019, there were over 600,000 cases of campylobacteriosis in the UK. For *Salmonella* it is estimated that for every report of non-typhoidal *Salmonella* infection made to national surveillance, there are potentially 4.7 cases of salmonellosis in the community (95% CI 1.2 – 18.2), suggesting the total number of undiagnosed *Salmonella* cases in the UK community in 2019 was 45,703 (95% CI 11,688-176,977).

In relation to figure 5.1.5b and rate of reported *Campylobacter* sp., non-typhoidal *Salmonella sp.,* STEC O157 and *Listeria monocytogenes* infections in the United Kingdom, 2015-2020. The table below includes the data of reported infections per 100,00 population in the United Kingdom, 2015-2020

Year	*Campylobacter* sp.	Non typhoidal *Salmonella* sp.	STEC O157	*Listeria monocytogenes*
2015	97.06	14.56	1.35	0.29
2016	90.1	14.64	1.49	0.31
2017	96.34	15.16	1.17	0.24
2018	102.33	15.21	1.26	0.26
2019	101.81	14.56	1.07	0.23
2020	82.31	7.98	0.86	0.22

It must be noted that the 2020 surveillance data indicators cannot be compared to the data from previous years, as a substantial and sustained reduction in reporting of gastrointestinal pathogens to national surveillance has been observed coinciding with the SARS-CoV-2 (COVID-19) pandemic. The impact is likely multi-factorial and related to the introduction of non-pharmaceutical interventions (NPIs) to control the pandemic, for example due to the effects of lockdowns on people's behaviours making them less at risk of acquiring infections, such as changes in eating out. However, changes in health care seeking behaviour are also likely to have contributed, with fewer people visiting general practitioners and hospitals and having samples taken for testing as well as changes in laboratory testing practices. Therefore, trend analysis for the data presented in this report should only be considered for 2015 – 2019, with exclusion of 2020 data.

Indicator 5.1.6 Foodborne disease outbreak surveillance

Systematic surveillance of foodborne disease outbreaks starts with UKHSA, PHW, PHS and/or PHA receiving preliminary reports of outbreaks of gastrointestinal disease from laboratories, health protection teams or boards or local authority environmental health departments or through detection of outbreaks through analysis of laboratory report exceedances or WGS data and epidemiological data. An appropriate minimum dataset for each outbreak is collected and supplemented with additional information as it becomes available during the investigation. This standardised dataset includes date and place of outbreak, number of cases, case demographic, admission to hospital, associated fatalities, details of the food vehicle suspected or implicated in the outbreak, the level of evidence implicating the food vehicle and contributory factors considered significant in terms of causality in the outbreak.

Data derived from foodborne outbreak investigations in England and Wales is reported into a stand-alone, web-based surveillance system: eFOSS (the electronic Foodborne and non-foodborne Gastrointestinal Outbreak Surveillance System). Data for Scotland is reported into a similar system: ObSurv, the surveillance system for all general outbreaks of infectious gastrointestinal disease in Scotland. In Northern Ireland data for foodborne outbreaks is collated in a local database for monitoring outbreaks of infectious disease in general. The surveillance information derived from foodborne disease outbreak investigations (comparable datasets based on accepted international definitions and criteria) is collated in these dedicated national surveillance databases and case management systems and summarised to provide annual national datasets. This national level foodborne outbreak surveillance data, the collation of which started nearly 30 years ago in 1992, provides an important source of information for foodborne disease trend analysis that is used alongside general surveillance indicators for gastrointestinal pathogens to inform risk assessment and policy development for the protection of UK consumers against risks posed by foodborne disease.

Only data for general outbreaks of foodborne disease are collated and presented in surveillance reports, i.e. household/family outbreaks and foreign travel associated outbreaks are excluded. Norovirus outbreaks associated with hospitals, other institutional/residential settings (care homes, schools, prisons, etc) and community outbreaks that are due to person-to-person transmission are also excluded from the foodborne outbreak datasets.

Not all outbreaks are microbiologically linked to an implicated food vehicle as food vehicles are not always identified or available for microbiological testing, and the level of evidence derived through epidemiological and microbiological investigations varies with some outbreaks having stronger epidemiological evidence in support of a link between the implicated food product and the outbreak than in other outbreaks. Additionally, for some outbreaks not all individuals linked to the outbreak will have laboratory confirmation of illness. The number of hospitalisations reported is only known for cases which received public health follow-up, e.g. via interviews with cases or through notification by their doctor, which is more likely to occur for certain pathogens such as STEC and *Listeria monocytogenes*. Ascertainment of both cases and hospitalisation varies according to the clinical severity and differences in testing of the causative agent (for example, testing for *Listeria monocytogenes* predominately occurs in people who are hospitalised, so non-hospitalised cases are less likely to be identified), as well as due to the setting of the outbreak. Where individuals are reported to have died, it is usually not known whether the cause of death was directly related to the outbreak.

In relation to figure 5.1.6b, the number of foodborne outbreaks by causative agent investigated and reported to national public health surveillance in the UK 2015 – 2020

Number of outbreaks per pathogen	2015	2016	2017	2018	2019	2020	Total
Salmonella sp.	11	12	13	10	15	7	68
Enteric viruses*	3	10	7	11	16	2	49
Campylobacter sp.	11	8	9	7	3	4	42
Clostridium perfringens	12	8	2	6	7	4	39
STEC/ Entero-invasive *E.* coli (EIEC)	6	8	6	2	6	7	35
Listeria monocytogenes	0	0	0	2	3	3	8
Shigella sp.	2	0	0	1	0	0	3
Cryptosporidium sp.	1	0	0	0	0	0	1
Other**	1	1	1	1	1	1	6
Unknown***	6	2	0	9	6	2	25
Total	53	49	38	49	57	30	276

*Includes foodborne norovirus outbreaks or norovirus outbreaks related to infected food handlers

**'Other' includes marine biotoxins such as scrombotoxin and okadaic acid as well as other entero-toxin producing bacteria such as *Staphylococcus* or *Bacillus* spp.

***'Unknown' are outbreaks where a causative agent was not identified as the cause of the disease in the outbreak associated human disease cases

Public Health Agencies in the UK now routinely perform whole genome sequencing (WGS) for genomic characterisation for several bacterial gastrointestinal pathogens, including *Salmonella* spp., *Listeria monocytogenes, Shigella* spp*, Yersinia* spp and shigatoxin producing *E. coli* (STEC). Isolates of *Campylobacter* spp may be submitted for WGS to inform specific outbreak investigations, but this is not always a routine approach.

The high resolution WGS typing of isolates for pathogen strain discrimination provides has enhanced the detection of outbreaks and enables 'sensitive and specific' case definitions to be applied, improving case ascertainment, focussing outbreak investigations and increasing the strength of association in analytical studies to identify the implicated food vehicles. Where possible integration of the microbiological genomic and epidemiological data derived from analysis of the human disease data with that from animal samples, environmental sampling or the food chain, has significantly improved the ability to identify the source of the outbreak and better understand transmission of contamination through food supply chains. The use of WGS has also resulted in an enhanced ability to detect re-emergence of outbreaks and trace them back to the same source of contamination as previously identified when control measures have not been fully effective in eliminating contamination (PHE, 2018)[169].

Implementation of WGS has enabled the consolidation of multiple local/regional outbreaks into single national level outbreaks based on the WGS and epidemiological information obtained during the investigations. This has resulted in a higher proportion of outbreaks being identified to be national rather than local/regional outbreaks with an associated increase in case numbers (Mook et al, 2018)[170]. Therefore, while consideration of total numbers of outbreaks reported is useful, these data are affected by whether WGS is used or not. Both the re-emergence of cases associated with outbreak clusters and the consolidation of multiple outbreaks into large national outbreaks of long duration has meant that comparison of number of foodborne outbreaks and number of associated cases pre and post the implementation of WGS should be undertaken with caution, and the foodborne outbreak surveillance data reported for the years prior to implementation of WGS (pre-2014 for *Salmonella,* pre-2015 for STEC and *Shigella* and pre-2017 for *Listeria monocytogenes*) is not directly comparable to the data held for subsequent years. Therefore, the size of the outbreak and number of individuals affected should be considered together with the information given on the overall numbers of outbreaks in this report.

Although whole genome sequencing is able to provide a highly discriminatory method to determine the genetic relatedness of bacterial strains and therefore improved detection of outbreaks and greater accuracy in ascertaining numbers of associated human outbreak cases, there is still under-ascertainment generally due to underreporting to healthcare settings and surveillance systems. It must also be noted that, as the foodborne outbreak surveillance databases rely upon reports to national surveillance systems, there is likely to be under-ascertainment due to incomplete reporting.

