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The Future of Land Use

WWF's Triple Challenge: Addressing the balance between Biodiversity, Climate Change Mitigation and Food Production to 2031

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Contents

Glossary

Afforestation: The establishment of a forest or stand of trees (forestation) in an area where there was no previous tree cover.

AFOLU: Agriculture, Forestry, and Other Land Use sector.[1]

Agri-environment scheme: Agri-environment schemes provide funding to farmers and land managers to farm in a way that supports biodiversity, enhances the landscape, and improves the quality of water, air and soil.[2]

Agroecology: Agroecology is a sustainable farming practice that works with nature. Agroforestry, silvo-pasture are examples of agroecology (please see below).

Agroforestry: Agroforestry is a land management approach that combines afforestation with agriculture - it has multiple benefits both to the biodiversity, carbon sequestration and food production.[3]

BAU: Business as usual

Carbon sink: Forests and other ecosystems that absorb the carbon they release, thereby removing it from the atmosphere and offsetting CO2 emissions.[4]

Catchment-based approach: An inclusive, civil society-led initiative that works in partnership with Government, Local Authorities, Water Companies, businesses and more, to maximise the natural value of the environment.[5]

GHGs: Greenhouse gases

Just Transition: A package of economic and social policies that ensure climate action and nature restoration are delivered fairly, and in a way that reduces inequalities.[6]

Land Use Change (LUC): Change in land management practice and intensity, which can influence ecosystem function, biodiversity, and the outputs of that land.

Low-carbon farming practices: Agricultural practices that leads to reduced greenhouse gas emissions from livestock, agricultural soils and farm machinery. Practices such as 'controlled-release' fertilisers, improving livestock health and slurry acidification,[7] which can cut ammonia emissions.

Nature-based solutions to climate change: Ecosystem conservation, management and/ or restoration interventions intentionally planned to deliver measurable positive climate adaptation and/or mitigation benefits that have human development and biodiversity co-benefits managing anticipated climate risks to nature that can undermine their long-term effectiveness.[8]

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1028157/net-zero-strategy.pdf
[2] https://www.daera-ni.gov.uk/articles/agri-environment-schemes
[3] https://www.soilassociation.org/causes-campaigns/agroforestry/what-is-agroforestry/
[4] https://www.eea.europa.eu/help/glossary/eea-glossary/carbon-sink
[5] https://catchmentbasedapproach.org/about/
[6] https://www.wwf.org.uk/sites/default/files/publications/Oct20/WWF%20TRIPLE%20CHALLENGE%20REPORT_1.pdf
[7] https://www.theccc.org.uk/2020/01/23/major-shift-in-uk-land-use-needed-to-deliver-net-zero-emissions/
[8] Idem

Net Zero: State in which emissions going into the atmosphere are balanced by removal out of the atmosphere through natural carbon sinks like forests, and new technologies like carbon capture state.

Silvo-Pasture: An agriculture practice that introduce trees into a pastoral system which benefit both livestock and the environment. This is an example of agroecology.

Trade-off: choices over the use or management of land, water, or marine resources, that increase the delivery of one (or more) ecosystem service(s) at the expense of the delivery of other ecosystem services (adapted from Turkelboom et al 2018). In the context of this report, these are ecosystem services towards food, climate and biodiversity goals.[9]

UK's Global footprint: A 'footprint' refers to the drivers and pressures that harm the environment, such as extraction of metals, production of goods, consumption of food and related socioeconomic activities. In a nutshell, it explains the environmental impact of the things we produce and consume.[10]

[9] https://www.wwf.org.uk/sites/default/files/publications/Oct20/WWF%20TRIPLE%20CHALLENGE%20REPORT_1.pdf
[10] https://www.wwf.org.uk/what-we-do/uk-global-footprint

Introduction

The Triple Challenge is a critical global goal that aims to simultaneously mitigate the effects of climate change to below 1.5, halt and reverse the dramatic loss of biodiversity, and meet the food needs and broader well-being of a growing human population. These interlinked issues must be overcome in the next 30 years to safeguard a prosperous future.

WWF-UK commissioned a consortium comprising of Ipsos, Imperial College's Centre for Environmental Policy, and technology consultancy Codelegs to build a research-based interactive tool as part of the Triple Challenge project. The objective of the tool is to provoke discussion and promote stakeholder engagement to address the Triple Challenge.

This report explains the design and development process of the Triple Challenge interactive tool and provides details of the research and evidence on which it is based. The Tool was designed using best practice for scenario development, including the involvement of experts and stakeholders to support clear and informed advocacy.

The user is introduced to three UK-based regional landscapes in this interactive tool. They must make land use decisions in each landscape, balancing the competing pressures on the same piece of land. Almost all Land Use Change (LUC) options have Win-wins and Trade-offs, so it is up to the user to prioritise and achieve a positive and balanced outcome. This interactive tool is not a spatial model, it is case-study based, focusing on trends in land use and direction of travel, informing the Triple Challenge.

This project is part of ongoing research and advocacy by WWF's Triple Challenge programme.

1. Background and Context

The Triple Challenge

Our world is at a tipping point that presents some truly daunting challenges. Finding ways to feed a growing world population estimated to approach 10 billion by 2050[11], must go along with limiting global temperature rise to 1.5 C, improving resilience to manage climate change and halting the loss of and restoring nature. These three interrelated and fundamental objectives must be achieved before 2050 to simultaneously avoid dangerous climate change, halt and reverse the dramatic loss of biodiversity, and meet the needs of a growing global human population. This is today's Triple Challenge.

The scientific evidence is clear. If we fail to address these three potentially competing pressures in an integrated way, the social, environmental, and economic consequences could be catastrophic. Addressing climate change, biodiversity loss and restoration, food security and sustainability is crucial for future wellbeing and prosperity of people globally.

The food system is one of the main drivers of climate change and biodiversity loss. A coherent approach to sustainable food production and consumption is necessary. Without it, the UK could fail to achieve its commitments to decarbonise all sectors of the UK economy by 2050, to achieve its goal to reverse nature's decline by 2030 or reduce its overseas footprint.[12]

WWF has integrated the Triple Challenge into its policy advocacy work around the world. Despite the unprecedented amount of scientific evidence, the Triple Challenge is not yet adequately addressed in decision-making and WWF's science and advocacy work is focusing on turning this around.

As part of WWF's efforts to call for more ambition and integration of national and international policy, and to engage all sectors of society, WWF has commissioned a consortium led by Ipsos to develop an interactive tool that demonstrates the necessary climate, nature and socioeconomic Trade-offs and parameters to address the Triple Challenge.

The Interactive Tool

The primary objective of this project is to create an engaging tool to demonstrate the complexities of the Triple Challenge and stimulate discussion among all sectors of society. The stages of this project are designed to interrogate and examine the Trade-offs and choices that need to be made to meet the Triple Challenge, and to understand the constraints and opportunities presented by the current state of land use and by choosing different priorities to meet society's expectations. The interactive tool is intended to serve as a platform that informs debate and advocacy to provide an array of evidence showing what is possible, the Trade-offs and choices that will be needed, and the resources that will be necessary.

A case study approach has been used for this first version of the interactive tool to provide the evidence of what is possible to address the Triple Challenge in the UK. The three landscapes selected for version one, are The Humber Region, Aberdeenshire and Pembrokeshire. We have assumed a time frame of approximately 10 years to make the tool forward-looking yet still explore policy choices that are actionable today. Therefore, we explore the ideal scenarios we want to see by the end of this decade.

[11] https://www.wri.org/insights/how-sustainably-feed-10-billion-people-2050-21-charts
[12] https://www.gov.uk/government/publications/industrial-decarbonisation-strategy

The audiences for the interactive tool include, but are not restricted to, policy makers, NGOs, environmental and social movements, WWF's corporate partners, representatives of the water and land management sectors, businesses, WWF advocates, and where appropriate to engage members of the public.

The interactive tool shows how the Triple Challenge could be met in the UK within the following scope:

- **Climate**: the potential of UK landscapes to store, mitigate and remove greenhouse gas emissions
- **Biodiversity**: the potential within UK landscapes to halt habitat, species and ecosystem loss, bend the curve on biodiversity loss, and ensure the recovery of habitats, species and ecosystems
- **Food**: the potential for UK landscapes to produce and secure food for the population, as well as animal feed in sustainably and economically viable ways
- **Social and economic context and impacts**: highlight social or economic impacts (positive or negative) that may arise from the options and Trade-offs for meeting the Triple Challenge
- **Offshoring impacts**: identify risks of significant environmental impacts to other countries

Through creative scenario development, academic literature review, detailed research and the involvement of experts and stakeholders, the evidence-based interactive tool presents future scenarios for UK landscapes, and the ways in which the Triple Challenge might – or might not – be achieved under each of them. The scenarios and interactive tool design are not based on quantitative data and modelling activity; instead, they aim to build a strong narrative and vision, telling stories of how the UK's future landscapes could look in an accessible and inspiring way that will create interest and help with WWF's advocacy objectives.

2. Methodology

Ipsos partnered with Imperial College and Codelegs to conduct a literature review, undertake scenario planning and build a tool to bring to life credible scenarios that demonstrate the Trade-offs and Win-wins of the Triple Challenge in the UK.

The key stages of this project are detailed below:

Literature Review

Ipsos' academic partner, Imperial College, conducted a rapid, semi-systematic review of UK level understanding and evidence to feed into the scenario building process. The aim of the literature review was to examine the Trade-offs and Win-wins that are inherent in approaching all three elements of the Triple Challenge. The work involved two literature searches. First, a grey literature list was established through published scenarios recommended by WWF and an online search through UK-based organisations (such as the RSPB). Second, a scoping review was conducted to collate research published in academic journals. After removing duplicates, this meta-analysis resulted in 48 scenarios that were short-listed for relevance against Imperial College's selection criteria. Throughout this report we refer to the scenarios from the literature review as meta-analysis, which are distinct to the bespoke scenarios developed for the tool.

The literature review provided a UK and individual level analysis for three target landscapes in the UK. The meta-analysis consisted of an assessment of existing and models of future trajectories, identifying and comparing pathways, Trade-offs and Win-wins, land-use decisions and policy choices associated with the Triple Challenge that accompany them.

The outputs of the literature review were synthesised into decision trees that were designed to inform the development of the bespoke scenarios and activities included in the interactive tool. Further details on the literature review methodology, analysis and findings were included in a separate literature review report.

The full literature review carried out by Imperial College can be downloaded on the Triple Challenge interactive tool website: Triple Challenge | WWF (wwf-tc.web.app)

Scenario planning

We learnt from the literature review that despite there being significant research into the integration of biophysical and socio-economic drivers of land use, accurately modelling and quantifying future land use is difficult. Therefore, scenario planning combined with a case study-based approach was identified as the most appropriate tool to investigate future land use pathways and bring coherence to the possible policy choices envisioned by the scenarios.

We complemented the literature review findings with four expert workshops to inform and develop the different scenarios and activities included in the interactive tool. All workshops included a cross-section of experts around climate change, biodiversity and food systems. Working closely with experts from WWF, we finessed the findings and the "end state" activities that feature in the interactive tool.

Workshops

The aim of the first workshop was to explore, critique and validate the decision trees and pathways that resulted from the literature review for three target landscapes in the UK. In this workshop, we used an

inductive scenario building approach to turn the analysis of Trade-offs and choices into specific challenges with decisions to make. We presented key learnings from the literature review, explored each dimension of the Triple Challenge and dug into the core policy and other decisions that need to be made in each dimension to achieve success.

Building on the learnings from this first expert workshop and the literature review, we agreed the top-level priorities and began to turn the meta-analysis and the policy directions into a set of example decisions. We created three to five narratives for each landscape at this early stage, which were accompanied by a series of choices with different implications for biodiversity, climate change mitigation and food production. These different narratives portrayed landscape-relevant challenges and the implications for the different dimensions of the Triple Challenge.

To test the relevance and accuracy of these outputs, we held three more workshops with experts and stakeholders – one for each landscape. In these workshops we built out the scenarios further and ensured key land use Trade-offs and important regional issues were covered. These landscape workshops provided a regional level understanding of the Triple Challenge and contextualised the drivers behind the policy and behavioural decisions that are relevant to each landscape.

The role of the experts

The experts were selected based on their experience and knowledge of different aspects of land use and at least one of the three areas of the Triple Challenge. They were academics, land use specialists and representatives from land management organisations with knowledge in biodiversity, climate change and food systems. In addition, the experts were selected according to their knowledge of the Humber Region, Aberdeenshire and Pembrokeshire landscapes.

The experts played a crucial role in the process of developing the final activities for the interactive tool. Their technical knowledge and expertise enhanced the findings from the literature review, providing varied perspectives on how pressing regional issues have been handled historically, currently and may be handled in the future.

Their involvement helped fill any gaps from the literature review and provided the necessary nuance to reflect the complexity of the Win-wins and Trade-offs of the Triple Challenge. Working alongside experts ensured the technical accuracy of the activities of the interactive tool, allowing us to create realistic but challenging scenarios that are relevant to the Triple Challenge within each regional context. The experts also advised us on key decisions that needed to be made during the design phase, such as the use of business as usual (BAU) scoring, incorporating the complexity of both food production and food sustainability in the tool, and considering the social and economic as well as global impacts in the tool design.

