LUPG

The UK statutory conservation, countryside and environment agencies

Potential Implications of leaving the EU for UK agriculture and the rural environment

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Institute for European Environmental Policy

August 2017

NATURAL ENGLAND
Environment Agency
Cyfoeth Naturiol Cymru Natural Resources Wales
Scottish Natural Heritage Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad
SEPA Scottish Environment Protection Agency
NIEA Northern Ireland Environment Agency www.daera-ni.gov.uk
Department of Agriculture, Environment and Rural Affairs

LUPG

LUPG comprises Natural England, Natural Resources Wales, Scottish Natural Heritage, the Environment Agency, Northern Ireland Environment Agency, Scottish Environment Protection Agency. LUPG provides independent evidence and analysis to Government on matters of common concern related to agriculture, woodlands and other rural land uses. It seeks to develop a common understanding of the pros and cons of policy mechanisms related to land use, particularly farming and forestry.

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Natural England is the government's advisor on the natural environment. We provide practical advice, grounded in science, on how best to safeguard England's natural wealth for the benefit of everyone. Our remit is to ensure sustainable stewardship of the land and sea so that people and nature can thrive. It is our responsibility to see that England's rich natural environment can adapt and survive intact for future generations to enjoy.

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Natural Resources Wales is a Welsh Government Sponsored Body. Our Purpose is to ensure that the environment and natural resources of Wales are sustainably maintained, sustainably enhanced and sustainably used, now and in the future.

http://naturalresources.wales/

Scottish Natural Heritage

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www.snh.org.uk

The Environment Agency

The Environment Agency (EA) is the leading public organisation for protecting and improving the environment in England and Wales. The EA achieves this by regulating industry, waste and water quality; managing flood risk and water resources, and improving wildlife habitats in addition to many other activities. The EA also monitors the environment, and makes the information that it collects widely available.

www.environment-agency.gov.uk

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The Northern Ireland Environment Agency takes the lead in advising on, and in implementing, the Government's environmental policy and strategy in Northern Ireland. The Agency carries out a range of activities, which promote the Government's key themes of sustainable development, biodiversity and climate change. Our overall aims are to protect and conserve Northern Ireland's natural heritage and built environment, to control pollution and to promote the wider appreciation of the environment and best environmental practices.

www.ni-environment.gov.uk

The Scottish Environment Protection Agency

The Scottish Environment Protection Agency (SEPA) is Scotland's environmental regulator. SEPA's main role is to protect and improve the environment, and it does so by regulating activities that can cause pollution, and by monitoring the quality of Scotland's air, land and water. SEPA reports on the state of Scotland's environment and publishes a wide range of environmental data and information.

http://www.sepa.org.uk/

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Preface

Since its formation in 1993, the work of the Land Use Policy Group (LUPG) has focused on examining the environmental impacts of the Common Agricultural Policy (CAP) as well as covering a range of topics of interest related to agriculture, woodlands and other rural land uses.

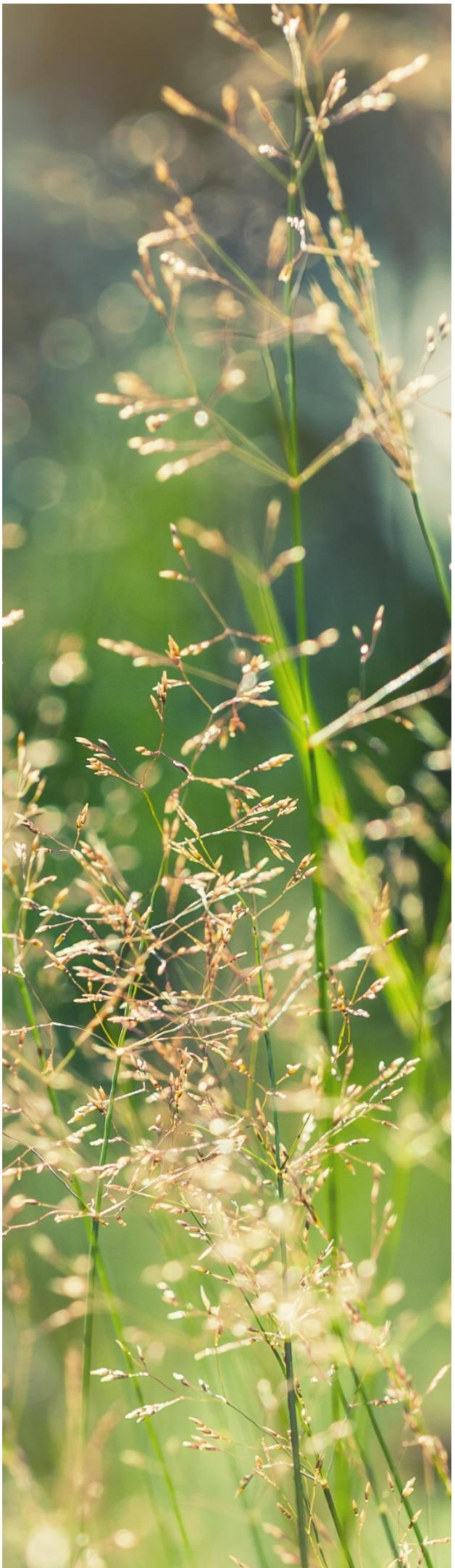
In the days immediately following the EU referendum on 23 June 2016, the members of LUPG were amongst a multitude of interested parties who began to discuss the implications of this decision for UK agriculture. We were conscious that events were likely to move fast and there was a significant risk that any work commissioned by LUPG could be outpaced even before it was published.

Our approach on this issue has differed to that of many others. We wanted to examine the potential impacts of a changing agricultural policy and the new post CAP context on the farmed environment in the UK. Many plausible alternative futures were suggested in those early days (with all of their opportunities and various constraints) but uncertainty was central to all of our discussions. It was for this reason that we decided to use an exploratory scenario-based approach in a piece of commissioned work which sets out a comprehensive range of possible directions of travel, enabling a more detailed discussion of the widest range of possibilities, but without favouring one particular scenario over another. We wish to emphasise this point; this is an exploration of possibilities; we favour no particular scenario(s), rather we see them as providing a framework for detailed discussions of a wide range of impacts which we hope will support the construction of new domestic agricultural policies. The analysis and views expressed are not those of the constituent organisations of LUPG but are an independent contribution by the authors of the report.

Finally, in setting out to contribute to the discussion, LUPG continues to remain mindful of the work that we started back in the early 1990s. In particular, that the CAP will continue to evolve in new and possibly unexpected directions. This will not only change the nature of part of the competitive environment within which UK agriculture will have to operate, but will continue to provide a source of relevant experience, new ideas and best practice. Based on our experience, a range of existing international networks remain well placed to explore these issues.

Rob Cooke, Chair of the LUPG

Institute for European Environmental Policy



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Funded by:

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Disclaimer: The arguments expressed in this report are solely those of the authors and do not reflect the opinion of any other party.

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List of acronyms

AECM	Agri-environment-climate measure
AoA	Agreement on Agriculture
ASSI	Areas of Special Scientific Interest
BESP	British Ecosystem Services Policy
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CEEC	Central and Eastern European Countries
CET	Common External Tariff
CITES	Convention on the Conservation of European Wildlife and Natural Habitats
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CO2	Carbon dioxide
CPVO	Community Plant Variety Office
CU	Customs Union
DEFRA	Department for Environment, Food and Rural Affairs
DP	Direct Payments
EA	Environment Agency
ECHA	European Chemicals Agency
ECJ	European Court of Justice
EEA	European Environment Agency
EFSA	European Food Standards Agency
EIP	European Innovation Partnership
ENCANET	European Nature Conservation Agencies Network
ETS	Emissions Trading System
EU	European Union
FAO	Food and Agriculture Organisation
FBI	Farm Business Income
FTA	Free Trade Agreement
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GHG	Greenhouse gas
GMO	Genetically Modified Organism
GVA	Gross Value Added
HMG	Her Majesty's Government
HNV	High Nature Value
IMO	International Maritime Organisation
IMPEL	European Union Network for the Implementation and Enforcement of Environmental Law
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JRC	Joint Research Centre

LEP	Local Enterprise Partnership
LFA	Less Favoured Area
LULUCF	Land Use Land Use Change and Forestry
MEA	Multilateral Environmental Agreement
MFN	Most Favoured Nation
MoU	Memorandum of Understanding
NEC	National Emission Ceiling
NGO	Non-governmental organisation
NH3	Ammonia
NRW	Natural Resources Wales
OSPAR Convention	Convention for the Protection of the Marine Environment of the North-East Atlantic
PDO	Protected Designation of Origin
PG	Public Goods
PGI	Protected Geographical Indication
R&D	Research and Development
RDP	Rural Development Programme
RoW	Rest of World
RPA	Rural Payments Agency
SAC	Special Area of Conservation
SM	Single Market
SOM	Soil organic matter
SRUC	Scotland's Rural College
TFEU	Treaty of the Functioning of the European Union
TIFF	Total Income From Farming
TRQ	Tariff Rate Quota
UAA	Utilised Agricultural Area
UK	United Kingdom
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPOV	International Convention for the Protection of New Varieties of Plants
WFD	Water Framework Directive
WTO	World Trade Organisation

Executive Summary

This report was commissioned by the Land Use Policy Group as a contribution to the debate on future policy trajectories in the UK for the agricultural sector once outside the CAP and the implications these have for the rural environment.

The report illustrates a series of exploratory scenarios, setting out alternative pathways for the agricultural sector in the UK over the next ten years and beyond (Chapters 5 and 6). To set these in context, evidence of the environmental sustainability of agriculture in different parts of the UK is considered, alongside the role of international environmental legislation in influencing domestic policy and some of the implications of the changes likely to arise in this policy sphere following the UK's departure from the EU. (Chapters 2, 3 and 4). The chosen scenarios reflect a range of factors that could drive future developments (including possible policy and market shifts). They provide a framework for discussing some of the key environmental risks and challenges which lie ahead (Chapter 7). The report concludes with a summary of the implications of these findings for future negotiations and discussions within the UK as well as some suggestions on next steps.

Setting the context

The sustainability of agriculture within the UK: The UK has one of the highest proportions of land in the EU under agricultural use (71%) second only to Ireland. The majority is made up of permanent grassland, which is the predominant land use in Scotland, Wales and Northern Ireland. The majority of the UK's arable land is in England, with some smaller but significant areas in Scotland. A large proportion of the agricultural area in Scotland, Wales and Northern Ireland is designated as Less Favoured Area (LFA) and characterised by less fertile soils with limited agricultural potential and below average economic returns. Extensive grazing systems with High Nature Value (HNV) but low profitability are frequently found in these areas. Only 3% of the agricultural land in the UK is farmed organically and there has been some decline over recent years.

In economic terms, the contribution of agriculture to the economy is falling, accounting for 0.61% of gross value added (2014 figures) although this ranges from 0.57% in England to 1.38% in Northern Ireland. Relative to global competitors, productivity growth in all four countries of the UK is low, and farm incomes are highly variable over time and between farm types. In the past five years, Farm Business Incomes (FBI) have declined for most types of farm with the exception of specialist poultry and pig farms (although the latter dropped severely in 2016). Dairy farming has experienced very erratic conditions and there is a chronic problem of low farm business income in the beef and sheep sectors.

The range of farming systems and associated management practices operating in different parts of the UK have a strong influence on the state of natural capital and the environmental costs and benefits that ensue. Given the extent of agricultural land, the limited area of woodland and forestry, together with the lack of almost any truly natural unmanaged land (compared with many other parts of the EU and globally) agricultural practices are disproportionately important for a range of environmental outcomes in the UK.

Certain trends are improving, for example, greenhouse gas emissions from agriculture have declined over the past 20 years, mainly because of special factors, such as declines in cattle and sheep numbers, but have been relatively constant over the last decade. There remains significant potential for more mitigation action: the Committee on Climate Change has recommended that policies are required to cut emissions from the agriculture, forestry and land use sector by 15% between 2014 and 2030 and to increase afforestation to 15 000 ha per annum to meet the UK Government's fourth and fifth carbon budgets.

Agri-environment schemes have shown a range of landscape and biodiversity benefits over the last thirty years as well as mitigating the impact of some agricultural practices. In several areas, however, the pressures from agriculture remain significant. For example, phosphate and nitrate levels in surface and ground water remain a major pressure on water quality and aquatic biodiversity. Soil degradation issues continue to be prevalent in many parts of the UK, populations of farmland birds and grassland butterflies continue to decline and many protected habitats associated with agriculture remain in unfavourable condition.

***Environmental commitments for the UK relating to international agreements*:** Following its departure from the EU the UK will continue to be party to a range of multilateral environmental agreements (MEA). Those MEAs with specific requirements on agriculture are relatively few and cover limited aspects of the environment. Some address global issues, such as climate change, others more regional matters such as air pollution in Europe or the management of regional seas. They provide an indication of the absolute minimum level of environmental protection that UK governments will need to address after leaving the EU. Although many are 'mixed agreements' ratified by both the UK and the EU, the working assumption is that existing MEAs will continue to apply in the UK. However, the obligations under MEAs are in practice a form of "soft law" and the powers of enforcement are limited compared to EU legislation. A number of MEA's are non-binding and comprise voluntary agreements and guidelines.

***Policy related issues associated with current EU membership**:* Agricultural and environmental policy making will take place in a different context once the UK has left the EU. A number of issues appear likely to be important to policy design and implementation outside the CAP, although the position is not yet clear in several areas. These include:

- the nature of agricultural budgetary rules and cycles;
- funding availability and arrangements for supporting activities such as networking, research and analysis, soft loans etc.;
- the continued status, if any, of EU Treaty principles, such as the precautionary principle, within UK law;
- the extent to which EU environmental, food safety, animal welfare and related legislation will continue to apply in the UK as time goes on;
- the implications of removing the European Commission's current role in monitoring and driving improvements in compliance, including reporting and monitoring structures;
- the extent to which the UK will adhere to existing agricultural policy regulations, standards and schemes giving products protected status (such as the PDO and PGI schemes) as well as the role of assurance and marketing schemes;
- applicability of the requirements of EU state aid rules.

The following Box provides a summary of the factors that were identified as being most likely to affect the development of a new set of agriculture and land management policies within the UK. Together with the associated dependencies, these informed the development of scenarios which underpinned the later part of the report.

Box 1: Factors relevant to the development of a new set of agriculture and land management policies in the UK

Policy, governance and environmental ambition:

- The chosen balance between stability and change in agricultural policy following Brexit and the rate of policy change that is considered feasible and desirable, with some expectation of significant change being tapered over time.
- The level of environmental ambition in the four countries, which will be linked to the issue of whether relevant EU environmental legislation continues to apply in the UK and how far compliance processes in the EU, including the ECJ, continue to have an influence e.g. under a Single Market model, and the degree of commitment to integrate natural capital into public and private decision making.
- Specific choices in relation to climate ambitions in the sector.
- Questions of governance and the powers of devolved authorities in the UK, arrangements for co-ordination of agricultural policy at the UK level (if any) and the extent to which powers and responsibilities in this field might be devolved to a more local level in the different countries (e.g. to the local/regional authorities or entities such as National Parks).
- The degree to which ministers are concerned by the perceived fairness of treatment of UK farmers and their competitive position, by comparison with farmers in the EU 27.
- The degree to which ministers are concerned about business failures and possibly sharp changes in incomes from farming.
- Perceptions and realities of administrative cost and feasibility, not least in relation to more localised policy making.
- Accompanying institutional changes, including those to the various Payment and Statutory Agencies as well as research institutions.
- The role of food supply chain and assurance schemes in producing food sustainably.
- A number of specific issues, including arrangements for migrant labour in the food processing and service sectors and the availability of seasonal/ casual labour for agriculture and horticulture together with the possibility of special treatment for individual sectors.
- The possibility of food related objectives influencing future policy in the light of its political profile. This might include initiatives related to animal welfare, public health, food labelling, marketing, public procurement or regulation.

Wider economic and political drivers:

- The economic strategy in place in relation to Brexit. This includes the degree of commitment to a more liberalised trade regime, the extent to which a de-regulatory approach is adopted and broader issues related to inflation, interest rates, food prices and other high-level economic issues.
- General economic developments, including GDP growth and employment levels, the volatility of exchange rates and value of sterling, interest rates and levels of inflation.
- Current and expected developments in market prices for agricultural products.
- Any major developments relating to devolution, the dynamics of developments in the four countries of the UK and at a more regional level. The extent to which there will be a political preference to maintain a broadly similar approach between the four countries and the special factors affecting Northern Ireland in relation to the Republic of Ireland.
- Reactions within the EU-27 to Brexit, in particular the impact on the EU budget as well as the future development of the CAP.
- The effectiveness of the many lobbies and interests in play.

Budget:

- The UK budgetary allocation for agriculture and related rural development expenditure post 2019, which will be set in competition with other policy areas, such as health, welfare and education, both at the UK and devolved levels.
- The extent to which any of the devolved administrations may be enabled and prepared to devote additional funds to the rural sector from their own resources.
- Institutional implications, especially the share of competencies among government and devolved administrations and possible variations in willingness to regulate.
- The settlement of the question of how much the UK may pay to the EU as a result of the Article 50 negotiations may have influence on these matters for several years.
- The level of budget made available for policy design and governance arrangements and for border and customs arrangements with the EU depending on the final settlement will also be relevant.

Trade:

- The central terms of the post Brexit settlement with the EU, including participation or otherwise in the Single Market and the Customs Union (this could be a matter of degree for the Customs Union in particular).
- The timescale for implementation, including any transition or adjustment periods).
- Future trade arrangements with both EU member states and third countries.
- WTO related factors such as: whether the UK receives a share of the EU's Agreement on Agriculture (AoA) "amber box" schedule following Brexit, any other constraints on the formation of domestic policy arising from the relevant WTO rules and dispute resolution system.
- In parallel, the extent to which WTO rules of this kind prove an inhibiting factor to UK governments (bearing in mind the questionable level of WTO compliance under the present CAP).

Scenarios for future agricultural policy in the UK

The report establishes five exploratory scenarios, alongside a baseline situation. These set out alternative directions of travel developed from a framework of variables. A consistent set of individual variables and considerations play different roles within these scenarios. Each hypothetical scenario follows an overall logic in which certain headline priorities are given precedence, creating alternative directions of travel which map out the "plausibility space" with well-spaced marker posts of how policy and certain other key drivers could unfold in future. These contrasting scenarios provide a basis for a comparative analysis of their environmental implications.

The variables chosen to structure the scenarios are those playing a significant role as drivers of agriculture, land use and the rural environment:

- The UK trade relationship model with the EU and rest of the world;
- The overall governance and institutional framework;
- Possible purposes and levels of overall financial support from the public purse for the agriculture and land management sector;
- Key policy objectives and mechanisms for providing economic and other support for the sector;
- Other important forms of intervention which may be adopted; and
- The overall level of environmental ambition and wider objectives.

For each of these variables, a number of different states are set out, creating a matrix of different combinations of choices or circumstances from which the scenarios are constructed. Each of the scenarios is characterised at the UK level, whilst acknowledging

that there will be differences in the way they are expressed and the particular policies adopted in the four UK countries. The five scenarios can be summarised as follows:

- **Scenario A**: *Full steam ahead for UK agriculture*, with a general goal of increasing agricultural production and its contribution to the UK's GDP;
- **Scenario B**: *Treating agriculture as a standard economic sector*, where reducing the level of protection offered to the agriculture sector and the size of the agricultural budget are priorities;
- **Scenario C**: *Promoting environmental sustainability*, with a strong emphasis on delivering more environmental goods and services from the countryside as well as creating farming systems which are resilient and robust in the long term;
- **Scenario D**: *A territorial approach*, with a much stronger devolution of for agricultural policy making to the sub-national level; and
- **Scenario E**: *Greener shades of liberalisation*, encompassing a combination of relatively liberalised trading relationships with other European and third countries, but accompanied by a medium degree of environmental ambition, not exceeding that exhibited in recent years.

The way in which these scenarios relate to the variables and their different states can be seen in Figure 1. In this figure the five scenarios are depicted as coloured lines, linking the particular state of six key choice variables (such as the level of public sector financial support that is provided to the agriculture sector) which are shown in the left hand column. These "states" range from "business as usual" to significant departures from this. Where the scenario is considered to be compatible with two or more states of a particular choice variable this is shown as a horizontal bar on the line depicting the scenario.

Exploring the potential environmental dimensions and consequences of the scenarios

Each of the scenarios creates new dynamics in relation to agricultural production, farm structure, land use and land management which in turn have implications for the environment of the farmed countryside. The final part of the report explores these dynamics, scenario by scenario, drawing out the key potential risks, opportunities and constraints for the farmed environment at UK level. Because the scenarios are designed to incorporate assumptions about the overall level of environmental ambition within national authorities in the years ahead, this naturally has an influence on the analysis of environmental risks and opportunities.

Under the baseline situation, no major policy changes are envisaged, with the measures currently under the CAP continuing broadly as now. The policy framework under this scenario includes the real, but relatively limited, ongoing differences between the four UK countries in the way they implement the flexibility currently available to them, for example in relation to utilising coupled support or designing agri-environment-climate measures. This scenario is not static as the CAP allows for considerable discretion to Member States in the way that many policies are implemented and the CAP itself is continuing to evolve, even though the precise direction remains unclear. To take one example, innovative approaches to agri-environment schemes, such as those focussed on rewarding outcomes are not only permitted and funded under the CAP but are currently the subject of a number of pilot or new generation schemes in different parts of the EU.

Figure 1: The relationship between each of the exploratory scenarios (coloured lines) and the different states of the six choice variables

Choice variables	State of variable				
Choice variable	1	2	3	4	5
UK trade relationship	Inside Single Market and Customs Union Mirror EU CET	Exit Single Market In Customs Union Mirror EU CET	Exit SM and CU FTA with EU Mirror EU CET	Exit SM and CU WTO tariffs on EU trade WTO tariffs with RoW	Exit SM and CU Reduce tariffs on trade with EU and RoW
Institutional frame / governance	Uniform UK approach to agricultural policy	Some differences between countries, as now	More variations between countries, fully devolved frame	More localised approach within devolved framework	
Level of agricultural support	Higher than now	At same level as under the current CAP	25% cut in overall expenditure	50% cut in spending	70% cut in spending
Key agricultural support mechanisms still dominant	As now, with Direct Payments (DP) converted into risk management measures	Direct payments reduced and new risk management regime, more loans	Lower DPs, more environmental Public Good (PG) focus and some coupled payments	Environmentally focused payments dominant alongside risk management regime and private funds for ecosystem services	Innovation, advice, capacity building & PGs dominant; little routine support
Other government actions / regulations	Active intervention, high standards strengthen regulations & eligibility conditions	Weaker regs and enforcement, voluntary focus & advice	Emphasise local & regional variation, devolved rules and approaches	Emphasis on supply chain standards, certification and advice via private suppliers, aversion to regulation	Reduced interventions, instead support is directed through advice, training etc. and more emphasis on voluntary measures
Environmental ambition	Broadly as now, including continued pursuit of goals in EU based legislation such as WFD with certain variations between countries	Higher level of ambition across the range, including climate related; aiming at leadership in greener agriculture	Ambition rises on selected domestic issues only, including public access and flood control	Lower ambition, especially re EU driven controls on agri-chemicals, GMOs , nutrients	All round fall in ambition

Legend:

	Scenario A	Full steam ahead for UK agriculture
	Scenario B	Treating agriculture as a standard economic sector
	Scenario C	Promoting environmental sustainability
	Scenario D	A territorial approach
	Scenario E	Greener shades of liberalisation

At the farm level, economic margins will continue to be tight in many systems and the extensive livestock sector in particular remains highly dependent on public support. However, the profitability of some crops and products has been increased by the depreciation of sterling over the last year and forecasting market prices is difficult. In the environmental sphere there are a variety of standards laid down in EU regulations that are not all being met in the agriculture sector as a whole and pressure to do so can be expected within the UK as well as other EU states. Looking ahead, there is likely to be increased demand for the agriculture sector to take action to reduce GHG and ammonia emissions, given domestic as well as EU targets, growing consumer awareness and progress in many other sectors. Whilst there are well rehearsed drawbacks to the current operation of the CAP, several policy tools to address environmental challenges are available within the policy, with considerable discretion for the UK and other national governments to tailor AECMs, other rural development measures, the Pillar I Greening provisions and cross-compliance to their own conditions and priorities. As a result, some progress in increasing the sustainability of agricultural and related land uses could be expected under this scenario, including further action to address water quality, air pollutants, soil management and loss of biodiversity.

Each of the other scenarios outlined above suggest a range of plausible futures related to agriculture, trade and governance once the UK has left the EU. The main implications of each of these on land use and farming patterns, farmland management and the environment are explored in Chapter 7. Some potential key risks, opportunities and constraints have been identified for each scenario and are synthesised in Table 1 below.