The COVID-19 pandemic impact is possibly less apparent in the foodborne disease outbreak surveillance data than in the laboratory testing surveillance data, but there are some notable differences in the 2020 data compared to the data

---

[169] PHE, 2018. Implementing pathogen genomics: a case study. https://www.gov.uk/government/publications/implementing-pathogen-genomics-a-case-study

[170] Mook P, Gardiner D, Verlander NQ, McCormick J, Usdin M, Crook P, Jenkins C, Dallman TJ. Operational burden of implementing Salmonella Enteritidis and Typhimurium cluster detection using whole genome sequencing surveillance data in England: a retrospective assessment. Epidemiol Infect. 2018 Aug;146(11):1452-1460. doi: 10.1017/S0950268818001589. Epub 2018 Jul 2. PMID: 29961436.

collected in the previous five years. These impacts are also likely related to the introduction of non-pharmaceutical interventions (NPIs) as well as multifactorial influences on surveillance systems for the detection and reporting of gastrointestinal pathogen outbreaks and potentially also impacted by the reduced resource availability for the investigation and reporting of particularly smaller regional foodborne outbreaks caused by pathogens with less severe clinical outcomes. The reduced number of *Campylobacter* and norovirus outbreaks is likely linked to the almost year-long restrictions on large events such as weddings where foods particularly associated with *Campylobacter* outbreaks (chicken liver pate/parfait) are often served and the closure of hospitality during national lockdowns is likely to have reduced consumption of raw oysters commonly associated with foodborne norovirus outbreaks, with also fewer outbreaks associated with infected food handlers. However, other influencers such as reduced investigation and reporting of outbreaks during 2020 due to COVID-19 make interpretation of these trends difficult.

E02702656

978-1-5286-3111-2

United Nations | Secretary-General

New York

14 February 2023

Secretary-General's remarks to the Security Council Debate on "Sea-level Rise: Implications for International Peace and Security"

[Bilingual, as delivered; scroll further down for all-English]

Mr. President, Dr. Ian Borg, Minister for Foreign and European Affairs and Trade of Malta, Excellencies,

I thank the government of Malta for shining a light on the dramatic implications of rising sea levels on global peace and security.

Rising seas are sinking futures.

Sea-level rise is not only a threat in itself.

It is a threat-multiplier.

For the hundreds of millions of people living in small island developing states and other low-lying coastal areas around the world, sea-level rise is a torrent of trouble.

Rising seas threaten lives, and jeopardize access to water, food and healthcare.

Saltwater intrusion can decimate jobs and entire economies in key industries like agriculture, fisheries and tourism.

It can damage or destroy vital infrastructure — including transportation systems, hospitals and schools, especially when combined with extreme weather events linked to the climate crisis.

And rising seas threaten the very existence of some low-lying communities and even countries.

The World Meteorological Organization has just released a new compilation of data that spells out the grave danger of rising seas.

Global average sea levels have risen faster since 1900 than over any preceding century in the last 3,000 years.

The global ocean has warmed faster over the past century than at any time in the past 11,000 years.

Meanwhile, the WMO tells us that even if global heating is miraculously limited to 1.5 degrees, there will still be a sizeable sea level rise.

But every fraction of a degree counts. If temperatures rise by 2 degrees, that level rise could double, with further temperature increases bringing exponential sea level increases.

Under any scenario, countries like Bangladesh, China, India and the Netherlands are all at risk.

Mega-cities on every continent will face serious impacts including Lagos, Maputo, Bangkok, Dhaka, Jakarta, Mumbai, Shanghai, Copenhagen, London, Los Angeles, New York, Buenos Aires and Santiago.

The danger is especially acute for nearly 900 million people who live in coastal zones at low elevations — that's one out of ten people on earth.

Some coastlines have already seen triple the average rate of sea-level rise.

I have seen with my own eyes how people in Small Island Developing States in the Western Pacific are facing sea-rise levels up to four times the global average.

In the Caribbean, rising seas have contributed to the devastation of local livelihoods in the tourism and agriculture sectors.

Rising seas and other climate impacts are already forcing some relocations in Fiji, Vanuatu, the Solomon Islands and elsewhere.

Flooding and coastal erosion in West Africa are damaging infrastructure and communities, undermining farming and often costing lives.

In North Africa, saltwater intrusion is contaminating land and freshwater resources, destroying crops and livelihoods alike.

Somalia is also grappling with saltwater intrusion, contributing to competition over scarce freshwater resources.

And around the world, a hotter planet is melting glaciers and ice sheets.

According to NASA, Antarctica is losing an average of 150 billion tons of ice mass annually.

The Greenland ice cap is melting even faster — losing 270 billion tons per year.

And consider the hundreds of millions of people living in the river basins of the Himalayas.

We have already seen how Himalayan melts have worsened flooding in Pakistan.

But as these glaciers recede over the coming decades, over time, the Indus, Ganges and Brahmaputra rivers will shrink.

And rising sea levels combined with a deep intrusion of saltwater will make large parts of their huge deltas simply uninhabitable.

We see similar threats in the Mekong Delta and beyond.

The consequences of all of this are unthinkable.

Low-lying communities and entire countries could disappear forever.

We would witness a mass exodus of entire populations on a biblical scale.

And we would see ever-fiercer competition for fresh water, land and other resources.

So, Excellencies, the impact of rising seas is already creating new sources of instability and conflict.

We must meet this rising tide of insecurity with action across three areas.

First — we must address the root cause of rising seas, the climate crisis.

Our world is hurtling past the 1.5-degree warming limit that a livable future requires, and with present policies, is careening towards 2.8 degrees — a death sentence for vulnerable countries.

We urgently need more concerted action to reduce emissions and ensure climate justice.

Developing countries must have the resources to adapt and build resilience against climate disaster.

Among other things, this means delivering on the loss and damage fund, making good on the $100-billion climate finance commitment to developing countries, doubling adaptation finance, and leveraging massive private financing at a reasonable cost.

Second — we must broaden our understanding of the root causes of insecurity.

That means identifying and addressing a much wider range of factors that undermine security — from poverty, discrimination and inequality, violations of human rights, to environmental disasters like rising sea levels.

That is why, for example, the Peacebuilding Fund is actively supporting grassroots resilience efforts against the effects of climate change.

We must also improve foresight and early warnings to prepare and protect vulnerable communities.

One prime example is our plan to ensure that early warning systems against natural disasters protect every person on earth within five years.

Troisièmement, nous devons aborder les conséquences de la montée des eaux sur les cadres juridiques et les droits humains.

L'élévation du niveau de la mer provoque – littéralement – un rétrécissement des masses terrestres, entrainant de possibles litiges liés à l'intégrité territoriale et aux espaces maritimes.

Le régime juridique actuel doit être tourné vers l'avenir et combler les lacunes des cadres existants.

Oui, cela inclut le droit international des réfugiés.

Mais il s'agit également de mettre en place des solutions juridiques et pratiques innovantes, pour faire face aux impacts de l'élévation du niveau de la mer sur les déplacements forcés de populations et sur l'existence même du territoire terrestre de certains États.

Les droits humains des personnes ne disparaissent pas lorsque leurs foyers disparaissent.

L'an dernier, la Commission du droit international a examiné cette question et exploré, pour y remédier, une série d'options qui consisteraient notamment à préserver le statut d'État malgré la perte de territoire, à céder ou à attribuer des portions de territoire à un État touché, voire à créer des confédérations d'États.

C'est essentiel de tenir ces débats pour trouver des solutions, et je salue les délégations de la Sixième Commission qui se penchent activement sur ces questions.

Nous devons continuer à œuvrer pour protéger les populations touchées et garantir leurs droits humains essentiels.

Le Conseil de sécurité a un rôle essentiel à jouer pour mobiliser la volonté politique nécessaire afin de relever les défis de sécurité dévastateurs que pose la montée des eaux.

Nous devons tous continuer de donner à cette question toute la visibilité qu'elle mérite, et à soutenir les vies, les moyens de subsistance et les communautés vivant en première ligne de cette crise.

Je vous remercie.

*****

[all-English]

Mr. President, Dr. Ian Borg, Minister for Foreign and European Affairs and Trade of Malta, Excellencies,

I thank the government of Malta for shining a light on the dramatic implications of rising sea levels on global peace and security.

Rising seas are sinking futures.