Crafting the interactive tool

Throughout the process of crafting the activities and options, we refined and improved the scenarios iteratively, adding more evidence, rich detail, and perspective. This scenario planning stage resulted in a series of activities designed for the interactive tool. We created three activities per landscape describing the current state and presenting a challenge to be solved. Each activity describes the landscape and its characteristics and places the end-tool user in a situation focusing on a particular dimension of the Triple Challenge that needs to be solved or improved. Each activity then offers three or four possible options that can be carried out to solve the challenge, which will together encapsulate the Trade-offs between biodiversity, climate change and food. Each of these options has an accompanying score and text to

reflect the implications for the Triple Challenge. The experts helped us build this scoring system based on the implications of the choices we wanted to highlight.

Codelegs' design ensures that the interactive tool visually displays the positive and negative impact of the user's decision for biodiversity, climate change and food. We worked closely with Codelegs to bring the interactive tool to life, refining the activities to create a positive user experience while capturing the complexity of the content. Finding this balance was key to ensuring that the tool reflects the different elements that interact in the Triple Challenge while at the same time being accessible enough to encourage discussion on WWF's broader call to action.

Limitations

The literature review gave us practical help by identifying the most frequently modelled connections between the three challenges in the meta-analysis. This allowed us to infer and summarise some characteristic actions which could be taken in land use that would lead us to success in each of the Triple Challenge pillars. It tells us the direction of Trade-offs which are most often described.

However, the literature review revealed low confidence in many of the 48 scenarios from the meta-analysis, as there was a limited amount of quantitative data available to support them. Therefore, we have not been able to provide quantitative analysis on the impacts of precise actions, either nationally or by landscape.

The types of outcomes associated with activities vary hugely, depending on contextual factors. For example, the biodiversity or climate change mitigation impact of afforestation always depends on the type of tree planted and the agricultural context in which the trees are planted. Processes of land sparing or land sharing have different outcomes depending on where the land is, the type of soil, type of crop or animal farmed and so on. This means there is no data on specific changes to land use and their impact on the Triple Challenge at a granular level in each region.

To estimate the impact on biodiversity, climate change or food, in quantitative terms, would involve many assumptions about the different spaces and the possible ways different activities could be carried out. The assumptions would need to be so far-reaching, and need so much explanation, that the eventual score would have wide bounds of uncertainty. This would then distract from the principle behind the interactive tool for users and would make it less convincing.

The interactive tool does not, therefore, include hard metrics such as impact on total food production or food sustainability, absolute carbon emissions reduced, or specific losses or gains in biodiversity values. In designing the interactive tool, we emphasised the creation of a clear narrative to highlight key advocacy considerations relating to the Triple Challenge.

3. Designing the interactive tool: key considerations

Our scope and considerations

Our goals for the tool were:

1. That it should be unambiguous and easy to follow
2. That it should offer simple tasks
3. That it should provide clear and plausible outcomes for the options
4. That it should illustrate each landscape indicatively in the tool rather than being geographically accurate. The detail of e.g., particular river catchments or impacts of specific changes to farmland are too granular to create scores that apply to the whole country.

As discussed in the Limitations section above, in designing the interactive tool, we identified two alternative approaches we could take:

1) A case study approach consisting of scenario-based activities
2) Quantitative approach consisting of modelling with measurable hard metrics

Of these, and based on the limitations, we felt a case study-based approach was more appropriate.

Therefore, this interactive tool offers:

- Evidence-based typical activities that highlight the most relevant types of decisions which will have to be made in the next ten years to improve the UK's ability to address the Triple Challenge.
- Examples of specific land use decisions that could take place on indicative farms or other land management systems (e.g., a particular scheme for habitat restoration).
- A choice of activities that are relevant for each of the three landscapes (for example, highlighting conservation and grazing pressures in Pembrokeshire, acknowledging that there is some exceptionally high-grade agricultural soil in the Humber region, interest in agroforestry in Aberdeenshire, etc.).
- Scoring for the activities to reflect indicative deviations from an assumed BAU pathway. These are "Rapid Decline" which is the worst-case scenario; "Slower Decline" which is a stable but progressively worsening scenario; "Resilience" which is the most desirable scenario whereby land use choices meet the needs of the Triple Challenge. These were derived through the scenario planning phases of the project, and we have based the outcomes of the activities on these three levels of scoring. Our BAU pathway sits in the Rapid Decline" scenario with the exceptions of food production and society and economy, which are in the Slower Decline scenario. The storytelling gives examples of the kinds of changes we might see along the way to Rapid or Slower Decline pathways or, at best, Resilience.

- Visual “thermometers” which display the impact of the user’s decisions as they explore the activities and options in the tool.

Defining the thermometers

The initial scope for the interactive tool was to uncover the tensions between the three aspects of the Triple Challenge. However, from our expert workshops, it is evident that the Triple Challenge has a consequential effect on peoples’ lives. Hence, we added a fourth element, “Society & Economy” which considers the impacts on people beyond just the food they eat. Furthermore, we recognise there are many layers of consideration that ladder up to a sustainable food system, including sustainability of supply chain and resilience of the UK food supply chain. Therefore, as well as the three thermometers for Biodiversity, Climate Change Mitigation and Society and Economy, we split the food thermometer into two thermometers, one to focus on Food Production and the other to focus on Food Sustainability in the UK. We therefore incorporate five thermometers in the tool.

We also understand through consultation with WWF experts that offshoring of the UK’s footprint is an important area of consideration when talking about supply chains and imports. A key challenge when considering the global footprint of UK-based decisions in the interactive tool is that the case-specific activities may not “ladder up” into issues affecting society directly. Therefore, we needed to make sure that the activities are presented as examples of the types of decisions that, if taken more widely, would lead to some of these difficult choices. For example, one farm’s potato planting will not affect the whole of the UK’s import strategy, but the potato imports of the entire country might affect the overall carbon footprint. Or, a global shift away from rice to potato would significantly affect both biodiversity and climate change mitigation. Mapping the global impacts in detail is outside the scope of the interactive tool, but these impacts are referenced in activities and results.

The scenarios framework

Rapid Decline scenario

We assume that species and habitat loss is more rapid, and habitats are more fragmented. We see a rapid increase in GHG emissions as more carbon is released from the soil. Local ecosystems are more likely to collapse as different species respond differently to the changing environment and temperatures. The effect of climate change could significantly impact crop yield in the long term. At the Rapid Decline stage, we assume agricultural production becomes more unstable, and yields go down as soil is degraded. There are no core standards for imports into the UK to be produced sustainably, driving deforestation abroad. We assume that from a society and economy perspective there will be a great deal of change with new industries emerging, accompanied by increasing job losses in traditional rural economies. The ever-worsening effects of climate change result in increased hazard risks such as floods and droughts, especially for disadvantaged communities.

Slower Decline scenario

We assume there are some signs of recovery in areas where biodiversity is prioritised and preserved. Land use practices mean that GHG emissions are reduced, and the UK gets closer to the Net Zero target through low-carbon farming practices. We assume that agriculture production remains at the same level for the next ten years. The expansion of agricultural land leads to increased fragmentation of habitats. While international trade standards have improved to match domestic sustainable food production policy, some imported food is still not produced sustainably. Not all food producers in the UK can reap the benefits of producing sustainably at a profit. However, the workforce can adapt to newly

emerged industries. Hazards like floods and droughts are mitigated as the UK gets closer to the Net Zero target.

Resilience scenario

We assume a significant increase in habitat areas and abundance and diversity, plus greater resilience to climate change. The UK becomes net positive in carbon sequestration and Net Zero in GHG emissions through changes in land use for forests and through the rewilding of naturel landscapes. Agricultural land expands because we are, at best, resilient, and production remains as high as today or higher. We have higher crop diversity, and technology innovation helps to improve food production and efficiency. Agricultural land use is meeting Net Zero targets by significantly reducing agricultural emissions. We adopt high domestic sustainable agricultural standards, which are also reflected in international trade policy. This reduces import and production of unsustainable products at home and abroad. UK food producers can run profitable and sustainable businesses. The UK's land use focus is on preserving and enhancing biodiversity and food sustainability.

Selection of regional landscapes and the activities

We selected Pembrokeshire in Wales, the Humber region in England, and Aberdeenshire in Scotland from the initial nine landscapes; these are summarised below. We believe each of these landscapes is distinct in its characteristics and land use challenges. We hope that selecting landscapes from three different regions of the UK will ladder-up to the national level effect that we want to convey to the end users of the tool. Inclusion of further landscapes into the Tool are in discussion with WWF.

Pembrokeshire has an extensive agriculture sector including dairy, arable, coastal and marine areas, and woodlands. Five key habitats include semi-natural grassland, enclosed farmland, costal margins, marine habitat, and woodlands. The county is home to Pembrokeshire Coast National Park which is a special area of conservation (SAC). The Park occupies more than a third of the county's area and includes the Preseli Hills in the north and the 190-mile (310 km) Pembrokeshire Coast Path. The significant challenge specific to this landscape is the use of upland and coastal areas which are common grazing areas with many issues in grazing management due to unclear ownership. Activity 3 in Pembrokeshire is designed to illustrate this issue and understand the Trade-offs and the Win-wins to different scenarios of land uses. Another key aspect of this landscape is the use of coastal areas of Pembrokeshire, as this area has the potential to meet all three dimensions of the Triple Challenge. Therefore, the farm in activity 1 is based near the coastal region of Pembrokeshire. The three activities in Pembrokeshire are in individually distinct locations. Activity 1 focuses on the coastal area, activity 2 is based on a lowland farm, and activity 3 is upland, and next to a SAC. In choosing these distinct locations, we hope to tease out the difference in land use between the uplands and lowlands and encourage the user to utilise the existing habitats and resources available on their land to meet the Triple Challenge.

The Humber region is rich in biodiversity, with 35 national priority habitats and 105 national priority species. This region has prime agricultural land, and it is one of the most productive landscapes in the UK. Key habitats include upland moorland and heathland, limestone pavements, lowland raised bogs, wetlands of national importance, and ancient woodland. The specific challenge in this landscape is that the Humber region has the second largest area at risk from flooding in England because of its low-lying and flat landscape. As land is frequently flooded, our first activity in the Humber region explores alternative uses for unproductive farmland that can benefit biodiversity and halt climate change. The second activity looks at the management of land use on a regional level instead of a specific farm. We highlight the importance of local knowledge and engagement from the relevant communities in the

decision-making process, e.g., through programmes such as catchment-based approach. Activity 3 looks at diversification methods that improve a farm's financial viability – raised as a hot topic during the research and key to include in the tool.

Aberdeenshire is located in the North-East of Scotland. Aberdeenshire contains over 9% of the Scottish total agricultural area and represents all the farming types found around the country. Typically, mixed farmland is found across the area with some farmland dominated by arable, but the rest sees a variety of mixed use, grazing pasture, hay and arable. As there is an extended amount of peat coverage in Aberdeenshire, the specific challenge on this landscape is examining the different methods of peatland restoration. Activity 1's sole focus is peatland restoration, although our options offer different scales of peatland improvement. We want the user to understand Trade-offs and Win-wins to climate change, food, society and economy if biodiversity is prioritised on different scales. At the time of writing this report Activity 1 is under review and may change. The second activity represents a typical mixed farm in Aberdeenshire that explores different low-carbon farming practices which are better for biodiversity and climate change. Activity 3 considers the options for diversification again, but the methods are specific to the Aberdeenshire landscape, and they are already practised by farmers in this region, such as agroforestry and silvo-pasture.

The Trade-offs and Win-wins

A key objective of this Triple Challenge project is to advocate for land use practices that can balance positive outcomes across biodiversity, climate mitigation and food production. We know that a siloed and BAU approach to each of these areas is unviable for the future, and that if food is produced at current rates and the land continues to be used as intensively as it is today, we will fail to cut carbon emissions, and fail to work towards Net Zero by 2050. The policy drivers and the decisions that are made about land use across the UK will need to consider the inevitable Trade-offs and advocate for the Win-win solutions that can be implemented to support nature recovery, nature-based climate solutions and low impact food production and consumption. If continuing down the current path is not an option, what are the key Trade-offs and the choices that need to be resolved? And how does this interactive tool advocate for the choices that will create Win-wins?

The Trade-offs and Win-wins are addressed at three levels within this report. In this section we discuss two of them. The first is at the broader level to reflect the findings from the literature review. The second is at the level of the interactive tool where we analyse the outcomes of the choices that the tool presents in the activities. A third level relates to the scoring of the thermometers and is within the 6. Scoring system section.

Trade-offs and Win-wins: the literature review

The meta-analysis of 298 papers in Imperial College's rapid systematic review went on to examine 48 scenarios of land use change and analysed the outcomes. From this process 29 scenarios were narrowed down. Table 1 below shows the relationship between the challenges when one of the three was prioritised, seeing which one of the three was then most likely to be the challenge that lost out. This does not cover when multiple challenges were prioritised.