Certain challenges and opportunities for UK agriculture are likely to arise under all the scenarios (such as an increased level of uncertainty) so the emphasis in the analysis has been on those areas where significant differences between the scenarios are expected, especially in relation to environmental sustainability.

Table 1: Synopsis of scenarios and possible environmental opportunities, risks and constraints

Scenario	Potential Environmental Implications	Key risks	Key opportunities	Key constraints
Scenario A: Full steam ahead for UK agriculture • Focus on expanded UK production. • Relatively high support level, more linked to output/productivity than to land management. • Regulatory requirements scaled back. • Less environmental ambition than now.	• Potential increase in cropped area, reductions in permanent grass. • Increased use of nutrients and agrochemicals relative to baseline and related increases in pollution. • Expanded livestock numbers, e.g. dairy cattle and pigs, potentially increasing GHG emissions. • Increased demand for water in some areas. • More air and water pollution and pressure on soils unless offset by remedial action. • Intensification in many sectors, potentially less constrained by regulatory requirements.	• Pressure on the environment from increased lowland (and perhaps some upland) production, with potential for intensification. • Potential for continuing economic marginalisation of many more extensive livestock systems, especially where fewer AECMs are available; localised over grazing in the uplands where intensification takes place. • Risk of weaker legislative framework and lower priority assigned to enforcement. • Diversion of investment and institutional focus in favour of increased production (this may also be at the expense of more extensive systems that are less commercially focused). • Reduced incentive for farmers to enter AECMs, on top of the uncertainty factor affecting all scenarios.	• Bringing a green element into the British food brand including via assurance schemes & retailers. • Expanding the role of green certification schemes, although risk of 'green wash'. • Building low carbon production and other public goods into a model for growth. • Harnessing the investment that is already taking place in improved environmental management, e.g. through more efficient nutrient management and precision farming. • Perhaps more focus on animal welfare with some environmental benefits.	• Competing pressures on farmers to simultaneously raise productivity and to meet environmental requirements. • Budgetary limitations squeezing the resources available for environmental payments and infrastructure, given other priorities. • The multiple demands on the time of government, agency and related staff tasked with developing and delivering new policies and systems as well as ensuring operability. • Potential limitations on the degree of change that can be accommodated without risking disruptions to delivery and/or tensions arising from differences in approach between the four countries.
Scenario B: Treating agriculture as a standard economic sector • Lower food price rather than domestic production the priority. • Liberal trade regime with lower tariffs on certain imports. • Reduced level of support for	• Accelerated structural change towards fewer, larger, more specialised farms following lower profitability: further pressure on landscape features. • Some areas affected by intensification and associated environmental pressures, including field margins in productive arable areas. • Potentially less resources and labour for environmental	• Pressure on costs leads to structural change in agriculture and increased adoption of more damaging practices and short cuts. Reduction in farmer numbers and expenditure on non-essential contractors results in less labour available for environmental management. • Continuation of the trends towards larger, more specialised farms and reduced management of landscape features.	• More incentive for farmers to enter those remaining AECMs, if these are funded, given income shortfall. • Less investment in damaging productive practices. • Some environmental benefits from shift to larger scale units, especially where legislation requires this; e.g. managing livestock emissions. • Less overgrazing and some	• Reduced levels of institutional capacity and a reduced agriculture budget will impact on the actions necessary to mitigate the risks set out above. • Less capacity to address damaging or unsustainable practices via legislative measures. • More exposure to world market price fluctuations and

Scenario	Potential Environmental Implications	Key risks	Key opportunities	Key constraints
agriculture. • Support for innovation and productivity increases but little or no use of untargeted direct payments. • Lower environmental ambition. • Reduced AECM budget.	management, linked with neglect/removal of features. • Some extensification and movement of land out of agriculture; abandonment or afforestation in marginal grazed areas. • Fewer livestock but more concentration. • Reduced GHG emissions and overall nutrient load. • Declining biodiversity value of many extensively grazed habitats following reduced management and abandonment; area of HNV farmland contracts. • Potentially more use of currently heavily regulated agrochemicals and extended authorisation/use of GMOs.	• Pressure to reduce legislative standards so as to ease the competitive position of producers. This will have associated environmental risks in terms of water pollution, emissions of ammonia and the possible re-introduction of certain pesticides no longer used within the EU. • More abandonment and withdrawal of management in extensively grazed areas e.g. a further decline in HNV farming. • Increased intensification in parts of the lowlands, especially in dairy, arable margins and horticulture. • Less support from government for agri-environment and climate measures (AECMs) including those for organic farming. • Reduction in the capacity to provide advice and support to farmers. • UK environmental food footprint domestically and in rest of world likely to increase as a result of increased agricultural imports.	benefits in the uplands from fewer sheep, more woodland creation and increased carbon sequestration (but negative impact of undergrazing in some areas). • Cheaper land prices in some places could drive an increase in 'nature focussed' schemes and provide opportunities for new entrants. • Some more marginal arable land may come out of cropping as a result of reduced support levels and more volatile prices.	volatility on these trade models; farmers understandably more cautious about long term investments in sustainability enhancing measures with limited short term return. • Less public sector leverage on farm environmental performance because of reduced support and end of cross-compliance.
Scenario C: Promoting Environmental Sustainability • High level of environmental ambition including effort to meet existing targets and set new ones e.g. in relation to climate, soil, biodiversity, flood	• Higher participation in AECMs than at present; actively supplemented by private initiatives, including Green certification schemes. • Decline of HNV farming slows or even halted if there is sufficient focus and expenditure on this theme. • Soil and water management improved because of focus on AECMs, strengthened private	• Lack of farmer engagement leading to failures to meet goals, inefficient outcomes and concern re use of public money. • High administrative burden. • Farm incomes fall and resulting structural changes are more powerful than the countervailing environmental measures e.g. a wave of farm amalgamations take place coupled with significant abandonment, leading to difficulties in maintaining farm	• Appropriate legislation is put in place and is respected, especially as incentive schemes are available. • Resources are available to apply a new approach properly and change longer term mind-sets. • Funds available to support environmental measures and much larger level of take up, especially in otherwise	• Trade-offs between different environmental objectives and with other key agricultural objectives would need to be confronted in this scenario even more than in others. • Budgetary constraints might limit the resources available to achieve sufficient take up by farmers and capacity to achieve objectives. • Limited willingness on the

Scenario	Potential Environmental Implications	Key risks	Key opportunities	Key constraints
management • Main focus of a diminished but still substantial agricultural support budget allocated to environmental schemes; a larger proportion allocated to the uplands. • Untargeted direct payments diminished. • Trade arrangements closer to existing arrangements than highly liberalised model.	schemes (e.g. in expanded number of water catchments). • Management and retention of landscape features higher than in other scenarios. • Combination of regulatory measures and incentives increases the adoption of IPM and organic methods, with reduced use of certain agrochemicals. • More attention to habitat restoration and recreation as well as carbon sequestration.	investment. • Increase in lower cost and lower quality imports (depending somewhat on the trade scenario) undermining those UK producers continuing to meet high standards and leading to an increased global footprint for the UK. • Institutional capacity not strong enough to support ambition with more limited budget for design and oversight resulting in simpler less effective schemes with reduced oversight? • Insufficient investment in advice and delivery systems leading to poorer results on the ground. • Failure to engage the private sector, leading to over reliance on public expenditure.	declining HNV areas. • Helpful context for building a longer term rural environment strategy. • More scope for experimenting in scheme design and delivery. • Better environmental outcomes. • A new paradigm for agriculture and land managers, better connected to local communities and priorities, with enhanced role for stakeholders and locally tailored approaches.	part of farmers to commit to long term agreements in a more unpredictable climate with greater exposure to market volatility and political change. As a result, the reach of environmentally focussed policies may be limited. • Farmers may need to maintain output to generate income to service debts, with limitations on their capacity to enter environmental schemes.
Scenario D: Territorial Approach • Stronger devolution of agricultural policy making to the sub-national level, including regions within England. • A variety of different trade arrangements would be compatible with this scenario. • Support levels for agriculture lower than now but not below half (will be influenced by trade arrangement). • Different weightings	• Greater variations in the trajectory of agriculture and rural land use than at present. • Examples might include greater focus on regional products e.g. dairying, beef or horticulture, in some localities, others may emphasise the cultural landscape or stronger role for agriculture in flood control or perhaps forestry. • Resources may be more concentrated on local priorities such as marginal hill livestock in some parts of the country. Probably would support biodiversity and/or reduced water pollution in certain areas • Meeting some national targets	• Arriving at a weaker overall strategy and possibly weaker national legislation, as an unwanted by-product of the decentralisation process. • Lack of coherence with regard to national priorities and the economic environment for agriculture. • Patchy availability of resources and some danger of duplication; perhaps harder to lever Treasury funding as a whole. • Danger that local priorities will fail to deliver enough to meet or undermine some larger national objectives. • Potentially a lack of institutional strength in some areas, especially smaller ones. • Possible fear of lack of continuity in environmental support due to local	• Policies can be better targeted to local needs. • More vigour and diversity at the local level. • Experimentation and learning from early adopters. • Potential benefits from more diverse approaches and perhaps healthy competition. • Better stakeholder engagement. • Better outcomes, especially at local level in some areas as a result of better local engagement and enhanced capacity to innovate. • Stronger sense of local identity could help to build sustainable supply chains and	• Whether the time and resources are available to bring about such a major change in approach during a period which includes many other pressing challenges, such as designing and implementing post CAP policies across the UK in a short timescale. • Capacity to organise the different layers and institutions and secure sufficient join up of systems as required and ability to carry the additional costs, including institutional overheads and potentially greater level of transactions.

Scenario	Potential Environmental Implications	Key risks	Key opportunities	Key constraints
for the environment and production in different parts of the UK. • Major variations in the scale and design of AECMs. • Elements of national framework retained with limits placed on policies pursuing competitive advantage and disparate standards.	e.g. for lower GHG emissions could be more challenging. • Differences in standards between different localities across the UK more likely to arise. • Potentially more discouragement of larger scale, more specialised units in some areas.	political changes/pressures, undermining uptake of or ability to offer/guarantee longer term schemes.	assist marketing, going beyond the farm gate. • Potentially enhanced capacity to ring fence funding to regional priorities, such as peripheral/remoter areas.	• Availability of data, appropriate software and support to establish independent policy and administrative systems with the necessary links between them. • A number of requirements will need to be met at the devolved or UK level, including the maintenance of efficient supply chains. • Possible political resistance from national Government to sanction extended devolution in this policy field.
Scenario E: Greener Shades of Liberalisation • Similar impetus towards trade liberalisation and lower levels of agricultural support as in Scenario B. • But with a higher level of environmental ambition. • And a larger proportion of a diminished agricultural support budget being highly targeted and mostly earmarked for AECMs. • Environmental regulation continues	• Trends towards structural change and reduced number of farms, farmers and many landscape features accelerates, much as in Scenario B. • Also reduced profitability of grazing livestock leads to marginalisation, agricultural land abandonment and afforestation, with fewer grazing livestock. • Associated erosion of biodiversity and landscape character in some areas but also benefits in certain areas from less managed landscapes, fewer livestock and more woodland and diverse vegetation (reduced GHG emissions) • However some environmental standards rise in response to combination of regulation,	• Similar environmental pressures to Scenario B associated with structural change and marginalisation which is less dampened by generic support than under Scenario B. • Significant structural change in extensive HNV livestock systems very likely; risk that measures to secure appropriate management in these areas are not sufficient and abandonment accelerates. • Difficult to support the higher levels of environmental ambition with sufficient resources, including AECM budget and institutional capacity given tight spending constraints. • Lack of credibility of some environmental schemes with many farmers aware of limited budgets and potentially weak engagement. • Continuity of funding over longer term	• Reduced cost of managing natural resources via incentive schemes, due to lower opportunity costs. • Potential for substantial take up of well-designed schemes; • Increased woodland and carbon sequestration and some increase in land availability for conservation if the resources to manage it are available. • Potentially more rapid take up of newer technologies contributing to environmental goals following sharper governmental focus and smaller number of competitive farmers. • Potentially faster uptake of low carbon systems and	• Tension between unrestricted trade and environmental standards – there is likely to be significant pressure from stakeholders facing external competition to weaken environmental targets. • Tight budgetary constraints. • Potential limitations in institutional capacity to operate effective and well targeted incentive schemes within budget, alongside the other demands on administrations to assure reasonable continuity and operability during a time of change. • Domestic progress in GHG emission reductions could be offset to some extent by

Scenario	Potential Environmental Implications	Key risks	Key opportunities	Key constraints
to be a major driver. • Alongside policy focus on innovation.	market requirements, more active pursuit of innovation etc. • Targeted incentives protect key sites.	might be in doubt. • Reticence of farmers to invest in higher tech approaches to addressing environmental issues that the Government is inclined to favour. • Territorial identity a low priority and stakeholder engagement likely to be weaker. • Some increase in livestock imports with associated growth of environmental footprint in countries supplying UK.	technologies and systems for similar reasons and because of the enhanced priority in government. • Incentives to develop relationship with private sector along the supply chain and in land management may be enhanced. • Stronger private sector engagement and expanded role for certification schemes.	more imports. • Increased reliance on voluntary certification schemes may not be effective in addressing site specific issues.

Reflections and Conclusions

Drawing on this analysis, a number of reflections and conclusions can be derived from the scenario exercise, whilst bearing in mind its inherently speculative nature. These might be useful to bear in mind when starting to design future agriculture and land management policies in the different parts of the UK. They include:

Greater uncertainty in agriculture and land use

- The scenarios reveal the extent of change that could occur in many of the drivers shaping agricultural practice and land use in the UK both during and after the EU withdrawal process. This contrasts sharply with the relative predictability of several of these parameters within the CAP.
- A period of greater uncertainty for agriculture seems probable arising from reduced predictability in both policy and markets as well as external economic factors such as exchange rates.
- Some uncertainties stem from policy choices and internal decisions, such as future support levels for agriculture, others from external conditions that are hard to control, as flagged in Box 1, above.
- Uncertainty itself has impacts on the climate of confidence and investment, including attitudes to planning ahead, investment, diversification and enterprise and willingness to undertake environmental commitments. These impacts are likely to vary between sectors and parts of the country, potentially more so than previously, not least because of varying levels of dependence on CAP payments and on markets that may be disrupted under certain scenarios.
- The pace of structural change (resulting in a smaller number of larger farms and probably more use of contractors) seems likely to accelerate under several scenarios. This has direct environmental implications, in relation to land use, field size, landscape features and the scale of buildings and infrastructure but also affects the availability of labour and the farming methods employed. It is possible that labour availability on farms would be further reduced by restrictions on the movement of people from EU countries seeking temporary work, especially in horticulture.

Environmental implications

- Whilst all of agriculture will be affected, the scenarios suggest that particularly large changes could occur in the grazing livestock sector because of its high dependence on CAP direct payments, low economic returns at present and vulnerability to market disruption under some scenarios. Changes in livestock numbers, distribution and management could all be of environmental significance and associated with changes in land use, which may include less grazing, more abandonment and/or afforestation. Permanent pasture looks likely to diminish in several scenarios.
- There are risks of accelerated decline in low intensity grazing systems and HNV farmland, potentially affecting SSSIs and Natura sites in some regions, unless there is remedial action.
- Larger, more specialised livestock and horticultural units could emerge under several scenarios while cereal producers could increase the use of fallow if support levels fall markedly whilst at the same time ploughing closer to boundaries, removing margins and buffer strips unless there are effective measures to retain them.

- Localised intensification may also occur under a number of scenarios, for example in relation to horticulture and non-ruminant livestock concentrated in larger units.
- At the same time there are also opportunities for reductions in pressure from some current intensive practices, new forms of land management and perhaps a transition to larger areas of woodland under several scenarios.
- Given a sufficient level of environmental ambition and related funding, policy could give more emphasis to the provision of public goods across a wider range than at present. For example the management of water catchments and soils could be improved, GHG emissions reduced and the biodiversity value of many farmed habitats enhanced.
- As well as the direct implications for the management of the rural environment, there are questions about the extent to which farmers will wish to or feel able to prioritise environmental outcomes given other calls on their resources and a changing approach to risk management. Policy choices will be important here. Clarity about long term government policy and the extent of a long-term commitment to funding incentive schemes almost certainly will be necessary to re-assure those who are concerned that priorities may have changed along with the withdrawal from the CAP.

Policy measures

- The key role of regulation coupled with the resources devoted to ensuring its effective implementation is a recurrent theme under all of the scenarios. It remains an important tool for pursuing agreed goals and addressing both current issues and those that might be anticipated, such as those arising from accentuated structural change and intensification. Uncertainty about the future of regulation will make the protection of the environment more difficult under all scenarios.
- The attractiveness of voluntary agri-environmental schemes and longer term land management commitments could be reduced on many farms during this period unless mitigating measures are taken.
- However, some farms will value the security of voluntary payments as a stable form of income and potentially a hedge against low market returns.
- The level of funding available for agri-environmental incentive schemes, whether innovative in approach or more on established models, stands out as a critical issue under all scenarios, whatever trade model is adopted.
- Under some scenarios these schemes become the main form of support for agriculture, potentially increasing their power to influence land management and making it all the more important that they are well designed, effective and attract the targeted participants.
- The need to secure greater environmental results against clear goals from public expenditure will be as pressing as it is now within the CAP and could be greater under many scenarios.
- Results based schemes, stronger measures to link environmental requirements to market opportunities, better delivery and support arrangements for farmers and other approaches could be developed more swiftly outside the CAP and this represents a substantial opportunity. Clearly this would require both the will and the resources to exploit the opportunities available.

- The case for experimental and pilot approaches will be strengthened as these should face less administrative barriers and budgetary risks outside the CAP. The results-based payments pilot currently being led by Natural England as part of an ongoing LIFE project is a good example.
- To supplement public sector funding for the environment there is clearly a need to mobilise private sector initiatives on a larger scale. There is potential for greater use of certification schemes and direct incentives for more sustainable land management for example. The private sector could be engaged in potentially new ways and at a faster pace. The existing experience with environmentally attuned catchment management undertaken by private water companies is one example, but others could be promoted as well.
- Uncertainties about the funding of voluntary measures and the possibility of reduced uptake by farmers suggests that a range of alternative approaches need to be considered very carefully.
- These alternative approaches include a continued or an increased use of regulation, which could be particularly necessary if the influence of incentive schemes diminishes. However, this could be in tension with the liberalisation and reduced administration themes emerging under some scenarios. The future of some well-established environmental legislation may be put in doubt under certain scenarios and careful appraisal of the costs and effectiveness of those measures and the expected consequences of changing them may be worthwhile as part of a planning process. The risks in terms of a recurrence of environmental problems or decline in progress towards meeting environmental targets associated with a weaker legal framework need to be recognised.
- One critical area is the regulation of agrochemicals and other inputs. Under some scenarios it seems possible that there will be significant divergence from the requirements of EU legislation within various parts of the UK.

Managing change

- A capacity to analyse and forecast future land management choices and their implications will become even more important than it is already. This will apply to policy makers as well as those agencies responsible for deploying measures such as voluntary schemes to meet key environmental goals.
- Sufficient investment in data and survey work will be required. This could include the establishment of a robust baseline for future measurement of environmental change and the monitoring of any policy interventions. Data collection strategies need to reflect the environmental goals established for agriculture and the countryside and this should be in the foreground as changes are made in the coming years, as seems likely.
- Other helpful tools might include the use of well elaborated impact assessments for new policy proposals. This kind of approach could be assisted by the deployment of an up to date model of UK agriculture and land use including appropriate environmental information. Geographical specificity looks likely to be of increasing relevance. The work of the Defra Agricultural Change and Environmental Observatory could provide an exemplar of the type of analysis that might be anticipated.

- Cost–effective approaches to new policy development and delivery challenges will be a clear priority. However, the resource implications of undertaking this preparatory work as well as the longer term management of the rural environment need to be recognised as part of the wider debate on policy choices outside the CAP. Adequate provision amongst the relevant departments, agencies and research institutions will form a key part of this.
- The scenarios are a reminder of the possibility of different policy responses emerging across the four UK countries. There is a clear need to anticipate what issues could arise as a result of this and to plan accordingly in light of the nature of the various devolution settlements.
- A rather different challenge is to assess the best ways of engaging a wider range of actors in the agriculture and land use arena so that policy is more embedded in domestic concerns and dynamics than it was under the CAP. This is likely to include building new relationships with stakeholders at different scales, including those at local level.
- Associated with this will be the need to engage the private sector more effectively in addressing rural environment and sustainability issues, including the food chain on one side and those with an interest in land management on the other. The latter will include water companies, some leisure and sporting concerns and NGOs with land holdings. A revised framing of the challenge and new approaches may be helpful here and looks relevant under almost any scenario.
- For example, within the food chain there could be renewed emphasis on labelling and branding food that has been produced to high environmental standards in a way that can be readily understood and trusted by consumers, complementing the progress that has been made in recognition of the produce marketed under the organic label.
- At the same time well-tuned measures to address specific goals will be required on almost all scenarios. These may be sectoral, for example in relation to HNV grazing systems which look particularly vulnerable in most scenarios, or thematic, for example achieving progress towards sustainable pest management in the arable sector. Or they may be territorial. The future of the uplands and more marginal and remote areas of farmland where significant land use change could occur is likely to require particular attention.

1 Introduction and context

Following the outcome of the UK referendum on EU membership it is clear that, whatever the result of the exit negotiations, a new suite of policies for the agricultural sector will be required to replace the current Common Agricultural Policy (CAP). What the nature of these new domestic policies might be is subject to intense discussions and, since there is likely to be a period of transition between transposing the existing EU rules into UK law and the development of new policies, change may be spread over time. Not least amongst the influences on the ultimate design of new agricultural and land management policies will be the final deal that the UK government makes with the EU on exit, particularly with respect to trade. There are therefore many uncertainties that remain. Discussions on the future shape of UK agricultural and land management policies are still at an early stage.

This report is intended to contribute to this debate, with a particular focus on the environmental risks and opportunities of possible future policy trajectories in the UK and its four constituent countries. The approach is based on the development of exploratory scenarios for the future of the agriculture and related land management sector outside the CAP for the next ten years and beyond. The scenarios are set against the context of the current environmental sustainability of agriculture in different parts of the UK, a review of relevant international law and the changing policy, budgetary and institutional background as the UK leaves the EU (Chapters 2, 3 and 4).

The exploratory scenarios, which include a baseline, are set out in Chapters 5 and 6. They have been created by taking into account a range of factors that could drive future agriculture and land use, including possible policy and market shifts that could conceivably arise in the context of the UK leaving the EU. The scenarios are then used as a means of assessing the range of risks and challenges that could arise for the environment under these different situations (Chapter 7).

There are many important aspects that require consideration in planning future agricultural policy in the UK countries. The appropriate means to address farm productivity, market volatility, plant and animal health and welfare are amongst them. However, here the focus is on the environmental implications of possible future trajectories for the agricultural sector.

The report concludes with some reflections on the scenarios and their possible implications for the next steps in policy development in relation to agriculture and rural land use, with an eye towards the opportunities and risks for the environment (Chapter 8).

2 The environmental sustainability of agriculture within the UK

This chapter provides a brief overview of the current sustainability of land management in the four countries of the UK and sets out briefly how this compares to other countries in the EU. It serves to provide some context for the subsequent analysis of the environmental implications of the exploratory scenarios in Chapter 7.

2.1 Agriculture, land use and economic dimensions in the UK

A high proportion (71%) of the UK's land area is under agricultural use[1] (Defra, 2016). This figure has hardly changed over the past two decades. Broken down by country, the figures are even higher in Wales (~80%) and Scotland (~73%), with the utilised agricultural area (UAA) accounting for 69% in England and 69% in Northern Ireland. The UK figure is one of the highest proportions in the EU, on a par with Ireland where 72.5% of land area is used for agriculture. Most other countries have far greater proportions of their land under forest compared to the UK. In terms of UAA. The management of agricultural land is particularly important for the environment in the UK because of its dominance in land use and the very limited area of more natural habitat.

The majority of agricultural land is made up of permanent grassland (58%), with a further 35% under crops, 5.5% classified as woodland and the remaining 1.5% either outdoor pigs or under non-agricultural use. The distribution of different types of land use varies significantly between the four UK countries, with arable cropping and horticulture constituting less than 5% of UAA in Wales and Northern Ireland compared to 54% in England. This is despite significant increases in these land uses in Wales over the past decade (Estimates from Welsh Agricultural Survey, June 2015). Wheat is the most important arable crop, with annual production generally more than double that of barley. The UK has a far higher proportion of permanent grassland and meadow compared to all other Member States with the exception of Ireland. Compared to the UK, only Slovenia, Portugal and Ireland have a smaller proportion of arable land.