Sea-level rise is not only a threat in itself.

It is a threat-multiplier.

For the hundreds of millions of people living in small island developing states and other low-lying coastal areas around the world, sea-level rise is a torrent of trouble.

Rising seas threaten lives, and jeopardize access to water, food and healthcare.

Saltwater intrusion can decimate jobs and entire economies in key industries like agriculture, fisheries and tourism.

It can damage or destroy vital infrastructure — including transportation systems, hospitals and schools, especially when combined with extreme weather events linked to the climate crisis.

And rising seas threaten the very existence of some low-lying communities and even countries.

The World Meteorological Organization has just released a new compilation of data that spells out the grave danger of rising seas.

Global average sea levels have risen faster since 1900 than over any preceding century in the last 3,000 years.

The global ocean has warmed faster over the past century than at any time in the past 11,000 years.

Meanwhile, the WMO tells us that even if global heating is miraculously limited to 1.5 degrees, there will still be a sizeable sea level rise.

But every fraction of a degree counts. If temperatures rise by 2 degrees, that level rise could double, with further temperature increases bringing exponential sea level increases.

Under any scenario, countries like Bangladesh, China, India and the Netherlands are all at risk.

Mega-cities on every continent will face serious impacts including Lagos, Maputo, Bangkok, Dhaka, Jakarta, Mumbai, Shanghai, Copenhagen, London, Los Angeles, New York, Buenos Aires and Santiago.

The danger is especially acute for nearly 900 million people who live in coastal zones at low elevations — that's one out of ten people on earth.

Some coastlines have already seen triple the average rate of sea-level rise.

I have seen with my own eyes how people in Small Island Developing States in the Western Pacific are facing sea-rise levels up to four times the global average.

In the Caribbean, rising seas have contributed to the devastation of local livelihoods in the tourism and agriculture sectors.

Rising seas and other climate impacts are already forcing some relocations in Fiji, Vanuatu, the Solomon Islands and elsewhere.

Flooding and coastal erosion in West Africa are damaging infrastructure and communities, undermining farming and often costing lives.

In North Africa, saltwater intrusion is contaminating land and freshwater resources, destroying crops and livelihoods alike.

Somalia is also grappling with saltwater intrusion, contributing to competition over scarce freshwater resources.

And around the world, a hotter planet is melting glaciers and ice sheets.

According to NASA, Antarctica is losing an average of 150 billion tons of ice mass annually.

The Greenland ice cap is melting even faster — losing 270 billion tons per year.

And consider the hundreds of millions of people living in the river basins of the Himalayas.

We have already seen how Himalayan melts have worsened flooding in Pakistan.

But as these glaciers recede over the coming decades, over time, the Indus, Ganges and Brahmaputra rivers will shrink.

And rising sea levels combined with a deep intrusion of saltwater will make large parts of their huge deltas simply uninhabitable.

We see similar threats in the Mekong Delta and beyond.

The consequences of all of this are unthinkable.

Low-lying communities and entire countries could disappear forever.

We would witness a mass exodus of entire populations on a biblical scale.

And we would see ever-fiercer competition for fresh water, land and other resources.

So, Excellencies, the impact of rising seas is already creating new sources of instability and conflict.

We must meet this rising tide of insecurity with action across three areas.

First — we must address the root cause of rising seas, the climate crisis.

Our world is hurtling past the 1.5-degree warming limit that a livable future requires, and with present policies, is careening towards 2.8 degrees — a death sentence for vulnerable countries.

We urgently need more concerted action to reduce emissions and ensure climate justice.

Developing countries must have the resources to adapt and build resilience against climate disaster.

Among other things, this means delivering on the loss and damage fund, making good on the $100-billion climate finance commitment to developing countries, doubling adaptation finance, and leveraging massive private financing at a reasonable cost.

Second — we must broaden our understanding of the root causes of insecurity.

That means identifying and addressing a much wider range of factors that undermine security — from poverty, discrimination and inequality, violations of human rights, to environmental disasters like rising sea levels.

That is why, for example, the Peacebuilding Fund is actively supporting grassroots resilience efforts against the effects of climate change.

We must also improve foresight and early warnings to prepare and protect vulnerable communities.

One prime example is our plan to ensure that early warning systems against natural disasters protect every person on earth within five years.

Third — we must address the impacts of rising seas across legal and human rights frameworks.

Rising sea levels are — literally — shrinking landmasses, a cause of possible disputes related to territorial integrity and maritime spaces.

The current legal regime must look to the future and address any gaps in existing frameworks.

Yes, this means international refugee law.

But is also means innovative legal and practical solutions to address the impact of rising sea levels on forced human displacement and on the very existence of the land territory of some states.

People's human rights do not disappear because their homes do.

Last year, the International Law Commission considered this issue and explored a range of potential solutions.

This includes continuing statehood despite loss of territory, ceding or assigning portions of territory to an affected state, or even establishing confederations of states.

These discussions are critical to finding solutions, and I appreciate the active consideration by delegations in the Sixth Committee.

We must keep working to protect affected populations and secure their essential human rights.

Excellencies,

The Security Council has a critical role to play in building the political will required to address the devastating security challenges arising from rising seas.

We must all work to continue turning up the volume on this critical issue, and supporting the lives, livelihoods and communities of people living on the front lines of this crisis.

Thank you.

INVESTMENT CASE FOR ROOFTOP SOLAR POWER IN WAREHOUSING

August 2022

Introduction & scope of work

SYNOPSIS

This research project, commissioned by UKWA, investigated the overall case for installing rooftop solar photovoltaic (PV) systems in the warehousing sector. Warehousing has steadily been increasing its energy efficiency over the last 10 years, through improved lighting, electrification of material handling and system efficiency; however, rooftop solar projects have expanded more slowly. As the warehousing sector possesses approximately a third of all commercial roof space it has a large potential role to support the rollout of solar PV generation.

This report summarises the potential benefits for rooftop solar PV in warehousing for the sector's key players and the overall national and local benefits. The key barriers are described, future opportunities for increased deployment have been explored. Finally three priority areas addressing key barriers have been identified.

AUTHORS:

Laurence Robinson
Laurence.Robinson@delta-ee.com

Katharine Blacklaws
Katharine.blacklaws@delta-ee.com

REVIEWED BY:

Andrew Turton
Andrew.Turton@delta-ee.com

Delta-EE

https://www.delta-ee.com/consultancy/

Delta-EE head office:
Floor F, Argyle House
3 Lady Lawson Street
Edinburgh
EH3 9DR
+44 (0)131 625 1011

Contents

Executive summary

UKWA The Voice of The UK Logistics Industry

Executive summary

What are the key benefits of rooftop solar on the UK's warehouses?

Warehousing is in a unique position for solar power, providing an unparalleled amount accessible roof space close to industrial and residential centres.

Rooftop solar PV provides, lower and secure electricity costs, reduced environmental impact, no additional land use and increased asset value and efficiency.

National and local benefits

UK warehousing has the roof space for up to 15GW of new solar, which would **double the UK's solar PV capacity.** This could meet National Grid's minimum requirements for solar expansion by 2030 according to their 2022 future energy scenarios (FES), producing up to 13.8 TWh of electricity per year enabling the warehouse sector to become a **net producer of green electricity.**

Rooftop solar PV in warehousing can play a significant role in delivering **local renewable energy**, particularly in urban areas where limited alternative options are available due to land and planning constraints.

The UK's 20% largest warehouses can provide 75million square metres of roof space, avoiding the need to develop new land **equivalent to the footprint of 500,000 houses.**

Industry benefits

Commercial electricity prices have doubled since the start of 2022 and are set to continue to rise into 2023. Solar PV can **reduce annual electricity costs by 40-80%** and protect occupiers against future electricity price rises while preparing for increased demand from electrification of heat and transportation.

In aggregate rooftop solar PV has the potential to save the industry **£3 billon per year.**

Rooftop solar PV presents the sector with a unique opportunity to significantly **reduce environmental impact,** potentially reducing CO_2 emissions by **2 million tonnes/year** while also providing a good financial investment.

For owners and landlords solar PV has a major role in **levelling up the UK's warehouses** increasing the value and desirability of the warehouse assets. It also supports the drive for increased efficiency and meeting energy performance regulations.

DELTA-EE

Executive summary

What are the barriers and future opportunities?

Investment costs, low electricity demand and grid connections are the main barriers to systems, and a culture shift is required to develop larger installations.

Electrification of heat and transportation will increase the need for low-cost electricity and improve solar PV economics in warehousing.