Table 1: Trade-offs and Win-wins from Literature Review:

		Priority			
		Biodiversity	Food	Carbon emission reduction	*Total (base = 29)*
Challenge that 'loses'	Biodiversity		12	5	*17*
	Food	5		5	*10*
	Carbon emission reduction	1	1		*2*
	Total (base=29)	*6*	*13*	*10*	

The analysis showed that 32% of the scenarios had food as the only prioritised challenge, with reducing carbon emissions at 20% and biodiversity at 14%. The rest of the scenarios either prioritised a combination of the three challenges, or none of them. Biodiversity was the challenge that 'lost out' the most in the scenarios analysed at 23% of scenarios; 18% and 11% saw food and reducing carbon emissions 'lose out' respectively, with the rest being a combination of the three challenges, or none of them.

In essence, the Triple Challenge will be resolved through today's land use choices. As an introduction to the Trade-offs and Win-wins, the literature review provides a brief overview of the agriculture, forestry and other land uses (AFOLU) sector, together with the challenges it presents. The literature review sets out that AFOLU is a complex sector, encompassing farming, forestry, recreation, and a wide range of land management practices. It produced over 12% of UK emissions in 2019. It is both a carbon sink through sequestration (atmospheric removals of CO_2) and a source of GHGs including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Emission reduction activities should encompass all three of these GHGs whilst removals are exclusively focused on carbon.

GHG emissions reduction and achieving the legally binding goal of Net Zero emissions by 2050 and a more recently agreed goal of 75% reduction in emissions by 2035, is one of three major environmental challenges that the UK will face over the coming decades. As few studies reviewed focused on agricultural emissions other than carbon, the interactive tool is currently largely focused on carbon reduction (although it considers methane reduction in some of the cases). WWF may wish to consider incorporating other types of emission in the tool in further iterations.

The second challenge is the provision of sufficient food that meets the expectations and dietary demands of the population that is expected to increase by 6 million over the next 25 years.[13] The final

[13] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections

challenge is to reverse biodiversity loss, whereby 41% of species across the UK continue to decline in abundance.

The literature review describes Land Use Change (LUC) as the transition from one type of land use or vegetational cover, to another and this plays an integral role to considering the dynamics, including the Trade-offs and Win-wins, between the three challenges. LUC can be between two uses (e.g., agricultural land to woodland) or within a use (e.g., arable farming to pastoral farming). It can also represent shifts between land management styles; for example, transitioning from coppiced woodland management to a silvo-pastoral system would not change the denotation of the area from a forest, but would imply changes in biodiversity, carbon stocks and storage capacity and GHG emissions of the area, as well as the food output. LUC, including changing management practice and intensity, can influence ecosystem function and the outputs of that land.

The literature review then concludes that the Trade-offs and Win-wins are as follows:

Food and Biodiversity are often in direct conflict with each other and shifts to prioritise one of these two challenges often comes hand in hand with direct Trade-offs with the other. When food is prioritised within the land sector it is most common to see actions such as conversion to arable land and intensification of farming. This primarily results in Trade-offs between food and the other two challenges - carbon emission reduction and biodiversity.

Carbon Emission Reduction and Food are also often in direct conflict with each other, so shifts to prioritise one of these two challenges often come hand in hand with direct Trade-offs with the other.

Both bio-crop production and habitat restoration pathways demonstrate broader ramifications on food. For both of these there is a Trade-off with food as the land previously dedicated to food production is displaced. Additionally, whilst there are Win-wins for both biodiversity and carbon emission reduction, the nature of these wins is dependent on variables such as the type of habitat restored and the patch allocation for bio-crops or habitat restoration.

When food is prioritised, organic farming, technological development and maximizing food production are the three actions that most feature in the literature. For all three pathways there are broader ramifications on carbon emission reduction. We primarily see Win-wins between biodiversity and food, whilst there is often a Trade-off for carbon emission reduction, as well as high levels of uncertainty in terms of time and cost commitments.

Biodiversity and Carbon Emissions Reduction. The strongest relationship between biodiversity and carbon emission reduction is the interaction that occurs during habitat restoration. When there is an increase in bio-crops, there can be a domino effect that negatively impacts biodiversity. Carbon emission reduction is often a by-product of biodiversity improvement, rather than the other way around.

Trade-offs and Win-wins in the interactive tool

The literature review provides at a high and general level the Trade-offs between the three elements of the Triple Challenge - as depicted in the Table 1 above.

We have conducted a further analysis below of the 28 options in the interactive tool across the nine activities in Aberdeenshire, Humber and Pembrokeshire. Our analysis of the scores across the five thermometers in the activities examines the Trade-offs and Win-wins at a granular level - see Tables 2-4 below for a detailed breakdown).

As mentioned in the literature review, there is a huge level of variation in what landscapes could prioritise; landscapes also evolve over time and behaviours need to be modified, so a more nuanced approach needed to be taken with the interactive tool. The activities for the tool were crafted through comprehensive additional research together with technical input from regional experts during three workshops. The three tables below summarise the impact of the options provided in the context of the tool. We have analysed the activities, options and scoring, and then categorised the outcomes by each Triple Challenge area (the thermometers) as Trade-offs or Win-wins. The numbers represent the scores in the interactive tool. The methodology for the categorisation in the three tables below is as follows:

- Only the areas that scored at the very highest level in the interactive tool for these purposes (20 and above for biodiversity, climate change mitigation and society & economy benefits; 14 and above for food production and food sustainability) appear in green font. These are categorised as clear wins.

- Where gains are balanced out by a loss, and / or the scores are at a medium level in the interactive tool for these purposes (10 – 19 for biodiversity, climate change mitigation and society & economy benefits; 7 – 13 for food production and food sustainability) these appear in amber font. These are still categorised as wins because, even though less significant, there are still improvements in some areas.

- Losses and declines appear in red font (scored of 1-9 for biodiversity, climate change mitigation and society & economy benefits; 1-6 for food production and food sustainability). These are categorised as Trade-offs.

Table 2: Tool Region 1, Pembrokeshire Trade-offs (T); Win-wins (W)

Key: B= biodiversity; FP= food production; FS=food sustainability; CM=climate change mitigation; SE: Social & economic benefits

Land use description	Objective	Options	T1	T2	T3	T4	T5	W1	W2	W3	W4	W5
Coastal farm, lowland, arable, potato	Make farm more productive	Agroecology & cattle grazing	-	-	-	-	-	B 21	FP 12	FS 12	CM 16	SE 17
		Intensify potato crop; add wheat and barley; Agri-tech; land sparing	FS 6	-	-	-	-	B 12	FP 10	CM 16	SE 17	-
		Timber farming	B 4	FP 5	FS 4	-	-	CM 19	SE 13	-	-	-
		Diversify away from farming	FP 6	FS 4	-	-	-	B 21	CM 19	SE 17	-	-
Lowland farm, wooded and wetland area; beef, sheep and dairy; combination of grades 2 & 3 soil	Restore habitats	Improve animal and soil health with herbal leys	-	-	-	-	-	B 18	FP 12	FS 12	CM 18	SE 15
		Increase soil organic matter with mob grazing	-	-	-	-	-	B 16	FP 10	FS 12	CM 16	SE 15
		River protection with riparian buffer zones, reed beds, soil testing, precision application of nutrients and cover crops	-	-	-	-	-	B 20	FP 10	FS 9	CM 18	SE 17
Future of upland landscape management	Create a common land management strategy for grazing	Light grazing regime	B 7	FP 6	FS 6	-	-	CM 14	SE 12	-	-	-
		Moderate grazing regime, main site open for tourism	CM 7	-	-	-	-	B 17	FP 13	FS 14	SE 14	-
		Intensive grazing all year round	B 6	FP 6	FS 5	CM 5	SE 9	-	-	-	-	-

Table 3: Tool Region 2, Humber Region Trade-offs (T) and Win-wins (W)

Key: B= biodiversity; FP= food production; FS=food sustainability; CM=climate change mitigation; SE: Social & economic benefits

Land use description	Objective	Options	T1	T2	T3	T4	T5	W1	W2	W3	W4	W5
Owner of arable land near the River Ouse	Flood management	Arable reversion to unimproved grassland - funding is available	FP 6	FS 5	-	-	-	B 27	CM 22	SE 10	-	-
		Peatland restoration and paludiculture, taking advantage of government incentives	FP 3	FS 4	-	-	-	B 22	CM 23	SE 21	-	-
		Riparian buffer strips, taking advantage of government incentives	-	-	-	-	-	B 21	FP 13	FS 11	CM 18	SE 17
Local decision maker addressing future land use	Prioritise biodiversity and climate change	Improving landscape connectivity and soil on farms	-	-	-	-	-	B 25	FP 14	FS 12	CM 21	SE 21
		Catchment-Based Approach, partnership engagement	-	-	-	-	-	B 17	FP 16	FS 14	CM 20	SE 23
		Implementation of estuary enhancement programmes	FS 4	-	-	-	-	B 28	FP 7	CM 21	SE 19	-
Owner of arable crops - seeking incentives for diversification	Diversify and maximise income	Plant new broadleaf woodlands on your farm	-	-	-	-	-	B 15	FP 13	FS 11	CM 15	SE 14
		Enter into the pork and poultry industry	B 4	FS 6	CM 7	-	-	FP 11	SE 10	-	-	-
		Join a nature recovery network	FP 3	FS 2	-	-	-	B 22	CM 17	SE 17	-	-

Table 4: Tool Region 3, Aberdeenshire Region Trade-offs (T) and Win-wins (W)

Key: B= biodiversity; FP= food production; FS=food sustainability; CM=climate change mitigation; SE: Social & economic benefits

Land use description	Objective	Options	T1	T2	T3	T4	T5	W1	W2	W3	W4	W5
Traditional mixed use lowland farm; cereals, potatoes, sheep and poultry. 30% of the land is ploughable, the rest is raised bog.	Improve the water quality and rewet the peatland	Full peatland restoration	FP 3	FS 3	-	-	-	B 27	CM 28	SE 12	-	-
		Peatland conservation and farming	FS 5	-	-	-	-	B 21	FP 11	CM 17	SE 16	-
		Rewetting and paludiculture	FP 5	FS 4	-	-	-	B 21	CM 22	SE 17	-	-
Mixed farm, rearing cattle and growing arable crops.	Move to natural systems	Conversion to organic	-	-	-	-	-	B 21	FP 12	FS 7	CM 22	SE 21
		Regenerative agriculture	-	-	-	-	-	B 18	FP 12	FS 9	CM 18	SE 15
		Targeted efficiency and pollution mitigation	-	-	-	-	-	B 17	FP 10	FS 10	CM 16	SE 17
A pastoral farm, current trajectory suggests government support mechanisms will decline	Ensure business viability and reduce financial risk whilst improving sustainability	Agroforestry and silvopasture	FS 5	-	-	-	-	B 20	FP 7	CM 17	SE 16	-
		Agritourism	FP 6	FS 4	-	-	-	B 22	CM 17	SE 17	-	-
		Investment in renewable wind energy on your farm	B 9	-	-	-	-	FP 10	FS 12	CM 18	SE 21	-

This tells a positive story about the variety of options that are available for land use decision-makers which can benefit in triplicate biodiversity, climate and food outcomes. Our analysis demonstrates that with appropriate policy and funding it is possible for there to be Win-wins across each of the three Triple Challenge elements, and that there are different degrees of Win-wins - it is not necessarily a case of an outright win or Trade-off. Upon an analysis of the activities across the three landscapes in the interactive tool, it can be seen that:

- 11 of the 28 options in the interactive tool have ONLY Win-wins (green and amber) and NO Trade-offs (red).
- 17 of the 28 options have at least four Win-wins (green and amber).
- 18 of the 28 options in the interactive tool have at least one clear Win-win (green).
- Only four of the 28 options have more Trade-offs (red) than wins.
- 13 of the 28 options only have one or two Trade-offs.

4. The structure of the interactive tool

There are four layers of information once the user has selected one of the landscapes:

- First level: the ACTIVITY – offers a narrative text about the land use characteristics, challenges and aims on a specific type of land, e.g., farm.
- Second level: the OPTIONS – the user makes three to four different choices to solve the challenges on this land. The options are described in text and require the user to select one option to proceed.
- Third level: the OUTCOMES – once the user has selected an option, the outcomes are illustrated to the user through indicative "scores" depicted visually on Biodiversity, Climate Change Mitigation, Food Production, Food Sustainability, and Society and Economy thermometers. The user also sees a visual change to the landscape graphic because of their decision.
- Fourth level: the RESULTS – a page of information that tells the user how they scored on the landscape overall and puts forward some questions for wider consideration of the Triple Challenge issues in this landscape.

The OPTIONS are designed to result in one of three scenarios:

1. Worst-case (Rapid Decline)
2. A stable but progressively worse scenario (Slower Decline)
3. A recovery scenario that addresses all elements of the Triple Challenge (Resilience)

The OUTCOMES of the options are designed to reveal some of the Trade-offs and Win-wins which might take place in a real-life situation. The scenarios that lie behind our scoring are crucial to this (see 6. The scoring system section below).

