



Climate Change Adaptation

Report for the Fourth Round of the
Adaptation Reporting Power (ARP4)

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Executive summary

The UK is experiencing a changing climate, less predictable seasons and more frequent and intense weather events. Agriculture is especially vulnerable to climate change. It is directly dependent on the climate – sunlight and temperature, rainfall and atmospheric conditions – and relies on natural assets like soils interacting with complex biological systems. Thus, climate change potentially compromises food security in the UK and other functions and services that agricultural systems provide. For AHDB it is imperative that we support our levy payers to be competitive and sustainable among these changes happening now and into the future.

This report concentrates on UK production up to farmgate, the impacts that production may have downstream on demand, and markets. It covers only sectors in which AHDB receives a levy, i.e. beef, lamb, cereal, oilseeds, dairy and pork, with other sectors considered where there are interdependencies, e.g. rotational or competitive displacement effect. The risks and opportunities selected are those affecting either the functions, services or assets of industry or AHDB, now, mid-century and by the end of the century. Thirteen risks/opportunities were determined, comprising the themes of productivity, business infrastructure, landscape and markets. These were assessed for the range of impacts, consequences and opportunities presented, and therefore the actions to address the risks or help realise the opportunities. The barriers and enablers to action were also explored. This was performed through a process of literature review and expert opinion from AHDB subject matter specialists and a range of stakeholders representing the AHDB sectors.

The high-priority risk/opportunities are critical now and will continue to be critical to 2100 in a 4°C scenario, all being major to significant in magnitude. They are all key to food production, being highly threatened by climatic changes, which lead to acute and/or chronic impacts. These are the risks to soils and from flooding, and the risks/opportunity from agricultural productivity. The medium risk/opportunities are those of relative moderate impact and likelihood but interdependent with the high-priority group. There are risks/opportunities around carbon stores, pests and pathogens, and on-farm infrastructure. Lastly, there is the group of relative lower-priority risks/opportunities but of no less importance. These tend to be the longer-term risk opportunities of relative lower magnitude, including opportunities for alternative species and risk from saltwater intrusion; these require a watching brief.

The actions fall into three main categories of a) scoping, b) on-farm best practice and c) research, knowledge exchange and analysis. A number of these actions are already embedded into priorities and functions at AHDB. However, the process has identified other actions that could be adopted, and AHDB will look to work in partnerships with industry, governments and research to determine the most appropriate way to support our levy payers in these areas.

One area that has been identified is learning from other countries which may be climate analogues for future conditions in the UK. Monitoring will be crucial to how risks/opportunities may change in nature and magnitude, and therefore the implications for response.

Finally, raising awareness of the impacts and opportunities presented by climate change to industry will be crucial. As well as providing the evidence, analysis, guidance and tools to help with decision making and implementation, ensuring a joined-up approach to knowledge exchange is pivotal to facilitating this.

The risk assessment approach has provided a systematic way of ascertaining the risks and opportunities that affect agricultural production, both in the short and long term, and those increasing in importance over time. Through the additional driver of climate change, new actions have emerged that have not previously been considered. Furthermore, it has also made us consider how our functions and activities may be better modified to meet the needs of our levy payers.

1. A changing climate for UK agriculture

Vulnerability of agriculture

As a whole, the UK is experiencing warmer, wetter winters and hotter, drier summers. These changes are likely to continue, with a warmer climate as the **UK Climate Projections (UKCP18)** [1] indicate, and will be accompanied by an increase in the frequency and intensity of extreme events such as heatwaves, heavy rainfall and droughts.

Agriculture as an industry in the UK is especially at risk to the impacts of climate change, particularly with shifting weather patterns, extreme temperatures and fluctuations in rainfall. The dominating commentary to date about agriculture has been framed around the GHG emissions that drive climate change. However, there is less general awareness on the impacts and consequences that climate change as a whole presents to farming and hence food production, the rural economy and food security. Agriculture will have to continue in adapting and building resilience in farming systems to ensure that natural assets and functions are protected and that these outcomes carry on being achieved [2] – as well as contributing to total climate resilience via land management, natural capital and ecosystem services delivered, e.g. flood management and natural carbon storage. Adaptation seeks to reduce the risks and impacts posed by climate change, and to benefit from any associated opportunities where possible, whereas mitigation aims to reduce greenhouse gas emissions to address the root causes of climate change.

The UK's average temperature was more than 0.9°C higher in the period 1991–2020, compared with the average for the equivalent period for 1961–1990. There was also a 7.3% average annual rainfall increase over the respective periods. There is regional variability as well; for instance, in England, the climate is wetter in the North West and warmer and drier in the South East [3].

Impacts and consequences from more unpredictable seasons from a changing climate have been experienced in agriculture in recent years. Examples from the heatwave in 2022 and autumn 2023–summer 2024 are given below.

Summer 2022 heatwave's impacts and consequences to AHDB sectors

- Parched grassland
- Feed intended for winter used in the summer

- Heat stress in livestock
- Drop in milk yields
- 2022 was the warmest year in the UK since 1884. The mean temperature at 17.1°C is the joint warmest recorded with 2018
- Rainfall was 6% below the 1991–2020 average, with January–August 2022 being the driest across southern England since 1976. Some saw less than 50% of their typical summer rainfall
- Extraordinarily hot and dry harvest with temperatures exceeding 40°C for the first time in the UK. A 21% increase in the number of farm fires
- 2022 wheat yields were 8% higher than the 2017–2021 average. Increases were least in the South and East where the heatwave intensity was strongest
- Other factors: Increased energy, feed and fertiliser costs post Ukraine war

[4] [5] [6] [7] [8] [9]

Autumn 2023 – Summer 2024 weather impacts and consequences to AHDB sectors

- Farmers were markedly affected by the heavy rainfall and flooding stemming from Storm Babet in October 2023. Much of Scotland, northern, central, and eastern England received more than the monthly average over the four-day period of Storm Babet. Some regions experienced winds of over 58mph. These conditions led to many cattle being brought in to sheds earlier than expected
- Wet/waterlogged soils. Implications for rooting, compaction and leaching risk. Highest Excess Winter Rainfall (EWR) in every part of the UK
- Cold, wet conditions, loss of lambs to hypothermia
- Land saturated or underwater resulting in damage to equipment and buildings
- Winter crops contended with the second-wettest August through February since 1837 (when records began)
- Wheat – down 15% at 1.463 Mha (biggest reduction in cropped areas since 2020)
- Spring crops generally performed better
- Ergot and fusarium risk to humans and livestock
- The wet summer and mild temperatures in 2024 were favourable for lungworm in cattle
- Testing for liver fluke encouraged in sheep and cattle
- Wet weather affected productivity of outdoor pigs
- Extra feed costs

[10] [11] [12] [13] [14] [15] [16]

2022 was a record-breaking warm year for the UK. Met Office studies found both the record warm year and July heatwave were made more probable by human-induced climate change [7]. It was also a relatively dry year; thus, there were combined heat and drought issues for both crops and livestock.

By mid-century, the chances of a hot summer occurring could increase by around 50–60% [17], and thus the impacts above could be more commonplace or more extreme. More recently, the weather has mostly been characterised by wetter-than-average rainfall, with the rainfall from autumn 2023 [18] [19] to spring 2024 [20] being 22–32% wetter than the average for 1991–2020 and summer 2024 [21] being 5% drier than the average. Thus, the impacts have been associated with wet and/or flooded conditions. The Met Office UKCP18 projections suggest that by mid-century, there will be a ~20% increase in heavy rainfall with average rainfall ~5% wetter (1981–2000 average). However, the rainfall patterns will continue to vary seasonally and regionally in the future [17].

AHDB recognises the constant challenges that volatility of weather and a changing climate present to our farmers and growers. Therefore, we need to continue to support industry to respond to and adapt to climate change while maintaining productivity and the multiple functions, goods and services that the agricultural system provides. Weather/climate change (55%) was the third-most cited external factor that led farmers to make changes on farm in the Defra Farmer Opinion Tracker for England (October 2023) [22]. The two most-cited factors were input (87%) and output prices changes (59%). A survey of dairy farmers found that more than 95% of farmers expect there to be a financial cost from climate change and 74% consider related risks to their farm strategies. But only 48.7% of those have so far made plans [23].

There is currently little data at scale of the implementation of what could be considered actions to adapt to climate change on farm in the UK. There is more reporting on climate change mitigations (e.g. the Defra Farm Practice Survey) [24], but those measures may also help in building resilience to climate change.

2. About AHDB

Overview

The Agriculture and Horticulture Development Board (AHDB) formed on 1 April 2008 and is funded by **levies** [25] paid by farmers, growers and others in the supply chain. Because the levy is statutory, AHDB is classified as a non-departmental public body (NDPB) and comes under the sponsorship of the Department for Environment, Food and Rural Affairs (Defra). Levy raised from a particular sector is ring-fenced for the benefit of that sector. Annual approval by Ministers is required for all levy rates, including higher rates for overdue payment of levy.

AHDB currently covers four sectors and for varying UK nations:

- Beef and lamb in **England**
- Cereals and oilseeds in the **UK**
- Dairy in **Great Britain**
- Pork in **England**

In 2021, levy payer ballots took place on the future of the statutory levy in the horticulture and potatoes sectors. The majority voted not to continue with the statutory levy in both sectors; as a consequence, **AHDB activity has now been wound down** [26].

AHDB is governed by the AHDB board, supported by the sector councils and statutory committees. Levy payers have the opportunity to vote on/ratify board and council members. AHDB board members are appointed by the Secretary of State for Defra, acting with the UK’s devolved governments, with at least half being recent or current levy payers. The Audit and Risk Assurance Committee provides oversight on risk management on behalf of the AHDB board. Sector councils play a huge part in how AHDB operates; they advise on wider sector matters, identify new industry challenges and continually act to represent levy payer interests. The four sector councils decide what programmes of work AHDB should carry out to support levy payers in their sectors and the rate of levy is needed to fund it [27].