Improved aggregation and energy storage will enable larger solar PV arrays.

Key barriers

The low warehousing typical **electricity demand** limits the economically viable installation size and therefore the viability of using the full roof area. However up-front investment costs can remain high.

Electricity **grid network connections availability** can limit the maximum system size, incur costly upgrades and even prevent projects where grid constraints are very high.

Larger installations require adopting different market risk as a power producer, either through outsourcing or a **culture shift** in the sector to see warehouses as **solar power plants** and maximise installation size**.**

Legal **agreements on repair and maintenance** to manage landlords and occupiers liability may delay and complicate installations. This can make some smaller projects uneconomic.

Future opportunities

Electrification of **heat**, new automation systems and critically electric **transportation** could significantly increase electricity demand in warehousing. This will **improve the economics** of rooftop solar through increased self-consumption.

Increasing initiatives to **streamline the aggregation** and resale of excess renewable energy from smaller facilities in local communities will enable **higher incomes** from exported power, allowing larger systems to operate more economically.

Reduction in the costs of **local energy storage** could allow **greater flexibility**, improving self-consumption and reducing impact on local network infrastructure.

Warehousing, net zero and rooftop solar PV

Why is now the time to investigate rooftop solar for warehousing?

Warehousing, net zero and rooftop solar PV

A range of drivers are improving the attractiveness of solar PV

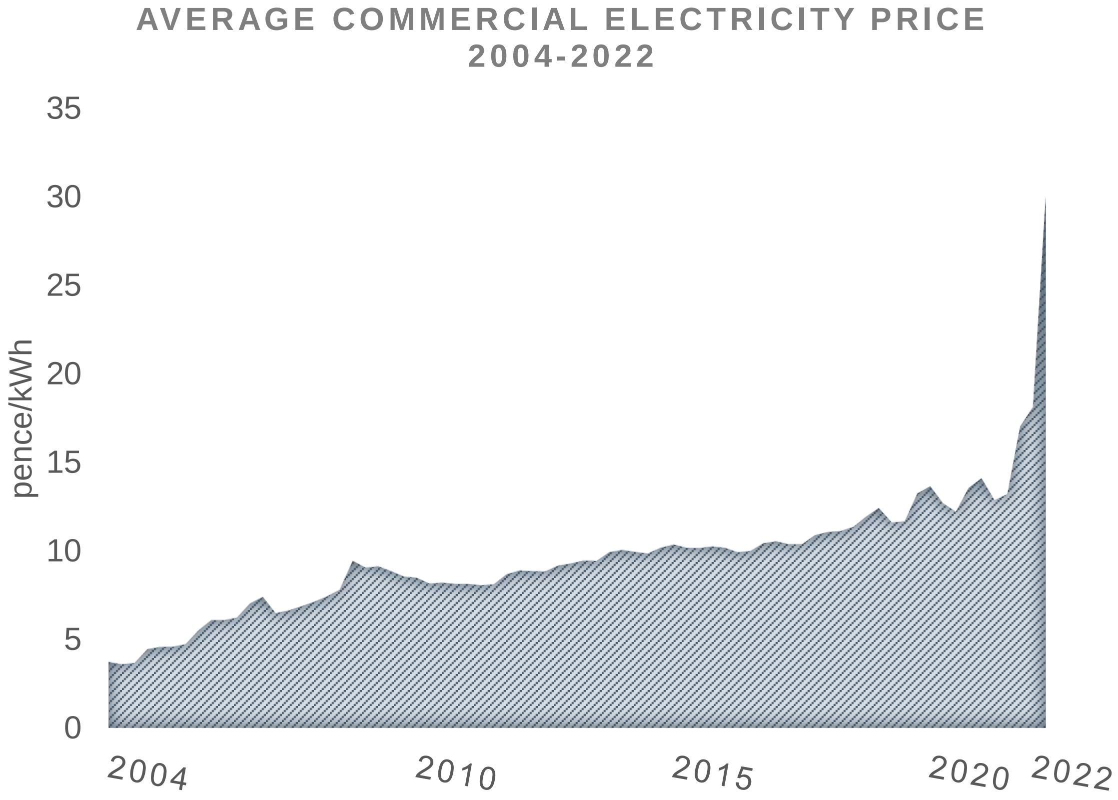
Solar is expected to expand greatly through the 2020's to support the transition to net zero. Warehousing has a unique asset to support the rollout.

In the UK, following the end of the Feed-in Tariff (FiT), and the subsequent market drop in 2018/19, installations are increasing again and are forecast to rise through to 2025 at least.

A combination of increasing energy prices, the drive to net zero and the prospect of heat and transport electrification means there is a strong need for low cost, low carbon and reliable electricity in the warehouse and logistics industry.

Solar PV UK rollout expanded significantly in the early 2010's due to generous feed-in tariff support. However, as this subsidy was reduced and ultimately removed in 2019, there has been a significant downturn in solar installations.

Solar panel cost reduction combined with energy price increases is improving the economics making solar PV more attractive to business, resulting in installations rising in 2021 and 2022.



Source: BEIS, 2022 Q2 price through consultation

DELTA-EE

Warehousing, net zero and rooftop solar PV

Why is now the time to invest in rooftop solar?

UK solar capacity is expected to increase two or threefold over the next 10-15 years to support the UK's net zero ambitions.

Solar installations are expected to rise to meet the UK's net zero ambitions. Analysis from National Grid[1], the Climate Change Committee[2] and National Infrastructure Commission[3] model a **doubling of solar capacity by 2030**, with some scenarios requiring much higher deployment. The UK Government published its Energy security strategy in April 2022[4], **proposed a five times in increase** in solar by 2035.

A major question is **where all this new solar capacity will be built;** over the last decade the majority of solar installations have been utility-scale ground-based systems, usually on farmland. With growing pressure on food security and housing there is an increasing need consider commercial rooftops as a priority for locating PV capacity.

While regulatory ambitions and the market conditions for solar are improving, there **remain barriers to unlocking the full potential** opportunity of the UK's commercial rooftops and, in particular, the unique position in the warehousing logistics sector which has the largest combined commercial rooftop space.

This report summarises the potential **benefits** of rooftop solar in warehousing sectors key players and the overall national and local benefits. The key **barriers** to solar deployment are described and **future opportunities** for increased deployment are explored.

Benefits of solar PV

An overview of the key benefits of solar PV at the national and local level and the misaligned benefits for warehousing occupiers and landlords

National benefits for rooftop solar in warehousing

What is the potential across the UK?

Rooftop solar power could transform the UK warehouse sector into a net producer of renewable electricity

Warehousing provides a unique opportunity for large scale rooftop solar deployment, with approximately one third of the UK's total non-domestic buildings' roof space.

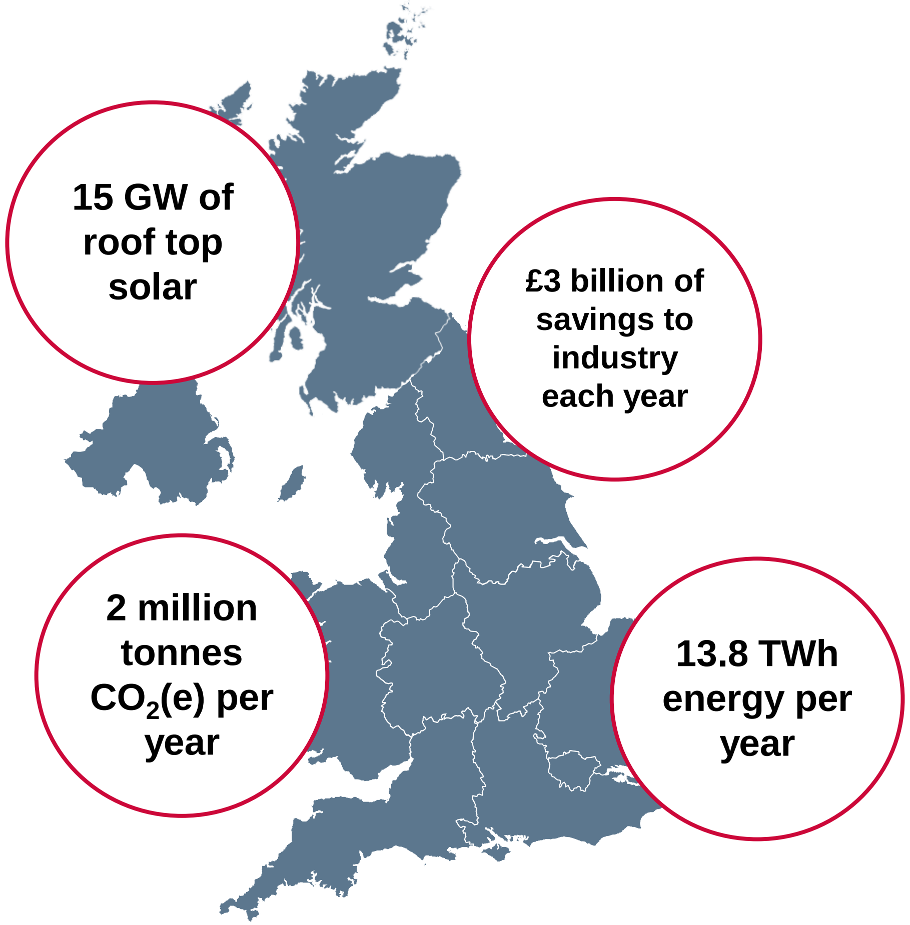
With **only the largest 20%** of warehouses there is enough roof space to **double the UK's solar generation capacity** from 14 to 28 GW

National Grid's future energy scenarios[1] consider 12-29 GW of additional solar is required by 2030; warehousing could play a major role in the next decade.