At the end of each landscape, the results card shows the user how their choices affect different aspects of the Triple Challenge, and how they prioritised the issues within their landscape. It prompts the user to consider the additional steps they need to take to solve the Triple Challenge (for more details on the results card, see 6. The scoring system section).

As the user navigates through the interactive tool, sometimes **warning signs** appear.

"You are increasing greenhouse gases emissions outside the UK".

The purpose of this warning is to highlight the nuance in the Trade-off between food production, the biodiversity footprint and the climate footprint. For example, in the Humber region Activity 3, if the user selects option B to enter the pork and poultry industry, while this may increase food production at home, it is also likely to increase imports of soy meal produced in areas such as Brazil and Argentina, which are highly sensitive to biodiversity loss.[14] Therefore, even though food production improves at home, the user is offshoring the biodiversity impact elsewhere globally.

[14] https://www.wwf.org.uk/riskybusiness

5. The thermometers

Overview

This section provides more detail about the five thermometers in the interactive tool, including:

- A description and definition of each thermometer's scope for the purposes of the interactive tool
- The ideal scenarios we want to see in 2031 (i.e., what good looks like)
- The Win-wins and Trade-offs for each element of the Triple Challenge
- Characteristic activities that help us get to Win-win situations
- A detailed narrative that was used to base each thermometer's outcomes and scores on

Biodiversity

Description of the Biodiversity thermometer in the tool

A huge challenge in the UK, (and globally) is to reverse biodiversity loss. In the UK, 41% of species across the country continue to decline in their abundance and distribution.[15] Climate change and food production present increasingly significant threats to biodiversity. Different species respond differently to temperature changes which can destabilise their ecosystems. Moving land use to urban areas or to farmland puts pressure on habitats, species, and the connectivity between different ecosystems. Although emissions of harmful pollutants are being reduced, these are still significant threats to waterways.

The extent to which we choose nature-positive farming, low carbon farming practices, agroforestry, and restoration of wildlife-rich habitats, along with changes to the way people in the UK consume food, will all make a difference to biodiversity.

What does good look like?

The literature review suggests the following features of a "good biodiversity" by 2031:

- Better habitat connectivity through linking up natural and semi-natural habitats.
- Abundance and distribution of "restored threatened or iconic or economically important species of animals, plants and fungi". This could include restoring red list species or important species such as pollinators or species which improve nature benefits. These are all mentioned in UK Gov's 25Y plan.[16]
- Restriction or removal of invasive species and diseases.
- "Thriving plants and wildlife" and "restored priority habitats" and preservation of ancient woodlands (as mentioned in the UK Government's 25-year plan).

[15] https://www.rspb.org.uk/our-work/state-of-nature-report/
[16] https://www.gov.uk/government/publications/25-year-environment-plan/25-year-environment-plan-our-targets-at-a-glance

- Water retention and purification within landscapes and ecosystems.
- Better ecosystem services, as they have the potential to provide a range of services that are crucial to human well-being, health, livelihoods, and survival, such as water, food, purification of air, and space for recreation, among others.
- Greater number and size of protected areas and important semi-natural habitats, along with the linkages between them.

Win-wins and Trade-offs

In the meta-analysis, biodiversity gains are often mapped against predicted reduced yield or land available for cultivation – so there can be Trade-offs in food yield. Carbon emission reduction / carbon sequestration is often a positive Win-win side effect. Afforestation can often lead to Trade-offs between immediate carbon benefits and longer-term biodiversity benefits.

Characteristic activities to get us there

- Land restoration
- Afforestation
- Agri-environment schemes (funding to farmers and land managers to farm in a way that supports biodiversity, enhances the landscape, and improves the quality of water, air and soil)
- Agroecology processes which lead to reduction in nitrogen and methane emissions as well as biodiversity benefits

Scoring the Biodiversity thermometer

To score on biodiversity, we look at three dimensions: overall habitat health, land connectivity, and impact on species. The scoring reflects whether the option selected by the user helps to achieve a future Rapid Decline, Slower Decline or Resilience outcome. We also consider how ecosystem services are impacted by biodiversity loss through our Society and Economy thermometer.

1. Habitat Health
    i. With Rapid Decline, we expect to see decreasing habitat quality and area, with little or no management of wildlife. Non-native invasive species bring diseases e.g., ash dieback. High levels of ammonia and nitrates are found in rivers and streams.
    ii. For Slower Decline, we expect to see the extent of habitat decline slow down. Ecosystems show an increase in wildlife-rich habitats, soil loss mitigation, reduced waterway flow change and runoff and improved habitat restoration.
    iii. For Resilience, we expect to see more extensive areas of wildlife-rich habitat, effectively managed for biodiversity. Ecosystems are able to resist climate change due to the abundance of plants and animals, which also brings wider biodiversity benefits.
2. Land Connectivity

i. For Rapid Decline, we expect to see a fragmentation of habitats into smaller isolated areas e.g., through mono-cropping or urbanisation, which prevents movement of species between patches and leads to reduced diversity, distribution, and abundance.

ii. With Slower Decline, we expect to see that land use has not significantly changed, but farmland or urban areas are managed better for biodiversity. This facilitates the movement of wildlife and connects remaining habitats while still prioritising food production. We see better buffers zones to act as wildlife corridors and to protect aquatic habitats.

iii. With Resilience, we expect to see habitats in the area under discussion newly or more comprehensively connected, allowing for movement of wildlife across much of the area, which also improves flood defence and livestock management.

3. Impact on Species

iv. For a Rapid Decline scenario, we expect to see ongoing declines in species abundance and distribution with species extinctions taking place. Invasive species will be more prevalent e.g., monocrops and pests. Loss of tree species diversity, loss of ancient woodland.

v. For a Slower Decline score, we expect to see the decline in species abundance/distribution slowing down, with some signs of recovery of threatened species. Ancient woodland is preserved.

vi. With Resilience, we expect to see a significant increase in species abundance, and these species are widely distributed across a wildlife-rich area. We expect to see improvement in status of red list threatened species. The ecosystem is more diverse, resilient to climate change and provides vital ecosystem services such as pollinations of crops and flower.

Climate Change Mitigation

Description of the Climate Change Mitigation thermometer in the tool

The global climate change challenge is to cap global GHG emissions and limit global warming to well below a 2°C increase - and preferably to limit warming to below 1.5°C, compared to pre-industrial levels. The legally binding goal for the UK is to achieve Net Zero emissions by 2050.

Although GHG emissions come from many sources (including the places where we most use fossil fuels for energy such as in our houses, industrial and transport sectors) this interactive tool focuses on addressing climate change through land use decisions in agriculture, forestry, recreational ground use and conservation.

This thermometer provides an indicative score of how well our activities help with climate change mitigation. We are not just looking at how to reduce GHG emissions today – we are also looking at how land use choices can help reverse climate change over the longer term.

We address climate change in this interactive tool through two lenses of cause and effect. We look at the causes of climate change in the AFOLU sector, aiming to reduce direct emissions and capture carbon to halt climate change. We also look at the impact of climate change on people's livelihoods, as signalled by changes that are already evident. We look at mitigating hazards such as flood and drought to

minimise the impacts of climate change that are already happening. Afforestation and regenerative agriculture which increase water retention and improve soil structure are good examples of this.

What does good look like?

The literature review suggests the following aspects of a "good climate change mitigation" by 2031:

- Reduction in nitrates, nitrite, methane, ammonia, carbon, by changes to farming methods overall or through specific changes in particularly vulnerable soils or ecosystems.
- On-farm energy taken from more renewable sources. This would involve changing the farm's energy use, but CO_2 emissions from manufacturing of fertilisers and food transport also need to be considered (this is complex as the issues are global).
- Land and water protected from the effects of climate change, and lower emissions of GHGs. This could involve protecting soil health from drought, protecting the landscape from flooding, and protecting ecosystems in waterways from climate change effects such as warmer water.

The design of the tool takes into account the fact that the quantity of reduced emissions and carbon captured over time is a challenge to model and the long-term value is complex to assess. The interactive tool does not attempt to measure quantitatively what could be achieved over the next ten years. Furthermore, many nature-based removal measures have minimal impact initially, but their ability to sequester (capture and store) carbon dioxide grows as the measures mature.

Win-wins and Trade-offs

In the meta-analysis, displacing land previously given over to food production reduces food outputs and can impact production and food sustainability. For example, whilst arable reversion to more low impact grazing benefits climate change mitigation, it reduces food production. Agroforestry and agri-environment methods designed to mitigate climate change can benefit biodiversity but reduce farm production, especially in shorter timeframes. Some agroforestry (e.g., planting conifers which are quick growing trees) can mitigate climate change, but it can negatively impact biodiversity. Some agri-environment approaches which focus on habitat restoration can improve biodiversity and reduce emissions. Carbon emission reduction / carbon sequestration is often a side effect of prioritising biodiversity.

Characteristic activities to get us there

- Habitat restoration. The types of habitats restored are crucial to achieving success. Upland and lowland peat restoration offer excellent climate change mitigation. Saltmarsh, floodplain, and seagrass restoration can reduce and remove emissions. Constructed wetlands and new woodlands, including different trees, all create different short and long-term benefits.
- Using legumes as nitrogen fixers.
- Land sharing and sparing to reduce agricultural land emissions and to reduce the intensity of farming through activities such as hedgerow management and soil management.
- Management of manure to reduce GHG emissions and leaching.

Scoring the Climate change mitigation thermometer

In the tool we measure the mitigation of climate change cause and effect using three dimensions:

1. Reduction or prevention of emissions from agricultural practices

    i. For Rapid Decline, there is increased use of manure and fertiliser. Greater land use for animal farming results in increased methane and other emissions. There are increased emissions from farm machinery. BAU processes for the agriculture industry and GHG emissions remain at the same level, leading to further global warming.

    ii. To score for Slower Decline, there is increased habitat restoration and agroecology farming practices, including the use of organic residues instead of fertilisers. Legume crops are introduced to arable land. Low carbon farming practice is adopted, and the energy input required for farm machinery is reduced. Emissions reduce because of a decrease in agricultural land area and technology improvements.

    iii. For Resilience, small-scale negative emission technologies are in use and are beginning to demonstrate benefits. Renewable energy is substituting the use of fossil fuels. Government funding for decarbonisation is available at its widest scale. More land is released from agricultural production.

2. Prevention of land degradation through improved practices

    i. For Rapid Decline, there is more intensive farming and more deforestation especially in ancient woodlands. Grassland is more heavily grazed and there is more peat burning which release more CO_2 into the atmosphere.

    ii. To score for Slower Decline, cover crops are introduced to stabilise the soil and trees are planted to protect soil and prevent runoff.

    iii. To score for Resilience, soil and water are more able to reverse the adverse impacts of climate change. Semi-natural grasslands are preserved. Till farming is no longer practiced.

3. Capturing and storing carbon to reverse climate change in the future

    i. For Rapid Decline there is substantial deforestation and an increase in peatland, marsh and wetland drainage together with removal of hedgerows.

    ii. For Slower Decline there are afforestation, shelter belt creation and agroforestry initiatives. There is some re-wetting of peatland, mostly in areas of less than prime farming soil.

    iii. To score for Resilience there is substantial afforestation including both rapidly growing conifers for soil carbon sequestration and longer-term plans around agroforestry. There is significant rewetting and rewilding of peatland and wetland.

Food Production

Description of the Food production thermometer in the tool

A key challenge for agricultural systems is food production. If production of the UK's land can be made as efficient as possible, some land can be released for other uses, such as nature-based solutions to improve biodiversity or mitigate climate change. There might be many ways to do this, involving both "sparing" land from food production and "sharing" the land between food production and other uses.

This thermometer measures two aspects of food production: yield roughly per unit area and how efficiently food is produced when using resources and inputs. Some choices take land out of food production or reduce yield – but they bring other benefits to ecosystems (for example improving biodiversity). However, this thermometer is concerned only with producing food from the land. Beating the Triple Challenge will involve making other improvements to the land without reducing the score on this thermometer.

Globally, AFOLU is responsible for ~25% of annual global GHG emissions[17], so it is important to farm in a way which improves our record on emissions. Even if we carry on as we are doing, food production won't decline rapidly in ten years. But if our BAU is to prioritise food production, this will lead to fragmented habitat by increasing expansion of agricultural land. We will also see emissions rise as livestock and crop volume increases.

If nothing changes, in twenty to thirty years soil erosion will continue to greatly exceed soil creation. Soil quality will continue to degrade due to intensive farming and high levels of nitrogen pollution and leaching into rivers. All of these factors threaten the future of UK's productive land.

What does good look like?

The literature review tells us that many scenarios from the meta-analysis assume that BAU is the continued prioritisation of agricultural production. The Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE) Consortium[18] report also offers current trends for the UK in line with these assumptions. One important dimension of measuring success in food production is the productivity of the agricultural land. Experts have different views on how to best measure food productivity. While some experts stated that food should be measured in profitability and productivity, rather than yield, others encouraged us to consider both yield per unit area, and yield per resources and inputs used, as ways to consider production. The profitability of the farm business has been considered here to a degree but is also part of the Economy and Society consideration.