Purpose and priorities

AHDB helps UK agriculture to be more competitive and sustainable in a rapidly changing world. It does this by working with farmers, growers, packers, processors, agronomists, vets, abattoirs and others in the supply chain.

Our current priorities are:

- **Competitiveness:** Includes developing new markets for high-quality products and driving profitability through expert insight, marketing and analysis
- **Productivity:** Accelerating innovation and productivity growth through coordinated research and knowledge exchange, and providing practical support to farmers and growers
- **Reputation:** Defending the reputation of our sectors
- **Consumers:** Helping the industry understand and deliver what consumers will trust and buy
- **Thought leadership:** Delivering thought leadership and horizon scanning to keep the industry prepared

Functions and sector plans

AHDB’s key functions are:



Figure 1. AHDB Functions

Each sector has a **specific plan**, setting out the work that AHDB will address over the next 3–5 years. These were launched in November 2022, with priorities determined from the Shape the Future consultation [28]. AHDB has an extensive **environment programme**, including the **baselining pilot**, but does not currently have specific climate change adaptation objectives in its sector plans [29].

Collaboration

AHDB has relationships with industry (as noted above), plus regular collaboration with a range of other stakeholders such as government, farming organisations, regulators and researchers over the UK nations. This is across its various functions and activities and enables AHDB to have a rounded view of issues, creating a wider reach and having greater impact. Furthermore, AHDB is involved in global partnerships, for instance in its exports work, e.g. the International Meat Secretariat.

AHDB is engaged in a number of partnerships within the environment and sustainability sphere, for example, the industry **Dairy Roadmap**. This is aimed at improving the environmental footprint of the entire dairy supply chain. It is led by Dairy UK, AHDB and the National Farmers' Union (NFU), and sets out ambitious targets to build a more sustainable dairy sector [30]. Also, the UK **Nutrient Management Partnership** [31] coordinates the research and knowledge exchange to generate independent, scientifically robust and practical data on crop nutrient management. AHDB is well placed and connected to coordinate and conduct mitigating actions on climate change impacts.

The industry sectors

Food production and food security

At present, it is estimated that the UK is around 75% self-sufficient, i.e. in foodstuffs that can be produced in the country and produces about 60% of its domestic food consumption by value. In total, 45% of the food consumed in the UK is imported from overseas, as well as for animal feed for domestic livestock production. Climate change impacts both domestically and abroad may compromise our food security. A diversity of global food sourcing contributes to the food resilience of the UK and reduces the risk of food becoming unavailable. Climate variability presents a risk to the availability and stability of these supplies – as well as to demand, prices and food quality – including a risk to human nutrition [32].

Cereals and oilseeds

The UK is largely self-sufficient in cereal grains. The production of barley and oats surpasses domestic consumption (113% and 120%, respectively, for 2023) and is over 96% for wheat in 2023. There have been stable average yields over recent decades; however, there is variability from year to year due to the changeable weather, and climate change is likely to intensify these. With regard to oilseeds, the UK was 63% self-sufficient in oilseed rape in 2023 [33].

Red meat and dairy

The UK produces about an equivalent volume to what it consumes in meat and milk. In 2023, the UK's self-sufficiency for pork, beef/veal, sheep meat, and milk was 58.0%, 80.9%, 110.7% and 105%, respectively. However, self-sufficiency for specific cuts and products is variable, and the UK is a net importer of dairy and beef in value terms. This is because UK consumers prefer the higher-value products, while lower value products tend to be exported, for instance to achieve carcass balance in meat [34].

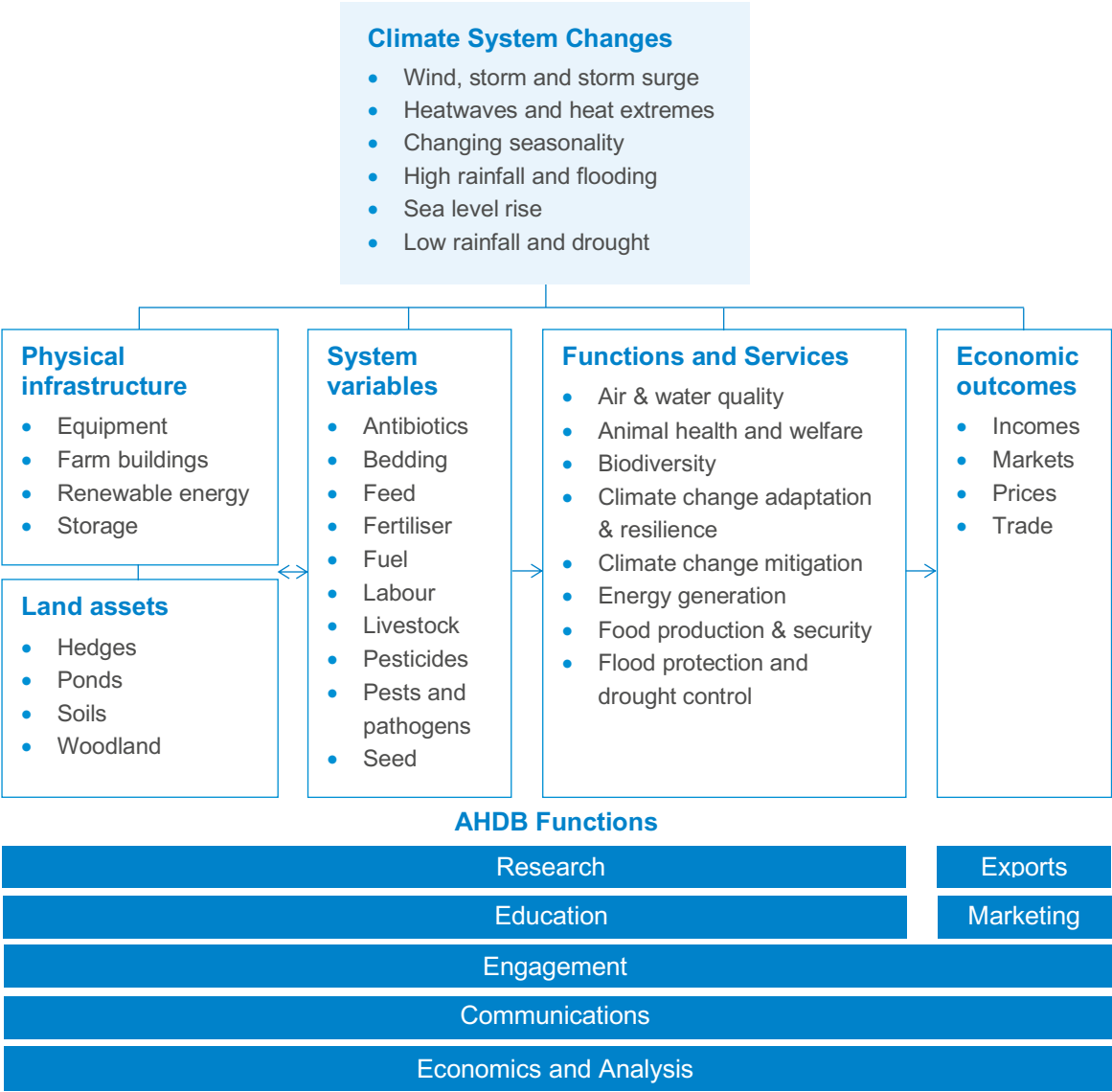
3. Scope of the AHDB report

AHDB's participation in the fourth round of the Adaptation Reporting Power (ARP) will be the first time that we have reported on climate change adaptation through this, or any other programmes, such as the Taskforce on Climate-Related Financial Disclosures (TCFD). AHDB falls below the requirement thresholds for the latter.

The scope of this report reflects AHDB's role as an NDPB in UK agriculture, working on behalf of levy payers and considering the climate change impacts to their businesses, and the potential opportunities. These in turn affect how AHDB delivers its functions and services to mitigate the impact for industry, help realise future opportunities and build resilience.

Figure 2 is a simplified schematic diagram of the relationship of the assets, functions and services of an agricultural production system, and the economic components. It also shows the climate system changes that may have an effect and the areas in which AHDB's functions operate.

Figure 2. A schematic diagram of climate changes, UK agricultural production and AHDB functions



Objectives

- To identify the risks and opportunities which are most likely to affect AHDB and AHDB levy payers, now and to 2100
- To determine the main risk mitigations and ways to facilitate opportunities for both AHDB and industry
- To inform AHDB’s activity planning on climate change adaptation across its various functions, including external collaborations and partnerships
- To identify knowledge, research, evidence and skills gaps on climate resilience
- To fulfil the Defra ARP requirements

Industry scope

In scope

Current AHDB industry sectors are the focus of this reporting. Risks and opportunities assessments have been applied to the whole of the UK, with a regional focus where appropriate. Non-AHDB sectors/commodities such as the legacy sectors are not included in the assessment. Exceptions are, for example, where there are interdependencies, integral to a system, co-benefits or other sectors causing a competition or displacement effect.

Owing to the shorter reporting cycle this round, the supply side focus is primary food production to farmgate only. On the demand side, risks to the consumer or to markets will be included where that risk originates from an impact from production, e.g. nutritional quality and food safety risks. In addition, the effects of climate change on markets, trade and food security are explored, since AHDB provides intelligence and analysis in these areas.