With 15 GW of solar fitted, the warehouse sector could **generate ~13.8 TWh** of renewable electricity per year – transforming the sector from **net consumers to net producers.**

This could save the logistics business **£3 billon per year**, through energy savings and additional income from energy sales.

This could avoid emissions for up to **2 million tonnes of CO_2(e) per year** by reducing reliance on grid electricity, which is still heavily supported by natural gas.



National potential of rooftop solar on UK's warehousing
Calculations in annex

UKWA
The Voice of The UK Logistics Industry

Benefits for occupiers

Why should tenants be pursuing rooftop solar on their sites?

Rooftop solar is one of the most cost-effective CO_2 reduction measures for warehouses.

Payback times for solar PV have been falling due to increased electricity costs.

Third party financing options enable installations without initial capital investment.

Environmental, social and governance
Meet environmental impact and corporate social responsibility targets. Solar PV is a direct solution to decarbonisation compared to outsourcing or offsetting.

Immediate and future cost reduction
Payback for upfront cost can be as low as 4 to 6 years.[5] Driven by currently high energy prices. Third party financing options can provide immediate annual cost savings without investment

Market and regulatory risk management
Meet customer requirements for reduced supply chain carbon footprints. Ensure operations are not disrupted later to upgrade facilities to meet upcoming efficiency regulations.

*A 500 kW solar PV system (suitable for 100,000 sq. ft. warehouses) can **reduce CO_2** emission by around **65 tonnes per year**, equivalent to driving an HGV approximately 87,000 km

DELTA-EE

Benefits for landlords

Why should landlords invest?

Solar PV is a complementary investment to commercial property in its own right, while providing additional benefits.

Increased asset returns, value, customer attractiveness and meeting environmental obligations.

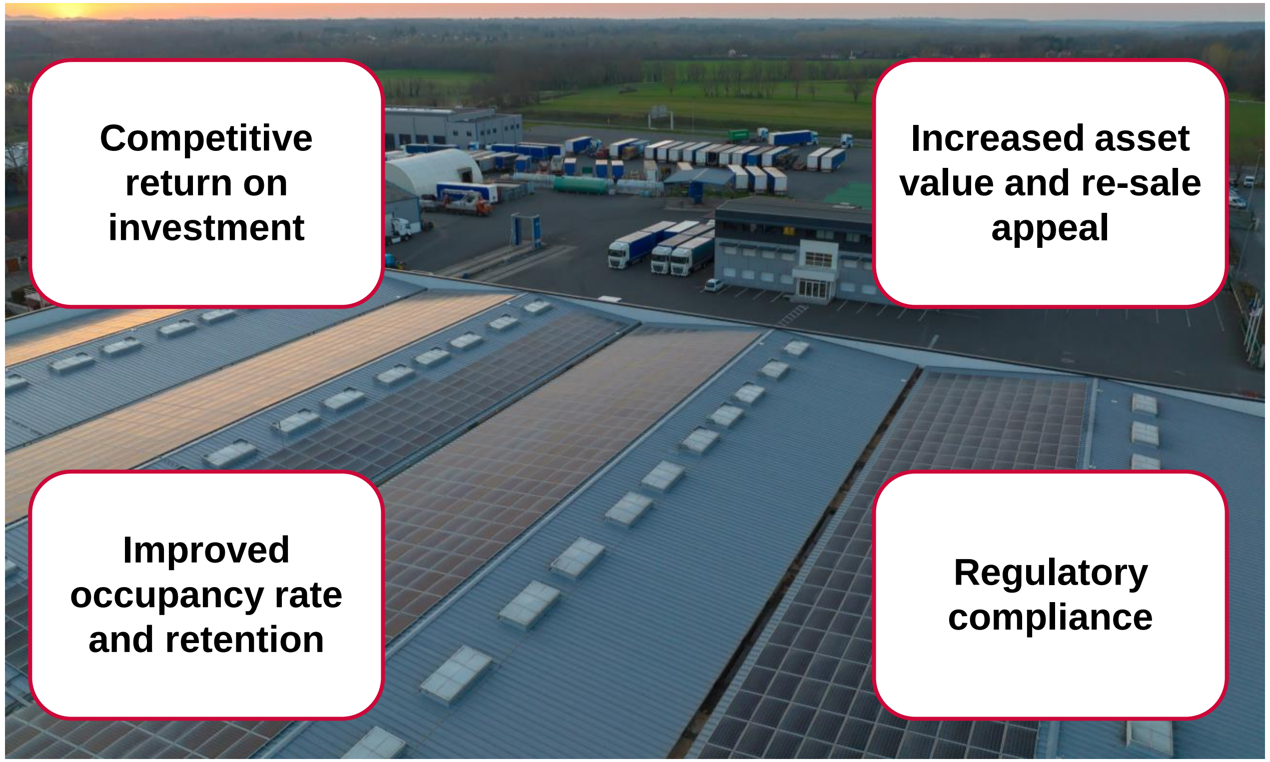
Rooftop solar PV de-risks meeting future regulations and prepares assets for electrification.

Return on investment
Rooftop solar PV is a good investment opportunity in its own right, providing an internal rate of return of 10-15%* on self financed projects.

Asset value and desirability
Solar PV systems have lifetime of 25 years adding to the total warehouse asset value. Increased ESG interest by institutional investors is leading to CO_2 emission-based investment criteria.

Lower energy costs are more attractive, increasing occupancy rate

Regulation compliance and investor attractiveness
By 2030, non-domestic minimum expected energy standards (MEES) is planned to be EPC B, with EPC C rating required by 2027. Solar PV can help meet this obligation while providing good financial return.



- The IRR is dependent on location, building size, orientation, onsite energy demand and through life electricity prices.

Benefits for local areas

Why should local communities support rooftop commercial solar?

Warehousing is unique in providing extensive commercial rooftop space in urban and sub-urban areas, where other renewable energy options are limited.