The literature review shows the following examples of a "good food production" by 2031:

- No constraint on expansion of agricultural land; more land brought into cultivation. It could also include improving yield on land which has not previously been very productive, for example, through new crops or technologies.
- Agricultural efficiency improves, decreasing inputs and allowing land to be spared for other uses such as afforestation.
- Food production is maintained to the current level at least. Food types do not change dramatically. The UK starts to grow some crops that are currently imported.
- Focus on the most productive soil at a national level – the highest quality farming soil is made available, intensively managed for production, and requires less synthetic input; while there is less effort put into farming lower quality soil, these areas can be made available for other uses.

Win-wins and Trade-offs

Frequent intensification leads to more fossil fuel use and GHG pollutants. Pressure on habitats increases if land is given over to agriculture. Agricultural intensification can spare land for other uses, but it

[17] https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter11.pdf
[18] http://pure.iiasa.ac.at/id/eprint/16896/1/2020%20FABLE%20Report_Full_High_Resolution.pdf

increases fertiliser use which in turn increases run offs and leaching. Through incorporation of technology and sustainable farming practices, the agricultural sector can significantly reduce emissions and actively help the UK to achieve Net Zero by 2050. If the land is productively farmed, farmers can make a profit, continue their livelihoods and the rural economy also benefits. When land is productive, food prices rise more slowly for consumers so the UK public benefits in the short term, but they may lose out in the long term as intensification leads to climate change. The prioritisation of farming on land can reduce the opportunity for other ecosystem services like leisure and tourism. Soil will degrade over the next 20 years if land is intensively farmed, even if the next 10 years show a steady state.

Characteristic activities to get us there

Some possible solutions for efficient food production that also support climate change mitigation and biodiversity are:

- Agricultural intensification, increased use of new technologies for breeding programmes and technology-based innovations such as insect protein/ synthetic meat to replace animal protein.
- Choosing the most fertile soil for agriculture and intensifying there, rather than sparing land which has high potential to be productive.
- Better solutions for managing nutrient input and improved soil conservation, for example, introducing cover crop which improves nitrogen efficiency.
- Different and new varieties of crop, livestock and trees that are more climate resilient.
- Reduction in livestock numbers as diets change and technology innovation improves – but also, simply using more land for arable farming.

Scoring the Food Production thermometer

Measuring how to improve Food Production is comprised of two dimensions:

1. Yield per area of farm
    i. To score for Rapid Decline, stocking yields decrease. Farmers “farm harder” and intensify, but with little increase in production. Reduced pollinators and predatory insects lead to lower crop yields. Overall yield decreases.
    ii. For Slower Decline scenario, crop and livestock production remain constant. Stocking yield increases by 10% and intensive grazing continues. Overall yield remains the same as today.
    iii. To score for Resilience, we assume crop production increases by two-thirds. Livestock production remains constant or increases. Dairy production increases. Stocking and livestock density ideally reduces, but with the same yield. High scores can also be obtained by expanding agricultural land. Overall yield increases.
2. The efficient use of resources and inputs to produce food
    i. For a Rapid Decline score, agricultural intensification maintains or increases inputs of fertiliser and water resources. There is an increase in leaching and runoffs due to the use of synthetic inputs. Land degradation and soil erosion occur and the soil becomes less

productive. Land use choices mean that land is taken out of food production entirely. Resources are used intensively, and practices degrade the land.

ii. To score for Slower Decline, there is improved soil and livestock health through the adoption of agroecological techniques. Agricultural land shrinks slightly or is shared due to improved yield. There are lower inputs of fertiliser and water resources due to an increase in agri-environmental options. Degradation is slowed as there is improved access to technological and sustainable alternatives. Resources are required less intensively, and practices are less damaging.

iii. To score for Resilience we see more agroecology and a diversification of crops together with the same level of production as today. High-tech crops that are more resilient to climate change are produced. Organic soils and nutrients are restored for the longer term. The water table is raised for cropland. More mixed agroecological methods reduce longer term damage to biodiversity. Degradation is slowed as there is greater access to technological and sustainable alternatives. Fertiliser and water are used even less intensively. Agricultural practices are less damaging. This restores the land, and degradation is reversing.

Food Sustainability

Description of the Food Sustainability thermometer in the tool

The UK's food system operates in a global system of producing food domestically, importing and exporting food products. This thermometer measures how well the UK is contributing to a globally sustainable food system, while also protecting its own food security. Some of the choices we might make about trade, regulation and relying on global or local supply chains will help score more highly than others here.

Food Sustainability has many dimensions. This thermometer creates scores on aspects of sustainability that are most relevant to the UK at the moment. The focus is on creating a resilient domestic food production sector, with seasonally appropriate food that grows well in our climate and can feed people without an overly long or fragile supply chain.

However, sustainability does not only mean local food production. In some cases, the most sustainable option for the UK is to import foods which are grown most efficiently in other parts of the world. In other cases, some foods grown outside the UK create far greater impacts in critical landscapes than if the same food were to be produced in the UK.

Another aspect of sustainability is having access to diverse types of food, both produced and imported, which mitigates the risk of local or global supply chains breaking down. And across the board, this sustainable production must be profitable for the food producers wherever they are in the world.

This thermometer helps the user of the interactive tool to explore how far the UK contributes to sustainable food production. It allows it to touch on the global impacts of outsourcing the UK's environmental footprint, and makes users think about what resilience means in terms of food supply.

What does good look like?

Food security on the demand side is an important challenge for the UK - in May 2020, there were nearly five million people in the UK experiencing food insecurity, including 1.7 million children.[19] The UK's food system operates in an open global market and is subject to the opportunities and challenges that this brings, and post-Brexit decisions will have an impact on our future food security.

The literature review shows the following examples of a "good food sustainability" by 2031:

- Availability, access, affordability, safety, and resilience are the common elements to definitions of food sustainability. One way of achieving some of this would be producing food in the UK – locally grown, seasonal food will be part of a good sustainability scenario.
- UK growers and processors diversifying production - e.g., increasing production of plant-based proteins, or trading in ways to import these as sustainably as possible.
- The supply chain becoming more resilient, through shortening and simplification, avoiding just-in-time supply and investing in the labour market for domestic food production and import supply chains.
- Household affordability and access to diverse, healthy foods. High levels of food safety and consumer confidence in food. Good trade relationships post-Brexit that ensure we will not suffer from food insecurity.
- Key to the sustainability picture is ensuring the choices we make do not offshore other problems (e.g., land cleared for beef in Brazil may have worse impacts on the world's climate and biodiversity than beef produced in the UK, so a good food security scenario will include balancing the UK's Triple Challenge Trade-offs with the world's).

This thermometer was the most challenging to design, as in a way it encompasses the whole Triple Challenge in one - producing food in ways which protect nature, humans, animals, and other aspects of the ecosystem. However, we think it is the best way to convey the role of trade relationships, growing the right food in the right climate in food security as well as producing food within the UK or improving supply chains in general. Our sustainability thermometer, therefore, comprises a general food security element but also a global impacts element.

Win-wins and Trade-offs

Extensive farming is better for biodiversity, but it leads to the risk of increasing dependence on imported food. There are potential benefits to rural economies in the form of employment or in a boosted supply chain; however, cheaper imports can make it hard for farmers to run at a profit and they also reduce food security.

Different levels of trade policy standards will have various implications for British food producers. Without knowing the outputs of trade deals after Brexit we have kept these quite general in the tool.

[19] https://www.unicef.org.uk/press-releases/statement-in-response-to-the-food-foundation-report-on-family-food-insecurity/

Characteristic activities to get us there

Some possible activities to achieve efficient food sustainability in tandem with climate change and biodiversity benefits:

- Arable land is extended in the UK but with better environmental benefits alongside, e.g., agri-environmental options.
- The best scenario would also include increased use of new technologies in farming and investment in technologies for plant-based or synthetic proteins, so that farming can be as efficient as possible and produce as much food locally as possible.
- Having the option to farm high-value produce (e.g., fruits and vegetables) for trade purposes, whilst also ensuring that we are growing the right kinds of food for the UK landscape (i.e., not growing foods which are overly resource-intensive in our climate when they could be grown better elsewhere – growing strawberries in Kent is less sustainable than those grown in Spain).
- Subsidising production of some types of food (e.g., chicken rather than beef, and more vegetables and salads) to change demand-side requirements.

Scoring the Food Sustainability thermometer

Measuring how we improve food sustainability is comprised of two dimensions.

1. Resilience of supply chain
    i. To score for Rapid Decline, there is an over-reliance on single sources of supply and there are domestic supply failures. We see high levels of concentration in specific parts of the food chain. Supply disruptions produce sharp price rises, and / or widespread shortages for particular fruits or vegetables. Increased flood risk, coastal inundations and urban expansion irreversibly erode the ability to produce food.
    ii. For Slower Decline supply chains become more decentralised, and demand starts to change to encompass a more diverse variety of foods - especially non-animal proteins.
    iii. To score for Resilience, we assume the food industry is prepared to deal effectively with a wide range of disruptions to supply chains. Diversification of domestic farming increases the resilience of supply chains. The food chain becomes sustainable throughout. Major operational failures in the domestic food manufacturing sector can be made up for by other suppliers filling the gap or through diversity of trade relationships. The labour market is flexible.
2. Sustainability of whole UK supply chain
    i. To score for Rapid Decline the UK is not capable post-Brexit of securing food in terms of both quality and quantity. The level of self-sufficiency continues to decline. Meat and dairy farming prices are undercut without strong trade regulation and UK farms cannot produce in a sustainable way and remain profitable. There are higher imports of unsustainably farmed foods.
    ii. For a Slower Decline score, government schemes incentivise adoption of sustainable food production practices within the UK. However, the availability of some foods is either

dependent on less sustainably farmed imports or less sustainably farmed local produce. Many of the costs and environmental impacts of production are offshored, e.g., for cheaper meat and dairy.

iii. For a Resilience score, there is a continued trading relationship between the UK, the EU post-Brexit and the rest of the world. Imports are produced and delivered sustainably. Should trading relationships between the UK and the rest of the world break down, the UK has the potential to meet demands at home in a timely and sustainable way. Technology innovations (synthetic meat) release land use for other types of agriculture.

Society and economy

Scoring the Society and economy thermometer

Decisions which help achieve the Triple Challenge can also help at a societal level. The idea of the "just transition" is to achieve a sustainable economy, while ensuring that meeting the Triple Challenge helps to improve equity, especially for disadvantaged groups.

Ensuring a just transition is already on national and regional agendas. Decision makers are increasingly engaging with citizens, the labour force, and all stakeholders across the UK.

However, some decisions made for the benefit of biodiversity, food production or carbon neutrality can be costly to people in other ways. For example, food products could become more expensive for households. Jobs could be lost or changed, and the wider economy could be strengthened or weakened. Risks and hazards such as floods or droughts could be intensified or mitigated. Decisions about access to land, or land use for leisure vs other uses, affect culture and recreation.

On the other hand, a sustainable economic approach can benefit local communities by prioritising local production of food without externalising the carbon footprint. Focusing on preserving and enhancing biodiversity can result in a more equitable access to land for the public. Similarly, creating better habitat connectivity while incorporating local decision makers and stakeholders can provide better preparedness against hazards.

This thermometer is intended to show the wider impacts on people and places, and the Trade-offs that might be required, when making land use decisions. It considers the impact of land use choices on people "in the round" – as consumers, employees, citizens and those who gain a range of other benefits from the land, from cultural to spiritual and health benefits.

What does good look like?

The literature review meta-analysis did not explore society and economy. However, we have identified through additional research and engagement with experts the typical impacts of different land use decisions on people at a societal level.

Ideas of equity and fairness are important within the Triple Challenge. There will be impacts of LUC on people in the UK, in particular if these lead to changes in the rural economy and drive changes to traditional ways of life for people. Another aspect of the Triple Challenge is to maintain the UK's food sustainability, which has an impact at the household level and for individual consumers as well as for the wider economy and trading relationships. Our fifth thermometer, therefore, looks at the impacts on humans in the round – beyond just the food they eat. It focuses on a just transition and how we might create a sustainable and equitable future for the landscape which does not harm or disenfranchise

different communities of people, and we acknowledge that these impacts are not felt evenly across society.