Out of scope

In this reporting round, the following items are out of scope but will be considered in future rounds:

- Processing and supply downstream into the value chain, which may vary per AHDB sector
- Social consequences, e.g. labour, rural community cohesion, and mental health
- Economic analysis and quantitative analysis will not be included; however, economic consequences will be stated where applicable

Identifying the risks and opportunities

The approach used to select the appropriate risks and opportunities to appraise is described below. A number of selection criteria were employed. The risks are commonly understood to be adverse risks, as opposed to the opportunities, presenting potential positive gains.

Impacts to levy payers and AHDB

The risks and opportunities considered had to satisfy *any of* the following criteria in relation to any impact to levy payers and AHDB:

- Likely to have an impact on AHDB's levy payer businesses, in terms of their functions, services and assets
- Likely to have an impact on AHDB's objectives and what it can and should deliver to levy payers in terms of its functions and services
- Likely to have an impact on how AHDB delivers its levy payer functions and services
- Likely to have an impact on AHDB's assets, e.g. staff and income

Risks that are likely to have an impact on AHDB's wider stakeholders, but which do not satisfy the above criteria were not included.

Types of risk and opportunity

Both direct and indirect climate risks to AHDB and the levy payers have been considered – with those affecting the levy payers being indirect risks to AHDB as an organisation owing to its funding model, and with levy payers being the receivers of AHDB's functions and services.

Both risks and opportunities that are acute or chronic in nature are considered. The former include risks that are driven by sudden events such as high winds and storms, while the latter could include evolving weather and longer-term shifts in climate patterns, such as landscape change from indirect. Within each risk, the impacts to sectors, cross sector or systems have been considered, as these impacts and their extent will differ. This will be reflected in the accompanying narrative. However, an overall risk score for all sectors will be assigned in this first report from AHDB.

Non-climate-change variables that may have a compounding effect on the climate change variables are considered in the risk and opportunity assessments. These may include policy, regulatory, economic/market effects and geopolitical events.

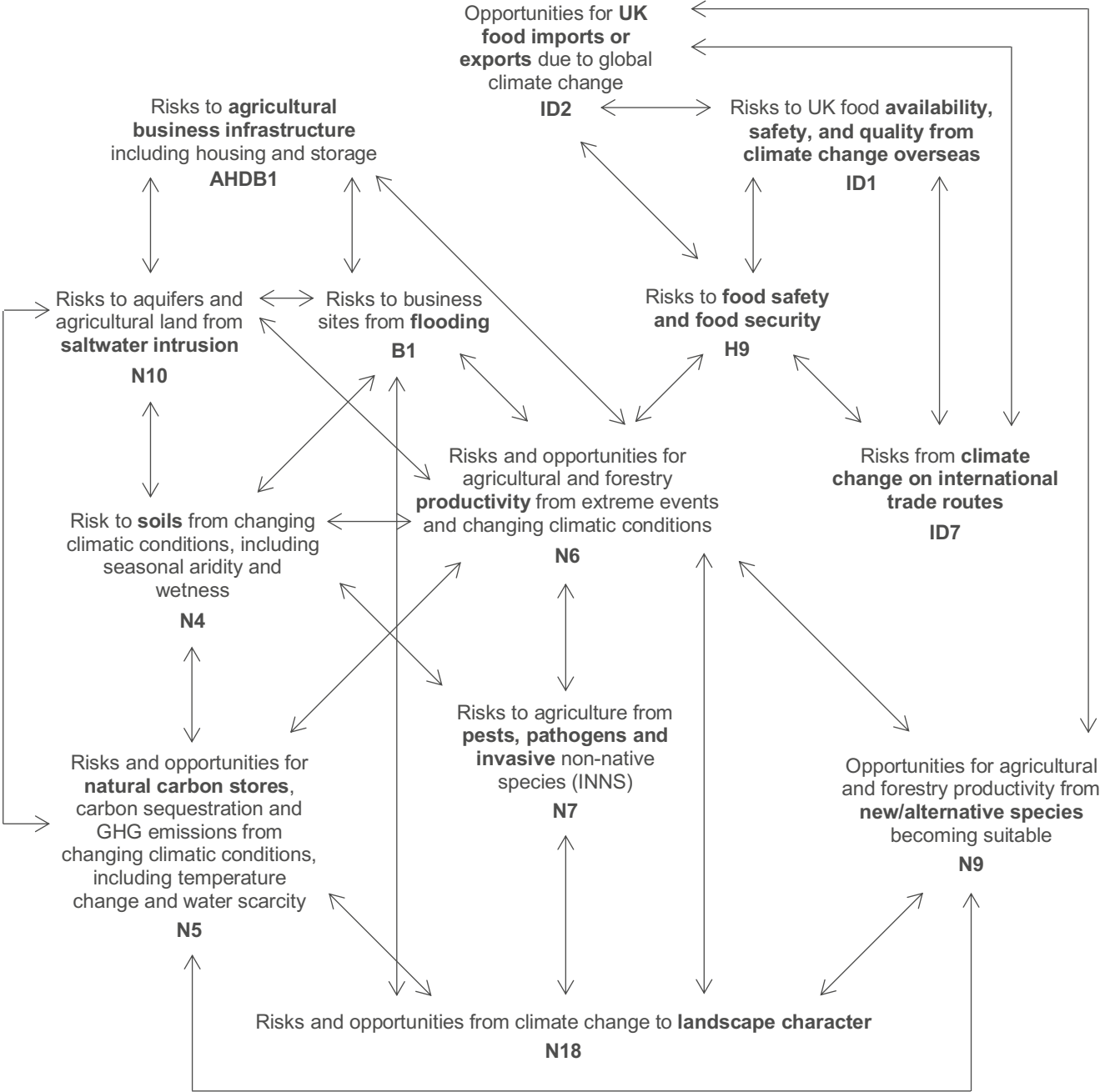
Finalising the risks and opportunities

The risks and opportunities chosen for assessment are a shortlist that originate from those used in the Climate Change Risk Assessment (CCRA) third round reporting [35]. The criteria described above were then applied to make the selection and then reviewed by an internal steering group and other experts within the organisation. There was one additional risk to fill a gap around the risks to agricultural physical business infrastructure. The schematic in Figure 2 reflects the areas where there are the risks/threats and opportunities for both AHDB and its levy payers (producers). In future reporting rounds, we may further tailor the general risk and opportunities to be more specific to agriculture in their description and to be as discrete as possible.

Risks that cover the entire range for confidence of evidence were included. Relevant risks for which there is insufficient evidence, knowledge or uncertainty are acknowledged and identified as a gap for future research where applicable.

The risks and opportunities selected and the direct interdependencies between them are displayed in Figure 3. Hence the indirect and cascading risks are also displayed.

Figure 3. The interdependencies between the risks and opportunities for UK agricultural production (the long name of the risk and opportunities is used here, including the alphanumeric reference prefixes from round 3 of the CCRA; from hereafter, the short name is used. A comparison table is provided in the annex).



These risks and opportunities cover the themes of productivity, business infrastructure, landscape and markets.

4. The assessments

Compiling the risk/opportunity assessment

Evidence was gathered from internal and stakeholder subject matter experts across the sectors, representing producers, levy boards (e.g. QMS and HCC) and member and trade associations (e.g. NFU, AIC and NPA), through meetings and workshops, alongside a literature and research review. For each risk/opportunity, assumptions have been made on the operational, regulatory, technological context/landscapes, how realistic they are and how these will interact with the climate changes, with risk scores then being determined. Collective impact and likelihood scores were used. Both the risk and opportunities were scored according to the schema below (Table 1). The definitions of the impact and likelihood scores can be found in Appendix II.

Table 1. Risk/opportunity scoring matrix

Risk/Opportunity Score		Impact				
		Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Extraordinary (5)
Likelihood	Highly unlikely (1)	1 Minor	2 Minor	3 Minor	4 Moderate	5 Moderate
	Unlikely (2)	2 Minor	4 Moderate	6 Moderate	8 Moderate	10 Major
	Possible (3)	3 Minor	6 Moderate	9 Moderate	12 Major	15 Major
	Likely (4)	4 Moderate	8 Moderate	12 Major	16 Major	20 Severe/significant
	Almost certain (5)	5 Moderate	10 Major	15 Major	20 Severe/significant	25 Severe/significant

Climate scenarios

The timeframe and climate scenarios follow those advised in the framework from Defra:

- 1. Present-day (near term)
- 2. 2050 (medium term) and a 2°C rise
- 3. 2100 (long term) and a 2°C rise
- 4. End of century (long term) and a 4°C rise

Here, 2°C and 4°C rises refer to changes in the global mean temperature compared to a pre-industrial baseline (emissions between 1850 and 1900 as an approximation). The climate changes that each of these scenarios present, e.g. hot summer occurrence, heavy rainfall and sea level rise, and the impacts that these will have for levy payer and AHDB operations were considered. The Met Office's UKCP18 projections [36] were used according to the scenarios and probability levels used in the Climate Change Committee's (CCC) independent assessment [37]. UK regional projections were not

used on this occasion owing to time constraints. The projections were combined with experts' knowledge and informed opinion of farming and markets, experiences and observations from climate change in present day, and potential consequences. Together, these informed the risk scoring, though apart from the climate projections, evidence from modelling is limited and thus the confidence of the risk scoring is low for all of the scenarios for 2050 to 2100. Barriers and enablers were also considered as part of the assessment.

Learnings

The risk assessment approach has provided a systematic way of ascertaining the risks and opportunities that affect agricultural production, both short term and long term, and those increasing in importance over time. Through the additional driver of climate change, new actions have emerged that have not previously been considered, or mitigations have been identified that can be integrated into current activities. The additional benefit of such actions would need to be conveyed, alongside climate change risk being another reason to act. Furthermore, it has also made us consider how our functions and activities may be better modified to meet the needs of our levy payers.

Limitations

We have limited the scope of actions to mitigate the risk or support the opportunities to those that could be delivered by AHDB on its own or with external partners.