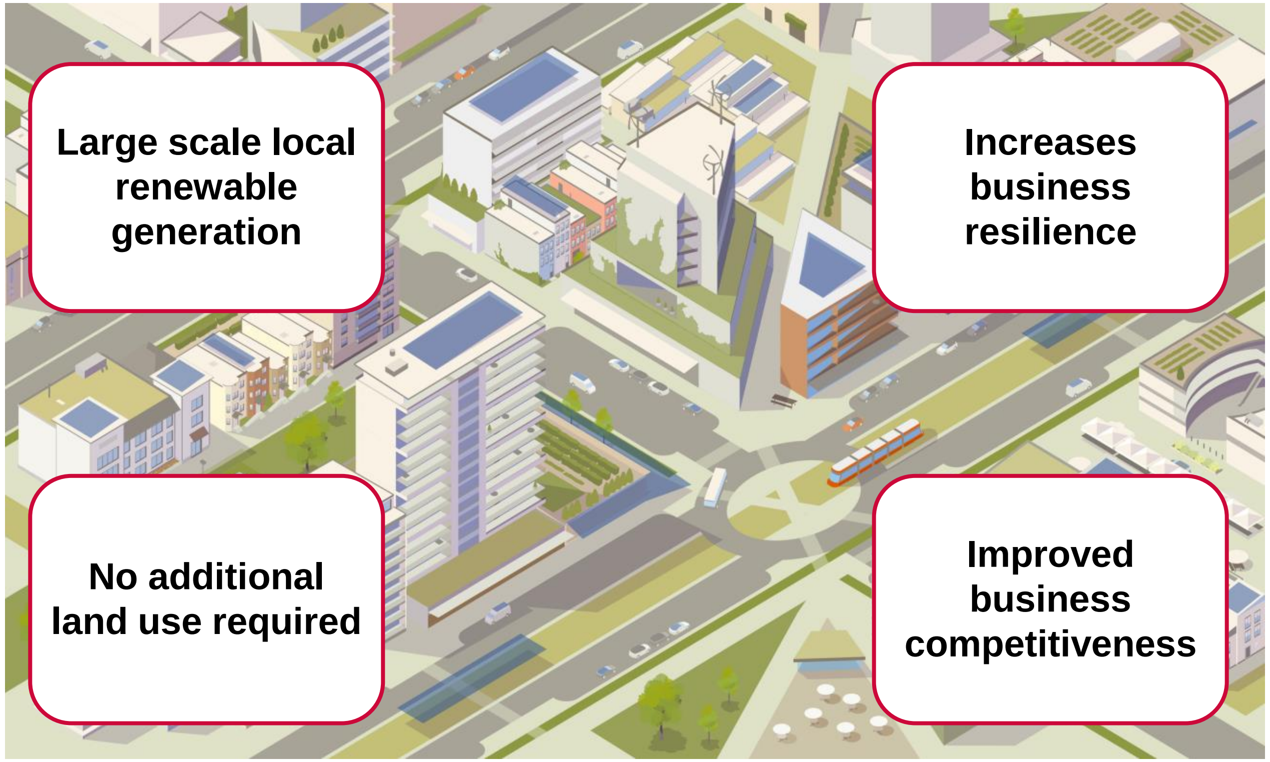
Rooftop solar on warehousing could be a significant element in local energy system planning.

It is ideally placed to meet the local net zero targets for 2030 as a ready to deploy technology.

Local area net zero planning targets
Local Government must play a major role in meeting UK's net zero targets.[6] In England, 91% of principal local authorities have commitments to decarbonise.

Warehousing rooftop solar PV provides large footprints in urban and sub-urban areas. The UK's 20% largest warehouses can provide 75million m^2, avoiding the need for additional land, equivalent to the footprint of 500,000* houses.

Attractiveness for businesses
Encouraging solar PV will reduce energy costs for business, providing greater business competitiveness and resilience in the local area. Local businesses will benefit from lower CO_2 emissions, increasing their attractiveness to customers through lower impact on the supply chain.



*Assuming average house plot area of 150m^2

Barriers

Examination of the key elements preventing or slowing the rollout of solar PV in the warehousing sector

Barriers to scale-up

Four key barriers that slow commercial solar PV roll out

Most barriers reduce the size and potential uptake speed of solar PV in warehousing, rather than preventing installations.

Energy demand and economics

Energy demand in warehousing is relatively low per unit floor area and does not match solar PV generation profiles.

Optimum economics are linked to higher on-site energy demand, therefore limit the economic optimum installation capacity.

Business model and contractual barriers

As the logistics market becomes more specialised and segmented it is harder for many operators and owners to justify investing.

Timing for installations with leases limits the window for installations being conducted.

Project complexity and commercial risks

The complexity of the process and design options can be challenging and require specialist input.

Full repairing and insuring leases create commercial barriers on liability for both tenants and landlords.

Local energy coordination and planning

Grid connection constraints are a major barrier to larger scale deployments and require local and national support.

Local energy planning to support installations and help achieve higher uptake is currently lacking.

The Voice of The UK Logistics Industry

Economics of solar power

What are the main costs, incomes and complexities?

Solar power economics are driven primarily by upfront cost and the degree of self-consumption.

Solar variability adds further challenges in size optimisation.

The typically lower value of exported power means smaller systems are favoured to maximise on-site consumption.

The principal economics of solar project are straight forward:
Costs included:

- Upfront planning and development
- Upfront equipment and installation
- Through life maintenance

Upfront costs are typically around 70-80% of the overall project costs.

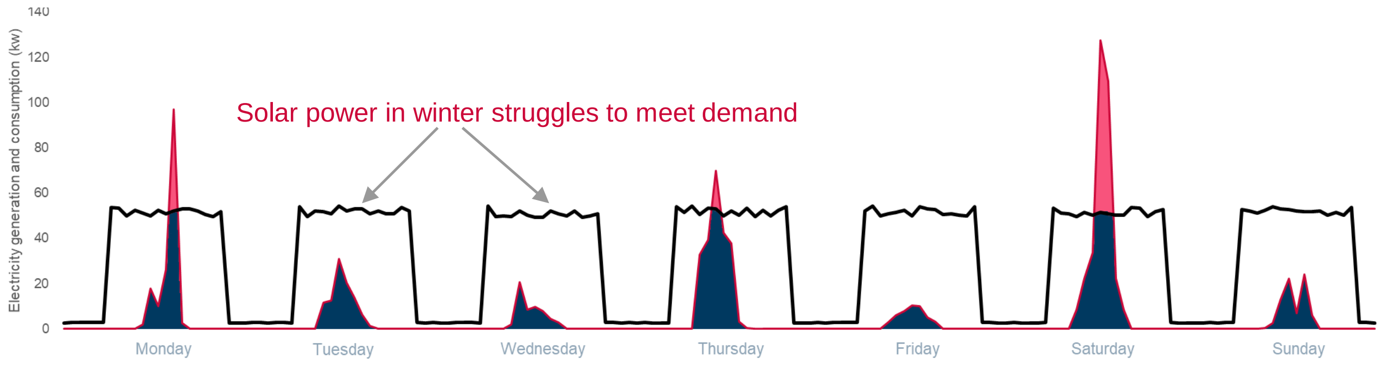
Income streams include:

- Self-consumption to avoid retail electricity costs
- Income from exported power.

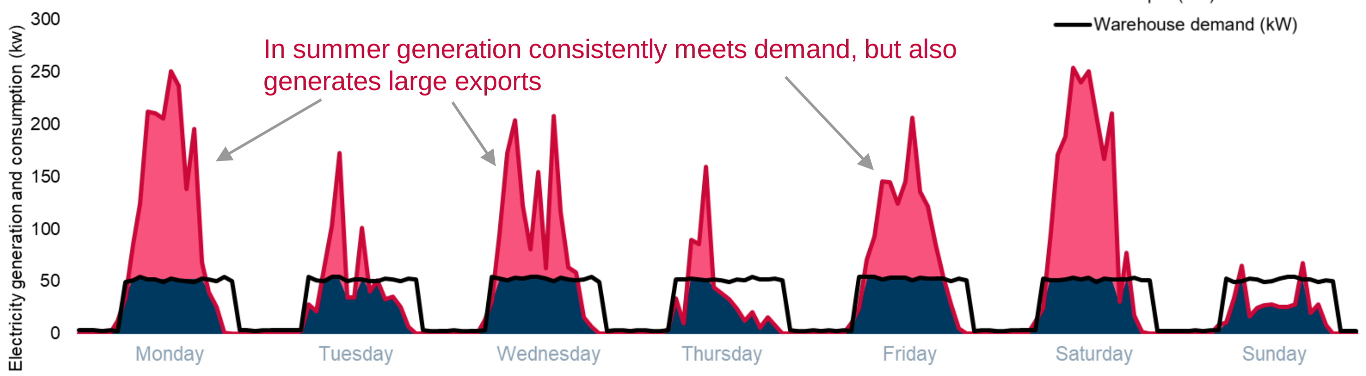
Avoided electricity costs are typically 2-3 times more valuable than exported power.

The complexity that comes with solar is due to its temporal and seasonal nature; it is challenging to match generation accurately with demand to maximise self-consumption. In winter there is low generation and in summer very high generation.

January week: example solar generation and consumption



June week: example solar generation and consumption



Illustrative examples – demand profiles simplified

DELTA-EE

Solar sizing and optimisation options

What is the impact on payback, profitability and emissions?

Understanding the primary aim of the project is important in determining the sizing approach.

Smaller installations with high self-consumption provide low risk returns, while larger systems can provide higher overall payback.

Optimise payback and return on investment

In this approach the solar system is sized to optimise the profitability of the solar system to balance payback time and system size.

This can generally be achieved by optimising for self-consumption and therefore the optimum PV array size is constrained by energy demand characteristics.