A “good impact on people and places” to 2031 would include the following domestic characteristics:

- Jobs are preserved in farming or related industries – or new jobs or industries emerge which harmonise well with previous jobs and do not impact specific communities (e.g., farm workers moving to transport or hospitality roles – rather than whole industries being replaced with unmanaged land or urbanisation; or the creation of different types of jobs for which the labour force is not skilled in).
- The nature-based green economy is emphasised and grows.
- Flood, drought and other hazards which can affect people in both rural and urban areas are reduced or mitigated.
- Ecosystem services around recreation, tourism, and spiritual uses of land are preserved. This means that the land is managed not just for commercial interest or food production, but that land use choices prioritise leisure and amenity, beauty and heritage, and recreation. 20% of England is designated a National Park or Area of Outstanding Natural Beauty.
- A just transition would consider the value of land in terms of its ability to promote wellbeing (e.g., the Welsh Government’s wellbeing goals[20]).
- It would also include engaging with people and communities where decisions are taken – for example, the Scottish Land Use strategy emphasises “greater collaboration and engagement between those making decisions about land and those affected by such decisions”.[21]

Win-wins and Trade-offs

Unlike other thermometers, this Society and Economy thermometer is designed to reflect the impacts on people beyond the Triple Challenge. It is a thermometer that intersects across biodiversity, food and climate change, and, therefore, there is no specific pattern of Win-wins and Trade-offs that exist here. Our approach for society and economy is nuanced. For example, there is a Win-win when food production increases, and the land use choice generates additional employment opportunities. Trade-offs can also happen if food production increases, but employment opportunities may also only last for the short term. Another example is that as food production decreases due to the adoption of low-carbon farming practices, the land use choice might explore new industries that boost the rural economy. This thermometer has a complex cause-and-effect relationship to the Triple Challenge, encompassing all its elements.

Characteristic activities to get us there

Some possible activities to achieve a resilient society and economy are:

- Encouragement of stewardship covenants and partnerships to reward landowners for the provision of public goods and services.

[20] https://gov.wales/programme-for-government-2021-to-2026-well-being-statement-html
[21] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

- Controls on land use and development to improve natural flood management and reduce flood risk and flood damage costs.
- Low-carbon agricultural techniques to reduce local air pollutants and improve physical health.
- Low-carbon farming practices and technology and managing existing broadleaf forests. New planting of coniferous and broadleaved woodland.

Scoring of Society and economy thermometer in tool

Measuring how we improve Society and Economy benefits is comprised of three dimensions.

1. Economic and social impact on UK, or on specific groups within it
    i. For a Rapid Decline score, we assume that food production and import strategy lead to lack of choice or high prices for consumers. Common lands have reduced access without local consultation. Polluting industries are potentially reduced, but rural jobs are lost (for example through automation or changed farming/ land use type). The costs of Net Zero are borne by consumers, while industry profits.
    ii. To score for Slower Decline, job transitions are managed to some extent so that investment is made in new rural industries as the old industries decline. Governments consider the local labour market when prioritising supply chains.
    iii. To score for Resilience, circular economies prioritise locally produced or low carbon products. This supports local employment, fair pricing and avoids externalising the carbon footprint. Access to land is woven in with other needs such as habitat connectivity and carbon sequestration.
2. Impact on hazards which might affect people's lives or livelihoods
    i. For a Rapid Decline score, farmland runoff pollutes watercourses. Large monoculture fields, tree removal and poor river management lead to increased risk of flooding in poorer rural areas. Due to global failure to prioritise climate change mitigation and a lack of tree planting in urban and suburban spaces, heatwaves and droughts increase.
    ii. For a Slower Decline score, communities are engaged to a certain extent in prioritising and preparing for extreme events like flooding and drought, but upstream issues (e.g., intensive farming practices) are not linked in.
    iii. To score for Resilience, hazard plans are co-produced with communities and farmland decision making bears this in mind. Urban and rural areas are not seen as siloed or separate places and regions take a joined-up approach.
3. Externalising of climate or biodiversity impacts to the rest of the world
    i. For a Rapid Decline score we are importing a higher proportion of food types that cause biodiversity loss in particularly important global habitats, e.g., rainforest, seas. Importing of products made with high polluting GHGs takes place and the UK's carbon footprint is being externalised.

ii. To score for Slower Decline, the same proportions of food are produced in the UK as today – with some attempts to create demand for lower carbon footprint products.

iii. For a Resilience score, we are actively working towards a clean economy, investing in renewable energy and farming practices which are carbon neutral or which sequester carbon.

6. The scoring system

Overview

This section provides more detail about how the system to denote the BAU scores and the OUTCOMES scores have been created. The literature review and several significant reports, including FABLE 2020, the State of Nature and the CCC report provided evidence to create the “better or worse than BAU” scenarios, and therefore our scoring system. In this section we also explain how the scores ladder up from landscape level impacts to national level impacts, and the reasoning behind our scoring system.

How is the scoring calculated?

Each thermometer is scored against dimensions that are specific to that thermometer, and each dimension can receive a maximum score of 10. We decided to take a nuanced approach for the scoring of the thermometers so that:

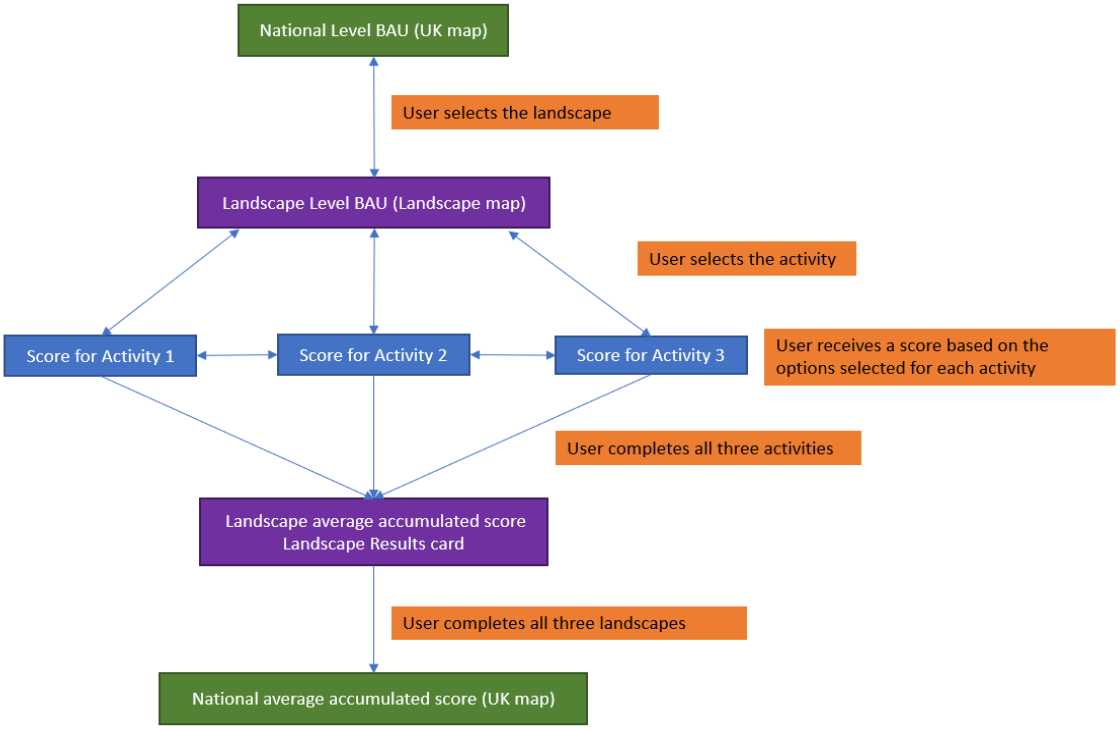
- The Biodiversity, Climate Change Mitigation and Society & Economy thermometers are scored on three dimensions, making the total possible score for each of these thermometers 30.
- We have spilt the Food thermometer into two thermometers of Food Production and Food Sustainability. The scoring is against two dimensions for each, setting the total possible score for each at 20.

Each dimension is scored to represent Rapid Decline (0-3), Slower Decline (4-7), and Resilience (8-10). When the user selects their option, their land use choices result in different scores for each dimension. The scores for each of the dimensions are then combined to give a final score for each thermometer relating to the option.

The different levels of scoring within the interactive tool

Figure 1 on the following page shows a flow map of the different levels of scoring.

Figure 1



We wanted to show how the options selected by users at a regional level might ladder-up nationally. We have addressed this by providing BAU Scores at both National level and at Landscape level and allowing the user to compare their scores against both – at a Landscape level once they have completed the activities in one of the regions (shown in purple boxes in Figure 1), and at a National level once they have completed all the activities in three landscapes (shown in green boxes in Figure 1).

The National Level BAU scores appear on the screen as the user enters the landing page.

When the user selects the landscape, they enter a landscape-specific map. On this map, the user sees the Landscape Level BAU score. Then as the user selects their option, the score on the thermometers adjusts up or down depending on the option the user chooses. Each activity in the landscape is played independently - the scores are also independent of each other at this stage. Landscape Level BAU scores are indicated on the thermometers to visually depict the impact of the options.

Once the user has finished all three activities on the landscape, they are presented with an average accumulated score for the complete landscape. The user also receives a results card summarising their land use choices on this landscape. The user can then compare their personal landscape score with the Landscape Level BAU scores.

Once the user has completed all three landscapes, they return to the UK map and see their accumulated scores at National level. The National level BAU scores are also indicated so the user can compare their results. The scores for the three landscapes are averaged to obtain the final National level score.

National Level BAU scores

The National Level BAU scores are the projection of our current pathway leading into 2031 if nothing is done differently. These scores are set at a low starting point and can be improved or worsened based on

the user's choices as they go through this interactive tool. We derived our National Level BAU scores are based on wider literature sources and discussions with WWF.

Biodiversity BAU: 9/30 Rapid Decline scenario

We are already seeing habitats becoming more fragmented and further rapid loss of species and habitats is expected as agricultural land continues to expand. If we carry on as we are doing, biodiversity will be lost rapidly. Our thermometer's BAU starting point is, therefore, set at a low score (9) to reflect the Rapid Decline scenario. The biodiversity thermometer comprises of three different dimensions: habitat health, land connectivity, and impact on species. The BAU score for each of these dimensions is 3/10 each, reflecting the total BAU score of 9/30.

Food Production: 8/20 Slow Decline scenario

Current BAU practice is to prioritise food production, which reflects the Slower Decline scenario. The BAU score for Food Production is set at (8). The Food Production thermometer comprises of two dimensions: yields per area of farm; and resource management / inputs to produce food. The BAU scores for these two dimensions are 4/10 each, reflecting the total BAU score of 8/20.

Food Sustainability: 6/20 Rapid Decline scenario

Currently, the UK's food system is producing some food inside the UK, but it mostly relies on imported food, with the proportion of imports rising. There are currently no regulations on the sustainability of the supply chain, so the BAU score is set to a low score (6). The Food Sustainability thermometer comprises two dimensions: resilience of the supply chain; and sustainability of whole UK supply chain. The BAU score for these dimensions is 3/10 each, reflecting the total BAU score of 6/20.

Climate Change Mitigation: 9/30 Rapid Decline scenario

Climate change impacts are already evident in our world. If we do nothing, the BAU option for Climate Change Mitigation is set at a low score (9) in the Rapid Decline scenario. The Climate Change Mitigation thermometer comprises of three dimensions: reduction or prevention of emissions from agricultural practices; prevention of land degradation through improved practices; and capturing and storing carbon to reverse climate change in the future. The BAU score for these dimensions is 3/10 each, reflecting the total BAU score of 9/30.

Society and Economy: 12/30 Slow Decline scenario

Society and Economy benefits reflect the Slower Decline scenario (12). The current BAU demonstrates that land is being managed not just for commercial interest or food production but also to some extent for the prioritisation of leisure and amenity, beauty and heritage, and recreation. The Society and Economy thermometer comprises three dimensions: economic and social impact on UK, or on specific groups within it; impact on hazards which might affect people's lives or livelihoods; and externalising of climate or biodiversity impacts to the rest of the world. The BAU score for these dimensions is 4/10 each, reflecting the total BAU score of 12/30.

Landscape level BAU scores

The Landscape level BAU scores for each thermometer provide the user with a starting point within each landscape. National BAU scores were the starting point. Experts with specialist knowledge of each of the landscapes then reviewed the regions, taking into account the scoring metric framework to provide their recommendations for BAU scores at landscape-level.

Results card

The results card appears after the user has played all three activities within in landscape. The purpose of the results card is to show a high-level summary of the user's choices on a specific landscape. The results card shows accumulated average scores for all five thermometers. The user receives a summary for Biodiversity, Food Production, Food Sustainability, Climate Change Mitigation and Society and Economy. The text received will vary depending on the user's specific land use choices and score.