The so-called tipping points at which a mitigation or action should be implemented are not included in the assessments. A number of actions are already taking place and may have a number of other interacting drivers, which may not be necessarily climate related, e.g. best practice for productivity, policy and regulation. For the future actions, other drivers also apply for implementing the change. But there is difficulty in quantifying the environmental tipping points, i.e. when there is a step change and/or a critical/damage threshold which causes the shift from one system state to another and a sudden change in the provision of environmental functions and services [38]. The environmental drivers may be incremental, e.g. carbon dioxide levels, soil degradation and biodiversity loss. Therefore, this has not been included in the assessments.

The net risk score after mitigations is not included, since, as described above, AHDB works in partnership with stakeholders in agriculture and nature over a number of initiatives. The risks and opportunities are considered in terms of effects on AHDB and its sector industries. It is only in a position to comment on its actions and those that it can influence. Thus, it is difficult to attribute these to a change in impact or likelihood if we are looking at these actions alone. Therefore, only a gross score is used. Nevertheless, through monitoring, tracking and evaluating the effectiveness of our actions, we shall ensure that there is active management of the risk to mitigate it from being unacceptable.

The results

A summary of the risk and opportunity assessments can be found in Table 2a. Examples of the potential impacts and opportunity to functions, services and assets are included. These are not

exhaustive. More details are available in the full risk assessments that are available in the annex. The rating categories are those outputted from the risk-scoring process described above and defined in Table 1. They range from minor to severe/significant, and the changes to these ratings over the scenarios through time is clear to see. The outcome of this process led to the prioritisation of the risk/opportunities, and the context and reasoning is described in Table 2b.

Table 2a. Risks and opportunities, impacts to functions, services and assets, and priority categories

Impacts and opportunities to functions, service and assets		Priority	Present day	2050 2°C	2100 2°C	2100 4°C
Risks to soils	<p>Impacts</p> <p>Heavier rainfall events present erosion, compaction/poaching risks from livestock and machinery.</p> <p>Soil aridity affecting water availability/soil moisture deficit to grassland and crops (including forage crops).</p> <p>Reduced grazing productivity and quality.</p> <p>Run-off and diffuse pollution of nutrients (N and P) into nearby waters. Increased N2O emissions, grass and crop damage, reduced access to farmland.</p>	High	Major	Major	Major	Severe/significant
Risks and opportunities for agricultural productivity	<p>Impacts</p> <p>Increases the need/demand to house livestock, as with high rainfall and flooding.</p> <p>Grazing livestock affected by adverse impacts on forage growth, quality and availability, which affects growth rates.</p> <p>Poorer crop establishment in the spring and autumn.</p> <p>Drought affecting water availability for drinking, cleaning/washing and evaporative cooling in livestock production.</p>	High	Major	Major	Major	Severe/significant
	<p>Opportunities</p> <p>Opportunity for different legumes for home-grown proteins.</p> <p>Lower winter feed and energy costs from livestock housing resulting from warmer winters.</p> <p>New crops such as soya, sunflower and grain maize could become viable in the UK.</p> <p>If summers are warmer and drier, there could be more timely crop harvests leading to better-quality crops and reduced drying costs.</p>					

Impacts and opportunities to functions, service and assets		Priority	Present day	2050 2°C	2100 2°C	2100 4°C
Risks to business sites from flooding	<p>Impacts</p> <p>Soils above field capacity leading to reduced land availability for spreading manure or slurry.</p> <p>Flooding leading to inaccessible fields from workers and livestock to grazing land. Extreme and rapid flooding may also pose a risk to livestock. On arable, flooding may lead to land becoming waterlogged at critical times of year, impeding cultivation and planting. Loss of livestock and crops.</p> <p>Run-off risks, soil sediment and phosphorus, and nitrate leaching.</p> <p>Changing precipitation patterns may also increase groundwater pollution issues in Nitrate Vulnerable Zones (or equivalent), i.e. areas designated as being at risk from agricultural nitrate pollution, as rainwater percolates through soil into groundwater systems.</p>	High	Major	Major	Major	Severe/significant
Risks and opportunities for natural carbon stores	<p>Impacts</p> <p>Increasing temperatures increasing loss of soil organic carbon (SOC), affects ability to build carbon stocks. For instance, accelerated CO2 emissions through degraded peatland. Soil biology populations, e.g. those involved in cycling of nutrients, may be affected.</p> <p>Changes in climate variables may affect the ability to implement soil conservation/regenerative practices, e.g. no till, affecting the ability to conserve soil carbon stocks.</p> <p>Restored peatlands for C sequestration, due to the water levels, cannot be used for grazing as it would be dangerous for livestock.</p> <p>The potential of crops to store carbon may decrease due to higher temperatures, increased water stress and increased disturbance.</p> <p>Loss of woody biomass carbon stores from wildfires.</p> <p>Opportunities</p> <p>Opportunities with increasing carbon in wetter soils and in upland peaty soils (where grazed by sheep and cattle).</p> <p>Opportunities with agroforestry, e.g. shelter belts, to provide co-benefits with carbon sequestration.</p>	Medium	Moderate	Major	Major	Major

Impacts and opportunities to functions, service and assets		Priority	Present day	2050 2°C	2100 2°C	2100 4°C
Risks from pests, pathogens and INNS	<p>Impacts</p> <p>Evolving pesticide resistance in combination with climate change effects may compound the problem, e.g. longer activity period and increased overwintering survival due to the warmer winters.</p> <p>Increased risks from parasites due to warmer, wetter winters that could reduce productivity and increase livestock disease. High-intensity parasite outbreaks would be a major concern. Changes to the seasonality of helminth parasites such as liver fluke, whose free-living stage survival would be favoured by wetter and milder weather.</p> <p>In housed livestock systems, there may be temperature events that are beyond the capacity of the ventilation system that can result in increased energy and water use and an increased risk of disease.</p> <p>Warmer and wetter conditions over winter may lead to increased prevalence of indigenous pest and disease, such as yellow and brown rust in wheat, net blotch in winter barley crops and club root in brassicas. Warmer summers may allow new diseases to become established, such as wheat stem rust which has re-emerged in the UK and Europe in recent warm summers</p>	Medium	Moderate	Major	Major	Major
Risks to agricultural business infrastructure	<p>Impacts</p> <p>Damage to farm buildings and physical infrastructure and to content.</p> <p>Generator requirements due to power failure/outage, may be compounded by fuel choices or fuel availability.</p> <p>Higher humidity could see an increase in mould growth, rot and insect infestation.</p> <p>Animals may require longer housing periods. Increased potential for ammonia, odour and dust emissions.</p> <p>Increased insurance premiums or lack of insurance.</p>	Medium	Moderate	Major	Major	Major

Impacts and opportunities to functions, service and assets		Priority	Present day	2050 2°C	2100 2°C	2100 4°C
Opportunities for UK food imports or exports	<p>Opportunities</p> <p>Altered global patterns of food production, potentially creating opportunities for imports and/or exports.</p> <p>If longer-term climate change results in a comparative advantage for UK agriculture relative to other food-producing regions, there will be opportunities for increased exports. But these opportunities come with a risk of unsustainable intensification of production.</p> <p>Regions of the UK which are less vulnerable to extreme heat and drought may focus more on arable development, and crop production nationally may tend toward species with more stable yields to avoid over-reliance on imports.</p>	Medium	Moderate	Major	Major	Severe/significant
Risks on international trade routes	<p>Impacts</p> <p>International supply chains are typically routed by sea, where the costs of bulk transport are minimised. Trade gets funnelled through a small number of globally important pinch points, e.g. Suez Canal, which if affected has a crucial impact on global supply. This would be consequential on routes that are key to achieving carcase balance.</p> <p>These include many routes that are associated with areas of broad geopolitical instability which may also be destabilised by climate impacts.</p> <p>A number of global conglomerates controlling shipping, food production and agriculture is a risk for global food supply.</p> <p>The UK relies on imports of key inputs: phosphate (no phosphate reserves in UK), N fertiliser (due to lack of domestic manufacturing) and soy meal.</p>	Medium	Moderate	Major	Major	Major

Impacts and opportunities to functions, service and assets		Priority	Present day	2050 2°C	2100 2°C	2100 4°C
Risks to food safety and food security	<p>Impacts</p> <p>Increased weather variability will increase UK costs of production, impacting competitiveness. Poor weather could reduce production and/or produce a surplus of a lower-quality product (crop or animal).</p> <p>Shortages in domestic food production will drive food availability and affordability.</p> <p>Increased risk of ergot and mycotoxins from wet harvests, affecting animal and human health.</p> <p>Food security linked to energy security; thus, changes in energy supply, mix and price likely to impact food supply.</p>	Medium	Moderate	Moderate	Moderate	Severe/significant
Opportunities from suitable new/alternative species	<p>Opportunities</p> <p>More resilient grass and forage species, including the use of mixed swards for multiple rooting depths.</p> <p>Opportunity for new crop species to become viable in the UK, e.g. sunflowers, soya, chickpeas, lentils, grain maize, durum wheat.</p> <p>Opportunity for different legumes for home-grown proteins and may be suited to higher altitudes.</p> <p>Hill/upland farming changing to hardier breeds, for instance more native, e.g. Hereford and Highland cross cows.</p>	Low	Moderate	Moderate	Moderate	Major
Risks to UK food availability from climate change overseas	<p>Impacts</p> <p>International food system becomes more exposed to climate-related hazards, the supply shocks may make food price spikes and market volatility increasingly likely, and in turn affecting food accessibility.</p> <p>New and emerging markets may expose the UK to increased climatic risks as many potential new partners are exposed to higher climate-related risks or lower ability to govern them, and also to poorer governance of natural resources (water, emissions, biodiversity). They may not have equivalent food standards to the UK.</p> <p>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.</p>	Low	Minor	Moderate	Moderate	Major