A significant share of farmed land is in the uplands and more mountainous areas of the country. This is reflected in the classification of "Less Favoured Areas" (LFA) for agricultural land established under the CAP. Such land is characterised by less fertile soils with limited agricultural potential and below average economic returns. A large proportion of the agricultural area in Scotland (84%), Wales (80%) and Northern Ireland (~70%) is officially designated as Less Favoured Area (LFA) under the definition of 'areas in danger of abandonment of land-use'. Most of these areas are grazed and large tracts comprise extensive grazing systems of High Nature Value (HNV). In England the LFA covers only 16% of the total farmed area, but this includes significant tracts of the uplands in the north of England and some in the south west.

[1] The utilised agricultural area is made up of all arable and horticultural crops, uncropped arable land, land used for outdoor pigs, temporary and permanent grassland and common rough grazing.

Three per cent of UAA in the UK is farmed organically, either registered as fully converted or under conversion (Defra, 2016c). While this proportion has declined in recent years it may now be more stable. The organic area in 2015 stood at 521,000 ha, a decline of 30% from a peak in 2008. Two thirds of the organic area is under permanent pasture, with a further quarter under arable land (either temporary grass or cereals). Sheep and poultry are the most popular types of livestock farmed organically.

In economic terms, the contribution of agriculture to the economy has been falling over time within the UK. Table 2 sets out the gross value added (GVA)[2] of agriculture in basic prices for the UK countries in 2014 and 2015 as well as the agricultural sector's share of regional GVA for 2014.

Table 2: Gross Value Added of agriculture in basic prices (2014 and 2015)

Country	Gross Value Added (GVA) - £million (2015 figures)	Gross Value Added (GVA) - £million (2014 figures)	Agricultural sector share of regional GVA (2014 figures)[1]
England	6,628	7,826	0.57
Northern Ireland	351	473	1.38
Scotland	1,132	1,184	0.96
Wales	385	473	0.71
UK	8,495	9,869	0.61

[1]Data on national and regional GVA for 2015 are not yet available
Source: Defra, 2016

Relative to global and European competitors, productivity growth in UK agriculture is low[3], and farm incomes are highly variable over time and between farm types. Looking at the sector as a whole, Total Income from Farming (TIFF) in real terms fell in the UK from over £7bn in 1995 to £2bn in 1999 and 2000. It then rose and peaked in 2011 and 2013 at about £5.5bn before dipping again below £4bn after 2014 (Defra, 2017). Within this aggregate, and over the most recent five years, Farm Business Incomes (FBI) as measured by the Farm Business Survey declined for most farm types except specialist poultry and pig units (although the latter dropped severely in 2016). Dairy farming has experienced more erratic conditions and the FBI was particularly low in 2015/16 following the Russian embargo on imported EU dairy products.

There is a chronic problem of low farm business income in the beef and sheep sectors. Many farms in these sectors (whether located in the lowlands or the uplands) are heavily

[2] GVA at basic prices is output at basic prices minus intermediate consumption at purchaser prices. The basic price is the amount receivable by the producer from the purchaser for a unit of a product minus any tax on the product plus any subsidy on the product

[3] USDA Economic Research Service: International Agriculture Productivity: https://www.ers.usda.gov/data-products/international-agricultural-productivity/ and CAP Context indicator 27 – total factor productivity: https://ec.europa.eu/agriculture/sites/agriculture/files/cap-indicators/context/2016/c27_en.pdf

dependent on direct payments received under the Common Agricultural Policy. These general trends apply across each of the four territories of the UK (Defra, 2016)[4].

2.2 The effects of the UK's land management on environmental public goods and ecosystem services

The farming systems and associated management practices used in different parts of the UK have a strong influence on many aspects of the environment and the state of natural capital. This includes contributing to environmental and climate benefits provided by functioning ecosystems such as providing high levels of biodiversity, clean water, functioning soils, clean air, reduced GHG emissions etc. Certain trends are improving, for example, the rate of hedgerow removal declined after the introduction of new regulations in 1997. Elsewhere, the pressures arising from agriculture remain significant; for example phosphate and nitrate levels in water bodies remain problematic and populations of farmland birds and grassland butterflies continue to decline, despite progress made through the implementation of agri-environment-climate schemes over the past thirty years.

A summary of the main effects of agricultural management on various aspects of the environment and climate, is provided below. More detail and a comparison with the situation in other EU countries is set out in Annex 1.

Biodiversity:

The need to reverse historic declines, as well as maintaining and restoring farmland biodiversity remains a key challenge in all UK countries. Farmland birds are still in decline in all UK countries although some levelling off in the downward trend and/or improvements have been seen for certain species since 2013 (Defra, 2016d; SNH, 2016; RSPB, 2015). The causes of such declines are complex and vary from species to species, but most are related to agricultural improvements, increased specialisation, the loss of non-farmed habitats in the landscape and the intensification of management. Amongst the farmland birds to experience long term declines are arable farmland specialists, which have been affected by changes in agricultural practices, including loss of field margins, a tendency towards autumn sowing of cereals, and increased use of fertilizers and pesticides (SNH, 2016; RSPB, 2015). Upland birds continue to show long term declines, particularly in Scotland, with the main drivers of the downward trends being habitat management and predation (SNH, 2016). Pollinators also continue to be under pressure and are exhibiting long term declines. The available evidence suggests that agricultural intensification and expansion are the most important factors contributing to the decline in pollinating insects, specifically bee species[5].

Despite some improvements over recent years, a significant proportion of protected habitats and species[6] associated with farmland continue to be in unfavourable condition.

[4] Data based on Agriculture in the UK 2015, DEFRA, Department of Agriculture Environment and Rural Affairs (Northern Ireland), Welsh Assembly Department of Rural Affairs and Heritage, and The Scottish Government Rural and Environment Research and analysis Directorate.

[5] See indicator 'change in the distribution of UK pollinators, 1980 to 2010' - http://jncc.defra.gov.uk/page-6851

[6] Related to the EU Birds and Habitats Directives

This is an issue highlighted in all four UK Rural Development Programmes covering the 2014-2020 period. Amongst the pressures identified are overgrazing of sensitive upland habitats (e.g. blanket bog), undergrazing, pollution from nitrogen deposition and inappropriate management of habitats such as hedgerows. This mirrors the situation in other parts of the EU, where those habitats and species protected under the Birds and Habitats Directives and depending on agricultural ecosystems (including natural and semi-natural grasslands) are doing worse than sites as a whole (EEA, 2015). The quality of habitats in the wider countryside continues to be a cause for concern. For example, changes in lowland or enclosed grassland management in Wales and Scotland continue to impact upon biodiversity, with continued intensification of grassland as a result of an increase in the area of grass leys in the past decade recently identified in Wales as significant (Welsh Agricultural Survey, June 2015). In Wales, 54 species of arable associated flora, the most threatened group of plants in the UK, are considered rare or threatened and 7 species extinct (Natural Resources Wales, 2016).

Water:

Agriculture continues to be a major contributor to the pollution of both surface water and groundwater, particularly in relation to nitrogen, phosphorous, pesticides and sediment. These lead to the contamination and eutrophication of water bodies, with effects on aquatic biodiversity. Of these issues, phosphate pollution is the most significant cause of concern for achieving good ecological status in water bodies across the UK[7]. According to the EEA, about 40% of UK's groundwater bodies were in a poor status in 2012[8], one of the highest proportions of any Member State. In England agriculture is the cause of 30% of all water bodies not achieving good ecological status whilst the figure for Scotland is 18%. The main causes are:

- nutrient enrichment from excess phosphorus and nitrogen on agricultural land and farming practices;
- sediment loss caused by livestock poaching and river bank erosion by livestock;
- diffuse pollution arising from farmyard runoff.

Across England and Wales, agriculture is estimated to account for 50-60% of nitrate in water bodies (Hughes et al, 2008), 75% of sediment (Collins et al, 2008) and 25-30% of phosphorus (Environment Agency, 2012), although these figures can vary significantly according to local circumstances.

In England, 80% of drinking water failures are due to agriculture, mainly pesticides[9]. Metaldehyde slug pellets account for the majority (83%) of surface drinking water being identified as being 'at risk' from pesticide related issues. The cost of removing nitrate and pesticides from surface water and groundwater drinking supplies is estimated at £133m/yr (Defra, 2006). EU indicators on the gross nitrogen and phosphorous balance of agriculture

[7] Phosphate pollution from agriculture accounted for 56% of failures in surface water not reaching good status in 2016 (EEA, 2016)

[8] Data from the EEA indicator 'Chemical status of groundwater bodies', last updated in November 2012, based on data from the EU WISE-WFD database – see: http://www.eea.europa.eu/data-and-maps/figures/chemical-status-of-groundwater-bodies

[9] See: Progressing towards wfd objectives – Role of agriculture, Environment Agency available at waterlife.org.uk

show that slight declines have taken place for both nutrients in the UK in 2009-13 compared with 2003-2008 and that the UK's gross nutrient balance remains slightly above the EU average[10].

The level of water abstraction for agriculture is likely to become a more significant issue over time. A report by the Environment Agency in 2014 concluded that current levels of water abstraction in some areas, particularly the south and east of both England and Wales are already harming nature and becoming unsustainable.

Soils:
Soil erosion affects the whole of the UK, albeit to varying degrees and is estimated to affect 17% of land in England and Wales where 2.2 million tonnes of soil are lost from fields every year (Environment Agency, 2005). Soil degradation costs England and Wales an estimated £0.9bn - £1.4bn per year (Graves et al, 2011). In terms of degradation, about 45% of total annual soil degradation costs are associated with loss of organic content of soils, 39% with compaction and 13% with erosion. Erosion by water appears to be more severe in England (in particular in the South-West where it can be between 5 and 10 tonnes per ha) and in central Scotland, where annual soil losses could be as high as 20 to 50 tonnes per ha[11]. Soil erosion by wind is estimated to be a serious problem in parts of eastern England, especially on the peat soils, but less so in other parts of the UK[12]. Compaction is also an issue as it reduces agricultural productivity and water infiltration, and increases flood risk through higher levels of run-off. Climate change is likely to exacerbate the problem as a result of more extreme weather events, resulting in more flooding and erosion issues.

Greenhouse Gas Emissions:
Between 1990 and 2014 total greenhouse gas emissions (GHG) from agriculture fell by almost 20% in the UK with most of this occurring between the mid-1990s and around 2006, since when emissions have been generally flat rather than falling.[13]. There are some similarities with the majority of other EU countries, where the rate of emission reductions is slowing over time. Nonetheless, agriculture is the UK's major source of both nitrous oxide and methane emissions accounting for 84% of total nitrous oxide emissions and 43% of total methane emissions. These mainly come from fertiliser application, enteric fermentation by livestock, agricultural combustion and agrochemical use. Significant reductions in the numbers of cattle and sheep and substantial reductions in the overall application rate for nitrogen fertilisers (particularly on grassland) have been the main drivers for the reductions in these emissions. However figures quoted in the Welsh RDP for 2014-2020 (Welsh Government, 2015) show that emissions from the agricultural sector have increased by 3.0% since 2011, compared with 2012. This is a result of both a reduction in the land-use sink of

[10] Eurostat agri-environmental indicators (AEI15 and AEI16)
[11] Estimates are based on the EEA indicator estimating soil erosion by water, last updated in 2012 http://www.eea.europa.eu/data-and-maps/figures/estimated-soil-erosion-by-water#tab-based-on-data
[12] See EEA indicator on number of erosive days/year - http://www.eea.europa.eu/data-and-maps/figures/estimated-number-of-erosive-days
[13] Data from CAP Context Indicator 45 'Emissions from agriculture' - https://ec.europa.eu/agriculture/sites/agriculture/files/cap-indicators/context/2016/c45_en.pdf

22% between 2011 and 2012 and an increase of agricultural emissions of 1% driven by changes in sheep and cattle numbers. Data from Northern Ireland suggest relatively little change in emissions.

Air Quality:
Emissions of sulphur dioxide, ammonia and nitrous oxides from agriculture have declined over time in the UK. Despite this, however, 97% of sensitive habitats exceeded the critical load for eutrophication from air pollution in the period 2006-2008 resulting from nitrous oxide and ammonia emissions, predominantly from agriculture. Agriculture is the main source of ammonia emissions in the UK, mainly from agricultural practices, such as manure and slurry storage, handling and spreading as well as grazing and use of synthetic nitrogen fertilisers. Information from the UK RDPs for 2014-2020 show that England accounts for the majority of ammonia emissions in the UK, with Wales accounting for only 9% of UK total ammonia emissions and Northern Ireland for 11% (2012 figures), with a very small contribution from the Scottish agricultural sector. Ammonia emissions from the UK as a whole have fluctuated over recent years but data from the EEA show a 4.8% increase between 2013 and 2014[14].

[14] CAP context indicator 45 – Emissions from agriculture: https://ec.europa.eu/agriculture/sites/agriculture/files/cap-indicators/context/2016/c45_en.pdf

3 Environmental commitments for the UK arising from international agreements

The UK is party to a range of international agreements, a group of which are concerned with the environment and often referred to as multilateral environmental agreements (or MEAs). Some address global issues, such as climate change, others more regional matters such as air pollution in Europe as a whole or the management of regional seas. In most cases they are "mixed agreements" in the sense that both the UK and the EU are signatories so that responsibility for implementation is shared. A few are signed only by the UK as well as by other European countries but not by the EU and there are also some that are signed by the EU but not by individual member countries. So the situation is a little complex and the consequences of withdrawal from the EU not entirely clear at this stage. The working assumption is that the UK will continue to abide by these obligations after leaving the EU and will not withdraw from those which now apply purely by virtue of EU membership. However, it must be noted that there are uncertainties that may not be removed rapidly.

These agreements and the obligations they entail are one factor potentially constraining policy choice for the UK for the farmed countryside. They have been taken into consideration when constructing the scenarios in Chapter 5.

This review shows that of the many MEAs, most have limited relevance to this report and cover a small proportion of the wide field of environmental law. A list of the most relevant international environmental conventions and agreements which the UK is party to can be found in Annex 2. Not all of these MEAs will necessarily have direct implications for UK farming policies, although they seem likely have a bearing on the overall legislative framework for future UK governments.

The selective list of MEAs is sorted by principal environmental issue and includes conventions/agreements that have some links with the agricultural sector but it excludes those purely concerned with agricultural and food trade issues. Most notably the WTO Agreement on Agriculture is not designed to pursue environmental goals and has not been included. However, this Agreement does lay down rules which impinge on the agricultural policies that legitimately can be adopted by WTO members. In principle these rules place important constraints on the future options for agricultural and land use policies in the UK. These are further discussed in Chapters 4 and 5.

As noted earlier, most of the listed environmental conventions have been ratified by both the UK and the EU because they are "mixed agreements", covering issues over which both jurisdictions have formal competence. The practicalities of negotiating stand alone status for the UK outside the EU in these agreements is currently a topic of discussion and very possibly will continue to be so in the next few years. Nonetheless, existing agreements are expected to continue to apply after the UK leaves the EU (House of Lords, 2017a).

The precise obligations arising from each MEA vary considerably and many requirements are framed in rather broad terms. In practice the EU has put in place binding EU legislation

to make the requirements more specific in a number of cases, effectively extending the requirements of these international agreements through transposition (House of Lords, 2017a).

This was illustrated during the recent inquiry by the House of Lords EU Select Committee relating to environmental and climate aspects of the decision to leave the EU:

> *"Generally, the EU has not simply taken an international convention and transposed it into international law and left it at that. It has often added in hard edges. It has added in deadlines, timetables and things like that. A classic example is how the Berne Convention was gradually developed, evolved and transmogrified into the Birds Directive and the Habitats directive"* (Jordan, 2017)

Where this has occurred, the European Commission oversees the implementing measures in Member States, and applies the associated compliance disciplines, backed up by the European Court of Justice, (the ECJ), as for other binding EU legislation. This discipline provides a significant motive for governments to comply. The underpinning mechanism of the ECJ appears very likely to be removed after the UK leaves the EU, although domestic measures allowing some degree of challenge to UK governmental decisions, notably judicial review, will remain in place.

Outside the EU, obligations on countries ratifying MEAs are not equivalent to those arising from binding EU legislation (with its associated machinery for compliance and enforcement). International agreements are generally a form of "soft law" and the secretariats administering them have much more limited powers (Reid 2016).

At present, some of these international obligations are met in the UK by virtue of purely national legislation or by non-statutory approaches. It is assumed these mechanisms would remain in place following the UK leaving the EU. Other international obligations are met by means of EU legislative measures that apply to the UK. The UK Government intends to "use the Great Repeal Bill to bring the current framework of environmental legislation into UK and devolved law" (HMG 2017a). Presumably this will result in continuity in the current measures to comply with MEA obligations in the UK. Despite this, questions remain about whether certain elements of the EU environmental acquis will in fact be transposed into UK law and how generic principles such as the application of the Precautionary Principle will be applied in the UK once it is no longer bound by the Treaty on the functioning of the European Union (House of Lords, 2017a).

Whilst future governments will be free to change this domestic legislation within certain limits in the future, any such action will need to respect international obligations. Where the UK meets international obligations through EU derived legislation and the EU has adopted implementing measures that go beyond the *de minimis* requirements of the MEA in question, for example CITES, the UK can choose whether to continue to apply measures at this enhanced level of ambition after leaving the EU.

Overall, relatively few MEAs impose specific requirements on agriculture in the UK or involve only limited aspects of the environment, compared to EU environmental legislation.

To illustrate their potential influence on future policy development in the UK, the provisions of conventions addressing four major environmental issues are summarised in Box 11 in Annex 2. This approach is particularly relevant in identifying the absolute minimum level of environmental protection that UK Governments will need to address in future after leaving the EU for certain issues. One interesting example is the topic of air pollution where there are relatively specific requirements for emissions reductions in the UK (and other parties) arising from the Convention on Long-Range Transboundary Air Pollution. These requirements, under the Gothenburg Protocol, apply to overall national emissions of specific pollutants, rather than to particular sectors, such as agriculture or land use. However, agriculture is responsible for 82% of total ammonia emissions, so the obligations [in the Protocol] are likely to have a direct bearing on the agriculture sector.

Other relevant areas of environmental policy have fewer international conventions applying to the UK and are less likely to influence future legislative standards. There are international agreements on aspects of marine management which may have implications for the pollution load discharged from littoral states, but they do not have a strong bearing on standards set for specifically agricultural pollutants, unlike the Nitrates Directive for example. Similarly, there are no binding conventions covering soil management. There are also voluntary agreements and guidelines, such as the Pan-European Operational Level Guidelines for forestry management established by Forest Europe (of which the UK is a member) but these are not binding.

On a broader scale, the UK along with many other countries has yet to put plans in place that will fulfil the commitments made within the new global development framework, "Transforming our world: the 2030 Agenda for sustainable Development" (UN 2015). Core to the Agenda are 17 Sustainable Development Goals (SDGs) and 169 targets which commit signatory countries to address issues such as ending hunger and tackling climate change. Several of these goals are relevant to the agriculture and food sector, but it is too early to predict what influence they will have on policy formation within the UK over the next decade.

4 Some agriculture and environment policy related issues associated with EU membership

Policy making in the land management sector, including agriculture, land use and forestry, will take place in a different context once the UK has left the EU. It is perhaps helpful to summarise some elements of the likely changes before considering scenarios for future UK agriculture and land use policy (see chapter 5). The focus in this chapter is on aspects beyond trade agreements and the future of EU based legislation in the UK. The aim here is simply to identify some issues of potential significance rather than to explore them in any depth, which would be a very substantial undertaking.

Some significant policy changes will occur under any departure scenario. These include UK withdrawal from the CAP together with domestic control being established over spending on policies now covered by the EU. These currently extend to most aspects of agricultural policy and many aspects of the natural environment (the LIFE + programme will cease to apply in the UK for example). The nature and extent of these and other possible changes will be affected by the outcome of the Article 50 negotiations between the UK and the EU-27. These will determine the UK's overall form of relationship with the EU in future as well as a range of more technical or detailed issues, albeit extremely important ones.

More broadly, it is unclear what priority or special treatment will be given to rural policy and its funding after the UK's exit. Pillar II of the CAP has given a particular focus to rural areas that generally has not been a feature of domestic policy.

4.1 Outside of the EU Treaty: some policy principles that may no longer apply

The Treaty on the functioning of the European Union (TFEU) has a number of provisions that affect the practical interpretation of the legislation adopted under it. Currently; it is unclear whether they will be transposed into UK law. These provisions include some of the principles that underlie legislation on the environment, including the Polluter Pays Principle and the Precautionary Principle, which have been an influence on current legislation on pesticides and other issues. The principle that environmental objectives should be integrated into other sectoral EU policies (including agriculture) is also embodied in the TFEU and does not have a counterpart in UK legislation.

4.2 Budgetary rules

The EU budget is set annually but within limits established under seven year cycles. This creates predictability and relative stability for planning expenditure within the period in question, but reduces annual flexibility and leads to major negotiations between the key players towards the end of each budgetary period. This framework applies to the EU Structural Funds and to the CAP where there is also a fixed division between the primary streams of expenditure (Pillar I and Pillar II etc.). In practice this provides more predictability at Member State level than might normally arise under purely national budgetary planning arrangements, including for expenditure on AECMs and other rural development measures. Predictability applies to both public administrations and farmers and is one factor that the latter take into account in making investment decisions. However currency fluctuations that can make a significant difference to farm income through CAP payments (and the funds

available to national administrations for AECMs) also create unpredictability; whether fluctuations will be more significant outside the CAP is difficult to assess but it is certainly possible.

As part of the CAP architecture there are also extensive rules on the management of the relevant budgets with potential penalties for national authorities if they are found to be in breach of the requirements. The aim of this approach is to require good practice with respect to issues such as transparency, accountability, the fulfilment of spending commitments within agreed timescales and verifiability. Similar principles would need to be addressed under purely national rules. In theory, in some respects the task could be easier, given the need to manage particular situations only within the UK rather than in the EU as a whole. However, the level of accountability and level of discipline that would be exercised is not yet discussed in any detail.

Programming over seven years is a key feature of Pillar II of the CAP, but is not the normal approach to planning public expenditure in the UK, so this change will have implications for budget planning by the four UK administrations. Additionally, commitments may extend beyond the duration of the programming period and ten year AECMs have been used relatively widely by national administrations. National authorities have programme budgets in some cases, but they are usually for shorter periods and are more exposed to the risk of being altered at some point during the budgetary cycle.

Under EU rules 30% of Pillar I direct payments is linked to the implementation of 'Greening' measures and there is a minimum level of rural development funding which has to be devoted to land management measures. Such rules do not exist at present in the UK, and it is not known whether earmarking requirements of this kind will be adopted by any of the UK countries after leaving the EU or what the structure of any future agricultural support or agri-environmental payments will look like. In recent years the level of expenditure on land management measures in the UK has been a long way above the EU minimum threshold, but these minimum thresholds have ensured a proportion of funding was earmarked to environmental schemes. It is quite possible that the requirement to spend a proportion of the agricultural budget on environmental measures could be removed.

While the choice of expenditure options on agricultural support options will in theory be much wider after the UK's withdrawal from the EU it is unclear how funds would be allocated. It has been estimated that the UK would need to spend an average of about £2bn per annum just to support the delivery of existing environmental objectives (Cao et al, 2009),which is the equivalent to about two thirds of current UK expenditure on agriculture, around £3 billion. This is key because there has become a heavy reliance on EU schemes, with currently limited domestic funding for agricultural land management and environmental purposes.

At a broad level there is a policy objective that 20% of the EU budget should be devoted to climate mitigation or adaptation measures. The way that these measures are categorised at present allows for a considerable proportion of CAP expenditure to fall into this category but there is no parallel principle governing UK government expenditure in relation to climate management measures.

Another significant consequence of EU withdrawal is the greater freedom that the UK would have to develop its own systems of budgetary administration and control outside the CAP. This would provide the UK with the ability to adapt systems to national requirements down to a detailed level including matters such as the frequency and focus of farm level inspections, the discretion available to inspectors, the verification requirements and the nature of the penalty regime. UK government departments such as Defra will no longer be subject to the threat of disallowance of EU derived funding following any breaches of EU rules. This should provide them with more scope to apply domestic agricultural funds to key priorities and reduce the incentive to make policy choices which are risk averse in this respect. There could also be opportunities to work more closely with certification, assurance or other private sector schemes, which could increase the efficiency and effectiveness of spending, both for farmers and public administrations. However EU derived rules relating to regulation of certain activities, trade and border control issues may continue to be relevant, depending on the arrangements agreed with the EU.

At the same time it is likely that new kinds of budgetary issues could become more prominent. These are likely to include the settlement of relevant budgets relating to agriculture and rural development between the four countries of the UK. Equally important will be detailed decisions about the devolution of overall policy frameworks, reflecting issues such as the degree to which it is considered important to avoid the creation of an unequal playing field for agriculture within the UK. Accountability to the European Commission for domestic agricultural expenditure eventually will cease, although rules relating to trade and border control issues may continue to be relevant to expenditure, depending on the arrangements agreed with the EU. However, there will continue to be scrutiny of a rather different kind from domestic bodies, including the Public Accounts Committees, the House of Commons Environmental Audit Committee and the various National Audit Offices for example on financial auditing aspects.