This landscape level average accumulated score follows the scoring for our Rapid Decline, Slow Decline and Recovery scenarios:

For Biodiversity, Climate Change Mitigation and Society and Economy:

- 0-10 scores for Rapid Decline
- 11-20 scores Slower Decline
- 21-30 scores Resilience

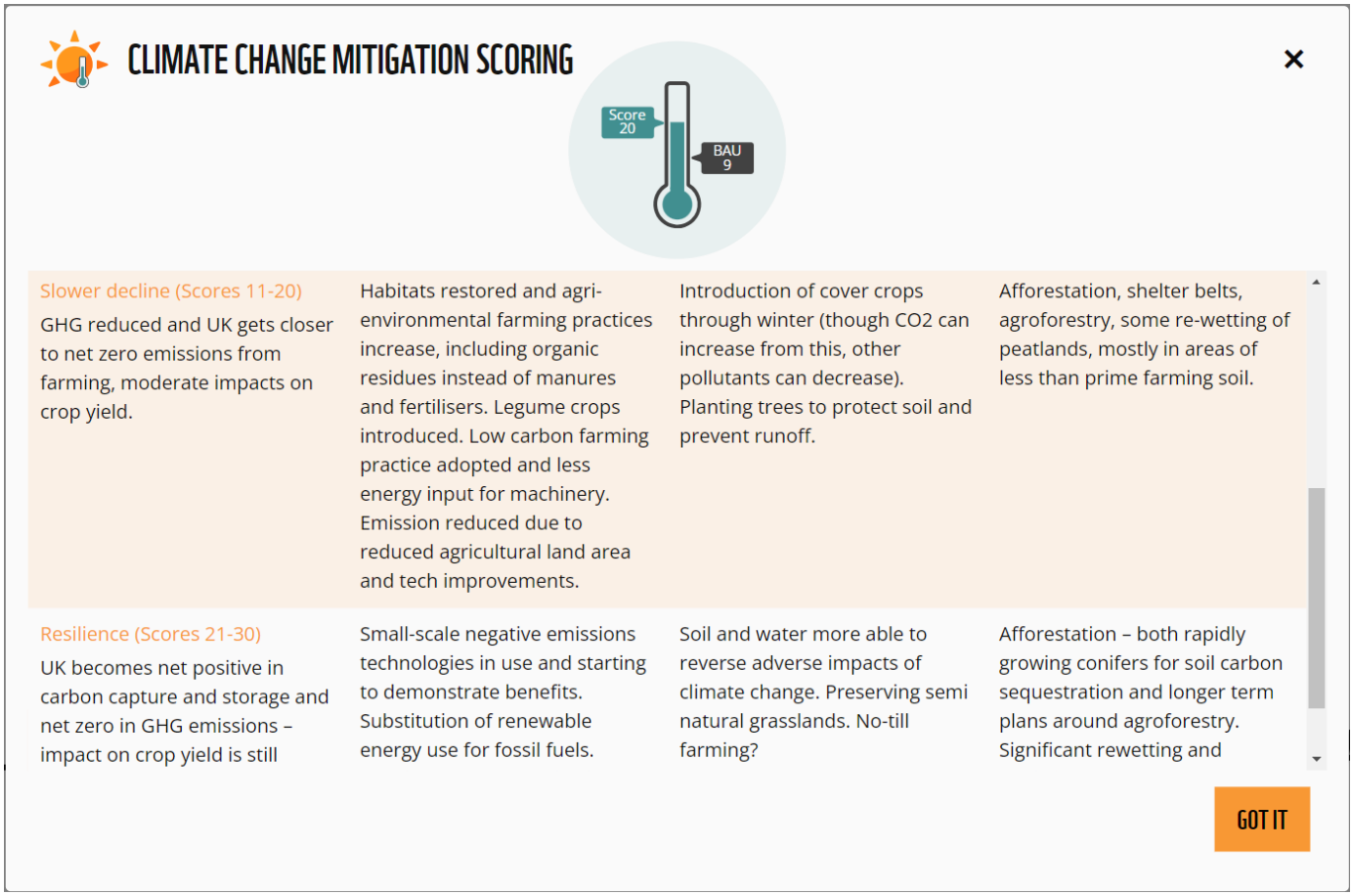
For Food Production and Food Sustainability:

- 0-6 scores for Rapid Decline
- 7-13 scores for Slower Decline
- 14-20 scores for Resilience

The user might receive identical scores for more than one thermometer. If this happens, their results card will be tailored accordingly. For example, the results card might say "your priorities for this landscape are [Highest Scoring Thermometer] and [Highest Scoring Thermometer]" or "Have you considered the impacts of your land use choices on [Lowest Scoring Thermometer] and [Lowest Scoring Thermometer]".

Figure 2 below shows an example of the results card for Climate Change Mitigation Scoring where the player's average accumulated score results in Slower Decline.

Figure 2



If the user receives a Rapid Decline score, the results card will prompt the user to “Have another go and rethink your land use choices to improve [the specific thermometer] on this landscape!” to remind the user that their land use choices are not solving the Triple Challenge.

When the user scores for Slower Decline, the results card will recommend further improvements the user could consider. We added this recommendation to remind the user that this scenario will progressively get worse, and their choices are insufficient to solve the Triple Challenge. We hope the recommendations can help the user consider areas of the Triple Challenge that they might have missed.

Resilience scores are the hardest to achieve. There are only a few combinations that users can choose to achieve Resilience. For example, in Pembrokeshire only six out 36 combinations score resilience scenario. As this is a rarity, the results card will congratulate the user with the text “Well done!” at the end to increase the entertainment element of this interactive tool.

How is the average accumulated score calculated?

The average accumulated score for each of the five thermometers is calculated by adding the thermometer scores from all three activities, then dividing by three. For instance, the example above shows a Biodiversity score of 66 in total. This score is divided by three for an average accumulated score of 22 for Biodiversity in Pembrokeshire. We are taking an average score instead of just a simple accumulation score of all three activities as this allows for a comparison against the landscape level BAU scores.

7. The diet-slider

Although the current tool measures the impact and Trade-offs of food sustainability and production, it does not consider the impact of changing diets in the UK, i.e., changes in demand-side factors. To resolve this, we are currently assessing the inclusion of a mechanism that would show the impact of different diets on the outcomes of the activities. This would take the form of a "diet-slider" in following iterations of the interactive tool.

In principle, this diet-slider would make assumptions (broadly from FABLE and other sources) about how moderately ambitious and highly ambitious changes to demand-side diets could impact the outcomes of the activities and the Triple Challenge as a whole. The diet-slider would inform the user about the different possible diets of the future (for example, moving to a full plant-based society), so the user is able to decide what assumptions they want to make about likely changes to the UK's diet. The food sustainability and food production thermometer scores are likely to be particularly affected with the inclusion of a diet-slider, as would the society and economy one.

Ipsos has proposed the following options as different ways to incorporate a diet-slider:

1. **Set the diet-slider at the beginning of the tool.** Users would see BAU scores/thermometers change as they set the slider to different levels of ambition. This would mean that their starting score changes. With very high levels of ambition, some alternatives per activity become unviable and they would be greyed out and non-selectable by the user.

2. **Set the diet-slider at the results page**. Different levels of ambition would be linked to pre-set scores, and these would change the user's final score accordingly. Users would see their scores change as they move the slider.

3. **Set the diet-slider at the beginning and grey out the options per activity that are no longer relevant.** This would only be indicative as it would not change the user's scores. The aim here is to show that options become reduced as diets become more sustainable.

4. **On/Off button instead of slider**. The On button would be set to one level of ambition according to WWF's advocacy statement on diet. This level of ambition would be explained in more detail. Options per activity that are no longer relevant would be greyed out and the BAU thermometers (starting score) would change.

Conversations are still ongoing and currently WWF's stakeholders and experts and considering the inclusion of the diet-slider based on the following questions:

1. What is the value of adding the slider as a mechanism?

2. At what point during the tool should it be available?

3. What are the levels of ambition that should be included? And how should these be defined?

4. Will our scoring system register the impacts of the change in dietary ambition? There is currently no measure of demand in our scoring system.

5. What is the alternative if we do not include the diet-slider mechanism?

8. Conclusion

This report has detailed the development of WWF's Triple Challenge interactive tool. Our world is reaching a point of no return and addressing the three interrelated and fundamental objectives of the Triple Challenge is crucial to ensure a prosperous society for the future. The creation of this tool was driven by the need to demonstrate the complexities of the Triple Challenge and stimulate discussion among policy makers and stakeholders. It seeks to be an advocacy instrument because engagement is fundamental to success in simultaneously avoiding dangerous climate change, halting and reversing dramatic loss of biodiversity, and meeting the food needs of a growing global human population.

Using scenario planning techniques, the interactive tool presents three future scenarios for UK landscapes, and the ways in which the Triple Challenge might - or might not - be achieved in each. The activities have been crafted through academic research, comprehensive secondary research, and technical input from regional experts during three workshops. In this first iteration of the interactive tool, we selected Pembrokeshire in Wales; the Humber region in England; and Aberdeenshire in Scotland as each of these landscapes is distinct in its characteristics and land use challenges.

The aim of the interactive tool is for its users to create a future which is better than the current state of play, reflected through the low BAU initial score. The user can achieve this by making decisions which help the landscape improve its scores across each of the Triple Challenges aspects– food, biodiversity, and climate change mitigation, as well as society & economy. However, to show the complexity of the Triple Challenge, the interactive tool presents users with Win-wins and Trade-offs that will force them to prioritise in order to achieve a high score representing a positive and balanced outcome.

To reflect the Win-wins and the Trade-offs in the outcomes, we derived the scoring criteria from three scenarios that apply to all five thermometers: Rapid Decline, Slower Decline, or at best Resilience. These scenarios are a qualitative description of the complex interplay of land use choices and their impact on the three areas of nature recovery, nature-based climate solutions and low-impact food production.

In our analysis of the activities and scoring across the three landscapes in the tool, we see that it is possible for there to be Win-wins across all the Triple Challenge areas. This is highly encouraging in terms of future land use options – so long as the funding and policies that are alluded to in the tool are available for LUC.

WWF expects to be able to use the outputs of the project to interrogate and examine the Trade-offs that would need to be made to meet the Triple Challenge, understand the constraints and opportunities presented by choosing different priorities, and present configurations to meet society's expectations. We hope The Triple Challenge interactive tool serves to bridge the evidence gap by providing an array of evidence showing what could be possible in the UK and acting as the strongest possible platform for informed debate and advocacy.

Appendix 1: Sources that informed the activities

Pembrokeshire

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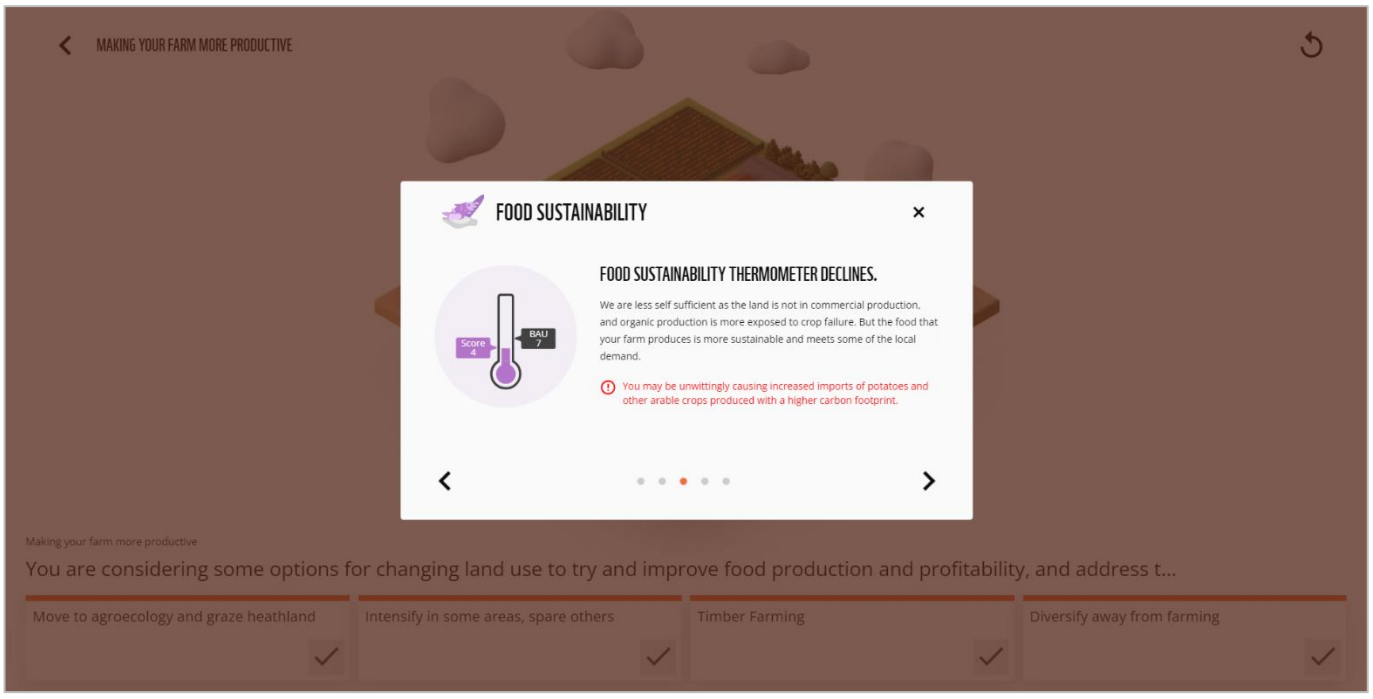
Appendix 2: User guide

The user will first view an introduction video explaining the purpose of the Triple Challenge and some basic rules about the interactive tool. They will then be directed to a UK map illustrating the three available landscapes to choose from.