Impacts and opportunities to functions, service and assets		Priority	Present day	2050 2°C	2100 2°C	2100 4°C
Risks and opportunities to landscape character	<p>Impacts</p> <p>Changes to the local landscape, e.g. the impact of urban protection, causing hydrological changes. For example, lower river and stream flows, affecting ability to abstract.</p> <p>River flow changes, need for dredging and desilting.</p> <p>Upland and lowland peatland drying out, causing damage and exacerbating flooding and/or impacting water catchment flow.</p> <p>Loss of soil structure and erosion risk from drought.</p> <p>Increasing incidence of wildfire.</p>	Low	Moderate	Moderate	Moderate	Major
	<p>Opportunities</p> <p>Opportunities in shifting areas of agricultural production due to change in climate and suitability of the landscape character. Though, some landscapes may not necessarily be suited to species movement and distribution (crops and animals).</p> <p>Hill farming may be the most vulnerable, vegetation may disappear. Environments may be too dry and rocky for livestock.</p> <p>Agroforestry of arable and grassland.</p>					
Risks from saltwater intrusion	<p>Impacts</p> <p>If sea levels rise relative to fresh groundwater levels, saltwater can enter the aquifer and increase salinity in agricultural land. This can also affect the quality of water for abstraction and the ability to obtain water by abstraction.</p> <p>In surface waters, drought may exacerbate the saltwater intrusion of estuaries, resulting in more severe water shortages in these areas for agriculture.</p> <p>Sodium will affect soil structure and quality as it is a dispersant of soils.</p> <p>Saltwater intrusion can alter soil C storage in low-lying coastal agricultural fields.</p>	Low	Minor	Moderate	Moderate	Major

Table 2b. Risk/opportunity priority

Priority	Definition and narrative
High	High-priority risk/opportunities. These are critical now and will continue to be critical to 2100 in a 4°C scenario. They are all key to food production, all being highly threatened by climate changes, which may be acute and/or pernicious. But also interdependent with the medium risks on carbon stores, pests and pathogens and on-farm infrastructure.
Medium	Of medium risk/opportunity now or increasing over time, with relative moderate impact and likelihood but interdependent with the high-priority risks/opportunities.
Low	Relatively low risk or opportunity and will continue to be. This includes risks that are more incremental and long term such as landscape character and saltwater intrusion. Moreover, they are very location specific. Opportunities for new/alternative species being suitable is seen to be relatively limited. Owing to the current resilience in the UK food system, the risk to climate changes from overseas has controls.

AHDB risk governance

Only the risks that pose direct impacts to AHDB are in the remit of the AHDB risk management policy. Consequently, only the risks and actions owned by AHDB, in the aggregate, will also be incorporated into the organisation's risk register. Also in accordance with our risk policy are the monitoring, review and reporting of risks, and thus will align with the process conducted under this climate change adaptation assessment.

There may be circumstances or triggers that invoke a revision of the risk/opportunity assessment and action plans. For instance, if there is a step change in the risk from, say, more frequent extreme weather events than expected or if background assumptions change. Or effects from non-climate variables – structural change to sector, economic crisis, geopolitical instability, severe disruption to inputs such as fertiliser supply, or an animal disease epidemic. Any disruption in any of the functions of AHDB may cause a revision, e.g. loss of sectors, pandemic. The AHDB actions are owned by our Leadership Team and will be reviewed annually.

Potential impacts and consequences for AHDB

In terms of potential risks to AHDB assets, the greatest potential impacts from climate change are to levy income and staff. More unpredictable and variable production means more volatile levy income and business planning difficulties, potentially compromising activities that could be delivered. Staff could be directly affected by heat stress, which affects the ability to deliver functions such as events. Functions are still operational outside of the HQ due to remote working, as demonstrated at scale after an office fire and the Covid pandemic.

The climate impacts will have consequences on what AHDB should and can deliver, and how it can be delivered.

- We may need to act rapidly in the best interests of levy payers, such as working with industry decision makers, or disseminate key information or guidance (e.g. in a disease outbreak), so that businesses can respond quickly if necessary
- There could be increased demand for AHDB's services, e.g. decision support tools, pest and disease monitoring or market intelligence
- It could mean that plans for some activities may have to change. For instance, export ambitions on market access may be curtailed or limited

5. Mitigating actions

As the risks have interdependencies, so will the actions, and hence some actions will be common to mitigate several risks, e.g. trade and food security. Therefore, actions for linked risks/opportunities have been grouped together. A summary of the actions for the high and medium-priority risks/opportunities can be found in Table 3. Please note that these are only a sample of mitigating actions to illustrate the range that will take place.

A substantial proportion of the actions are already taking place and are embedded, due to various drivers besides climate change and will continue, e.g. best practice for maintaining soil health for productivity and animal health and welfare. The majority of other actions have a timescale of within the next five years. Then there is a minority of actions that have a timescale of 5–15 years, for instance due to capital costs or infrastructure changes.

Since the actions are recommendations for both industry and AHDB, there are a variety of owners that includes levy payers, government, researchers and others, including membership organisations (e.g. NFU) and trade associations. It will be for those individual organisations to decide whether to adopt the recommendations. The main categories of action are:

a) Scoping, scanning and strategy

These comprise horizon scanning of countries and regions which may be climate analogues for the UK in the future. As well as investigative actions to survey and monitor changes, such as baselining of soil nutrients and carbon. They also include scenario modelling, such as the effects on costs of production. These are usually collaborative actions involving AHDB in partnership with industry and could involve information and data sharing.

b) Best management practice

These are practical on-farm measures that may be considered best practice already but could be encouraged to address the climate-specific impacts, e.g. soil health measures.

c) Research, knowledge exchange, economics and analysis

This may be further research or evidence gathering, dissemination of guidance and economic analysis, in which AHDB will have a significant role.

The actions will cut across a number of functions within AHDB, and those functions have been involved in the risk assessment process. The next stage for AHDB is to determine how implementation of actions (if not already in place) should integrate with current and future **sector plans** [28]. All adopted mitigating actions will be monitored and evaluated where possible as commensurate with all our levy-payer-facing activities. A number of these are shown in Table 3.

Table 3. Summary of action plans both at AHDB and industry level, including enablers and challenges (risks and opportunities by theme)

Actions		Action Owner(s)*	Monitoring and Evaluation
Soils	<p>Scoping, scanning and strategy</p> <p>Adaptation strategies included in industry environmental roadmaps.</p> <p>Investigating data on how the uptake of regenerative farming principles on soils could be measured.</p>	AHDB; industry	<p>AHDB/QMS baselining – soil nutrient status, soil organic carbon (SOC) % and SOC stocks, run-off risk maps.</p> <p>AHDB analysis of the effectiveness of soils SFI actions (and equivalent).</p> <p>Deployment of the AHDB soil health scorecard and collecting on-farm data where possible.</p> <p>CEH soil-monitoring network for near-real-time soil moisture data.</p> <p>Soil health data from supply chain groups.</p> <p>Collaboration with Sustainable Soils Alliance and Defra in monitoring of soil health and degradation.</p> <p>Collaboration with water companies to monitor surface and groundwater quality and link to farming practice.</p>
	<p>Maintaining best management practice on farm (examples)</p> <p>Modify stock movement routes and distances and consideration of land conditions to reduce wider impacts on soils.</p> <p>Increase soil organic matter, e.g. through use of manures, compost, cover crops and mulches.</p> <p>Use of AHDB GREATsoils information and decision support tools, e.g. Terranimo to prevent compaction from machinery, establishment tool.</p>	Industry	
	<p>Research, knowledge exchange (KE), economics and analysis</p> <p>Collaboration on research: on the multiple benefits/ecosystem services delivered by soils and impacts on soil organic carbon (SOC); emerging technologies to help farmers.</p> <p>Collaborating on modelling climate change impacts on cropping and grassland.</p> <p>AHDB soil health guidance will look to address climate change adaptation, e.g. changes in cultivation methods and soil organic matter (SOM), adjust rotations, include cover crops, change species in grass-seed mixes/sward diversity, adjust stocking density, and grazing management.</p> <p>AHDB to communicate how actions integrate with the environmental schemes.</p>	<p>AHDB; industry; researchers; other</p> <p>AHDB</p>	

Actions		Action Owner(s)*	Monitoring and Evaluation
Productivity	<p>Scoping, scanning and strategy</p> <p>AHDB to consider the possibility of developing climate change risk assessments for all sectors, in addition to the guidance and template for pigs as part of environmental permitting, which details both the risks and outline potential mitigations in an adaptation plan.</p> <p>AHDB, in collaboration, to explore the systematic research of the impacts and adaptations of livestock systems to climate change, including lack of linkages between impacts and adaptations, little emphasis on mixed crop livestock systems and monogastric livestock. Use of quantitative methods including models for predicting productivity.</p>	<p>AHDB</p> <p>AHDB; government; industry; researchers; other</p>	<p>Progress against targets in the industry road maps.</p> <p>AHDB Farmbench (Cereals & Oilseeds and Beef & Lamb sectors) cost of production data.</p> <p>Farm assurance schemes, e.g. Red Tractor.</p> <p>AHDB market intelligence data collection: planting, production (including slaughter) and market movement data.</p> <p>AHDB levy payer and stakeholder customer insight measure survey – positive qualitative feedback and importance of relevant tools and insight, e.g. Recommended Lists.</p> <p>Attendance of AHDB events where climate change risks and adaptations, and its mitigations, are answered.</p> <p>Indicators of soils health and carbon stocks.</p> <p>Defra farm business survey and nutrient use indicators.</p>
	<p>Maintaining best management practice on farm (examples)</p> <p>Improve on-farm water management and efficiency, e.g. rainwater harvesting and improving drainage.</p> <p>In livestock housing, increase building capacity, the use of sprinklers, fans, better ventilation plus optimal maintenance.</p> <p>Growers may diversify their crops by selecting other species or varieties (e.g. shorter season varieties), and vary the timing of cultivation, to protect against crop yield fluctuations in extreme years; for instance, sowing earlier and harvesting later can help to compensate for lower yields due to drought.</p> <p>More diverse rotations and swards encouraged. For example, putting legumes or herbs in reseeding leys. Deeper-rooting forage species such as chicory can help to retain moisture in the soil and therefore maintain pasture. There may also be co-benefits; chicory also has anthelmintic properties.</p>	<p>Industry</p>	
	<p>Knowledge exchange</p> <p>Encourage take-up of AHDB decision support guidance and tools, e.g. Recommended Lists for cereals and grass, excess winter rainfall, establishment approach tool, livestock breeding services.</p> <p>Signpost to financial guidance and relevant organisations, e.g. insurance.</p>	<p>AHDB</p>	