4.3 Funding of supporting activities

Within the EU a number of activities that are (in principle) helpful to building appropriate policies for agriculture, land management and rural development are partly or wholly funded from the EU budget. These activities include some elements of the Structural Funds (active in many rural areas) as well as programmes of research under the Horizon 2020 programme (for which the main themes for the period 2014-2020 include sustainable agriculture, food security and the bioeconomy). Although much smaller, the LIFE+ programme has funded several projects exploring or demonstrating useful approaches to land management in the UK. Significant EU resources are also devoted to the European Innovation Partnerships (EIP) and other mechanisms promoting innovation and co-operation, such as the Rural Development Networks and Contact Point, research and analysis within the JRC, aid for marketing foodstuffs etc. In addition, soft loans for infrastructure projects and PES schemes, including water treatment activities for example, are currently available from the European Investment Bank (EIB) of which the UK is expected to cease to be a member.

In future the UK authorities in principle would be able choose whether or not to spend resources on equivalent initiatives (or on others that are deemed useful to support policy

and investment in this area) following departure from the EU. An important element of these funding interventions is the sharing of resources and/or intellectual capital between countries. The UK could look into future collaboration options but will not have the same standing in a number of circles once outside the EU (House of Lords 2017b) Irrespective of the scale, quality or value for money of domestic (as opposed to EU funded work) in this sphere, it is clear there will be a different backdrop to policy making in future.

4.4 European Agencies

Several of the agencies established by the EU play a significant role in relation to agriculture, land use and the food chain. For example, monitoring and analysing the changing state of the environment on a European scale and issues arising from this, as well as providing information to policy makers and the wider public, is the main mission of the EEA, (the European Environment Agency). Other agencies have a variety of mainly technical roles, some with a regulatory element. The latter include the European Chemicals Agency (ECHA) and the European Food Standards Authority (EFSA) and the Community Plant Variety Office (CPVO).

The UK could choose to remain a member of the EEA since membership is not confined to EU Member States, but the position is not the same for most other agencies. EFSA for example is devoted to providing scientific advice to the EU institutions and Member States on risk related issues, including some concerned with pesticides and its membership is confined to EU countries under present rules. Given their role and rules on who can participate, there is a strong possibility that the UK will no longer have membership of several of these agencies after its withdrawal from the EU is completed. Alternative arrangements will need to be made in relation to sourcing and deploying expertise, not a completely trivial matter. These arrangements are very likely to involve building up new capacity over a period of time with associated costs.

4.5 State aid rules

While the outcome of the negotiations following the service of notice under Article 50 is unlikely to be clear for some time, in theory EU state aid rules will no longer apply if the UK is outside the Single Market and Customs Union. These rules impose certain constraints on agricultural policy options in the EU Member States, alongside the requirements of the CAP. However, these would very likely continue to apply if the UK was to establish a Free Trade Agreement with the EU, or would be required in some form under the WTO framework). Many current rules are now embedded in national legislation, which will continue to apply until such time as it is changed, as highlighted in the Government's recent White Paper "Legislating for the United Kingdom's withdrawal from the European Union" (HMG 2017b).

Looking beyond these current constraints and subject to the outcome of the Article 50 negotiations, and the need to comply with any relevant WTO rules, the UK could be free to introduce agri-environmental policies that do not conform to the requirements of the Rural Development Regulation. In practice, however, this might not represent a very significant change in the agricultural policy domain. The WTO rules on agriculture, including those established with regard to "domestic support" (Annex 2 of the Agreement on Agriculture) will continue to apply when the UK is outside the CAP. They include the requirement to base payments for environmentally driven schemes in agriculture on the principle of

compensating for costs and income foregone. Precisely how this requirement might be interpreted in future is a different question and would be an issue for domestic rather than EU policy makers.

4.6 The EC as monitor and driver of compliance

As noted above, the European Commission has obligations to ensure that Member States implement EU legislation in the appropriate way, not least in the environmental sphere where there are a large number of individual measures. Their role is backed up by the European Court of Justice which has powers to fine those Member States in breach of their obligations. This provides a strong motivation for all EU governments to implement environmental legislation and to do so either within the prescribed period of time or at least within a period that they judge the Commission is likely to tolerate. Assuming the UK is outside the EEA as well as the EU, these strong incentives to implement environmental legislation will no longer apply. Consequently there is the potential for implementation efforts to slow and expenditure to reduce, with legal experts commenting that in these circumstances there will be "…challenging questions over how the government can be held to account over its environmental commitments" (Reid 2016). Established domestic mechanisms for pursuing environmental grievances will continue to apply, including the judicial review procedure but, these have a rather more restricted role. How mechanisms such as this could be reinforced under national law after UK withdrawal is not straightforward, and there has not been any indication whether this is being considered, so some significant governance issues in this domain remain on the table.

4.7 Reporting and indicators

Outside the EU the UK will not be under an obligation to report on action it has taken in relation to its obligations under EU agricultural or environmental legislation, unless it is part of the EEA. Reporting on activities or progress against goals and targets, as required under many environmental directives, could continue but there is likely to be a reduced readiness to do so, except perhaps on a reciprocal basis (see HMG 2017b). In principle, reports could continue to be compiled, but -directed at domestic authorities or national parliaments rather than at European institutions. This could have implications for the nature of the information that is collected and available in future, the metrics and measurements that are used, comparability with other countries in Europe and the overall level of transparency. At present, indicators agreed at the EU level are used to measure and report in several areas, including on the impact of measures in rural development programmes. It is too early to predict whether the same indicators would be employed by the various UK authorities after UK withdrawal. Changes that weaken the UK's ability to set its agricultural and environmental performance in a European context could be seen as an issue in the negotiation of an FTA with the EU.

4.8 Expert networks

Policy development and implementation within the UK is supported by expertise available through a variety of European scale networks, mainly linked to the EU. UK participation in these also contributes to policy and practice elsewhere. Some of these networks are inter-governmental, with experts from national ministries and agencies. Rural development networks at the national and EU levels receive funding via the CAP alongside support from a Contact Point in Brussels for example. Some existing networks are completely or largely

independent of the Commission, such as IMPEL, which brings together representatives of environmental agencies and ENCA-NET[15], a less formal grouping of nature conservation agencies. Others are scientific, academic and technical.

Choices will need to be made about whether organisations and authorities in the UK will participate in such networks after leaving the EU. Overall, participation and influence seems almost certain to diminish, on leaving although much will depend on the detailed arrangements concluded in the relevant fields, including, for example, whether or not the UK continues to participate in the Horizon 2020 research programmes and their successors, which in turn is linked to budgetary questions. The competing demands on the time of UK officials from the policymaking challenges identified in this paper will also reduce their capacity to engage in such cooperative networks. Assuming reduced participation, there will be subsequent questions about how to compensate for the loss of access to expertise and exchange that could arise.

4.9 Specific agricultural policy regulations and certification regimes

There are a number of mechanisms within the CAP and the policies associated with it that deal with specific topics beyond the principal measures in Pillars I and II. They include regulations and arrangements for addressing animal health and welfare standards, food safety questions, GMOs, pesticides, fertiliser standards and numerous other issues. As with EU environment policy, generally the purpose is to set common standards often at a relatively high level in global terms, and to maintain a reasonably level playing field within the EU in relation to food and agriculture. Certification schemes for agricultural products from the EU, such as PDOs, PGIs and the organic label are of considerable commercial significance in Europe and further afield and some also have a distinctive influence on land management; the organic label is a clear example.

If the UK leaves the Single Market as well as the EU it will no longer be obliged to maintain all of these regulations, even if they are retained for an initial period under the provisions of the European Union Withdrawal Bill. In principle there will be other options for domestic policy, most notably in relation to those regulations that are not essential for maintaining access to certain markets, particularly the EU. For example, the UK, or countries within it, may decide to implement equivalent or identical standards and approaches but within a domestic rather than EU framework. There is the possibility that new domestic standards might vary considerably between the four constituent countries of the UK, depending on the national framework that is established and the choices made subsequently. Alternatively, the UK could adopt either significantly more, or less, stringent standards than those applying in the EU and may, or may not, choose to link UK standards closely with any changes which occur in EU standards over time. A similar range of options is conceivable in relation to certification schemes. Withdrawal from EU schemes is likely to have consequences for the products concerned unless domestic measures are introduced in their place.

[15] http://www.encanetwork.eu/

However many of the existing standards relating to food production will have to be maintained if the UK wishes to continue to export to EU countries without encountering significant tariff and non-tariff barriers. This raises questions about whether some sort of twin- track regime might develop, with certain standards only applying to the proportion of output which is destined for export, although this would be difficult to operate and justify and would be politically problematic. Export opportunities will continue to be an influence on the future composition of organic standards even if the existing EU standard ceased to apply within the UK. Such constraints on altering standards will apply to many aspects of the food sector not just the organic sector. Further, the extent to which UK products could continue to be protected in the global market through the PDO and PGI schemes after the UK's withdrawal from the EU will have to be clarified, along with the alternatives for the future. This is already is a subject of public discussion.

5 Scenarios for future agriculture policy in the UK

The purpose of the scenarios developed in this chapter is to conceive and explore a diverse set of pathways for the agriculture and related land management sector in the UK over the next ten years and beyond. These scenarios are exploratory rather than normative or predictive. They are intended to map out a fairly broad panorama of plausible developments and to offer well-spaced "markers" in this space. Their purpose is to enable an analysis of the opportunities and challenges that could arise for the environment under different situations and the various policy mechanisms that might be appropriate to address these within the different countries of the UK. This analysis is set out in Chapter 7.

The scenarios have been constructed around a range of key factors, which can be conceptualised as potentially important drivers of change that could be influenced by the processes involved in the EU exit negotiations, the subsequent agreements covering trade and other relationships with the EU and the rest of the world, the adoption of policies for the agriculture and related sectors in the UK and the broader economic changes that may accompany this transition. No judgement is made about the inherent merits of the different exit variants that are explored in the scenarios.

Whilst a large number of drivers are likely to have some influence over agriculture and land use during the period, only a limited number can be utilised if the number of scenarios is to remain manageable. To select these drivers and to consider the variables that could be explored in relation to these key drivers, an initial scoping exercise was undertaken.

5.1 Scoping exercise to inform the development of the scenarios

As a first step in building the scenarios and identifying the drivers we have examined the emerging literature and the debate that has taken place since the referendum in all four countries and, externally. The UK Government has published two White Papers (HMG 2017a and 2017b). There have also been political statements by the governing authorities in the four countries. Certain stakeholders have articulated their views, including the NFU, the CLA and some environmental NGOs, alongside other studies and commentaries (such as Matthews, 2016 and 2017; Swinbank, 2016, Buckwell 2016).

We have used these and other sources in developing our thinking on the drivers and other factors to be taken into account in formulating the scenarios for this study.

On this basis we concluded that a number of factors will be relevant to the construction of a new set of agricultural and land management policies which we expect to emerge, at least in an initial form, in the next few years. These are set out in Box 2 below.

Box 2: Factors relevant to the development of a new set of agriculture and land management policies in the UK

Policy, governance and environmental ambition:

- The chosen balance between stability and change in agricultural policy following Brexit and the rate of policy change that is considered feasible and desirable, with some expectation of significant change being tapered over time.
- The level of environmental ambition in the four countries, which will be linked to the issue of whether relevant EU environmental legislation continues to apply in the UK and how far compliance processes in the EU, including the ECJ, continue to have an influence e.g. under a Single Market model, and the degree of commitment to integrate natural capital into public and private decision making.
- The development of climate policy, including the incentives for carbon sequestration, for renewable energy production, (some forms of which impinge on farmland or utilise agricultural crops and residues as a feedstock) and the extent to which specific targets or actions are required of the agricultural sector in future.
- Questions of governance and the powers of devolved authorities in the UK, arrangements for co-ordination of agricultural policy at the UK level (if any) and the extent to which powers and responsibilities in this field might be devolved to a more local level in the different countries (e.g. to the local/regional authorities or entities such as National Parks).
- The degree to which ministers are concerned by the perceived fairness of treatment of UK farmers and their competitive position, by comparison with farmers in the EU 27.
- The degree to which ministers are concerned about business failures and possibly sharp changes in incomes from farming.
- Perceptions and realities of administrative cost and feasibility, not least in relation to more localised policy making.
- Accompanying institutional changes, including those to the various Payment and Statutory Agencies as well as research institutions.
- The role of food supply chain and assurance in producing food sustainably.
- A number of specific issues, including arrangements for migrant labour in the food processing and service sectors and the availability of seasonal/ casual labour for agriculture and horticulture together with the possibility of special treatment for individual sectors.
- The possibility of food related objectives influencing future policy in the light of its political profile. This might include initiatives related to animal welfare, public health, food labelling, marketing, public procurement or regulation.

Wider economic and political drivers:

- The economic strategy in place in relation to Brexit. This includes the degree of commitment to a more liberalised trade regime, the extent to which a de-regulatory approach is adopted and broader issues related to inflation, interest rates, food prices and other high-level economic issues
- General economic developments, including GDP growth and employment levels, the volatility of exchange rates and value of sterling, interest rates and levels of inflation.
- Current and expected developments in market prices for agricultural products.
- Any major developments relating to devolution, the dynamics of developments in the four countries of the UK and at a more regional level. The extent to which there will be a political preference to maintain a broadly similar approach between the four countries and the special factors affecting Northern Ireland in relation to the Republic of Ireland.
- Reactions within the EU-27 to Brexit, in particular the impact on EU budget as well as the future development of the CAP.
- The effectiveness of the many lobbies and interests in play.

Budget:

- The UK budgetary allocation for agriculture and related rural development expenditure post 2019, which will be set in competition with other policy areas, such as health, welfare and education both at the UK and devolved levels.
- The extent to which any of the devolved administrations may be enabled and prepared to devote additional funds to the rural sector from their own resources.

- Institutional implications, especially the share of competencies among government and devolved administrations and possible variations in willingness to regulate are also relevant.
- The settlement of the question of how much the UK may pay to the EU as a result of the Article 50 negotiations may have influence on these matters for several years.
- The level of budget made available for policy design and governance arrangements and for border and customs arrangements with the EU depending on the final settlement will also be relevant.

Trade:

- The central terms of the post Brexit settlement with the EU, including participation or otherwise in the Single Market and the Customs Union (this could be a matter of degree for the Customs Union in particular).
- The timescale for implementation, including any transition or adjustment periods).
- Future trade arrangements with both EU member states and third countries.
- WTO related factors such as: whether the UK receives a share of the EU's Agreement on Agriculture (AoA) "amber box" schedule following Brexit, any other constraints on the formation of domestic policy arising from the relevant WTO rules and dispute resolution system.
- In parallel, the extent to which WTO rules of this kind prove an inhibiting factor to UK governments (bearing in mind the questionable level of WTO compliance under the present CAP).

We have drawn on this review and the policy parameters set out in the brief for this study in arriving at a shorter and more practical list of key drivers to utilise in the scenarios. These are referred to in the text below as "choice variables" and are intended to capture the broader range of drivers listed above, while being unavoidably selective. Some choice variables are relatively synthetic and aim to cover more than one of the drivers listed above. Certain issues, such as technological change, are clearly drivers of agricultural change but are considered to be less influenced by EU exit and so are not selected as choice variables for this exercise.

Before considering these variables (and the scenarios built on them) the issue of future trade options between the UK and the rest of the world is explored further, especially in relation to agriculture.

5.1.1 UK Trade relations options

Although the future trade relationship of the UK with the EU and third countries in the rest of the world does not drive the development of the scenarios, it is worth setting out in more detail the range of possible options that could apply.

The critical trade questions concern the UK's prospective relationship with the EU and then its trading stance with third countries in the rest of the world. The central questions about the UK's relationship with the EU are membership of the Single Market (SM) and the Customs Union (CU[16]). The Prime Minister's stated motivations for leaving the Single Market are to end the obligation to allow the free movement of labour, concerns over the role of the European Court of Justice (ECJ) and at least some of the obligations arising from EU regulation, and to avoid further significant contributions to the EU budget[17]. A key reason given for leaving the Customs Union is in order to be free to negotiate trade

[16] A customs union means the abolition of tariffs and other restrictive regulations on substantially all trade between its members and also the application of the same duties on all third countries.

[17] Lancaster House speech 17 February 2017.

agreements with third countries. The principal alternative to membership of the EU, its Single Market and Customs Union is to strike a Free Trade Agreement (FTA) with the EU.

Whatever the outcome on these matters, there are related but distinct choices on the UK's trading relations with the rest of the world. These could seek to replace existing EU Free Trade and Preferential Trade agreements with corresponding bilateral agreements between the UK and each such third country or bloc. Also the UK could seek to establish new agreements with other countries.

These trade issues are particularly important for the agricultural sector because the status quo is that tariffs between the EU and its trading partners on agricultural and food products are much higher on average than for other sectors. Non-tariff, technical, sanitary and phytosanitary barriers, and attitudes to production techniques, crop protection and animal health products, and novel technologies are also all potentially very important for food and agricultural products. A significant part of the rationale for EU legislation under the single market and a range of other areas has been to harmonise such matters within the EU.

In selecting amongst these trade options the Government will need to make choices about its ambitions and vision for the agri-food sector, including its role as an exporter and the attitude struck towards imports. Sentiments and attitudes amongst stakeholders in the UK on the latter range from the "mercantilist" stance that imports are "bad" and efforts should be made to increase self-supply, to a desire to restrict any rise in food and raw material prices to a minimum e.g. by buying from the lowest cost sources of such products and commodities.

These trade matters are the subject of negotiations both within and outside the EU, the outcome of which is difficult to foresee. These are likely to take a minimum of two years to clarify, or perhaps considerably longer, especially with regard to new trade deals with non-EU partners. In the meantime there is unavoidable uncertainty. For analytical convenience we have arranged the possible outcomes within the following five possible models, starting with the least disturbance to the status quo on trade and ending up with the most radical change, accepting that they may take some years to develop fully. A wide spectrum of possible outcomes has been kept open.

1. *The UK remains inside the EU single market and the customs union and negotiates the details of treatment of labour mobility and migration*. This poses relatively little disturbance of the status quo for agricultural trade within the EU. It retains existing trading conditions with third countries as the EU common external tariff would continue to be applied. Remaining in both the Single Market and the Customs Union would mean that there is no need to introduce customs controls at the frontiers with the EU. It is worth noting that Norway, which is in the Single Market and the European Economic area is not in the EU Customs Union so it does have border controls along its frontier with the EU.

   All other options will mean that border controls of some kind are necessary to assess the suitability of entry of goods into the EU, to check compliance with rules of origin and impose any potential tariffs or duties. The economic implications of this are worth considering. Border controls in themselves, even without tariffs or import duties, introduce additional costs of conducting business with other Member States. The controls themselves demand public resources (buildings, parking space, and staff) and they add time to private transportation, and further costs for perishables. Economists

estimate these trade facilitation costs typically lie in the range of 4% to 8% of the value of the goods traded (see Matthews, 2016). For imported goods the incidence of these costs means typically that prices rise in the importing country. This provides more protection to local production. Such impacts may be small considering other factors in play, such as exchange rates and differences in production costs. However, in principle they also reduce local consumption, potentially reducing trade. For exported products the opposite is true, the exporters will bear some of the additional costs so their exports will be dearer abroad, their domestic consumption may rise in response to possibly lower prices and exports fall.

Two other factors can amplify these effects. First, if tariffs are imposed this drives up the price of imports further, giving more protection to the local producers (but increasing costs for those businesses that rely on imported goods). If UK exports face tariffs then the local price falls further. Second, if the changes in trading relationships spark a fall in the currency (c.f. the 12% fall in the value of Sterling vs the Euro since June 2016) this also tends to amplify the local price effects of the border controls (i.e. imports look dearer at home and exports look cheaper abroad). Each of the following scenarios will therefore exhibit these impacts to some extent or other.

2. *The UK leaves the single market but remains in the customs union*. For agricultural trade this could, in common with Option 1, provide relative stability: both for intra-EU trade and external trade outside Europe. Membership of the customs union may well imply constraints on the scope to deregulate in the UK even if the country is outside the Single Market, and it certainly prevents the UK negotiating different trade deals with third countries. This option might avoid the need to introduce border controls.

3. *The UK leaves the single market and customs union but successfully negotiates a FTA with the EU which includes tariff-free access for agricultural products both ways.* It is not unusual in FTAs that the partners have particularly sensitive product areas for which they request a Tariff Rate Quota (TRQ) which allows tariff free access up to the quota but the full tariff applies for imports beyond this quantity. A likely candidate for such treatment could be an EU request for a TRQ for lamb from the UK, which is a major producer. Under this option it would be fairly certain that border controls would have to be introduced. This is because a FTA eliminates tariffs and other barriers to trade on substantially all the trade *originating within the free trade area*. This means that border officials have to determine which products are outside any TRQs and also which products originated in the free trade area and which have come from outside. For food products with many ingredients potentially originating from many different parts of the world the implementation of trade rules, including the EU's rather demanding rules of origin requirements can be complex involving certain costs. These necessary border controls would seem to be the minimum impediments to trade post EU exit, setting aside any special arrangements on the island of Ireland.

   To further minimise disturbance to the status quo on food and agricultural trade this option also assumes that the UK persuades trading partners with which the EU has negotiated free and preferential trade arrangements that these would be adopted by the UK for agricultural produce. It is also specified that this option involves no change in the tariffs the UK imposes on the rest of the world through its current application of the EU common external tariff. Specific arrangements are likely to be needed for the management of Tariff Rate Quotas (TRQs) already agreed by the EU, including

decisions on whether the UK is entitled to a TRQ for particular products and the allocation of TRQs between the EU27 and the UK markets.

4. *The UK is outside the single market and the customs union but does not seek, or fails to agree a UK-EU FTA.* This means that WTO tariffs will apply to trade between the UK and the EU both ways. For analytical convenience, it is assumed that trading relationships with the rest of the world continue unchanged – both through the UK mirroring EU FTAs with other countries and through the application of existing EU tariffs on imports from countries outside all FTAs and PTAs. The WTO most favoured nation principle (MFN) would apply, so that countries with MFN status trading with the UK are treated on the same basis. Thus the main disturbance in this option is on intra-EU agricultural trade. As the UK is a large net importer of food and agricultural produce this mostly increases protection of domestic agriculture. However for significant sectors, specifically lamb for which the UK is a net exporter to the EU, this could result in large fall in domestic prices.

5. *As option 4 but additionally the UK unilaterally, or by agreement, eliminates all or most tariffs and trade barriers on agricultural imports with third countries.* This could be the trade option with the largest disturbance to the status quo for agriculture. It seeks to exploit to the full the logic of leaving the EU in order to be a 'global Britain' seeking to maximise UK exports of the outputs of sectors in which we have comparative advantage such as financial and creative services, for example, and offering as negotiating leverage to drop the protection of our most protected sectors, viz. food and agriculture.

The novelty, scale, scope and complexity of the trade negotiations which now lie ahead also open the possibility that a transition or 'implementation' period may follow the moment of EU exit itself, which it is assumed will be around April 2019. It is hard to imagine how the arrangements which apply during such a transition period could be very different to the status quo (on tariffs, borders, at least three of the freedoms, budget contributions and regulatory standards). In the scenario analysis which follows it must therefore be assumed that we are considering the period after any transition has expired and the UK has fully exited the EU. However, the impact of transitional arrangements, particularly if they are extended over a lengthy period, on the development of future UK agriculture policy is clearly potentially significant. Such a transition could take a number of forms and could for example be based on an existing model, such as the EEA, in which many aspects of the single Market would apply but not the CAP.

In addition to the above possibilities on UK – EU trading relationships, other international trade factors include WTO considerations, such as whether the UK receives a share of the EU's Agreement on Agriculture (AoA) "amber box" schedule following departure from the EU and any other constraints on the formation of domestic policy arising from the relevant WTO rules and adaptation of dispute resolution procedures. The sharing of existing Tariff Rate Quotas that the EU already has with various countries (e.g. with New Zealand for lamb) will also be a matter for negotiation. In parallel, a further consideration is the extent to which WTO rules of this kind are likely to be an inhibiting factor to the development of UK agricultural policy. This is in itself a complex matter as there is currently a questionable level of WTO compliance under several aspects of the present CAP, and indeed the agricultural and trade policies of other WTO members.

The five possible trade options are summarised in the table below.