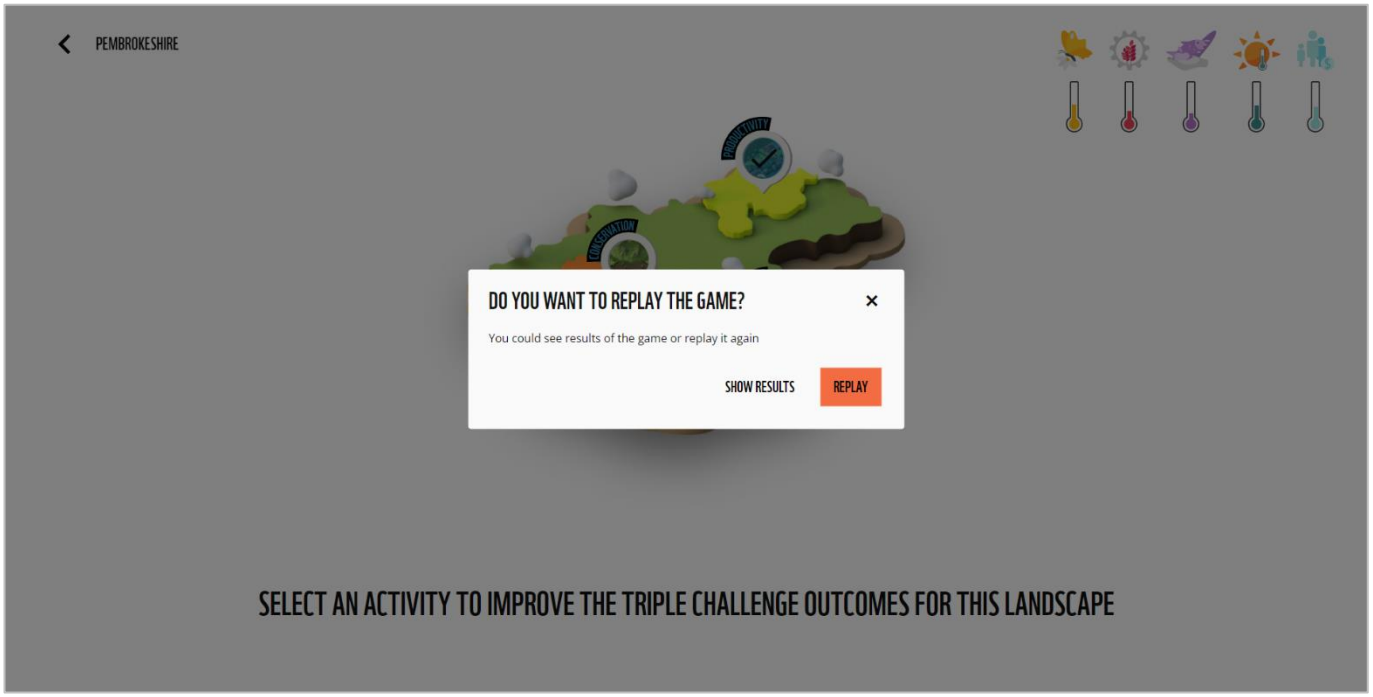
After the user has selected a landscape, they enter the landscape map, where the user sees three activities across the landscape for the user to select from. Each activity describes the land characteristics, the specific challenges and aims of the activity.

When the user selects the activity, the interactive tool gives 3-4 to choose from to solve the challenge. Each option provides a short description of the interventions or land use changes in the specific landscape – each option will present different opportunities and Trade-offs for the user to consider. Some options may display a 'hint' for the user to consider, which will help them to understand the option and the potential outcome.

After the user has selected their option, each of the thermometers will move up and down as a result of the user's choice, and the user is still able to see how their score compares to the BAU score for that landscape. The user will see detailed commentary alongside their scores for each thermometer explaining the rationale for how they scored. Once a user has finished that activity, they can go onto the next activity in that landscape.

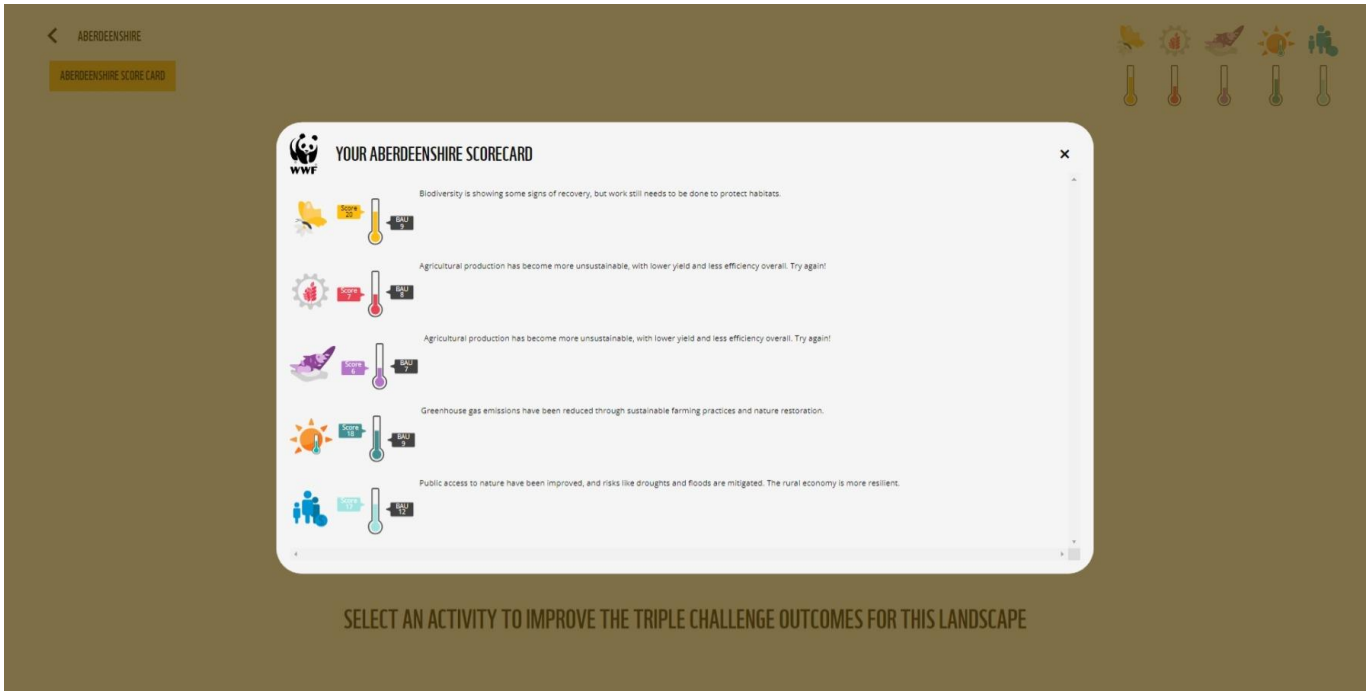


The user can stop the activity and return to the landscape map at any time. They can also restart the landscape or any activities to obtain a higher score. All the scores are stored in the interactive tool as they play.

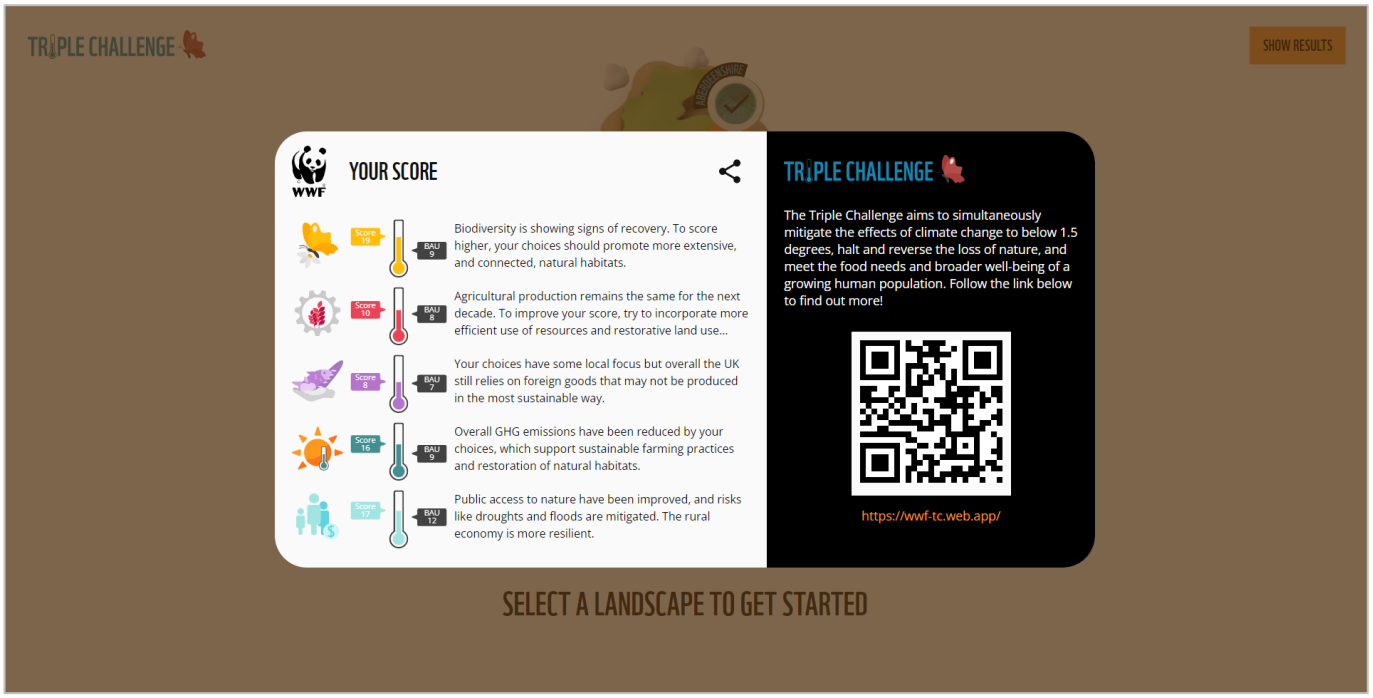


After the user has completed one landscape, they receive a “results card” about how they scored for that landscape, together with links to further reading materials (see Results Card in 6. The scoring system section). Then the user moves on to another landscape (or they have the option to replay the same landscape).

At this stage, the user sees an average accumulated score for the completed landscape and indictive lines representing the landscape BAU to help them map their landscape results against the BAU scenarios.



After the user has completed Pembrokeshire, the Humber region and Aberdeenshire, they return to the UK map, where they see their national average accumulated score which is calculated by combining the total scores for all three landscape and then averaged. The user can use their national average accumulated score to compare with the national BAU score that they started from.



Our standards and accreditations

Ipsos' standards and accreditations provide our clients with the peace of mind that they can always depend on us to deliver reliable, sustainable findings. Our focus on quality and continuous improvement means we have embedded a "right first time" approach throughout our organisation.

ISO 20252

This is the international market research specific standard that supersedes BS 7911/MRQSA and incorporates IQCS (Interviewer Quality Control Scheme). It covers the five stages of a Market Research project. Ipsos was the first company in the world to gain this accreditation.

Market Research Society (MRS) Company Partnership

By being an MRS Company Partner, Ipsos endorses and supports the core MRS brand values of professionalism, research excellence and business effectiveness, and commits to comply with the MRS Code of Conduct throughout the organisation. We were the first company to sign up to the requirements and self-regulation of the MRS Code. More than 350 companies have followed our lead.

ISO 9001

This is the international general company standard with a focus on continual improvement through quality management systems. In 1994, we became one of the early adopters of the ISO 9001 business standard.

ISO 27001

This is the international standard for information security, designed to ensure the selection of adequate and proportionate security controls. Ipsos was the first research company in the UK to be awarded this in August 2008.

The UK General Data Protection Regulation (GDPR) and the UK Data Protection Act (DPA) 2018

Ipsos is required to comply with the UK GDPR and the UK DPA. It covers the processing of personal data and the protection of privacy.

HMG Cyber Essentials

This is a government-backed scheme and a key deliverable of the UK's National Cyber Security Programme. Ipsos was assessment-validated for Cyber Essentials certification in 2016. Cyber Essentials defines a set of controls which, when properly implemented, provide organisations with basic protection from the most prevalent forms of threat coming from the internet.

Fair Data

Ipsos is signed up as a "Fair Data" company, agreeing to adhere to 10 core principles. The principles support and complement other standards such as ISOs, and the requirements of Data Protection legislation.

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About Ipsos Trends & Foresight

The Ipsos Trends and Foresight team offers foresight services including scenario planning, horizon scanning, trend spotting and trend framework building, to help today's governments, businesses and brands take the strategic decisions which fit their organisations for the complex challenges of the future.

About Codelegs

Codelegs is a boutique technology consultancy that works on projects that range in size from bespoke solutions to mass-market products. Founded in 2011, Codelegs provide full-service consulting, from architecture and design, to build and launch and post-launch support.

About WWF-UK

WWF is the world's leading independent conservation organisation. WWF's mission is to create a world where people and wildlife can thrive together.