Actions		Action Owner(s)*	Monitoring and Evaluation
	<p>Research</p> <p>Use of remote/precision/proximal sensing, e.g. in-field sensors, in monitoring to help deployment of adaptation strategies/practices and to gauge effectiveness.</p> <p>Explore the application of categories, e.g. new distilling category for winter barley – non-glycosidic nitrile varieties.</p> <p>Explore alternative bedding.</p>	AHDB; industry; researchers	
Flooding	<p>Scoping, scanning and strategy</p> <p>Use of run-off risk maps to assess the risk of soil erosion and diffuse pollution risk. For instance, as part of the AHDB/QMS baselining project and also Environment Agency satellite risk mapping.</p> <p>Catchment-based collaborative groups/networks (e.g. involving natural resources/conservation bodies, regulators, NFU, farmers, water companies, Defra and devolved administrations, AHDB), on flood management and diffuse pollution risk.</p> <p>National partnerships to improve support and information sharing on building flood resilience, e.g. guidance and signposting for support, e.g. The Rural Flood Resilience Partnership in England.</p>	AHDB; government; industry; researchers	<p>Environment Agency flood warnings and alerts on farmland by agricultural land grade. Collaboration with Sustainable Soils Alliance and Defra in monitoring of soil health and degradation.</p> <p>Collaboration on Natural Capital and Ecosystem Assessment Programme/Environment Agency – Big Soil Stocktake.</p> <p>Deployment of the AHDB soil health scorecard and collecting on-farm data where possible.</p>
	<p>Maintaining best management practice on farm</p> <p>Risk assessment and identification of process equipment and services at greatest risk from flooding.</p> <p>Building winter water storage facilities/reservoirs to take advantage of periods of heavy rainfall and store rainwater. Storage and use of rainfall to reduce to enable farmers to cope with the reduced availability and reliability of summer rivers and reliance on abstracted water.</p> <p>Calculate the need for and install additional slurry storage.</p> <p>Drains and lagoons managed throughout the year.</p>	Industry	<p>AHDB/QMS baselining – soil nutrient status, SOC % and SOC stocks, run-off risk maps.</p> <p>Defra Farm Practices Survey – holding back spreading manure and slurry onto grass and arable land.</p> <p>Water quality indicators from regulators and water companies to assess the downstream impacts, such as nutrients/pesticides/sediment in surface water.</p>

Actions		Action Owner(s)*	Monitoring and Evaluation
	<p>Research and knowledge exchange</p> <p>Collaboration with organisations on knowledge exchange, e.g. NFU and Catchment Sensitive Farming in England.</p> <p>Continue with the best management practice guidance on dealing with the consequences of flooding: https://ahdb.org.uk/knowledge-library/weather</p> <p>Update guidance on field drainage, and knowledge exchange on drainage.</p> <p>Continue guidance and knowledge exchange on the Slurry Wizard to help with the planning of slurry storage.</p>	<p>AHDB; government; industry; researchers; other</p> <p>AHDB</p>	
Business infrastructure	<p>Scoping, scanning and strategy</p> <p>Monitoring the support and uptake of capital grants for improving existing buildings or erecting new ones for climate resilience.</p> <p>Explore the barriers in building regulations for farmers.</p> <p>Consider in collaboration with industry stakeholders, how current regulations, e.g. slurry regulations, are interacting with changes in climate, effectiveness and suggestions for adjustments.</p>	<p>AHDB; government; industry; other</p>	<p>AHDB events and guidance disseminating relevant information on farm buildings.</p> <p>Collection of on-farm data of farm business practices, e.g. via carbon audits from the AHDB/QMS environment baselining project.</p>
	<p>Maintaining best management practice on farm</p> <p>Review the design of vulnerable structures and buildings, reviewing wind-loading calculations.</p> <p>Conduct a review of ventilation and energy requirements.</p> <p>Implementation of novel approaches to environmental control and cooling technologies in livestock housing/facilities.</p> <p>Slurry and manure storage to cope with wetter winters and reduce the risks of pollution. An uncovered store means a greater volume of slurry due to rainfall and a bigger problem. Building a cover or a new store will be an additional cost.</p>	<p>Industry</p>	<p>Defra Farm Practice survey data – manure and slurry storage, anaerobic digestion.</p> <p>Farm assurance data on farms meeting standards on housing and shelter.</p>

Actions		Action Owner(s)*	Monitoring and Evaluation
	<p>Research, knowledge exchange, economics and analysis</p> <p>Research into future housing design and placement to maintain optimal conditions in a changing climate.</p> <p>Research into ventilation and cooling systems to prevent heat stress in livestock.</p> <p>Continued guidance on best practice to build resilience and maintain optimal operating conditions, disseminated in publications, online and via events.</p>	AHDB; researchers	
Trade and food security	<p>Scoping, scanning and strategy</p> <p>AHDB continues to help UK producers secure entry to new market opportunities. Through close partnership with the Government, particularly Defra, the Food Standards Agency (FSA), the Animal and Plant Health Agency (APHA) and the equivalent authorities in Scotland, Wales and Northern Ireland.</p> <p>Working with supply chain groups to understand the potential impacts on food and feed availability and explore contingency markets, working on crisis planning.</p> <p>AHDB monitoring of cereals contaminants continues with industry partners.</p> <p>Review and analysis of current import markets to the UK for AHDB's sector commodities and the potential effects of climate change impacts, and pinch points. Including animal feed such as soybean, and opportunities presented by UK-grown protein for animal feed.</p> <p>AHDB's continual monitoring and reporting both on global supply and domestic production for its sector commodities, throughout the production cycle, as part of its market intelligence service.</p>	<p>AHDB; Government; Industry; Other</p> <p>AHDB</p>	<p>AHDB to continue to monitor trends in global agricultural production and keep abreast of any food price volatility and supply shocks.</p> <p>AHDB to continue to monitor consumption trends in the UK, and also consumer affordability.</p> <p>AHDB continues to conduct country analysis to improve the understanding of target emerging export markets.</p> <p>Monitoring of AHDB communications reads/uses on risk to food safety and food security including AHDB's markets analysis.</p> <p>Effectiveness of biosecurity plans through the networks with which AHDB is involved.</p> <p>Defra's UK Food Security index, e.g. global food supply for human consumption.</p> <p>DBT and Defra import statistics.</p>

Actions		Action Owner(s)*	Monitoring and Evaluation
	<p>Research, economics and analysis</p> <p>AHDB scenario modelling of potential economic impacts from import changes, including the impacts of externalities including energy and fertiliser prices and carbon leakage risks.</p> <p>AHDB regular market, price and trade updates and longer-term outlook newsletters continue, to include the direct or indirect climate change risk impacts.</p> <p>AHDB, with partners, continues the proposal for the Digital Passport (combinable crops).</p> <p>AHDB continues to review and update the potential export opportunities for UK producers (Prospects for UK agri-food exports (2023)). Covering the UK's potential to maximise exports, its main competitor producer for exports, and learning from current successful exporters.</p> <p>AHDB continues to update and develop price risk management tools.</p> <p>AHDB continues to update and develop decision support tools that evaluate risk factors that may impair food quality and safety, e.g. mycotoxin risk tool for cereals.</p> <p>AHDB research on the impacts of a changing climate and extreme weather on nutritional quality.</p>	AHDB	<p>Monitoring use/downloads of relevant AHDB decision support tools.</p> <p>AHDB's planting surveys, crop monitoring and harvest reports.</p>

	Actions	Action Owner(s)*	Monitoring and Evaluation
Pest and pathogens	<p>Scoping, scanning and strategy</p> <p>Horizon scanning and long-term monitoring to detect emerging threats, for example for invasive non-native species (INNS) from overseas. Disease surveillance collaboration and continual review of the implications for surveillance, monitoring and prevention.</p> <p>Some pesticides/biopesticides for some pests and diseases are not registered in the UK; in collaboration, explore how the registration process can be more efficient and effective.</p> <p>AHDB continues monitoring and tracking of animal livestock resistance – medicine hub, eMB, SCOPS and COWS.</p> <p>Biosecurity and contingency planning in all sectors, coordinated communications at key points of the year by sector.</p> <p>Cross-industry group with Defra/APHA/levy payers to agree a vision on control or eradication in light of climate change pressures. Facilitation of data sharing.</p>	<p>AHDB; government; industry; researchers; other</p>	<p>AHDB develops on-farm climate change risk assessment for all its sectors.</p> <p>AHDB continues monitoring and tracking of animal livestock resistance – medicine hub, eMB-Pigs, SCOPS, COWS.</p> <p>AHDB crop monitoring and harvest reports.</p> <p>AHDB economic analysis – potential profit and loss due to pest and disease losses.</p>
	<p>Maintaining best management practice on farm</p> <p>New disease-resistant crop varieties, biological, cultivation and rotational controls.</p> <p>For livestock, increased building capacity and improved shed ventilation.</p> <p>Continue conducting an animal annual health and welfare review.</p>	<p>Industry</p>	<p>Ruminant Health and Welfare Group and stakeholder survey.</p> <p>AHDB to use the Medicine Hub as the tool to provide evidence and data on responsible anti-parasitic use.</p> <p>AHDB pest monitoring, e.g. cabbage stem flea beetle (CSFB) monitoring and analysis.</p>
	<p>Research, knowledge exchange, economics and analysis</p> <p>AHDB helping farmers select crop types resistant to extreme weather – add to selection tools/monitoring tools, making sure they are up to date.</p> <p>Support development of novel traits such as drought tolerance, including those introduced to crop varieties through precision breeding through AHDB's Recommend Lists of varieties.</p> <p>AHDB review and update contingency planning and website content, including guidance on how to control emerging threats from weeds, pests and diseases, as well as endemic.</p>	<p>AHDB</p>	<p>Industry vaccine uptake reports in livestock for endemic diseases.</p>