Table 3: Summary of the five possible trade options identified

	UK – EU trade relationship				UK – Rest of World (RoW) trade relationship		
Option	Single Market	Customs Union	UK-EU Free Trade Agreement	WTO-MFN tariffs apply	EU FTAs/PTAs plus CET	WTO – MFN tariffs	Reduce tariffs
1	Y	Y			Y		
2	X	Y			Y		
3	X	X	Y		Y		
4	X	X		Y		Y	
5	X	X		?			Y

5.1.2 Key choice variables for the scenarios (drivers)

A number of key choice variables have been selected to structure the scenarios because of their role as potential drivers of agriculture, land use and the rural environment. These are set out below. For each of them a series of different states can be envisaged so as to create a wide field of possibilities from which exploratory scenarios can be constructed. The variables are:

- The UK trade relationship model with the EU and rest of the world, as discussed above;
- The overall governance and institutional frame, relating to the countries within the UK and the level of devolution of powers in this sector to more local agencies;
- Possible purposes and levels of overall financial support from the public purse for the agriculture and land management sector;
- Key policy objectives and mechanisms for providing economic and other support for the sector;
- Other important forms of intervention which may be adopted, including the approach taken to environmental regulation and to the involvement of the private sector in meeting environmental goals; and
- The overall level of environmental ambition and wider objectives e.g. in relation to the UN Sustainable Development Goals.

For each of these variables/drivers a range of different states or dynamics can be envisaged in the coming years up to and after leaving the EU. The position will not be uniform in all parts of the UK but some common elements will apply. The, different states are an attempt to set out a range of possible choices or circumstances. Where the variable is a policy driver, a spectrum of policy options within a broadly plausible range has been selected, accepting that these are an aggregation of and shorthand for a more complex and dynamic set of factors and forces that would be in play. Policy changes and major developments in the market would be expected to build up over time rather than consisting of sudden and discrete changes.

A very broad field of possibilities can be created by considering the full range of possibilities for each of these variables, which have been set out below in a summary table (Table 4). This shows the different states of the six choice variables along one axis and the variables themselves on the vertical axis.

The scenarios, including a baseline case, are then developed by choosing a selection of options from this very wide field. This was done by a series of iterative steps, with the core team of authors considering the literature in the field (e.g. Garnett et al 2014), historic experience and positions (e.g. Defra and HM Treasury 2005), the contemporary discourse in related fields, including policy positions being adopted by various experts and stakeholders (e.g. NFU2016, CLA 2016 and House of Lords 2017b) and the views and perspectives of a range of experts in the field. Initial proposals were discussed in brainstorm sessions within IEEP and then explored further and refined. This involved further brainstorming, discussion of options with experts from the sponsoring agencies and invited challenges from colleagues not working directly in this field to try to capture wider perspectives and possibilities.

Table 4: Summary of scenario choice variables and states, looking ten years ahead

	State of variable				
Choice variable	**1**	**2**	**3**	**4**	**5**
1 UK trade relationship	**Inside Single Market and Customs Union** Mirror EU CET.	**Exit Single Market In Customs Union** Mirror EU CET.	**Exit SM and CU** FTA with EU Mirror EU CET.	**Exit SM and CU WTO tariffs on EU trade WTO tariffs** with RoW.	**Exit SM and CU Reduce tariffs on trade with EU** and RoW.
2 Institutional frame / governance	Uniform UK approach to agricultural policy.	Some differences between countries, as now.	More variations between countries, fully devolved frame.	More localised approach within devolved framework.	
3 Level of agricultural support	Higher than now.	At same level as under the current CAP.	25% cut in overall expenditure.	50% cut in spending.	70% cut in spending.
4 Key agricultural support mechanisms still dominant	As now, with some Direct Payments (DP) converted into risk management measures.	Direct payments reduced and new risk management regime, more loans.	Lower DPs, more environmental Public Good (PG) focus and some coupled payments.	Environmentally focussed payments dominant alongside risk management regime and private funds for ecosystem services.	Innovation, advice, capacity building & PGs dominant; little routine support.
5 Other government actions / regulations	Active intervention: high standards strengthen regulations & eligibility conditions.	Weaker regs and enforcement, voluntary focus & advice.	Emphasise local & regional variation. Devolved rules and approaches.	Emphasis on supply chain standards, certification and advice via private suppliers, aversion to regulation.	Reduced interventions, instead support is directed through advice, and training etc. and more emphasis on voluntary measures.
6 Environmental ambition	Broadly as now, including continued pursuit of goals in EU based legislation such as WFD with certain variations between countries.	Higher level of ambition across the range, including climate related; aiming at leadership in greener agriculture.	Ambition rises on selected domestic issues only, including public access and flood control.	Lower ambition, especially re EU driven controls on agri-chemicals, GMOs, nutrients.	All round fall in ambition.

The scenarios in the study are “exploratory” in the sense that they develop potential directions of travel within which a consistent set of individual variables and considerations play different parts or are weighted differently. Each scenario follows an overall logic wherein certain headline priorities are given precedence to create a plausible picture of how policy and certain other key drivers, for example in the market, could unfold in future. The characterisation of contrasting scenarios covering a wide territory of possibilities, provides a basis for a comparative analysis of their environmental implications.

Five scenarios have been established alongside a baseline situation (see Figure 2). They are all sketched at the UK level while acknowledging that differences in the way they are expressed and the particular policies adopted will apply in the different nations within the UK. Furthermore, one of the parameters, (number 2), relates primarily to institutional structures so that some of the potential variations in levels of difference and uniformity between countries and smaller regions can be captured, as seems realistic, but without much further specification of divergent routes. Examples of potential differences between England, Northern Ireland, Scotland and Wales are given.

Each scenario reflects a certain conceivable direction of travel, bringing together different combinations of choice variables/drivers ranging over a panorama of plausible futures but not assuming continuity with the present approaches and attitudes. Different selections of variables have been made with the aim of having a level of coherence or affinity between the variables brought together into a scenario, without implying a prediction or a specified objective. There is no defined end point for each scenario (such as a certain level of production or farm incomes or environmental management) but they all aim to be germane to an exploration of the factors affecting the agriculture/food /land management sector and the potential environmental consequences. Consequences at the local and wider national level will be relevant and even the global level in the case of climate mitigation for example.

The scenarios are constructed taking account of the possible forms of the post EU departure trading and economic relationship between the UK and the EU 27 but are not driven primarily by this variable, important though it is. In principle, each could apply in any future trading relationship (e.g. Membership of the Single Market or a WTO only trade model). However, clearly the nature of the trade relationship will have an important influence on economic conditions in agriculture and on the business choices made by farmers and other land managers as well as on the policies adopted by the different administrations in the UK. Consequently, some scenarios are associated with one or two particular trade models, others to more than this and there is some consideration of the possible impact of the different trade relationship options in each of the exploratory scenarios. Scenario D is an extreme case in that is not related to a particular trade model and conceivably could proceed under any of them.

Figure 2: Relationship between each of the exploratory scenarios and the different states for the choice variables

Choice variables	State of variable				
Choice variable	1	2	3	4	5
UK trade relationship	Inside Single Market and Customs Union Mirror EU CET	Exit Single Market In Customs Union Mirror EU CET	Exit SM and CU FTA with EU Mirror EU CET	Exit SM and CU WTO tariffs on EU trade WTO tariffs with RoW	Exit SM and CU Reduce tariffs on trade with EU and RoW
Institutional frame / governance	Uniform UK approach to agricultural policy	Some differences between countries, as now	More variations between countries, fully devolved frame	More localised approach within devolved framework	
Level of agricultural support	Higher than now	At same level as under the current CAP	25% cut in overall expenditure	50% cut in spending	70% cut in spending
Key agricultural support mechanisms still dominant	As now, with Direct Payments (DP) converted into risk management measures	Direct payments reduced and new risk management regime, more loans	Lower DPs, more environmental Public Good (PG) focus and some coupled payments	Environmentally focused payments dominant alongside risk management regime and private funds for ecosystem services	Innovation, advice, capacity building & PGs dominant; little routine support
Other government actions / regulations	Active intervention, high standards strengthen regulations & eligibility conditions	Weaker regs and enforcement, voluntary focus & advice	Emphasise local & regional variation, devolved rules and approaches	Emphasis on supply chain standards, certification and advice via private suppliers, aversion to regulation	Reduced interventions, instead support is directed through advice, training etc. and more emphasis on voluntary measures
Environmental ambition	Broadly as now, including continued pursuit of goals in EU based legislation such as WFD with certain variations between countries	Higher level of ambition across the range, including climate related; aiming at leadership in greener agriculture	Ambition rises on selected domestic issues only, including public access and flood control	Lower ambition, especially re EU driven controls on agri-chemicals, GMOs , nutrients	All round fall in ambition

Legend:

	Scenario A : Full steam ahead for UK agriculture
	Scenario B: Treating agriculture as a standard economic sector
	Scenario C : Promoting environmental sustainability
	Scenario D: A territorial approach
	Scenario E: Greener shades of liberalisation

6 The Scenarios

As described in Chapter 5, five scenarios and a baseline have been selected by choosing variables from Table 4 above in different combinations, chosen because they might occur in relation to a conceivable direction of travel.

Following the process of development, each scenario was given a short title to reflect its key characteristics and provide a general sense of its content to ease the analysis in this and the following chapter. These are as follows:

- Scenario A: Full steam ahead for UK agriculture
- Scenario B: Treating agriculture as a standard economic sector
- Scenario C: Promoting environmental sustainability
- Scenario D: A Territorial approach
- Scenario E: Greener shades of liberalisation

The key characteristics of each scenario, including the principal policy measures under consideration are summarised below in Table 5. They are described more fully in the text together with a summary of the way in which each of these scenarios relates to the variables and states depicted in Table 4 above.

Other scenario exercises relating to agricultural policy have been undertaken. As a comparator we show in Table 7 (Annex 3), a summary of the results of one of the only available quantitative analyses of options relating to the UK's withdrawal from the EU. This was conducted by Wageningen University on behalf of the National Farmers Union. This study examined three trade scenarios (UK-EU Free Trade Agreement, WTO tariffs on UK – EU trade, and full liberalisation), and three domestic agricultural policy scenarios (100% direct payments, 50% cuts in DPs and zero DPs). Both the scenarios chosen and the subsequent analysis have been informative.

Table 5: The Scenarios - imaginable futures for UK agriculture and rural land management and sketches of the policies consistent with them

Scenario label	Scenario concept	Policies consistent with the scenario		
		UK Agricultural Policy	UK Environmental & other policy	Trade Policy Option
Baseline Scenario	• Assumes no UK exit but no foreseeable further EU enlargement either. • EU focussed on jobs and growth and keeping Eurozone intact. • UK continues to participate in CAP.	• Continued incremental CAP reform. • More priority for risk management. • Curbs on value of direct payments. • Some restructuring of greening payments. • More focus on climate, water and soil protection.	• No major new EU initiatives (i.e. no soils directive) but continued pressure on climate action in agriculture, and tightening of sustainable use of pesticides. • More stress on growth – deployment of AI / robotics.	• Stable: potentially some liberalisation via trade agreements (Mercosur) or, depending on USA, protectionism rises? • More competition within EU too – e.g. from CEEC. • No momentum in multi-lateral trade deals.
Scenario A **Full steam ahead for UK Agriculture**	**Focus on farming** (Denmark or France as models), • Increase agricultural and food contribution to GDP. • Food security, Investment and productivity emphasised. • Encouragement to food and forest supply chains. • Buy British encouraged.	**States 1 and 2** • Continued, perhaps higher agricultural support, more risk based management. • Some coupled support where WTO compatible. • More high tech and R&D. • Less AECMs. • Voluntary approaches, certification & professionalization encouraged as much as or more than in other scenarios.	**State 4** • Focus on resource productivity. • Encouragement to biotech. • Switch back to risk- not hazard-, based crop protection licensing. • Less pressure on environmental law enforcement, such as WFD etc. • Lower overall environmental ambition.	**States 1 and 2** • In Single Market and Customs Union or could be outside the single market. • Continue with status quo for RoW with agriculture as a protected sector.
Scenario B **Agriculture as a standard economic sector**	• Less special treatment of agriculture and lower protection levels. • Independence from the state. • More private standards, certification and professionalising farming. • Preference to lower food prices. • Some parallels with New Zealand.	**State 5** • Direct Payments phased out. • Some, relatively low cost risk management measures. • Less institutional support for sector. • Focus on productivity, biotech and precision agriculture. • LFAs reduced & perhaps eliminated? • Much less of AECM / Pillar 2. • Regulation pared back.	**States 4 and 5** • Less enforcement of existing regulations. • No major new initiatives. • General reduction in environmental ambition.	**States 3 and 5** • Outside SM and CU. • WTO models more likely, does EU FTA succeed or not? • Do we adopt WTO tariffs or liberalise?

Scenario C **Promoting environmental sustainability**	**The environmental sustainability scenario** • Secure food via sustainable agriculture. • UK seeks leadership role in relation to greener agriculture. • Role of agriculture in relation to climate, water protection, flood control, soil and biodiversity goals seen as central. • Agricultural policy goals specify progress towards environmental objectives and targets: public goods specified and incentives aligned to them. • Healthier eating more of an ethos. • Public and private food chain support to achieve viable farming.	**States 3 and 4** • More developed and targeted environmental public goods support, mostly Pillar 2-tiered approach – more results-based & catchment scale. • Landscape protection support for LFAs. • Some help for risk management. • Coupled supports used selectively (e.g. Scotland)? • More ecosystem service provision via private funding.	**States 1 and 2** • Clearer integration of agricultural and environmental 25 year plans. • Emphasis on sustainability criteria, including for crop and pest management. • More environmental ambition across the board, with higher targets for climate, soil, catchment based flood control and biodiversity for example. • More organic farming and new approaches such as agro-forestry.	**States 1, 2 and 3** • This scenario is probably incompatible with trade options 4 or 5. • Less pressure to take on biotech as will still be exporting to EU market.
Scenario D **Territorial approach**	**Strongly devolved domestic policies** • Regional responsibilities for agriculture and land use expanded significantly. • Within common UK trade, fiscal and agricultural policy arrangements and common UK technical standards. • Much more devolution of budgets. • Probably common higher targets for climate, water quality & biodiversity but differences between countries significant. • Yet avoidance of internal UK border controls.	**States 2 and 3, maybe 4** • Variable between devolved authorities and between regions in England. • Support divided between risk management and PGs. • Shared risk management in single UK market. • Variable coupled support. • Less uniform LFA. • Some will opt for high tech – others for low intensity systems, or different mixes.	**State 3 and 1-3** • Variations in level of environmental ambition and enforcement. • Variations in stakeholder engagement. • And policy tools adopted. • More territorial approach in many cases including whole landscape/ecological planning.	**States 1, 2 and 3** • Can differentiated choices on trade be compatible with no intra-UK border controls? • This scenario is probably incompatible with trade options 4 or 5.
Scenario E **Greener shades of liberalisation**	**Integrating environment and trade liberalisation** • Reduce protection and agricultural expenditure levels as in Scenario B but not quite as far. • But greater willingness to offset undesired environmental impacts via domestic policy. • Emphasis on raising productivity and technical change in agriculture.	**States 3 and 4** • Significantly reduced support to farming. • More emphasis on aid for public good provision than in Scenario B. • Some but low cost help for farmers with risk management. • More investment aid to moderate impacts of expected structural change. • More attention to food quality than under Scenario B and more engagement of food supply chains in environmental and animal welfare.	**States 3 and 1-2** • AECMs continue to be used although alongside a liberal external world. • More extensive and pronounced use of private sector to purchase ecosystem services.	**State 5** • Extensive, perhaps unilateral liberalisation. • Potentially cheaper food. • Higher farm exposure to price volatility. • Large scale structural change. • But some constraints on liberalisation – e.g. maintaining farm animal health & welfare standards a priority.

1. The Baseline Scenario

This is represented as a continuation of current policy into the future in the four UK countries. In effect all EU policy and process continues to apply, as do the budgetary arrangements. It is not specified whether the UK has left the EU or not and this is immaterial to the scenario. For example, the RDP framework would continue and be renewed in the next programming period. Greening would continue in Pillar I, but could well be modified within the CAP rules, accepting the probability of some evolution in these. Cross compliance against direct payments would continue to be in place. One complication is the Sterling/Euro exchange rate, which has changed considerably since before the referendum. This is assumed to be closer to the current rate rather than that prevailing in May 2016 i.e. about 14% lower.

The broad policy assumptions in the scenario are set out in Table 5 and discussed further in Chapter 7.

2. Exploratory Scenarios

Scenario A can be characterised as '**full steam ahead for UK agriculture'**. It includes a selection of variables compatible with a general goal of increasing agricultural production and its contribution to GDP in the UK (see Annex A). The economic output of the farm and forest sectors would be increasing, potentially for both domestic and export markets. Agriculture would effectively be treated as a priority sector, potentially associated with a food security agenda.

New investment would be encouraged and government interventions would aim to increase the competitiveness of the sector in all four countries. The market share of domestic agriculture would rise and there would be encouragement of stronger links between UK producers in the food and forest supply chains. Regional and national variations in farming and agricultural products might be celebrated more actively than now, as one aspect of variations between the four countries and a "Buy British" ethos encouraged. This would be easier to accomplish outside the CAP and the rules related to public procurement.

Public expenditure on agriculture would be sufficiently generous to support the goals of expansion and growing market share. The overall agricultural budget might be relatively high, especially under more liberal trade scenarios, several of which would be conceivable alongside the main thrust of this scenario. Interventions would aim at supporting agriculture and fostering stability and confidence to invest, as well as actively addressing risk management as a priority, as noted in Table 5. Some direct payments could be continued as well as selective coupled support where compatible with WTO rules. There may be assistance for farms undergoing structural change, at least for a period of time and investment aid to allow modernisation and new buildings, equipment and infrastructure and innovation at farm level.

Cross-compliance rules are unlikely to apply. Greening is removed entirely with some re-focussing on public aid for competitive farming. AECM spending would be at a lower level than now and not scaled up to compensate for the removal of the level of funding dedicated to Greening at present (in contrast to Scenario C on environmental sustainability).

Programming of measures through RDPs could cease or be substantially simplified. Incentives for utilising biomass for energy e.g. via anaerobic digestion (AD) are increased.

Regulations would be adapted to ease the pathway to greater production, with more weight given to risk rather than hazard based approaches for licensing agrochemicals for example. This might entail reversing the EU ban on neonicotinoid insecticides for example. Minimising transaction costs for farmers arising from regulation and maintaining support policies would be a priority.

At the same time there would be attention given to supporting the reputation of British (as well as the distinctive character of Scottish/Welsh/Northern Irish) produce on the market and animal welfare standards would be maintained. Some of the policy environment would be more like that found in parts of continental Europe where support for a thriving agriculture sector is a high priority. The type of policies deployed in Denmark, France or Italy for example might also find a place in parts of the UK.

As depicted in Figure 2 this scenario corresponds to Columns 1 and 2 for most variables but corresponds more with Column 4 with regard to the style of policy interventions and the level of environmental ambition. It is compatible with trade scenarios that tend to maintain or increase domestic price levels for food but not with the removal of import tariffs and tougher export markets assumed in the fifth and most liberalised trade model.

This scenario could emerge from the current CAP model if decisions were made to alter some of the objectives but retain substantial resources inside the agricultural budget. It would imply more focus on agriculture and the food supply chain (c.f. emerging policies in the UK such as the industrial strategy) and perhaps a closer involvement of relevant stakeholders in policy development and delivery.

Scenario B, 'agriculture as a standard economic sector' would be characterised as one where reducing the level of protection offered to the agriculture sector and the size of the agricultural budget were seen as priorities. There would be more emphasis on lower food prices rather than domestic preference, which would be a distinctive difference from Scenario A. Agriculture and forestry would be treated more like other sectors of the economy and less as special cases. This scenario would imply a substantially lower level of support for agriculture within the UK than at present, although with differences between the four countries still being maintained. It could arise relatively quickly following departure from the EU with opportunities to cut expenditure in this policy area in the face of competing priorities.

This approach would be particularly coherent with reduced protection for agriculture in the UK and with trade models that involved lower or zero tariffs on imports (and perhaps less so with those arrangements that maintained higher levels of border protection for agricultural products). Trade model 5 in Table 3 would be the clearest example.

The system of support for agriculture would need to reflect the lower budget and different goals. It might include an element of government aid for risk management but routine direct payments along the lines of the current CAP model would be phased out relatively rapidly,

perhaps with a “Bond” scheme in operation to ease the transition (although the potential implications of this specific mechanism are not explored further in this paper). The emphasis would be on greater independence from the State, together with political acceptance of more rapid structural change and diversification of employment out of agriculture where this arose. Some long established policies, including some in the fiscal domain, could be challenged and possibly changed in this scenario. For example, the tax and excise privileges applying in the agriculture sector, such as the special status regarding inheritance tax and red diesel, could be eroded. Innovation and technological development would be more readily supported than land management practices per se.

Regulation including planning controls might be lighter and geared more to encouraging change and innovation, with less emphasis on the conservation of biodiversity and natural resources and a lower level of environmental ambition. Land uses other than agriculture could expand, including forestry, some urban development and space dedicated to renewable energy sources, alongside an increase in farmland abandonment, especially in more remote areas. Environmental interventions and regulations would remain in place, but might focus less on trying to integrate environmental considerations into production and more on segregated land uses.

This scenario corresponds more to the columns 4 and 5 in Table 4 and sketched in Figure 2 but with some variables in column 3. For variable 2 (governance) several possibilities are conceivable.

Scenario C would focus on ‘promoting **environmental sustainability’.** This is a version of the future driven by a strong emphasis on delivering a larger quotient of environmental public goods in the countryside as well as farming systems that are more resilient in the long term. A transition towards greater sustainability would be anticipated over a period of years, with public support measures more focussed on achieving the necessary transition and strengthened environmental targets than on increased competitiveness in the short term. Such an approach could be built upon the current policy model in a series of relatively rapid steps, re-deploying the budget currently devoted to Pillar I of the CAP.

Policy would be more interventionist than in the previous scenario and could include more explicit longer- term environmental targets, such as for percentage reductions in GHG emissions from the sector and enhanced levels of carbon sequestration by 2050. Biodiversity, water and air quality objectives for the farmed countryside would extend beyond those embodied in current EU legislation, such as the Water Framework Directive in several areas and be more ambitious than now. Policies on protecting water from pollution by nutrients and pesticides and on air pollution from farming might be expected to be more stringent for example and the restoration and recreation of farmed habitats given higher priority. There would be more emphasis on catchment management to address flooding, water quality and ecological integrity.

It would be accepted that this would impinge on production to some degree, especially in the shorter term. For example there could be more use of buffer strips and well-designed EFA type measures on arable farms, potentially in the cropped areas as well as the margins and a relatively stringent approach to the regulation of pesticides and other agrochemicals.

Similarly there would be increased momentum towards meeting the Water Framework Directive standards (or new equivalents) in each of the UK countries.

Agricultural policy support levels could vary greatly under different variants of this scenario but are assumed to be significant, albeit focussed differently and with an overall budget lower than now. Maintaining sufficient prosperity in agriculture to deliver both food and higher environmental standards to levels required might be a challenge. Current untargeted direct payments would be phased out and future support would be more tailored and targeted and related to specific objectives, rather than the continuation of farming per se. A spectrum of different support and incentive mechanisms could be deployed, with varying levels of targeting. Mechanisms might vary significantly between the four countries of the UK with some using more results based payment schemes and experimenting with auctions and some perhaps utilising green versions of coupled payments, for example an approach that has been used with suckler beef in Scotland.

Private funding sources for the delivery of ecosystem services including cleaner water and flood control would be encouraged. Support for organic and other specified systems might be expected to increase, alongside increased attention to newer approaches such as agro-ecology and agro-forestry.

There might be a difficult balance between environmental goals and the acceptance of higher food prices under this model as well as a need to protect the competitiveness of UK producers against imports where these were produced to lower standards.

There is no single trade model that matches with this scenario but it might seem to fit most comfortably with columns 1, 2 and 3 within Table 4. It is compatible with a range of governance options, but the direction of travel here is rather more centralised and target driven than the highly localised one developed in the next scenario.

Scenario C could evolve fairly quickly from the current trajectory, initially using similar approaches to those now being employed, including modified versions of Greening and rural development measures perhaps but re-allocating the funds for the Single Farm Payment to a purely contractual approach to farm level support on a fairly ambitious timetable. Over time more finely tuned measures and innovative approaches would take their place, with increasing variations between the four countries.

Under Scenario D, the 'territorial approach', there would be a much stronger devolution of policy making for agriculture to the sub-national level, certainly to regions in England and perhaps in Scotland as well as to the four UK nations. The assumption here would be that there was one common regime at UK level to cover trade issues, including tariffs, technical standards for products and inputs and a free market for agricultural products within the UK. A simple regime providing some coverage for risk management at farm level (in relation to natural or more man made forms of crisis) might also be embodied in this common approach because of the need to underpin the market within the UK. However, such an approach to risk management is not critical to the scenario and there could be variations in the approach between the countries.