- Size(kWp): 150
- Payback (years) : 6
- IRR(%): 15%
- Energy (GWh): 3
- Carbon savings(tonnes): 500
- Net present value(25yrs):£303k

Maximise financial impact

A focus can be to maximise the net present return – this may reduce the profitability, but increase the overall return. While this increases the investment risk, the potential benefits are also increased.

This is typically constrained by grid connection and the potential for electricity exports and their value.

- Size(kWp): 400
- Payback (years) : 8
- IRR(%): 9%
- Energy (GWh): 9
- Carbon savings(tonnes): 1300
- Net present value(25yrs):£357k

Maximise environmental impact

Prioritising environmental impact aims to maximise generation to reduce CO_2 emissions as far as possible and therefore businesses' environmental impact.

This is primarily constrained by roof size and structure and the maximum allowable installation for the grid connection.

- Size(kWp): 1000
- Payback (years) : 12
- IRR(%): 3%
- Energy (GWh): 22
- Carbon savings(tonnes): 3300
- Net present value(25yrs):£317k

This is an illustrative example calculation, specific costs and payback is highly dependant on circumstances, assumptions in annex.

Business model and contractual barriers

How do existing warehousing business approaches deter investment?

Market segmentation, deters investment in solar generation due to the benefit being split by multiple parties.

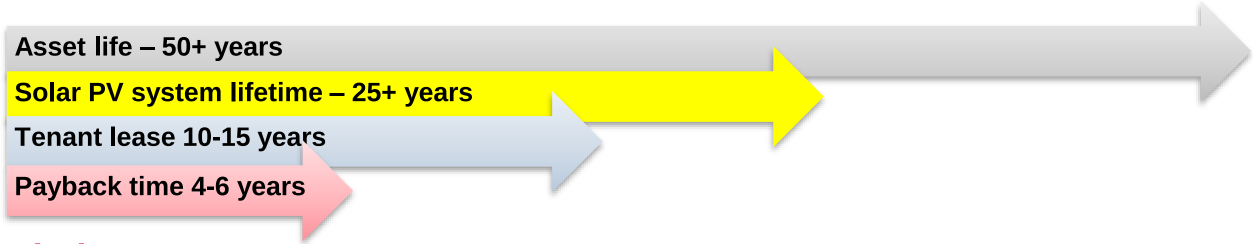
Long leases provide a short window for low friction contractual negotiations.

Business model and market segmentation

The warehousing market is increasingly segmented, in particular with the rise of third party logistic models requiring agile operations to manage short term customer contract risks (1-3 years) and shorter leases.

Solar PV projects are longer term investment 10-25 years and linked to the warehouse, this mismatch in timescales deters investment from occupiers.

Extracting the full benefits is challenging when ownership and delivery are separated. There is a need for standardisation to reduce interface frictions.



Timing

Some occupiers are keen to invest to reduce costs and environmental impact. However, justifying investment in property you don’t own is challenging unless there is sufficient time to make a return.

- Lease durations are typically 10-15 years while the payback time for rooftop solar - typically 4-6 years - means at the start of most leases there is sufficient time to realise financial benefit, however this diminishes quickly over time
- When remaining lease duration approaches payback time, the perceived project risk is higher for tenants to invest.
- The ideal solar PV installation time is at the start of a new lease every 10-15 years to simplify the contractual negotiations.
- Older buildings with asset life of <25 years may not receive full benefit from solar and may also have higher cost installations.

Complexity and risk

What are the main risks that prevent, delay, or reduce installations?

There are a range of risks in installing a solar PV system, but as with any construction project careful planning and the use of experienced professionals can help minimise the impact.

Feasibility

In the feasibility phase, the key expenditures are feasibility assessment and surveys, design, legal costs. The key elements to address in this stage are:

- Structural: a professional survey is necessary to ensure chosen roof(s) can accommodate PV systems.
- Contractual: clear alignment between tenant, landlord or other parties either allowing rights for installation and roof access or commitment to resolve any issues identified.
- Energy audit: good understanding of the daily and seasonal energy demand of your building is critical for economic assessments.
- Engage solar company(s) to initiate early consultancy on solar design – key due diligence to select company to collaborate on detailed design and planning and permit applications.

Design and consenting

After establishing feasibility, a detailed site survey and financial modelling will be required to support a detailed system design. The next stages are:

- Application for grid connection permits: this critical stage can delay and limit the installation and therefore should be made as early as possible.
- Planning permission: this is rarely an issue for rooftop solar, as small scale solar is permitted development. However for installations >1MW there is specific requirement to apply for full planning permission this can take several months.
- Finalisation of legal agreements, including power purchasing agreements.
- Finalisation of financing options and internal project approval for the investment.

Installation, operation and end of life

With all consents in place installation of the system can begin. The following factors are key risks:

- Quality of installation: critical to the long-term performance of the solar PV system.
- Disruption during installation: careful planning can enable installers to minimise or eliminate installation disruption as much as possible.
- Damage during installation: agreements with the installers to ensure any damage during installations is repaired.

System operation requires:

- Through- life performance monitoring and maintenance.
- Financial monitoring and management of export agreement and contracts.

End of life:

- Decommissioning, dismantling and recycling costs.

Local energy coordination and planning

How is lack of local energy planning obstructing installations?

Local energy planning does not currently coordinate grid upgrades or facilitate local energy generation and consumption.

Grid connection permits are a major barrier to rooftop solar installations, increasing costs and constraining project size.

In some cases, these additions can prevent projects from being developed.

Grid connection permitting

When building any solar project over 16A per phase (3.68kWp for a single phase or 11.04kWp three phase) the local distribution network operator (DNO) must be informed and provide prior permission. In response to an application, DNO's typically respond in 4 ways:

- Proceed with no constraints or charges
- Constraints on maximum system size and export limitation, without requiring grid upgrade costs. (Verification costs are required)
- Requirement to upgrade grid connection infrastructure, some cost must be born by the solar project owner.
- In some cases constraints can be so tight as to prevent a project from being developed.

For smaller commercial systems (<100-250kWp), there is infrequently an issue with grid connections, but for sizes over 250kWp there is increasing likelihood that constraints and significant costs will be required, which diminishes project returns and increases installation time and complexity.

Local area energy planning

Deficit of local energy planning is acting as a barrier to commercial solar installations in warehousing.

As electricity usage and local renewable generation is increasing grid infrastructure needs to be upgraded to support the local community and businesses. These costs are typically shared through distribution use of system charges.

However when building solar generation projects, there is a currently a first come basis on access to the available capacity for free. Later project required to pay for upgrades that would typically be shared.

Solar PV has the potential to provide low-cost energy locally, increasing the value to the project owners, while also sharing benefits to local business/community energy costs. The matching of generation and customers is not currently coordinated and acts as a barrier.

Future opportunities

An overview of potential opportunities that will mitigate some barriers and enable increased benefits

Technology drivers

What technology changes will increase the attractiveness of Solar PV?

Increasing local demand and self-consumption could enable significantly larger installations.

Energy storage has the potential to offset grid connection limitations and improve economics as costs reduce.

Electrification of transport

Decarbonisation of light and heavy goods vehicles is likely to cause be the biggest increase in energy demand in the logistics sector in the near future.

Whether through direct electrification or hydrogen conversion, decarbonisation of 25% of the UK's HGVs alone would require between 60-100%(8-14TWh) of the current annual electricity consumption of the whole warehouse sector.

HGV electric charging or hydrogen generation on-site at warehouses could double the electricity demand, increasing the attractiveness of on-site solar PV generation through higher self-consumption and larger capacity systems.

Energy storage

On-site battery storage can improve solar PV financial viability by:

- Increasing the % of energy self-consumption and therefore increasing the economic value.
- Reducing the peak exports, therefore reducing the necessary grid connections or enabling larger installations.
- Opening up the opportunities for providing flexibility services and accessing new forms of revenue from the energy system.

Currently the capital cost of battery systems is typically too high to be justified for most installations.

However, as costs further decrease and the second life battery market grows, battery storage systems could enable significantly larger solar installations on a wider range of warehouses.

Automation and light manufacturing

The warehousing and logistics industry is already estimated to have the highest proportion of automation of any industry[7] and is forecast to grow dramatically in the next 5-10 years to meet the high and growing penetration of e-commerce in the UK retail industry. This trend is likely to further increase the energy demand in some warehousing.

However, the overall energy demand picture for automation and manufacturing is complex as some solutions can reduce demand for the same throughput while others increase demand but significantly increase the warehouse efficiency.