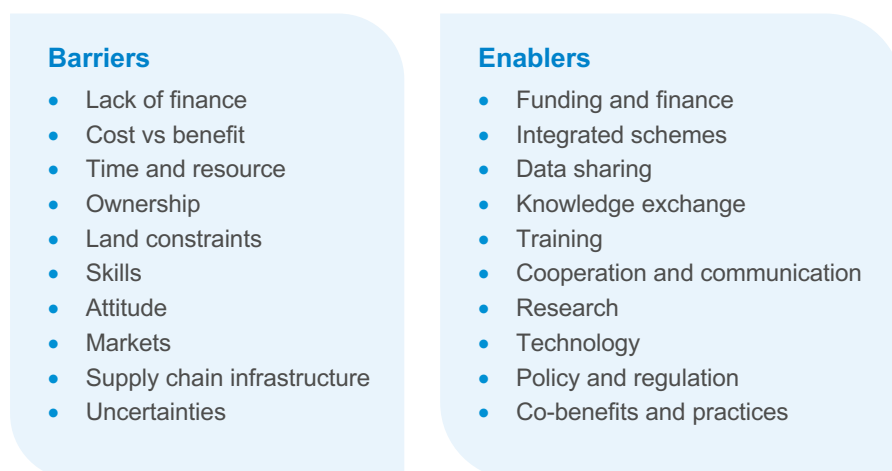
Actions		Action Owner(s)*	Monitoring and Evaluation
Natural carbon stores	<p>Scoping, scanning and strategy</p> <p>AHDB keeps a watching brief on the effectiveness of semi-engineered GHG removals, such as enhanced rock weathering and biochar, in building carbon stores.</p> <p>AHDB and partners scope prevention and planning on wildfires.</p> <p>Potential for voluntary carbon markets to be employed at scale on agricultural land, e.g. through established woodland and peatland credits routes, and for soil carbon and hedgerow routes in the near future.</p> <p>AHDB/QMS baselining – soil nutrient status, SOC % and SOC stocks.</p>	AHDB; industry; researchers; other	<p>AHDB/QMS and NI SNHS baselining of soil carbon stocks and approximation of carbon sequestration.</p> <p>Use of relevant AHDB guidance and attendance at events.</p> <p>AHDB analysis of the effectiveness of SFI actions on carbon sequestration (and equivalent).</p>
	<p>Maintaining best management practice on farm</p> <p>Prevention of soil compaction to prevent waterlogging and soil erosion.</p> <p>Use of cover crops to prevent soil erosion and capture of N to prevent loss of N₂O indirectly from leaching.</p> <p>Appropriate use of agroforestry – silvoarable, silvopasture and forest grazing.</p> <p>Maintaining and protecting existing hedgerows.</p>	Industry	
	<p>Research, knowledge exchange, economics and analysis</p> <p>AHDB continues to provide guidance on soil health and opportunities for voluntary natural carbon credits as the markets evolve.</p> <p>AHDB to continue analysis of agri-environment schemes such as SFI, including measures to increase carbon stores.</p>	AHDB	

*Action owners: Industry includes farmers and those in the supply chain; government includes devolved administrations and regulators; others, e.g. membership associations, trade associations. The monitoring and evaluation owner will be AHDB it is responsible for monitoring and evaluating the action, but not necessarily responsible for generating the monitoring procedure or measure.

Barriers and enablers

Figure 4 provides a summary of the barriers and enablers to adopting mitigating actions to address climate change impacts and building resilience. It is important to note that there are non-climate-change drivers that may be interacting, and thus these barriers and enablers are not exclusive to actions related to climate change. Certain barriers and enablers may be counterparts to each other. For instance, lack of finance to support adaptations, e.g. increasing livestock housing capacity or slurry storage capacity, and availability of finance as an enabler, e.g. support through government agri-environment schemes and capital grants. Knowing the cost benefit would be a helpful deciding factor, not just the return on investment, but it could identify other co-benefits in the process, such as ecosystem benefits. Policy and regulation would facilitate some actions taking place, e.g. flood prevention, building regulations/planning permission. A joined-up approach between government and industry, and other relevant actors, means that risks and opportunities can be identified more quickly, including sharing of data and information.

Figure 4. Barriers and enablers to adopting actions to build climate resilience



Furthermore, the time to research, plan and conduct changes is another challenge, as well as the type of ownership, which may make it difficult to make decisions for the medium to long term and balancing of perceived needs of the land and farm business. The supply infrastructure may not be there for changing enterprise or alternative species.

It may be challenging for farmers to adapt to ways that are new and unfamiliar. Cooperative networks, knowledge exchange and training may provide support. Lastly, research and technology to offer the evidence, tools to aid decision making, e.g. AI and predictive modelling, accelerated trials, and breeding programmes.

6. Next steps

Our next steps and recommendations for mitigating actions are:

Actions with industry and stakeholders

The recommended actions will feed into the business planning process within AHDB to determine how they could be adopted and embedded within functional priorities and sector plans. This process requires sector council approval, and, for some recommendations, the approach may vary from sector to sector. The recommended actions are as follows:

- Help farmers assess the risks of climate change for their businesses and identify the suitable actions to take
- Provide farmers with the evidence and analysis, guidance and tools for decision making and implementation (current tools and guidance in Appendix IV), e.g. cost benefit analysis
- Engagement and knowledge exchange working with levy payers to support the implementation of on-farm actions. This could include key topics and trials as part of AHDB's Monitor and Strategic Farms
- Learn more about the adaptation actions happening on farm. Quantitative and qualitative research to understand the actions taken and continue to monitor the change over time. Also, to understand the drivers and needs behind the actions – do they include climate change adaptation and resilience? This will be important in monitoring and evaluation. Furthermore, investigate the specific challenges, barriers and the enablers
- AHDB will integrate climate change adaptation in its current collaborations where appropriate, for example the industry environmental roadmaps
- AHDB-owned actions to be incorporated into the organisational risk register
- Monitoring and evaluation of uptake and effectiveness of mitigating actions across the industry and at AHDB

Scoping and monitoring

The following scoping and monitoring actions will also be considered, as appropriate:

- Horizon scanning, learning from other countries which may be climate analogues for future conditions in the UK
- Modelling and analysis to help determine how risks and opportunities may change in the future, and therefore the implications for action
- Continuing and developing new partnerships to monitor risks and opportunities, including monitoring changes across climate variables, and data sharing, where appropriate, will be extremely important
- Understanding background or compounding factors, e.g. policy and regulation and market trends

Research

We will consider the research areas identified for potential investigation and partnerships, where applicable, and suitability for reviews, rapid evidence assessment and practical research.

Consultation

We will work with the CCC on farming in the production of the CCRA4.

7. Future reporting

The out-of-scope elements identified in Section 3 will be included in future reporting where appropriate, such as processing as applicable to the AHDB sector, and socio-economic impacts and analysis. The interdependencies with other agricultural and horticultural sectors as well as other competing land uses will be further investigated. Risks and opportunities will be worded to be more specific to agriculture, alongside the inclusion of farmer case studies where changes for climate resilience have been implemented. The impacts, opportunities and actions at a sector level will be explored in more detail, as well as looking at the regional differences, due to variability in local weather and climate. In addition, we plan to further delve into the longer-term risks and opportunities that are deemed of relative low priority. Finally, we will endeavour to attribute the contribution of industry and AHDB actions to estimate the net risks or opportunities and investigate the potential in quantifying the environmental tipping points.

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10. Appendices

I. Risk/opportunity – short title and long title

Long (original) name	Short name
AHDB1 Risks to agricultural business infrastructure, including housing, storage and transport	Risks to agricultural business infrastructure
B1 Risks to business sites from flooding	Risks to business sites from flooding
H9 Risks to food safety and food security	Risks to food safety and food security
ID1 Risks to UK food availability, safety and quality from climate change overseas	Risks to UK food availability from climate change overseas
ID2 Opportunities for UK food imports or exports due to global climate change	Opportunities for UK food imports or exports
ID7 Risks from climate change on international trade routes	Risks on international trade routes
N4 Risk to soils from changing climatic conditions, including seasonal aridity and wetness	Risks to soils
N5 Risks and opportunities for natural carbon stores, carbon sequestration and GHG emissions from changing climatic conditions, including temperature change and water scarcity	Risks and opportunities for natural carbon stores
N6 Risks and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions	Risks and opportunities for agricultural productivity
N7 Risks to agriculture from pests, pathogens and invasive non-native species (INNS)	Risks from pests, pathogens and INNS
N9 Opportunities for agricultural and forestry productivity from new/alternative species becoming suitable	Opportunities from suitable new/alternative species
N10 Risks to aquifers and agricultural land from saltwater intrusion	Risks from saltwater intrusion
N18 Risks and opportunities from climate change to landscape character	Risks and opportunities to landscape character

II. Risk/opportunity scoring

Impact	
Rating	Definition
Minimal (1)	Risk: Minimal threats, negligible delays or disruption. Opportunity: Negligible opportunities.
Minor (2)	Risk: Minor threats, delays or additional work that could be contained with existing contingencies. Opportunity: Limited opportunities arising.
Moderate (3)	Risk: Moderate threats, delays or additional work that would exceed existing contingencies, resulting in exceeded time scales, additional resource/budget. Opportunity: Moderate range of opportunities.
Major (4)	Risk: Major threat, significant disruption to the industry's/AHDB's functional delivery, resulting in the need to make changes where necessary. It may result in failure of the function. Opportunity: Major range of opportunities at scale.
Extraordinary (5)	Risk: Catastrophic events resulting in failure to deliver the industry's/AHDB's functions. Opportunity: Very extensive range of opportunities and widely available.