Building on this common base a much more diverse set of agricultural, rural and agri-environmental policies could be constructed than at present. These would be subject to a set of UK wide rules about transparency, common reporting regimes to national capitals (including to the Treasury?), accountability and perhaps a system to prevent the most severe threats to competition within the UK internal market. There could be ceilings on coupled payments for example, although any common regime might be challenging to negotiate. Regional authorities would be given budgets for agricultural support on a fair basis, perhaps with freedom to deploy these to other rural actors if they chose. The relevant authorities could determine their own balance between generic and more targeted support and might be required to go through a lighter version of the CAP RDP programming process, setting goals in an explicit way over a particular timescale. Some kind of central oversight would still be required e.g. through DEFRA or a new agency in the case of England.

The territorial scenario would represent a fairly fundamental change, needing to be phased in and aligned with institutional capacities. However, it might start with a "business as usual" approach that regions or Devolved Administrations would be able to diverge from over time. There could be a decline in the national agricultural budget over 5 years to, say 50-75% of current expenditure (although other variants on the overall level of support would be entirely plausible).

New institutions and stakeholder formations would emerge and public engagement in agricultural and rural policy would be expected to increase. Rural/urban synergies (or indeed new tensions) could emerge in some regions. It would not be practical to specify precisely what choices different regions could adopt, but several options can be illustrated, based on a combination of past evidence and experience in other parts of Europe. For example, some regions might focus more on biodiversity and landscape management, or promote organic systems, whilst others could build up agricultural production and those industries dependent on it. Local specialities and food supply chains could get more attention and farming would be seen as part of a wider socio-economic web rather than a sector with its own policy domain. Most national legislation on the environment would be assumed to remain the same and some national targets would continue to apply.

More integrated and territorial approaches to agricultural and wider land management might be expected to emerge in several areas under this scenario. There would be opportunities for finer grain interventions and more reliance on local partnerships. This might lead to more landscape scale and catchment management schemes and the use of ecological mapping, where the enthusiasm and the resources were available. The capacity, energy and competence of the responsible public bodies would be a key variable in determining the results.

The trade relationship between the UK and the rest of the world is difficult to specify; it might be a model with an FTA with the EU, but other variants would need to be considered as well.

Generous support for environmental measures would be a key foundation for some regions under this scenario, but others might put more emphasis on coupled support or integrated rural development approaches. The result would be an extensive palette of interventions,

but with a major reduction or elimination of the kinds of untargeted direct payments now being deployed (i.e. choice 3 under variable 4 in Table 4 above). This could be consistent with a range of options for the other variables. For example, there could be a range of possible levels of environmental ambition (variable 6) chosen across the regions.

Scenario E, which could be styled **'Greener shades of liberalisation'** would represent a different combination of relatively liberalised trading relationships with other European and third countries, with less protection for domestic producers than now and a significantly reduced agricultural budget but this would be accompanied by a stronger level of environmental ambition than in Scenario B. Tensions between these key attributes could create both risks and a spur to innovation.

In this case the trade arrangements would be outside the Single Market and would probably correspond with option 5 (and perhaps 3) above. Unlike in Scenario B there would be a greater willingness to intervene by public authorities to secure environmental outcomes, including greater resource efficiency and a lower carbon footprint within the food chain. There would be a sharp focus on using the most efficient means to obtain such goals, with tight constraints on expenditure reducing, but not eliminating, the use of incentives.

Productivity gains and innovation would be a high priority under this scenario and there may be more emphasis on "sustainable intensification", with the environmental dimension part of a forward looking image for farming in pursuit of a robust market position. Technological innovation and more rapid take up of best practice would be a central policy goal. The idea would be to appeal to consumers in supporting a sustainable approach and to draw investment into an enhanced UK brand. The connections between a healthy environment and a healthy diet might be examined more closely and promoted both by the Government and a proportion of retailers.

The approach and mechanisms deployed in the four UK countries would include regulatory measures, enhanced advice, market based measures, an emphasis on technological development and an accelerated transfer of new technology to farmers. The private sector, including processors and retailers, would be encouraged to pursue higher standards, including through commercial contracts and certification schemes. Should this involve some increase in certain food prices, it would be less of a constraint than in Scenario B and there would be a readiness to internalise environmental costs more fully. Current regulatory standards would be maintained and some might be strengthened over time.

Public expenditure on agriculture would fall substantially, but not as far as within scenario B. Limited support for farming in LFAs would continue but, on a smaller scale and on a much more stringently targeted basis referring to specified environmental management. This pared down model of support would be expected to drive both formal and informal structural change involving farm cooperation and amalgamation. Economic incentives to co-operate more at farm level might be supplemented by the channelling of more public support via farm groups and collective action rather than putting such high priority on individual farmers joining voluntary schemes. There would be much more emphasis on private sector approaches to providing ecosystem services through different mechanisms, for example to increase soil carbon levels, and active use of advanced technology in policy

delivery and enforcement. The State's willingness to fund land management payments without a very strong rationale would be more limited.

Under this scenario, there would be significant differences between the four UK countries but without substantive devolution to the lower regional levels (in contrast to Scenario D).

The greener shades of liberalisation scenario could develop in steps after departure from the EU, especially if trade conditions moved in this direction and there was an immediate reduction in the agricultural budget but little appetite for easing back on environmental priorities.

7 Exploring the environmental risks and opportunities of the scenarios

All the scenarios indicate potential environmental consequences and new dynamics substantially affecting the achievement of environmental goals in the farmed countryside. These are considered further in this chapter, drawing out the potential consequences of the conditions outlined for each scenario in Chapter 5.

Attention is given to the variations in the dynamics of agricultural production, farm structures and land use that are expected to arise under the various scenarios. Drawing on this an attempt is made to identify any consequences for the long term sustainability of the agricultural industry as well as the environment in different parts of the UK. The analysis draws on our understanding of the current status of the rural environment and the role of agriculture as one of the key variables in shaping environmental outcomes (as set out in Chapter 2 and the accompanying Annex). Key risks and opportunities are highlighted and discussed in relation to the Baseline Scenario outlined previously.

The primary focus in this chapter is on the UK environment as a whole, but some potential impacts beyond the UK are noted. It is assumed that there will be variations between the different countries of the UK in the policies that are adopted within any individual scenario. No attempt is made to elaborate on these in detail, but some potentially important variations between the countries are noted, for example in relation to the different patterns of land use and varying proportions of crop and livestock production.

At the outset it is also worth noting that the scenarios are designed in such a way that they incorporate assumptions about the overall level of environmental ambition in national authorities both during and after the Government's EU exit negotiations. These levels are set higher in some scenarios (e.g. Scenario 3) than in others. This has particular implications, for example, legislative standards relating to the environment (such as water quality) are assumed to be amongst the variables that are set at different values between certain scenarios. Similarly, targets for future environmental outcomes e.g. lower emissions of pollutants, together with the resources devoted to policy delivery, monitoring and enforcement, would be expected to vary somewhat according to the overall level of environmental ambition. This affects the risks and opportunities and hence the environmental outcome anticipated within each scenario.

At a more instrumental level it is already clear that future expenditure levels and, in particular the future of Pillar I direct payments to farmers will be a central question for agricultural policy. This concerns both the merits of retaining such payments at all and some of the more detailed design issues, such as any conditions that might be attached, whether payments are tapered or capped for larger holdings, whether they are time-limited or reduced over time, as well as to the scale of the overall budget. Given the current degree of dependence of many farms on public payments, especially in certain agricultural sectors and regions, it seems likely that some continuing form of support to farmers will be retained beyond 2020. For example, the UK Government has already announced existing CAP payments will continue to that date (HM Treasury 2016) and further expenditure

guarantees have been given for a slightly longer period subsequently, although without underwriting the future of any particular measures.

7.1 The Baseline Scenario

Under the baseline scenario, it is assumed that there would be a relatively stable policy framework and continued changes in agricultural production, farm structures and land use following the same general pattern as is being experienced today. No new policies are assumed to arise in the environmental sphere other than those already in the pipeline, such as the requirement to reduce air pollution from agriculture stemming from the recent revisions to the National Emissions Ceiling Directive. No significant changes in the implementation of EU environmental legislation (such as the Birds and Habitats Directives) are assumed. EU policies continue to evolve in several areas of relevance to agriculture, such as organic standards, the authorisation of specific pesticides/agrochemicals (e.g. glysophate) and the broader circular economy. In the latter case, EU might well propose new measures to reduce food waste in future. In addition, new policies on GHG emission reductions and LULUCF are being debated at the moment and new legislation could be agreed within the next two years.

There may be some increased pressure to reduce GHG emissions and increase carbon sequestration in the agriculture sector, but without a requirement to achieve significant reductions by 2030 (Hart et al 2017). Meanwhile, policy uncertainty over the future of glysophate and other agrochemicals has arisen and is continuing to cause concern within the farming community. In principle, stricter authorisation requirements are expected to reduce environmental risks, but there is also the question of how farmers will adapt their crop protection regimes as certain products are withdrawn - and there is as yet no clear consensus regarding the level of environmental improvement that could be obtained by different policy choices in this sphere.

Similarly, the operation of agricultural policy under the CAP continues within the baseline scenario and no major changes before 2020 have been assumed. Subsequent adjustments are assumed to be gradual rather than radical. However, it must be noted that the public consultation on the future of the CAP completed in spring 2017 is expected to be followed by a White Paper from the Commission outlining some forward thinking. This may appear in 2018 or perhaps later. Commissioner Hogan already has highlighted the importance of simplification, a theme that has been prominent in the recent changes to the CAP "Greening" measures. Further steps in this direction would not be surprising and the proposals from the Commission have been set out in a draft delegated regulation.

There are also some uncertainties about the next steps in the development of EFA policy. In late March 2017 the Commission released a paper recommending that the minimum percentage of eligible land devoted to the EFA measure should not be increased above five per cent. The separate Commission proposal to eliminate the use of plant protection products within EFAs has proved controversial with a number of Member States although the European Parliament's plenary have now voted to accept the Commission's proposals, contrary to the proposals from the Agriculture Committee. This is expected to lead to

changes in the management of arable EFAs, with perhaps reduced planting of catch crops and more use of fallow.

Expenditure on the CAP, both generally and within the UK, is expected to be relatively stable in the period to 2020, but there are some reasons for thinking that CAP expenditure in the next programming period might be lower, even without the impact of the UK's departure. There are other demands on the EU budget including the pursuit of more employment for younger people (see, for example Buckwell *et al* 2017 and Matthews 2017).

Agricultural margins are very tight in many sectors within the UK (see Chapter 2) and the extensive livestock sector continues to remain heavily dependent on CAP support. Consolidation is taking place in most sectors, most notably in dairying. In the arable sector the role of direct payments is also an important source of income, the EU is the principal market for UK exports of wheat and barley and there is a trend towards the use of contractors rather than farming in hand as this can produce higher returns per hectare (Savills Spotlight 2017, Arable benchmarking survey). CAP funding plays an important part in ensuring the ongoing funding of AECMs, support for organic farming and other measures. Funding commitments are locked in to the CAP and thereby to aspects of domestic agriculture spending, especially in the period to 2020, by virtue of EU membership. At the same time the environmental benefits of the Pillar I greening payments are still in the process of being tested, although they are currently unpopular with many farmers.

In summary, the Baseline is associated with continued incremental change and evolution, in the CAP and other policies. There are some uncertainties, for example in relation to the future development of the greening of Pillar 1 and agrochemical policy, but radical change in policy or delivery systems and cultures is not expected. Policy for biodiversity remains relatively stable, with a focus on better implementation of the EU nature directives following the outcome of the recent Fitness Check. Expenditure on green aspects of agricultural policy is relatively secure, but there are considerable constraints on the way that this is spent due to existing CAP rules, including the rather onerous compliance regime that has been put in place.

At the domestic level there are certain important broad aspirations, such as to leave the environment in a better state than the current generation found it (re-stated in HMG, 2017b) but with no new major environmental proposals on the table. There are already significant differences between the four UK countries in some areas of policy, including the proportion of RDP expenditure allocated to AECMs and the extent to which coupled payments are being used.

In the light of this set of assumptions and accompanying analysis some potential key risks, opportunities and constraints are set out in the box below.

Box 3:Summary of key risks and opportunities for the environment of the baseline situation

The **risks** to the environment under this scenario are:

- Those associated with current trends described in Chapter 2, such as water and air pollution.
- Regulation has been driving improvements but there is risk of aggravation of some of these risks because of continued intensification within certain sectors, such as dairy, driven by market pressures.
- Insufficient uptake of voluntary measures that are needed to meet wider targets such as stopping the loss of biodiversity and protecting landscapes, because of insufficient incentives, heavy administrative requirements and/or information failures in difficult conditions.
- Insufficient progress in achieving climate emission reductions and greater carbon sequestration within both agriculture and forestry.
- Some consequences arising from changes within particular sectors such as intensification within the dairy sector (more planting of maize and issues with both storing and disposing of slurry) and the expansion of free range poultry units (increased emissions of ammonia).
- Reduction of resources on many farms to enable them to address environmental challenges. These include capital, labour and skills. Abandonment and under-grazing is now an issue in many less prosperous LFA areas across the UK and Europe.
- Limited investment in support mechanisms such as advisory systems and new infrastructure to help farmers adapt to making the necessary environmental transitions over time.

The **opportunities** are:

- To utilise substantial CAP resources (including those now allocated to Pillar I direct payments) in a better way, resulting in more effective policies for the environment.
- To build on new thinking in the design and use of voluntary agri-environmental measures, drawing on experience in the UK and elsewhere in Europe.
- To refine any continuing direct payments and associated Greening measures in a way that increases environmental benefits and also their acceptability to farmers.
- To progress towards a range of defined environmental standards and targets, supported by the need for the UK to maintain equivalence with EU environmental legislation as part of future trading arrangements.
- To develop sub-national initiatives that can address key problems (such as phosphate pollution in Northern Ireland) within a new legislative framework.
- To utilise a new UK policy framework to encourage environmental investment.
- To improve delivery of current measures in different ways.

Amongst the **constraints** are:

- Those CAP rules that inhibit the deployment of more locally targeted and tailored measures.
- The demanding compliance regime under the CAP and incentives risk averse responses by farmers and public authorities at risk of disallowance and other penalties.
- The capacity of public agencies to deal with high levels of demand from farmers for voluntary schemes when they arise.
- Low levels of income on many farms curtailing their willingness to invest in environmental measures.

The risks and opportunities summarised here are not comprehensive but form one of the foundations for the analysis that follows. Many of the risks apply in the other Scenarios as well, including the difficulty of tackling the scale of environmental change with the current level of resources and regulatory model. They need to be set in the wider context of a relatively stable support system for agriculture within the CAP and accompanying regulatory regime that carries considerable weight and for obvious reasons is more predictable than the conditions that will apply post the UK leaving the EU.

7.2 Scenario A-Full steam ahead for UK agriculture

7.2.1 General synopsis

In this scenario there is strong economic momentum behind agriculture, as measured by output and the emphasis placed on increasing productivity and improving efficiency. The trend towards larger farm size and increased specialisation continues, but farm incomes are relatively steady or increasing, depending on price levels and the extent of support through agricultural policy interventions. Land prices are relatively stable despite the cessation of CAP influence. Investment, especially in production related assets, is higher than in the baseline. There is increased emphasis on technological advances and a less precautionary approach to the regulation of agrochemicals.

In agri-environmental terms, this scenario might see more public sector support for investment in win-win technologies and practices, such as slurry injection and better housing for livestock, as well as precision farming in the arable sector, but with less priority given to maintaining low intensity and more traditional systems through AECMs or other incentives. The strength of environmental legislation as a driver of change in farmland management, practice and investment is likely to be weaker than in the baseline scenario, with less priority given to complying with EU legislative requirements by national and devolved authorities unless they correspond to domestic priorities. There may be less investment in environmental monitoring and data collection, with fewer requirements on farmers to record individual landscape features as a condition of claiming public support payments.

The compliance and enforcement culture is likely to be different once the UK is outside the EU and the CAP, with more freedom to adopt simpler systems aligned more closely to national requirements and practice. This might result in easing relationships between environmental authorities and farmers, but also introduces the possibility of reducing the motivation for public authorities to pursue those national environmental targets already agreed within the EU, but now dependent on national policy decisions. This kind of shift in emphasis could apply at the more local level as well, for example in relation to the requirement to meet favourable conservation status on Natura 2000 sites in the UK.

Private certification schemes could play a larger role than they do at present under this scenario and the environmental elements may be emphasized more strongly. This could provide some additional market benefits for producers of grass-fed beef and dairy for example. Competition between certification schemes in different parts of the UK could arise and this might lead to some upward (or possibly downward) pressure on the environmental requirements they include.

These and other factors would alter the goals and workload of the web of public institutions involved in influencing and regulating agriculture, land use and the farmed environment and the respective role of the private sector, which seems likely to increase under all scenarios. The scale and capacity of the public sector, including the environmental agencies is less certain once the UK has left the EU and CAP requirements fall away but their role may evolve in new directions. They may become more involved in food and farm animal welfare issues for example (House of Lords 2017b). However, the question of funding seems likely to

be a challenge in a period of expenditure constraints. In this scenario such constraints would be less than in others with respect to agriculture.

Box 4: Summary of key risks and opportunities for the environment of Scenario A

Amongst the key **risks** are:

- Pressure on the environment from increased lowland (and perhaps some upland) production, with potential for intensification.
- Potential for continuing economic marginalisation of many more extensive livestock systems and reductions in extensive grazing, especially where fewer AECMs are available; localised over grazing in the uplands where intensification takes place.
- Risk of weaker legislative framework and lower priority assigned to enforcement.
- Diversion of investment and institutional focus in favour of increased production (this may also be at the expense of more extensive systems that are less commercially focused).
- Reduced incentive for farmers to enter AECMs, on top of the uncertainty factor affecting all scenarios.

Amongst the **opportunities** are:

- Bringing a green element into the UK and national food brands including via retailers.
- Expanding the role of green certification schemes, but risk of 'green wash'.
- Building low-carbon production and other public goods into a model for growth.
- Harnessing the investment already taking place in improved environmental management, e.g. through more efficient nutrient management and precision farming.
- Perhaps more focus on animal welfare, with some environmental benefits.

Amongst the **constraints** are:

- Competing pressures on farmers to simultaneously raise productivity and to meet environmental requirements; This is an issue already being addressed within the Defra Sustainable Intensification Platform.
- Budgetary limitations which could squeeze the resources available for environmental payments and infrastructure, given other priorities.
- The multiple demands on the time of government, agency and related staff tasked with developing and delivering new policies and systems as well as ensuring operability.
- Potential limitations on the degree of change that can be accommodated without risking disruptions to delivery and/or tensions arising from differences in approach between the four UK countries.

The possible implications of this Scenario (and subsequently others) are considered below under three headings:

- The overall pattern of rural land use and the trajectory of the farming sector;
- Potential changes in agricultural management with environmental implications;
- Broader environmental impacts, considered in general and indicative terms given the uncertainties involved.

7.2.2 Implications for land use and farming patterns

There might be some expansion in the **cropped area** as a result of new market opportunities, the likely ending of the restraints imposed by Greening and more demand for maize (for both renewable energy and livestock feed purposes). There may be greater cereal export opportunities as well under some trade scenarios, for example for barley, exports of which are rising, mainly for the EU market (AHDB, 2017). However this expansion might be relatively modest and localised. In the LEI/Wageningen study for the NFU referred to earlier

(see Table 7 in Annex 3) it is predicted that even with a price rise of 8-11% for a number of crops, output might not rise all that much, for example, an increase of 2.9% in the case of sugar (van Berkum et al 2016). If sterling values against the Euro remain lower than in the past this increases the cost of several key inputs that are mainly imported, including oil and fertiliser and may give some advantage to crops which require fewer inputs, such as malting barley (AHDB, 2017).

Promotion of dairy products in export markets and elsewhere will occur as part of this scenario with a possible increase in dairy cattle numbers. This could be associated with further consolidation of production on larger farms where automated forms of stock management are more likely to be prevalent and an increasing proportion of cattle are zero-grazed (over the five years to June 2016 the number of dairy farms has fallen by about 12% in England and Wales while dairy cow numbers in the UK have grown by 1.6%[18]). Intensive production of pigs and poultry would continue, potentially with a larger free range sector, given continued or perhaps higher farm animal welfare standards.

Horticulture might expand given an emphasis on domestic production, but this is highly dependent on price levels, competition from imports and the availability of suitable labour. Aid for development and meeting domestic production goals for fruit, vegetables, flowers and novel crops might be more freely available than at present and could stimulate more investment in automation and water management, for example. Niche crops, such as vines could become the focus of more support and active promotion, leading to a continued expansion in area.

Trends in **grassland management** in recent years have been towards a decline in the area of permanent pasture and the UK was close to the ceiling on the loss of recorded permanent pasture under the rules applying in the pre-2013 CAP. Given this and other pressures on grassland noted above, including the anticipated increase in the demand for **maize,** there is a risk that the area of permanent pasture will continue to decline in favour of arable and improved pasture. Losses of pasture do not necessarily involve grassland of conservation value, much is not, but there are implications for soil management and carbon sequestration. Exactly how much scope remains for converting pasture to arable with any chance of an economic return is not entirely clear (unpublished interview findings, IEEP 2017). The level of protection for permanent grassland might be lower than previously under this scenario, especially if EIA regulations were not very vigorously enforced.

The risks of continued decline in the management of the **extensively grazed environment** in the uplands, mountains and other marginal areas (including significant parts of the lowlands, including common land) would continue because of the ongoing economic pressures on producers which might continue to apply in this scenario although there may also be some revival in quality extensively reared meat markets, channelling more income into a portion of these farms. The role of policy might vary significantly within the UK, with some countries giving priority to the sector and the building of markets for grass fed beef and lamb for example whilst others may reduce existing support via CAP mechanisms in

[18] AHDB market information website.

favour of higher yielding producers in other parts of the country. Patches of abandonment and intensification might grow simultaneously as they are doing already, with potentially more grazing pressure in this scenario than in others, at least in some areas.

Expenditure on AECMs would fall and there might be more re-distribution of AECM payments between farms than in the past because of the declining influence of CAP rules and priorities, including those concerning LFA/ANC areas. Funding may be more focussed on building up high quality beef and lamb for the market for example.

In England, where the upland livestock sector is proportionally less significant, the inclination to refocus on measures other than AECM might be much stronger than in Scotland, Wales and Northern Ireland.

Aid to establish new **woodland and forestry** operations could conceivably increase under this scenario, perhaps in relation to renewable energy goals and a greater emphasis on biomass production as well as some withdrawal of grazing. However there could also be areas of the UK where such an approach would be seen as conflicting with the creation of a more prosperous and productive agricultural sector.

7.2.3 Implications for farmland management

Within a broad trajectory and land use dynamic of this kind, significant changes in land management could occur over a relatively short period of time. Certain forms of **intensification** could be expected, especially if market prices were higher than now. This could occur under trade scenarios 1 and 2 (which are associated with the full steam ahead for agriculture Scenario) and if Government support was strongly associated with increased productivity and expansion of the domestic food supply and less so with supporting farming per se or with enhanced environmental management. This was more the flavour of the older CAP and still is in some EU countries. In the LEI/Wageningen study for the NFU the incomes of the more intensive farms i.e. in horticulture, poultry and pig production rise under a broad range of scenarios even with a cut in direct payments, which they are less dependent on than other sectors. For pigs and poultry, incomes fall under a strong trade liberalisation scenario but remain higher than now in horticulture (van Berkum et al 2016).

Further concentration of livestock in larger units seems likely in the light of recent trends, as noted in Chapter 2. There is also some uncertainty about how far this and a possible growth in horticulture and other intensively managed field crops might lead to greater use of **fertilisers and plant protection products**, following the patterns seen in some earlier periods but bearing in mind that costs of many inputs will be higher. Alternatively, pressures in this direction could be more than balanced by a stronger roll-out of precision farming based on field mapping, leading in turn to a much more targeted use of nutrients and less leakage to the environment, particularly on larger farms (see Buckwell 2016, 2017). Usage could also be affected by a revised approach to the authorisation of certain active ingredients, making more products available to farmers than would be the case under the baseline scenario. Certain neonicotinoids could be re-introduced to the UK market for example, given the UK Government's stance on the authorisation issue in recent years, with potential consequences for pollinators.

Enrolment by farmers in voluntary **agri-environment and climate measures** might be more difficult to achieve than now, even if the scheme payment levels were maintained, given the potentially greater prospects for increased agricultural outputs and sales, and desire for flexibility to respond to more unpredictable market signals. There may also be a risk that farmers will be less confident of the continued availability of AECM's outside the CAP, especially where there may be heavy and competing demands on public expenditure, as seems likely in this and the other scenarios.