Economics and business models

Improving the value of exported energy

Self-consumption dominates the economics of solar power, which is challenging for low demand warehousing.

Increasing the value of export power, greatly increase the optimum size of solar installation.

Power purchasing agreements for export

Larger installations can take advantage of power purchasing agreements (PPA) to significantly increase the value and decrease the risk of energy exports.

Sleeved PPA allows the user to have little knowledge of the electricity market, working with energy suppliers to manage the purchasing and sale of the electricity over the network. A number of specialist PPA companies provide this service.

Aggregation and virtual power plants (VPP)

An emerging opportunity for smaller installations is the increasing capabilities of aggregators to combine smaller generators into virtual power plants.

In this approach partnering with third party aggregator allows the solar PV owner to achieve higher value export. The aggregator is able to achieve a higher value by combining several solar PV systems (and potentially other assets) into a single VPP that can either bid directly into the electricity market, can secure contract for difference contracts or can be sold through long term PPA.

Community energy

New business models and approaches for local energy markets such as peer-to-peer trading can allow significant improvements in export price. These approaches are new and could bring more risk and complexity.

More sophisticated options, such as collective self-consumption can allow local communities to work together, maximising use of local energy and minimising the impact on the local grid. The current regulation in the UK makes these approaches difficult to implement but this is likely to evolve.

Priority areas

What are the key priorities areas to alleviate barriers and enable widespread solar deployment

Priority areas

Identified priorities areas to enable widespread solar PV

Government can support solar PV deployment through tax incentives and electricity market reform and reduce barriers in accessing grid connections.

The industry must develop best practice approaches.

Investment costs

Whilst high energy prices are helping to improve solar PV economic performance, the investment costs are also increasing as solar panels installation is influenced by global inflation and supply chain pressure.

As 70%+ of costs involved in solar projects are upfront and interest rates are rising, financing these projects is increasingly challenging. In particular for small and medium businesses where cash flow is tight.

In April 2021 the UK government extended a super deduction on capital investment including solar panels, which will end in 2023. This could be extended to 2030 to support continued investment.

Grid connection permits

The UK grid is becoming more constrained with growing electricity demand and increased residential and commercial generation. This will increase costs when securing connection permits for rooftop solar and limit their viable size, therefore limiting the national, local and business benefits.

The department of business, energy and industrial strategy is currently reviewing the electricity market arrangements and Ofgem is consulting on the future of DNO/DSO structures.

These activities should address how new arrangements will improve planning and reduce grid connection barriers for deployment of commercial rooftop solar.

Industry perception, knowledge and best practice

The knowledge and perception for solar PV projects is fractured with challenges regarding risks, costs, legal issues and business models.

There is a need to provide best practice guidance to the industry for solar projects, especially in regards to contractual arrangements between tenants and landlords, and the opportunities for third party financing.

UKWA is providing a step-by-step guide for UKWA members outlining the overall process of developing a solar project, the key design options, economics financing and legal considerations.

Annex

References, calculations and acknowledgements

References

1. National grid, future energy scenarios 2022
2. Climate change committee, The sixth carbon budget, December 2020
3. Renewables, Recovery and Reaching Net Zero, national infrastructure commission 11 August 2020
4. https://www.gov.uk/government/news/major-acceleration-of-homegrown-power-in-britains-plan-for-greater-energy-independence
5. Solar Energy UK: Corporate buyers' guide (2022)
6. Local government and net zero in England, NAO, SESSION 2021-22 16 JULY 2021 HC 304
7. THE ECONOMIC IMPACT OF ROBOTICS & AUTONOMOUS SYSTEMS ACROSS UK SECTORS, BEIS Research Paper Number: 2021/043

Calculations (1/2)

Installation and energy generation capacity

BEIS Non-Domestic National Energy Efficiency Data Framework has been used to estimate total warehouse floor area. This data shows 35000 warehouses over 1000 sq. m (~10000 sq. ft) in size, with a total floor area of 150 million sq. m and average energy use of 11.2 TWh (75% of 14.4 TWh total electricity use)

Assumptions:

- Roof area = floor area
- Solar peak capacity = 200kW/m^2 = 5000m^2/MW
- Roof space fitted = 50%
- Average load factor = 11%

Total peak capacity = (150,000,000/5000)×50% = 15000MW = **15 GW**

Annual generation = 11% × 8760 × 15GW = 13797 GWh = **13.797 TWh**

Carbon and cost savings

Carbon savings
The UK average grid carbon intensity is currently between 150-250g/kWh, mid point of 200g/kwh has been used. Solar PV carbon intensity is typically quoted at 50g/kWh.

- Carbon saving of 150g/kWh has been calculated

13,800,000,000 kWh × 150g = **2.07 million tonnes**

Cost savings
New commercial contracts for electricity supply are starting at 33 pence/kWh (June 2022). Minimum export rates are around 5-7.5p/kWh. Export contracts at the time of writing are 10-15p/kWh.
Assumptions:

- 50% average self-consumption
- 33p/kWh average self-consumption savings
- 10p/kWh average export income

7,900,000,000 kWh × 0.33 +7,900,000,000 kWh × 0.1 = £2,966,355,000 = **£3 billion**

Calculations (2/2)

The Voice of The UK Logistics Industry

Opportunity for occupiers

Grid electricity carbon intensity in the UK is typically around 150-250g/kWh in 2021 – 200g/kWh was used.

Solar electricity carbon intensity is around 50g/kWh, including construction, installation and decommissioning.

500kWp solar plant is estimated to make 433,000kWh/year.

433,000 x150 = 65.0 tonnes.

HGV truck emission around 750 gCO2/km: https://theicct.org/publication/co2-emissions-from-trucks-in-the-eu-an-analysis-of-the-heavy-duty-co2-standards-baseline-data/

Solar sizing optimisation

Scenario – ambient warehousing looking to invest in solar power with following characteristics:

- 100,000 sq. ft
- Location: UK Midlands
- Electricity usage: 30kWh/m^2/year
- Operating 7 days/week (6am-8pm)
- Flat roof, all panels south facing

Solar techno-economic assumptions

- Equipment and Installation costs - £1000-1500/kW (including site, electrical and grid connection costs)
- Inverter cost and lifetime -10% installation cost, 11 year life time.
- Solar irradiance data – PVGIS-SARAH 2
- Slope, Azimuth - 41/-11 degrees,south facing
- System losses - 21%
- Performance degradation - 0.5%/year
- O&M costs -10 £/kWp/year
- Maximum solar - 200W/m^2
- Maximum roof space coverage- 60%
- Discount factor - 5%

DELTA-EE

Acknowledgements

This report was developed with contributions from a wide range of organisations. In particular, we would like to thank the following organisations for their input and expertise in the development of this study.

- Solar Energy UK – *an established trade association working for and representing the entire solar and energy storage value chain representing a member-led community of over 300 businesses and associates.*
- ABP – *Associated British Ports operate 21 ports across the UK, supporting around 120,000 jobs. In 2021,17 of 21 ports have renewable energy generation projects, including 6.5MW of solar energy installed and new installations planned for 2022 and beyond.*
- Conrad Energy – *Conrad Energy's generation portfolio powers the equivalent of over a million homes from embedded, flexible generation projects, solar and battery storage. Conrad Energy has over 150 experts dedicated to supporting critical national infrastructure, enabling the UK's energy transition to net zero by 2050*
- Potter Space – *SME warehouse and industrial space developer, with five locations across the UK covering over 250 acres. Potter Space has completed five solar installation projects since 2011, with over 3000 sqm of PV panels installed.*

Please note the contents and conclusions of this report do not necessarily represent the views of any of these organisations.

Disclaimer

Disclaimer
While Delta Energy & Environment Ltd (‘Delta-EE’) considers that the information and opinions given in this work are sound, all parties must rely upon their own skill and judgement when making use of it. Delta-EE does not make any representation or warranty, expressed or implied, as to the accuracy or completeness of the information contained in the report and assumes no responsibility for the accuracy or completeness of such information. Delta will not assume any liability to anyone for any loss or damage arising out of the provision of this report.

Where this report contains projections, these are based on assumptions that are subject to uncertainties and contingencies. Because of the subjective judgements and inherent uncertainties of projections, and because events frequently do not occur as expected, there can be no assurance that the projections contained herein will be realised and actual events may be difference from projected results. Hence the projections supplied are not to be regarded as firm predictions of the future, but rather as illustrations of what might happen. Parties are advised to base their actions of an awareness of the range of such projections, and to note that the range necessarily broadens in the latter years of the projections.