Likelihood	
Rating	Definition
Highly unlikely (1)	No known event or if known extremely rare.
Unlikely (2)	Events are rare, required mitigations in place, controls are effective.
Possible (3)	Past events satisfactorily resolved, mitigations are in place or are on track to be in place, control improvements are under active management.
Likely (4)	Past events have not been fully resolved, effective mitigations are not yet identified, controls of weaknesses are known and are being managed.
Almost certain (5)	Almost certain probability of occurrence, no effective mitigations identified, may already be actively managed.

Risk/opportunity score = impact x likelihood

Risk/Opportunity Score		Impact				
		Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Extraordinary (5)
Likelihood	Highly unlikely (1)	1 Minor	2 Minor	3 Minor	4 Moderate	5 Moderate
	Unlikely (2)	2 Minor	4 Moderate	6 Moderate	8 Moderate	10 Major
	Possible (3)	3 Minor	6 Moderate	9 Moderate	12 Major	15 Major
	Likely (4)	4 Moderate	8 Moderate	12 Major	16 Major	20 Severe/significant
	Almost certain (5)	5 Moderate	10 Major	15 Major	20 Severe/significant	25 Severe/significant

III. Acronyms

AHDB	Agriculture and Horticulture Development Board
AIC	Agricultural Industries Confederation
APHA	Animal Plant and Health Agency
BBSRC	Biotechnology and Biological Sciences Research Council
BSAS	British Society of Animal Science
BSPB	British Society of Plant Breeders
CCC	Climate Change Committee
CEG	Cattle Expert Group
CEH	UK Centre for Ecology and Hydrology
CLA	Country Land and Business Association
COWS	Control of Worms Sustainably
CSF	Catchment Sensitive Farming
DAERA	Department of Agriculture, Environment and Rural Affairs of Northern Ireland
Defra	Department for Environment, Food and Rural Affairs
ELM	Environmental Land Management (Scheme)
eMB	Electronic Medicine Book
FAnGR	Farm Animal Genetic Resources

FSA	Food Standards Agency
HCC	Hybu Cig Cymru/Meat Promotion Wales
JNCC	The Joint Nature Conservation Committee
NDPB	Non-Departmental Public Body
NFU	National Farmers' Union
NIEA	Northern Ireland Environment Agency
NPA	National Pig Association
NRW	Natural Resources Wales
PEG	Pig Expert Group
PHWC	Pig Health and Welfare Council
QMS	Quality Meat Scotland
RHW	Ruminant Health and Welfare
RUMA	Responsible Use of Medicine in Agriculture Alliance (RUMA)
SCOPS	Sustainable Control of Parasites in Sheep
SEPA	Scottish Environment Protection Agency
SFI	Sustainable Farming Incentive
SREG	Small Ruminant Expert Group
TCFD	Taskforce on Climate-Related Financial Disclosures
TFA	Tenant Farmers Association
UKECP	UK Export Certification Partnership

IV. AHDB guidance and tools

This is a selection of the AHDB's guidance and tools that can support climate resilience and are subject to revision. More information is available on the **AHDB website**.

Climate change risk assessment

For pigs, as part of the guidance for the Environmental Permitting Regulations ahdb.org.uk/knowledge-library/environmental-permitting-regulations

Preparing for changing seasons

[AHDB weather hub](https://ahdb.org.uk/knowledge-library/weather)

ahdb.org.uk/knowledge-library/weather

Heat and heat extremes

Heat stress

ahdb.org.uk/Tags/heat%20stress

Fire prevention and control

ahdb.org.uk/drought-fire-prevention

Managing cattle and sheep in hot weather

ahdb.org.uk/knowledge-library/managing-cattle-and-sheep-in-hot-weather

Dealing with summer 2022 – Mark Jelly, Strategic Farmer

ahdb.org.uk/knowledge-library/mark-jelley-dealing-with-summer-2022

Drought and low rainfall

Drought

ahdb.org.uk/knowledge-library/drought

Top tips on managing prolonged dry conditions

ahdb.org.uk/news/top-tips-on-managing-prolonged-dry-conditions

Water supply problems? A guide for livestock farms

ahdb.org.uk/news/water-supply-problems-a-guide-for-livestock-farms

High rainfall and flooding

Advice for livestock farmers affected by flooding

ahdb.org.uk/knowledge-library/advice-for-livestock-farmers-affected-by-flooding

How to prepare for heavy rainfall

ahdb.org.uk/news/how-to-prepare-for-heavy-rainfall

Dealing with flooded pastures

ahdb.org.uk/news/dealing-with-flooded-pastures

Soil erosion risks with flash flooding

ahdb.org.uk/news/soil-erosion-risks-with-flash-flooding

How to nurture wet-weather-ravaged cereals

ahdb.org.uk/news/how-to-nurture-wet-weather-ravaged-cereals

How will the wet weather affect your nitrogen use?

ahdb.org.uk/news/how-will-the-wet-weather-affect-your-nitrogen-use

Excess Winter Rainfall (EWR) data

ahdb.org.uk/knowledge-library/how-to-use-excess-winter-rainfall-data-to-plan-nitrogen-applications

[Tips for on/off grazing to avoid poaching](#)

ahdb.org.uk/knowledge-library/tips-for-on-off-grazing-to-avoid-poaching

Other extreme weather events

[Managing cattle and sheep during extreme weather events](#)

ahdb.org.uk/knowledge-library/managing-cattle-and-sheep-during-extreme-weather-events

[Long-term planning for extreme weather – beef, sheep and dairy](#)

ahdb.org.uk/long-term-planning-for-extreme-weather-beef-sheep-and-dairy

Prevention of soil degradation and erosion

[AHDB GREATsoils](#)

ahdb.org.uk/greatsoils

[Healthy grassland soils pocketbook](#)

ahdb.org.uk/knowledge-library/healthy-grassland-soils-pocketbook

[Impacts of poor soil structure](#)

ahdb.org.uk/knowledge-library/impacts-of-poor-soil-structure

[Wind and water erosion of soil](#)

ahdb.org.uk/knowledge-library/wind-and-water-erosion-of-soil

[Soil Management Plan](#)

ahdb.org.uk/knowledge-library/soil-management-plan

[Field drainage: Benefits and costs to farm businesses](#)

ahdb.org.uk/knowledge-library/field-drainage-benefits-and-costs-to-farm-businesses

Pest and disease surveillance and monitoring

[The UK aphid-monitoring network](#)

ahdb.org.uk/knowledge-library/the-uk-aphid-monitoring-network

[Barley yellow dwarf virus \(BYDV\) management tool for cereals](#)

ahdb.org.uk/bydv

[Mycotoxin rainfall risk tool for cereals](#)

ahdb.org.uk/mycotoxin-rainfall-risk-tool-for-cereals

[Sclerotinia infection risk alerts \(forecast\) for oilseed rape](#)

ahdb.org.uk/sclerotinia-infection-risk-alerts-for-oilseed-rape

[Phoma leaf spot forecast](#)

ahdb.org.uk/phoma-leaf-spot-forecast

[Light leaf spot forecast for oilseed rape](https://ahdb.org.uk/light-leaf-spot-forecast)

ahdb.org.uk/light-leaf-spot-forecast

Market trends on UK and global markets

[Prospects for UK agri-food exports](https://ahdb.org.uk/export-opps)

ahdb.org.uk/export-opps

[Markets and prices](https://ahdb.org.uk/markets-and-prices)

ahdb.org.uk/markets-and-prices

[Food security](https://ahdb.org.uk/trade-and-policy/food-security)

ahdb.org.uk/trade-and-policy/food-security

[Beef and lamb 2030 series: The long-term outlook for domestic GB cattle and sheep production](https://ahdb.org.uk/knowledge-library/beef-and-lamb-2030-series-the-long-term-outlook-for-domestic-gb-cattle-and-sheep-production)

ahdb.org.uk/knowledge-library/beef-and-lamb-2030-series-the-long-term-outlook-for-domestic-gb-cattle-and-sheep-production

Resource use efficiency tools

[Cost benefit calculator for nitrogen fertiliser use on grassland](https://ahdb.org.uk/knowledge-library/cost-benefit-calculator-for-nitrogen-fertiliser-use-on-grassland)

ahdb.org.uk/knowledge-library/cost-benefit-calculator-for-nitrogen-fertiliser-use-on-grassland

[Nitrogen fertiliser adjustment calculator for cereals and oilseeds](https://ahdb.org.uk/knowledge-library/nitrogen-fertiliser-adjustment-calculator-for-cereals-and-oilseeds)

ahdb.org.uk/knowledge-library/nitrogen-fertiliser-adjustment-calculator-for-cereals-and-oilseeds

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