At the same time, **new domestic environmental priorities,** both in the commercial supply chain and in the public sector will emerge and could have a significant influence. For example, catchment management initiatives could become more prominent in the face of the enhanced risk of water pollution and local flooding. More funds for catchment management could come from the private sector, especially water supply companies and such initiatives could develop faster under this scenario than in some others, especially with less public sector emphasis on environmental incentives and more interest in pursuing innovative approaches outside the CAP (see Green Alliance 2017 for example). Again this could be reflected in increasing scale of operation and more co-operative arrangements.

Private certification schemes, including those operated by retailers, could become an even more important driver of standards for agrochemical use than they are now, particularly if governments opt for a looser regime for their control than is in place now. New initiatives to reduce GHG emissions could emerge as the agricultural share of overall emissions continues to rise over time. If an increased emphasis on maintaining the productive base for agriculture (and other key national resources) emerges as a priority, as could be logical under this scenario, both soil conservation and the re-building of its organic content could be the focus of growing attention in both the private and public sectors.

The removal of the EFA measure and market-driven land use changes on lowland farms could accelerate pressure on some **landscape features** such as field margins, buffer strips and hedges in arable areas. There is likely to be some decrease in the diversity of arable crops following the probable removal of the crop diversification requirement within the Greening element of direct payments. Labour availability on farms to manage environmental features might be less than now if productivity is the main focus and AECMs are reduced. An increase in dependence on contractors might be expected given recent trends in this direction, leaving aside any effects of new arrangements for migrant workers from other EU countries (although this too would be a potentially significant factor).

The impact on **organic** producers would depend on many factors, including price levels, and the extent to which the support now available within rural development programmes is continued. Once the CAP ceases to apply, the approach could vary even more between the different parts of the UK than it does today. Support levels could drop in a scenario focussed on more productivity rather than public goods, but organic farmers could still benefit from the more explicit promotion of UK produce that could occur outside EU rules and also from more aid being made available for productive investment. In addition, if public procurement rules were re-visited after the UK leaves the EU it might become easier for public bodies to

restrict certain purchases to more local and/or organic suppliers, where this route was judged to be affordable.

Farm **animal welfare standards** are higher in the UK in some sectors than under the baseline required within the EU and it seems reasonable to assume that this will continue to be the case. Competition from low cost food imports is not significantly intensified under this scenario and standards could rise if they became a key factor in private certification schemes. This might have associated environmental benefits, for example lower GHG emissions and better management of housed livestock.

7.2.4 Implications for the environment as a whole

Some enhanced pressures on **farmland biodiversity, soils and cultural landscapes** associated with an increase in production in several sectors and reduced use of AECMs and Greening measures can be expected in this scenario. This could result in more removal of landscape features and an increase in field size and issues associated with intensification. The production focus also will make it more challenging to restore habitats, including those that require major scaling back or cessation of farming activity (See Chapter 2).

At the same time, the trend to increase resource efficiency, employ more precision farming techniques and perhaps follow a "sustainable intensification" model on many arable farms in particular could reduce or constrain input use as well as contribute to reduced emissions (see Buckwell 2015). Nonetheless some pollutant pressures may increase. Ammonia emissions for example could be affected by a range of developments, including possible increases in dairy cattle on the one hand and more investment in better slurry handling and storage systems on the other. Investing in well directed technical advice (in combination with enhanced farm assurance schemes) could reduce them but there is the risk that a more permissive regulatory regime could increase these problems. The role of environmental regulation in securing adherence to standards would be important in this scenario, as in others.

Water pollution could increase in some areas, such as those with a preponderance of intensive dairying or horticulture unless mitigating measures (including better regulation, advice and investment) are adopted. Pressure on water supplies in areas of lower rainfall, for example the Eastern and Southern England and South-East Wales, could also intensify relative to the baseline scenario if mitigating measures are not taken, especially where increased arable cropping takes place against a background of climate change.

Intensification and less controls from for example, cross compliance, may increase soil run-off in areas already known to be at risk. Intensive production on some of the marginal land would increase muddy floods and nutrient levels in water leading to some water deterioration at locations that depend on clean water, e.g. water abstraction points, bathing waters and water dependent SSSIs.

At the more extensive end of the scale, the environmental risks arising from a decline in the management of grassland and semi-natural vegetation in parts of the uplands would be present, as now, but less than in Scenario B where they are explored further. However, the

risks of enhanced environmental pressure from intensification and the replacement of traditional practices, such as hay making by silage, appear to be higher under this scenario (by comparison with the Baseline) in the absence of any mitigating measures.

With an emphasis on modernisation there could be greater investment in more efficient production systems and infrastructure, with potential benefits for **natural resource use** and emission reductions. Factors that could influence net **GHG emissions** from the arable sector in a downward direction include the potentially greater uptake of more efficient technologies such as precision farming and reduced tillage. On the other hand there would probably be fewer benefits arising from AECMs and associated Greening measures such as EFAs as well as a rise in the demand for irrigation and an increase in the conversion of pasture to maize and other crops. In the livestock sector, GHG emissions might be expected to increase with any further growth in stock numbers and arable cropping but be constrained to some degree as a result of more investment in modern housing and slurry management systems as well as pressure on farmers to improve soil management.

7.3 Scenario B- Agriculture as a standard economic sector

7.3.1 General Synopsis

In this scenario agriculture in the UK is much more exposed to market forces and the impact is particularly pronounced in the beef and sheep sectors because of their relatively high dependence on the current system of CAP support. Price levels for arable crops could increase, depending on the trade scenario, but overall farm incomes in this sector may fall, depending on how far government support levels are cut.

The level of agricultural support provided by the four governments within the UK is very considerably less than it is now and focussed more on providing a safety net to guard against a collapse in farm incomes and excessive volatility in agricultural markets. The focus of intervention can be expected to vary within the UK and to be more concerned with the beef and sheep sectors in Northern Ireland, Scotland and Wales than would be the case in England.

The general reduction in Government intervention under this scenario would affect the pattern and intensity of all support policies, which are likely to be simplified wherever possible. Direct payments and cross-compliance would be removed and there would be fewer payment mechanisms to influence farmland management for environmental or other purposes. Funding for AECMs is sharply reduced, although not eliminated entirely. The surviving AECMs are likely to focus more narrowly on internationally important conservation sites or other highly selective national issues. Data collection, reporting and administrative requirements on farmers would be reduced where not seen as essential. Conventional AECMs might be accompanied or even replaced by newer approaches, including payments by results and perhaps more open market payments for ecosystem services (Helm 2016).

Some of the existing environmental legislation applying to agriculture might be removed or enforced under a “light touch” or private sector regime as part of a general shift towards liberalisation. For example, GMOs might be authorised for a wider range of crops along

with a number of currently prohibited, or strictly controlled, pesticides. Legislative constraints would continue to influence farm management in a number of areas, but there may be a relaxation of environmental targets, such as those established under the Water Framework Directive (WFD), or simply less pressure to meet them within a given time frame.

The use of private funds for environmental purposes e.g. through water companies, new enterprises and NGOs would be expected to increase. The scale and capacity of publicly funded institutions in the agriculture sector would diminish, affecting the provision of advice and technical support as well as the character and operation of any remaining AECMs

Box 5: Summary of key risks and opportunities for the environment of Scenario B

Amongst the key **risks** are:

- Pressure on costs leads to structural change in agriculture and increased adoption of more damaging practices and short cuts. Reduction in farmer numbers and expenditure on inessential contractors results in less labour being available for environmental management.
- Continuation of the trends towards larger, more specialised farms and reduced management of landscape features.
- Pressure to reduce legislative standards so as to ease the competitive position of producers. This will have associated environmental risks e.g. in terms of water pollution, emissions of ammonia and the possible re-introduction of certain pesticides no longer used within the EU.
- More abandonment and withdrawal of management in extensively grazed areas e.g. a further decline in HNV farming.
- Increased intensification in parts of the lowlands, especially in dairy and horticulture.
- Less support from government for agri-environment and climate measures (AECMs) including those for organic farming.
- Reduction in the capacity to provide advice and support to farmers.
- UK environmental food footprint domestically and in rest of world likely to increase as a result of increased agricultural imports.

The **opportunities** are:

- More incentive for farmers to enter those remaining AECMs, if these are funded, given their income shortfall.
- Less investment in damaging productive practices.
- Some environmental benefits from a shift to larger scale units e.g. in control of GHG emissions from housed livestock, as could be required under legislation.
- Less overgrazing and some benefits in the uplands from fewer sheep, more woodland creation and increased carbon sequestration (with undergrazing in some areas).
- Cheaper land prices in certain places could drive an increase in “nature focussed” schemes and provide opportunities for new entrants.
- Some more marginal arable land may come out of cropping as a result of reduced support levels and more volatile prices.

Amongst the **constraints** are:

- Reduced levels of institutional capacity and a much smaller agricultural budget will impact on the actions necessary to mitigate the risks set out above.
- Less capacity to address damaging or unsustainable practices via legislative measures.
- More exposure to world market price fluctuations and volatility on these trade models; farmers understandably more cautious about long term investments in sustainability enhancing measures with limited short term return.
- Less public sector leverage on farm environmental performance because of reduced support.

7.3.2 Implications for land use and farming patterns

The agricultural sector as a whole would experience a significant loss of income under scenario B. Under Trade Policy options 3 and 5 (but not 4) there are likely to be significant price reductions for beef, sheep, pork, poultry and sugar, but price rises for grains and some dairy products (see Annex 3). Even under those trade scenarios that assume an increase in domestic prices outside the EU and the Customs Union, the benefits for farm income are generally offset by reductions in public support payments (van Berkum et al 2016).

According to most models, the changes in net farm incomes would be most severe in the **sheep and beef** sectors following the drop in support. UK farm management survey data suggests that, without direct payments at all, these sectors would have a negative income. Incomes from farming fall very considerably in the variants of the LEI/ Wageningen model that assume a halving of direct payment levels (van Berkum et al 2016). Consequently structural changes and alterations in land use are likely to be most pronounced in the sheep and beef sectors.

Farmland rents would certainly fall and land prices, especially in marginal areas, could be expected to be reduced insofar as they are influenced by agricultural returns. It is difficult to forecast the magnitude of this effect given the influence of support over many decades without interruption. The overall **area devoted to farming** and active management would almost certainly fall as a result. This would affect more marginal livestock producers and less favoured areas in particular. Land on which grazing is greatly reduced (or ceases altogether) might be left wholly or partly without management or actively re-deployed.

Structural change in agriculture would accelerate considerably relative to the baseline scenario, particularly in the livestock sector and this would result in larger average farm business sizes, the amalgamation of holdings and retirements being brought forward. Most such changes are likely to occur through contracting, share farming and short term leasing rather than sale and purchase or tenancies. Much arable farming is already managed through the use of contract farming agreements which achieve economies of scale in machine use and management. This could increase further, along with other structural developments, which could include more structural co-operation with specialist livestock producers to bring about a multi-enterprise version of more mixed farming (AHDB 2017).

There could be some increase in the level of co-operation between farms, especially if this were to be facilitated through rural policy interventions or by private sector actors in the food chain. A proportion of farms might sell land to help them to adjust to the new conditions and to reduce debt. Some of this land could be used to expand neighbouring holdings, but there might also be an increase in newcomers entering agriculture as part-time farmers with other sources of dependable income, and also in very small and hobby farms. Existing trends for farming families to seek outside income to boost earnings from agriculture could accelerate.

Interviews with 150 farmers in different parts of the UK about their response to hypothetical futures, including a “full liberalisation” model were undertaken in the late

1990s. It was suggested that reactions of this kind would emerge over a period of years with a significant proportion of farmers reporting that they would retire within ten years in such circumstances (Potter et al 1998).

Perhaps one opportunity could be more access for new and younger entrants to farming and for niche enterprises, assuming that more farmers might bring forward their retirement and a more active land market could emerge. The current subsidy system is often difficult to access for those that are outside it or are not family members. Private sector interests, including water companies could become more active in land management if the costs of doing so fall as seems very possible.

If policy change were very rapid in this direction it could disrupt recent patterns of land ownership and management to a degree that has not occurred for many decades, with potentially sharp changes in output and environmental outcomes. Assuming a more gradual policy shift, a complex set of changes in land use and ownership could be expected over time with significant variations between localities. In Northern Ireland for example the Single Farm Payment is significantly higher than the UK average and the impacts of a much reduced level of support could be considerable. In Scotland there is an active initiative in relation to community land ownership which might have an influence on the changes arising.

The number of farmers, family members, paid staff, seasonal workers and contractors who currently have a role in the management of the countryside, either as part of daily farm practice or in dedicated services, such as hedge laying, would alter, probably rather significantly over a period. Many of the pressures would be to reduce numbers, notably of paid staff and contractors supporting "inessential" aspects of land management. Total labour availability for environmental management within farming seems likely to decline.

Changes in land uses and cropping patterns might include a growth in forestry **and energy crops (**which might be more cost-effective under this scenario) as well as leisure related uses, including horses, small scale production and private conservation initiatives. The area of naturally regenerated and plantation woodland might be expected to grow in response to the changing economic conditions for agriculture and lower land prices in locations where the support system has been a significant factor in determining prices. The scope for larger scale **habitat restoration projects**, including're-wilding' (approaches based on a less interventionist approach to management) would grow, provided that the funds were available. Under this scenario, such activity would be dependent on the availability of resources from outside the current subsidy system, potentially including more corporate players, so the scale of uptake is difficult to forecast.

Planning authorities might be more willing to **release agricultural land** for other uses, including housing, leisure and urban development under this scenario, although a range of other factors will clearly play an important role in such decisions.

In the lowlands there would be changes in **cropping patterns** alongside a reduction in cattle and sheep numbers, with smaller income reductions on dairy farms compared to beef farms. Field crop producers would suffer a drop in income under all the LEI/Wageningen

scenarios (see Table 7), involving a cut of 50% or more in direct payments, as would mixed farms. By contrast, horticulture and poultry producers are likely to achieve higher incomes and may be in a position to acquire more land and expand production.

7.3.3 Implications for farmland management

The **overall intensity** of agricultural land management can be expected to fall under this scenario, with an increase in very lightly managed or abandoned land in the more marginal areas. There would be less incentive to retain land under purely nominal agricultural management (as can happen now in order to claim CAP payments) since direct payments would be at a low level. Some intensification of production might occur as well as a result of some of the adaptive strategies chosen by farmers and higher than usual rates of structural change, allowing enterprising market oriented producers to expand.

Although conditions in New Zealand were rather different from the UK at the time of a radical liberalisation of agricultural policy in the late 1980s, it is interesting to note the increase in mainly export focussed dairy production that took place in response, partly at the expense of the sheep sector. There was an overall increase in water pollution as a result which proved testing for a regulatory system that was also in a process of change. (Barnett and Pauling 2005). However, pesticide use is reported to have declined by half, partly because of the pursuit of greater efficiency (Environmental Performance Index quoted in House of Commons 2016 p18).

At present cereal producers tend to maintain production and crop area even in years when market prices are below production costs. This seems to be partly because of the influence of direct payments which form about 60 % of income on these farms in recent years. Without direct payments, management may take a different form when prices are low. For example the AHDB suggests that some, lower yielding, fields might be converted to cover crops or green manure to build fertility in such years (AHDB 2017).

Larger scale farming units would almost certainly emerge over time as less efficient producers struggled to survive and the availability of labour for environmental management work could be expected to decline as well. Greater scale can be expected to give rise to larger individual fields and machinery, with environmental costs including the simplification of farmed landscapes (see Potter et al 1998) testing the effectiveness of legislation to protect hedges for example. In parallel, there would be an expectation of reduced inputs of agrochemicals and inorganic fertilisers, saving costs and providing opportunities to improve resource management through the use of more efficient but relatively costly equipment. Larger intensive pig and poultry units could also emerge to exploit economies of scale.

The extensive livestock and more marginal arable areas would be less likely to remain economically viable and management changes could be expected on a considerable scale. **Lower stocking densities** could be widespread with considerable areas going out of production. This would have varied environmental consequences, with benefits from a reduction of grazing in some areas and a range of more complex effects in others (see Box below).

Box 6: Marginalisation, Abandonment and Environmental Change

The literature suggests that declining profitability in the marginal extensive grazing sector leads to a drop in livestock numbers, reduced management input and a less uniform grazing pattern as a result. Some farms may exhibit a mixture of under-grazed vegetation and patches of over-grazing close to areas where livestock receive supplementary feed for example (Baldock et al, 1996). Unless new land uses are introduced this could result in natural succession taking place in areas where grazing ceases. Typically this involves a period of scrub invasion, more structural variation in habitats and the gradual emergence of dominant species, reducing the space available for species associated with grassland, and leading to a less species rich habitat over time. Eventually this process may be expected to reach the stage of a naturally regenerated woodland, but such a change may take more than a century to occur.

During this extended period, cultural landscapes go through transformational change, with open landscapes being replaced by scrub then woodland, greatly altering views and the visitor experience. Familiar landscapes are replaced by evolving ones with more tall vegetation and scrub and certain features, such as stone walls and livestock pens falling into disrepair. New landscapes may be more complex and varied and for a period may well be richer in flora.

Biodiversity impacts can vary considerably between locations and over time. In some parts of the uplands there are protected sites (SACs and SPAs) that have been designated for species adapted to the current level of grazing and there would be conservation concerns if this level was reduced. Elsewhere current grazing pressures may inhibit the emergence of a more complex flora and fauna and natural succession following stock removal could be considered an enhancement of biodiversity value. Dense scrub, once this emerges, is usually of less biodiversity interest.

Organic farmers, also heavily reliant on public sector support, could face a reduction in incomes and declining market share unless they received special aid against the grain of this scenario. Alternatively consumers may be willing to pay larger premiums for organic produce.

Some of these trends could be modified by greater private sector engagement in the supply of environmental public goods, as prompted by the changing conditions. **Certification** schemes could have a greater role for example and the introduction in March 2017 of 'free range 'milk in Asda, sourced from cows that are grazed outside for at least six months a year is an interesting example of experimentation in this area. Water companies might play a more proactive role in seeking systematic catchment management, although they may benefit from seeing fewer livestock in some areas without the need to deploying fresh incentives to reduce the level of grazing. Conservation bodies might take advantage of lower land prices to increase their purchases of sites where biodiversity goals would be the primary objective of management. New entrants, part-time and hobby farms could introduce some variety into lowland landscapes which would otherwise become more functional. Whilst patterns would vary and will be influenced by policy choices in the four countries a trend towards more increased polarisation in farmland management (with intensification in some areas and abandonment in others) seems likely to emerge.

7.3.4 Implications for the environment as a whole

Land use changes of the kind highlighted above (which are predicted to varying degrees in different scenarios) are likely to have a range of environmental consequences. **Biodiversity impacts** may vary considerably between locations and over time as noted in Box 6 above.

Some of the non-traditional land uses that might gain a more significant footing on former farmland would be beneficial for biodiversity. These include nature reserves and some leisure uses, while other uses such as intensive urban development would be less so. The impact of new housing can depend on the way it is planned and the management of green space. This may compare favourably with intensively managed farmland in habitat terms. The space devoted to energy crops could increase substantially as the forces retaining land in agricultural use start to diminish; this could have potentially large impacts depending on market conditions and any environmental requirements applied to the energy sector.

Traditional farmland landscapes would be at risk in many locations under this scenario as the scale of production increases and both the number of farms and the need for field boundaries declines. Current policies designed to soften such impacts, especially AECMs, would be more limited in their coverage and perhaps confined to designated sites and other sensitive areas such as National Parks.

New landscapes are likely to emerge however and a 'wilder" countryside could be anticipated in some of the areas now dominated by sheep and suckler beef production. The consequences for biodiversity would emerge over time. There are likely to be increasing difficulties in maintaining those habitats requiring extensive grazing and for maintaining HNV systems more generally. At the same time there may be benefits for a range of species and habitats as a result of reduced stocking levels and more structural diversity emerging within farmland vegetation. Woodland species are likely benefit from an increase in the amount of tree cover, although woodland management may be less attuned to environmental priorities, unless there is a strong private sector response to the decline in publicly funded programmes likely to be experienced in this area.

In terms of **water quality and flood management risks** any reduction of livestock numbers and the growth of more natural vegetation is likely to contribute to a fall in overall water pollution in those catchments affected. The retention of more water in upland soils and vegetation will also potentially contribute to a reduction in flood risk. At the same time, the resources available to farmers to manage pollution and avoid local over-grazing will be stretched ever more tightly and levels of investment in slurry stores, buildings and other equipment may fall. There would also be enhanced risks of water pollution and damage to biodiversity from a lighter touch regulation of agrochemicals and nutrient management.

GHG emissions on beef and sheep farms will decline if stock numbers decrease as expected. Some farms may pay increased attention to the health and productivity of individual animals and this might decrease emissions per unit of production. However, others might adopt 'ranching' techniques, with relatively little management time available per animal, which could lead to falls in the productivity of the individual animals and a corresponding increase in emissions per kilo of meat produced. If there is an overall decline in stock numbers, as seems likely, then GHG emissions would fall in the UK. However, if meat consumption in the UK remains constant then emissions will transfer to those countries from which additional food is being imported. These emissions will contribute to overall warming of the climate and there will be no net benefit unless emissions per unit of output are lower in those countries to which food production has transferred. Added to this, impacts on carbon

sequestration need to be taken into account. With lower grazing pressure and more woody vegetation, the amount of carbon sequestration in the UK could be expected to increase. If UK meat consumption levels remain unchanged, however this benefit could also be offset by changes in sequestration levels in other countries.

The overall **environmental footprint** of agriculture is likely to change with an accentuated divide between extensive and intensive systems, impacting in turn on GHG emissions, biodiversity and water quality. Where environmental gains arose from the shrinkage of domestic production, (as would be the case with cattle and sheep), these could be offset by corresponding increases in other countries unless domestic consumption also fell. The resources available to invest in longer term environmental restoration, including soils and peatland, would be more difficult to marshal in the face of declining farm incomes and reduced public funding for the agricultural sector.

Whilst remedial measures could be taken to diminish most of the risks identified, these are likely to require a level of public intervention incompatible with the assumptions underlying this scenario.

7.4 Scenario C- Promoting Environmental Sustainability

7.4.1 General synopsis

In this scenario explicitly environmental objectives play an important role in shaping policy and support measures for agriculture. The overall level of **public expenditure** on agriculture is lower than in Scenario A but higher than in Scenario B, principally because of the enhanced level of incentives deployed to purchase public goods. Support for the agricultural industry per se is limited and might take the form of risk management measures in some parts of the UK. Current direct payments would be phased out. Scotland and some other UK countries may deploy coupled payments in the livestock sector as a key tool for maintaining grazing in the less favoured areas. Trade policy could take various forms, but strong downward pressure on UK food prices arising from imports is not assumed to take place. However there is more exposure to world market prices and potentially more price volatility than at present.

The **four countries** within the UK adopt their own strategies for pursuing environmental sustainability and a wider public goods agenda in rural areas and may well choose to adopt somewhat different goals although regulatory standards would be rather similar. For example, the focus in England might be on predominantly environmental priorities, but with more limited reference to social concerns, as evidenced by recent rural development programmes. In the other UK countries the social dimension might be more prominent. There may also be differences in the nature of environmental priorities, especially given the predominance of uplands and less favoured areas in Scotland and Wales in particular. Approaches to carbon sequestration and afforestation could also be different, especially in view of existing patterns of land use and the range of both environmental and socio-economic issues to consider.

In this scenario a **full suite of intervention measures** probably would be deployed, including regulation, advice and extension services as well as incentives for providing desired forms of land management and other public goods. At the same time the private sector would be encouraged to play a larger part in supporting both sustainable forms of production and wider improvements in environmental land management, with, perhaps, governments underwriting part of the cost of such schemes for an initial period. Other forms of support for agriculture would be relatively limited so farmers would have an incentive to enter environmental schemes to diversify and augment their incomes and to provide some buffer against price volatility in the market.

The **menu of potential measures** would be wide and not restricted to those now eligible for CAP funds for Member States under Pillar II. The need to conform to EU state aid requirements also would be removed although this may not have major consequences, as discussed in Chapter 4. It is likely that some overarching framework would be required within the UK in order to constrain genuinely problematic differences of approach between different parts of the country and avoid significant competitive distortions.

WTO rules would continue to apply to the UK and all four constituent countries. Annex 2 of the WTO Agreement on Agriculture contains a number of rules relevant to the design of agricultural support schemes and these place certain constraints on the approach to setting AECM payments, assuming such rules are strictly observed. Notably, under Article 12 (b), the amount of payments under environmental programmes *"shall be limited to the extra costs or loss of income involved in complying with the government rules".* There have been concerns about the extent to which this approach precludes sufficient payment levels to be attractive to farmers. In practice, however, this formula provides headroom for larger payments per hectare than under a number of current AECMs if full account is taken of opportunity costs for land managers and owners. Payments would need to be sufficiently high to attract participants, whether in conventional multi-year contracts or different approaches such as competitive auctions. There are alternative models to explore which might include contracts for groups of farmers, results based schemes and auctions and these could be actively trialled through pilot schemes for example (see Barnes et al 2011).

The broad assumption under this scenario is that new objectives and targets for the farmed environment are put in place, including enhanced sustainability for food production, an enrichment of biodiversity and rural ecosystems, a greater contribution to climate mitigation and adaptation and a more attractive countryside with lower pollution loads. The aim would be to make the UK a world leader in greener agriculture. Current **environmental legislation** affecting farmland would be maintained, along with existing targets e.g. for improvements in water quality and reductions in ammonia emissions. New measures would then augment this baseline, addressing issues such as more ecological pest management, soil restoration and carbon sequestration, using a mixture of approaches including regulation, guidance and enhanced advisory services, certification schemes, targeted incentives and more active private sector engagement.

Cross compliance might be retained in some parts of the UK but its role would be much more limited given reductions in direct payments and it could be focussed more on major breaches of law and good practice rather than minor errors. Some aspects of the current

cross-compliance system, such as the protection of permanent grassland could be addressed through legislation. Alternatively, this could become an essential baseline condition to be met by all land managers wishing to enrol in lower-tier AECMs where these are retained.

Box 7: Summary of key risks and opportunities for the environment under Scenario C

The **risks** include:

- Lack of farmer engagement leading to failures to meet goals, inefficient outcomes and concern re use of public money.
- Too much bureaucracy imposed in an effort to target well, monitor thoroughly etc., leading to rising costs and barriers to farm participation.
- Farm incomes fall and the resulting structural changes are more powerful than the countervailing environmental measures e.g. a wave of farm amalgamations take place coupled with significant land abandonment, leading to difficulties in maintaining farm investment.
- Increase in lower cost and lower quality agricultural imports (depending somewhat on the trade scenario) undermining those UK producers continuing to meet high standards and leading to an increased global footprint for the UK.
- Institutional capacity not strong enough to support ambition especially if more limited budget for design and oversight resulting in simpler less effective schemes with reduced oversight?
- Insufficient investment in advice and delivery systems leading to poorer results on the ground.
- Failure to engage the private sector, leading to over reliance on public expenditure.

The **opportunities** are:

- Appropriate legislation is put in place and is respected, especially as incentive schemes are available.
- Resources are available to apply a new approach properly and change longer term mind-sets.
- Funds are available to support environmental measures and a much larger level of take up, including in otherwise declining HNV areas and more intensive arable and dairy farms.
- Helpful context for building a longer term rural environment strategy.
- More scope for experimenting in scheme design and delivery.
- Better environmental outcomes.
- A new paradigm for agriculture and land managers, better connected to local communities and priorities.

The **constraints** are:

- Trade-offs between different environmental objectives and with other key agricultural objectives would need to be confronted in this scenario.
- Budgetary constraints might limit the resources available to achieve sufficient take up by farmers and capacity to achieve objectives.
- Limited willingness on the part of farmers to commit to long term agreements in a more unpredictable climate with greater exposure to market volatility and political change. As a result, the reach of environmentally focussed policies may be limited.
- Farmers may need to maintain output to generate income to service debts, with limitations on their capacity to enter environmental schemes.

Box 8: Policy design and delivery

In policy terms there would be a tension between the attractions of using a legislative approach to achieving higher environmental standards (with the cost of meeting standards falling mainly on land managers) and a more incentive based approach. If the latter route is used mainly, payments to farmers remain a significant share of overall income on many holdings and the decline in levels of support for the agricultural sector relative to the baseline position is softened. Under the first option it might be possible to pass some of the costs through to consumers in the form of higher food prices but there would be constraints on this process in the form of competition from imports, especially under the more open trading scenarios. Subject to any overarching UK framework, the four constituent countries might adopt a significantly different position along this continuum, especially with regard to the use of incentives.

The extent to which legislative regimes might differ between the four countries is difficult to predict but there are reasons to expect a reasonable level of alignment. Not only would each country be starting from much the same baseline, rooted in EU legislation, there would be obvious drawbacks to setting different requirements for inputs such as agrochemicals. Any legislation that affected production costs in a significant way would be politically contentious, given the assumption of an open market within the UK. Nonetheless, uniformity seems unlikely and variations in approach to the use of certain incentives exist already and seem likely to grow in future.

As already noted in Chapter 4, domestic priorities also might be influenced by the removal of pressure on the UK Government and Devolved Administrations from the European Commission and the ECJ to comply with EU environmental legislation. Under this scenario maintaining a timetable of environmental improvement of the kind established under EU legislation and targets would be retained and given more impetus (in contrast to some other scenarios) but the precise goals and the pattern of priorities might well change.

This scenario would need to be associated with a stronger public investment in institutional capacity to address rural environmental issues than either Scenario A or Scenario B. This investment would need to include research, data collection, monitoring of the environment and the performance of individual measures, the maintenance and improvement of advice, information, training and outreach services to farmers. The capacity and expertise of the relevant agencies would be aligned to the requirements of a more proactive approach that would include increased interaction with farmers and private sector interests so that an efficient and joined up public/private strategy could be implemented. Experimental and more innovative approaches, including outcome focussed and auction based schemes would almost certainly play a larger role.

The current culture of agricultural policy delivery will change under all scenarios once the UK is outside the constraints imposed by the CAP regulations. However, this kind of change would be particularly pronounced under this scenario given the focus on the methods and skills needed to deliver effective programmes for public goods rather than oversee the validity of claims for generic direct payments. This new approach would include the training of advisory and inspection staff and perhaps farmers as peer group leaders, to cover a wide range of issues together with ensuring they have sufficient discretion to focus on results rather than compliance with certain less essential rules. Such an upscaling of capacity would come at a cost, with a larger proportion of overall agricultural expenditure being devoted to administration rather than payments to land managers (relative to other scenarios).

7.4.2 Implications for land use and farming patterns

Some of the underlying dynamics in agricultural production and land use under Scenario C would be similar to those under Scenario B. This is because of the lower level of support for agriculture (compared to the baseline) and the potentially greater exposure to world prices in some sectors, such as sheep and beef, outside of the CAP. However, support levels under Scenario C would be higher than those within Scenario B so the resulting pressure to cut costs, re-structure holdings and abandon unprofitable extensive livestock farming may be less intense.

The incentive for farmers to enter voluntary AECM schemes would be expected to be greater than under the baseline because of the much reduced scale of other support mechanisms, potentially greater levels of uncertainty and price volatility outside the CAP and the deployment of more user friendly delivery systems. However the level of incentives available would have a major influence on the amount of take-up by farmers. If these incentives were too low (reflecting actual land management costs, but little to cover transaction and/or opportunity costs) then they could fail to attract key participants, especially those wondering whether it is worthwhile to continue with HNV livestock farming in more marginal areas. There may also be some scepticism about the political longevity of a strong commitment to a policy focussed on environmental public goods which would need to be overcome by the deployment of attractive schemes.

On one model, a two or three tier system of incentive schemes, with progressively greater environmental requirements and higher payments could be introduced in place of Greening and the current tiers (see Buckwell et al 2017 for example). However, several different approaches are possible and there would be close scrutiny of the precise benefits expected from any lower tier measures in particular.

Impacts on land use would depend very much on the goals and design of the incentive measures as well as the payment levels and external conditions such as market prices. It seems likely that organic, upland, HNV and extensive livestock producers would be amongst the primary beneficiaries under this approach. Such an outcome seems particularly likely in Scotland, Wales and Northern Ireland given the pattern of land use and environmental priorities. With sufficient funds being made available, the trends towards marginalisation and abandonment already identified under Scenario B would be substantially modified, although policies in the uplands could include a greater emphasis on woodland creation and management, especially in England. The maintenance of grazing on nationally and internationally important wildlife sites and cultural landscapes might be a priority for several administrations.

To meet the environmental goals in this scenario, policy measures would need to have a significant impact in the arable sector as well. Targeted measures designed to influence cropping patterns, soil and pest management, margins and in-field strips, the use of fallow, nutrient, agro-chemical and water inputs, the accelerated deployment of precision techniques, infrastructure renewal and uptake of organic and novel systems would overlie adjustments propelled by the market. Developments in the market, including certification schemes, would be important drivers on arable and dairy farms with more intensive land uses and management practices, given a reduced access to public funds. More rapid structural change may be expected with greater reliance on contractors and more large holdings emerging. For those sectors often characterised by a low take up of voluntary measures (dairy farms for example) a more carefully targeted and sector focussed approach might be necessary, probably incorporating more ambitious certification schemes for example. On the most intensively managed farms, historically contributing fewer environmental public goods, a transition strategy might be enacted which could include significant aid for critical investments for a limited period of time or equivalent measures.

7.4.3 Implications for farmland management

New agri-environment measures (which might take more varied and novel forms and generally rely less on management contracts with individual farms) would be introduced to address a range of concerns, including but going beyond the current priorities. These might include the restoration of peatland and other key habitats, addressing the decline in soil organic matter and targeting further reductions in GHG emissions from agriculture and erosion. There could also be a stronger emphasis on catchment management initiatives to reduce flood risk as the freedom to address domestic concerns rather than EU priorities exerts a growing influence on policy. Rural environmental priorities falling outside the competence of the EU (such as conservation of the historic environment and the maintenance of public access to farmland) were not eligible for funding via the CAP and could become more prominent in domestic incentive schemes in future.

A focus on healthy soil and nutrient management would be a higher priority than now. This might include incentives for taking vulnerable soils out of arable production and increasing the level of carbon sequestration in agricultural soils.

Other interventions might result in a better link between sustainable land management and supply chain initiatives so that measures at farm level are more closely aligned with market incentives. “Bottom up” and more collective approaches would be required and would be easier to apply if the administrative culture developed in a sympathetic way from the perspective of farmers and land managers and there was more support for facilitation. Greater investment in advice and engagement would be required and the level of funding available for this would be a key question.

Given the economic pressures on farm incomes and constraints on available capital, support for investment and innovation probably would be necessary on a significant scale under this scenario. Similarly, the adverse impacts of farm re-structuring could be addressed to some degree by fostering transition and local development projects capable of delivering results at a landscape scale.

7.4.4 Implications for the environment as a whole

A wide spectrum of environmental goals would be pursued under this scenario. Both synergies and trade-offs would need to be addressed, with a different balance perhaps being struck in each of the four countries. One example of this would be the trade-off between maintaining low intensity grazing in large parts of the Less Favoured Areas so as to benefit elements of biodiversity and traditional landscapes, set against a stronger emphasis on reducing methane emissions from livestock and the merits of converting grazed areas to woodland so as to enhance carbon sequestration.

Under some models, environmental public goods would be purchased from the lowest bidder on a contractual basis, with bids open to all, irrespective of whether they are farmers, still less active farmers (Helm, 2016). This highly focussed approach would appear most feasible where outcomes are fairly concrete and easily measured and the purchaser’s requirements are not site specific. The institutional scope for such approaches would be greater once CAP requirements ceased to apply. However, there seems likely to be a

continuing role for measures addressing bundles of inter-related environmental issues, such as soil, carbon and nutrient management and seeking to support coherent farmed landscapes as well as highly site specific objectives. Different combinations of the various models available could be pursued in this scenario.

Specific impacts might include an increase in organic farming and other less conventional approaches such as agro-forestry. These might be coupled with a reduction in the consumption of inorganic fertiliser and agrochemicals, which would arise for a variety of reasons, including the impact of both legislative and incentive measures.

The efficiency with which environmental outcomes are acquired through policy interventions should increase under this scenario. However, the extent of net environmental benefit attained relative to "business as usual" would depend on many factors, including the scale of ambition, the level of resources available for the policies being introduced, the conviction of farmers that this was a long term direction of travel (rather than a temporary political preoccupation) the response in the food chain as a whole, (where extensive adaptation to new approaches and active new initiatives would be needed), the intensity of competition from imports from countries with lower standards and, more generally, prices and other conditions existing within those agricultural markets to which UK producers have access.

Amongst the risks would be the danger that underlying structural drivers in agriculture would prove stronger in influencing land management than environmentally driven policies. As a consequence, the impact of such policies could be much less than planned, especially if the budget and institutional capacity to support the new direction of travel was insufficient. In these conditions, some areas and certain types of farms/agricultural sectors might participate to a relatively limited extent in voluntary schemes, resulting in a decline in environmental quality. Arable weeds and farmland birds might both be affected in this way.

Despite such risks, the assumption is that there would be progress against the baseline situation given a substantive commitment and greater success than under the current CAP in building positive relationships with farmers. For example, it would be important to ensure that the cynicism associated with the CAP Greening does not undermine participation levels (Buckwell et al, RISE Foundation 2017). There is clearly a risk that many farmers will not welcome a policy change of this kind and some may continue to choose not to participate in voluntary measures. The development of effective certification schemes, also envisaged as part of this scenario, would be one way of addressing this concern.

7.5 Scenario D-Territorial approach

7.5.1 General synopsis

Multi-level governance in agriculture and land use would be taken several steps further under this scenario. It differs from the other scenarios in that the governance dimension is the key variable to explore, while other attributes are less specified and could follow the tracks explored in other scenarios.

At the top level, an international framework would remain in place (in the form of international environmental commitments, the WTO and new trade deals with other countries). The UK Government would also retain certain key competences. These might relate to trade, avoidance of market disruption, aspects of the agricultural budget and specific issues where there would need to be a consensus to avoid market distortions, for example, input standards or animal health. National frameworks setting certain boundaries around the discretion of sub-national authorities within the four countries of the UK would also be important under this scenario. These would set and oversee some national rules and would be designed to facilitate UK trade as well as preventing excess competition and other spill-overs arising from the actions of others. Otherwise powers would be devolved down as far as possible.

This scenario also assumes a higher level of support and intervention than under Scenario B but with more variation in the goals being pursued. These would not be confined to public goods or the environment. They are set at the level of the four UK countries and to some degree the regions within them so that responsibility for agriculture and rural land use is dispersed much more widely than it is now. There could be several different regions of this kind in Scotland and Wales as well as within England and in sub-regions below this for some purposes. Some measures would apply at a more local level, for example within catchments or National Parks. In this sense, Scenario D it is a more localist as well as a territorial approach, intended to be responsive to local character and aspirations although within a national framework. Italian and Spanish regions with their pride in their distinctive identities and sometimes diverse rural development programmes have some of these characteristics (Mantino, 2011).

This model could be married to an ecosystem services approach, as argued by Ian Hodge:

> *"A British Ecosystem Services Policy (BESP) would start from the aim of supporting the long term social value that is delivered from ecosystems in the UK. The policy would adopt a territorial rather than a sectoral perspective. Policy would be more decentralised and implemented with regard to the governance of ecosystems within particular localities. … It demands a different system of governance, more collaborative, adaptive and devolved."* (Hodge 2016)

Different approaches are entirely possible within this framework. Some regions might focus effort on increasing the production and profitability of local products, others might take up a strongly pro-organic stance for example.

Box 9: Summary of key risks and opportunities for the environment of Scenario D

Amongst the **risks** are:

- Arriving at a weaker overall strategy and possibly weaker national legislation, as an unwanted by-product of the decentralisation process.
- Lack of coherence with regard to national priorities and the economic environment for agriculture.
- Patchy availability of resources and some danger of duplication; perhaps harder to lever Treasury funding as a whole.
- Danger that local priorities will fail to deliver enough to meet or undermine some larger national objectives.
- Potentially a lack of institutional strength in some areas, especially smaller ones.
- Possible fear of lack of continuity in environmental support due to local political changes/pressures, undermining uptake of or ability to offer/guarantee longer term schemes.

The **opportunities** could be:

- Policies can be better targeted and tailored to local needs.
- More vigour and diversity at the local level.
- Experimentation and learning from early adopters.
- Potential benefits from more diverse approaches and perhaps healthy competition.
- Better stakeholder engagement.
- Better outcomes, especially at local level in some areas as a result of stronger local engagement and enhanced capacity to innovate.
- Stronger sense of local identity could help to build sustainable supply chains and assist marketing beyond the farm gate.
- Potentially enhanced capacity to ring fence funding to regional priorities, such as peripheral/remoter areas.

The **constraints** are:

- Whether the time and resources are available to bring about such a major change in approach during a period which includes many other pressing challenges, such as designing and implementing post-CAP policies across the UK within a relatively short timescale.
- Capacity to organise the different layers and institutions and secure sufficient join up of systems as required and ability to carry the additional costs, including institutional overheads and potentially greater level of transactions.
- Availability of data, appropriate software and the support to establish independent policy and administrative systems with the necessary linkages between them.
- A number of requirements will need to be met at the Devolved or UK level, including the maintenance of orderly and efficient supply chains.
- Possible political resistance from national Government to sanction extended devolution in this policy field.

7.5.2 Implications for land use and farming patterns

Much more diversity in policy design and scale would be exhibited under this scenario. Some regional administrations might put the emphasis on enhancing local production and strengthening supply chains, giving greater regional identity to certain products and marketing them more vigorously. This could include more investment in processing and marketing both food and fibre locally and perhaps building up food links between cities and their hinterland. Other administrations might seek to widen and deepen stakeholder involvement in policy design and delivery. They might invest in a more influential role for local interests, seeking to address the conflicts that might arise and accepting that multiple and perhaps complex objectives might need to be pursued to avoid a one-sided approach.

Another approach might see a regional administration choosing to focus on environmental public goods or ESS provision, potentially adopting more novel approaches to suit their priorities. This could involve support for large scale conservation areas administered by non-farming groups focussing on land being withdrawn from agriculture or paying for conservation covenants to protect valued sites over the long term (Hodge 2016).

The design and delivery of policy would vary, as would local levels of expenditure and scheme payment rates, if this was permitted by national administrations and the UK Government. Although there would be costs incurred in building up significant capacity in local institutions (both those already in existence as well as new ones) to support policy, some regions would choose do so. The sense of engagement by farmers, local supply chains, authorities and other stakeholders would be expected to be stronger, at least in principle. Connections with some other areas of more local policymaking, such as land use planning could, in principle, be strengthened.

The distance from policies handled mainly at the national level, such as aspects of trade and fiscal policy would, however, be greater than now. Conflicts between regions could arise if significantly different policy directions were adopted and some central government functions would be retained in order to resolve these. Establishing common standards for products and inputs might be considered important to ensure markets functioned properly, for example.

Impacts on farming and land use are difficult to forecast, but a range of increasingly diverse approaches can be expected to develop. For example, there may be a greater concentration of certain forms of production in selected regions where the relevant administrations choose to build up their competitive position and utilise targeted measures to foster specific sectors. Other administrations may promote less traditional crops or focus on developing new supply chains such as feedstocks for bioenergy production. Smaller administrations may not be all that well equipped to deal with crisis situations such as serious supply chain interruptions and co-operative arrangements would seem likely to be necessary.

7.5.3 Implications for farmland management

Regions with a substantial area of extensively grazed livestock might make this a key focus of their interventions in a way that would not necessarily happen in more centrally driven scenarios. This kind of emphasis might be evident in the approach to working with processors, retailers and other actors in the food chain, as well as in the design of farm support policies. In some cases, it could result in stronger support for the less profitable grazing systems than is the case than under current policies.

Depending on the approach adopted, Scenario D might involve primarily environmental or territorial bodies (such as National Parks) obtaining a new kind of influence over agricultural policy and land management. This could help to strengthen the focus on issues of particular local prominence, including flood management, public access, and the management of protected areas. Public access to the countryside is a sensitive and important issues in some areas but has not been the topic of CAP funded interventions because it has lain outside the legal competence of the EU. Access issues could be more integrated into AECMs in future, particularly on this scenario.

Large regional differences in the level of support for agriculture might trigger greater mobility amongst farmers and increased concentration of production in certain areas if farmers were more inclined to invest in those regions with more supportive policies. A fear of losing local investment could therefore prove to be a constraint on whether regions choose to diverge significantly from the mainstream. The role of the UK Government and the Devolved Administrations in authorising and overseeing budgets would need to be clear. Accountability and transparency on the part of regional administrations would form a critical part of the new territorial model.

Under scenario D, more investment might flow into some regions than others, but many of the underlying trends already discussed under scenarios A, B and C would also apply. These would be modified to varying degrees by a spectrum of more local interventions. The existing trend towards a polarised pattern of less/more heavily managed land could be accentuated, especially if the maintenance of livestock grazing were supported much more generously in some areas than in others. As a result, it might be necessary to promote active co-operation between regions in order to achieve greater coherence, for example between the more arable East of England (and Scotland) and the more pastoral West. This would be a new challenge. Experience in Germany and other European countries with extensively devolved powers provides examples of how a regionalised system can work without disrupting the coherence of the internal market in a serious way. This experience could be used to help manage potential problems, in particular the risk that a greater sense of uncertainty amongst land managers could reduce their confidence and inhibit investment.

7.5.4 Implications for the environment as a whole

The outcomes from this scenario are not easy to predict. Different priorities could be given serious attention in different places, including the sheep industry in Wales, phosphorous pollution in Northern Ireland and the management of peat soils in the Fens for example. Levels of dynamism and environmental ambition are likely to vary significantly from one part of the UK to another. Progress towards international and national targets such as reductions in CO2 emissions could be more difficult to achieve unless there was a strong national framework and mechanisms to connect the targets to local policies. For example, some sites of international importance for biodiversity might be seen as being of lesser importance at local level. These sites could be neglected whilst other, less valuable, locations could be selected for special attention, making it more difficult to deliver biodiversity goals in a consistent way.

However, there would be scope for a more integrated approach to land and resource use and building a stronger policy foundation in local ecosystems, traditions and socio-economic networks, potentially gaining a fresh and more robust buy-in from local stakeholders. This could ease the way to more novel and ambitious approaches, such as landscape scale nature and soil restoration projects, enhanced co-operation at farm level, finely targeted woodland planting and restoration etc. Innovation could flourish, at least in some areas. Many food chain initiatives could be stronger within a tighter territorial identity. Where environmental issues had strong local support, progress could be considerably more rapid than under a more centralised regime.

7.6 Scenario-E Greener shades of liberalisation

7.6.1 General Synopsis

In this scenario there is no FTA with the EU and WTO rules apply to external agricultural trade. The effects on trade and farm incomes are as described under Scenario B but the level of environmental ambition is substantially higher. Lower food prices are important in political and economic terms, as are savings in public expenditure. Domestic support levels for agriculture are low (as in Scenario B) but a substantial proportion of available resources is focussed on public goods provision and the environment.

Technological development and productivity growth within the agricultural sector and within the economy as a whole are also seen as a priority and are reflected in a greater focus on R&D, training and investment aid. The share of support aimed at longer term infrastructure and capacity (physical and human) is greater than now and there is a tendency to favour investment aid and training rather than large scale support for farmland management. Technological and organisational innovation is regarded as critical for productivity and environmental management. The linkages between agriculture and the wider bioeconomy and renewable energy sector are promoted, including the increased utilisation of wastes and residues such as straw. There is less interest in maintaining traditional, but unprofitable, production and land management systems for their own sake or for their socio-cultural value but a willingness to assist those HNV systems where environmental performance is demonstrably high.

Collective schemes and integrated food chain initiatives are encouraged, with public authorities playing more of a facilitative role. Where it is seen as cost-effective to transfer rural services, such as flood control and other aspects of catchment management to private suppliers, (which could include farmers in mixed consortia) there is little hesitation in doing so.

There are no direct payments to farmers within this scenario, at least after an adjustment period, but some aid is provided in relation to risk management. There is also a range of environmental public goods incentive measures, together with active efforts to secure a bigger role for the private sector. Aid is available in return for introducing new approaches such as precision farming and agro-forestry. Rapid structural change in the agricultural sector is accepted as likely, including in HNV areas and forms a base for productivity growth.

Environmental legislation affecting the countryside remains broadly the same as it is now, although more ambitious goals such as for reducing GHG emissions from farming and reducing flood risk are introduced over time. Concrete goals are developed for specific time periods, as in Scenario C, so that government interventions can be better targeted and results assessed more easily. Closing the gap between many of the existing environmental targets in the countryside (outlined in Chapter 2 and the Annex to it) and the current level of performance is a key priority.

Box 10: Summary of key risks and opportunities for the environment of Scenario E

Amongst the **risks** are:

- Similar environmental pressures to Scenario B associated with structural change and marginalisation, which is less dampened by generic support than in Scenario B.
- Significant structural change, especially in extensive HNV livestock systems very likely; risk that measures to secure appropriate management in these areas are not sufficient and abandonment accelerates.
- Difficult to support the higher levels of environmental ambition with sufficient resources, including AECM budget and institutional capacity given tight spending constraints.
- Lack of credibility of some environmental schemes with many farmers aware of limited budgets and so danger of weakened engagement.
- Continuity of funding over longer term might be in doubt.
- Reticence of farmers to invest in higher tech approaches to addressing environmental issues that the Government is inclined to favour.
- Territorial identity a low priority and stakeholder engagement likely to be weaker.
- Some increase in livestock imports with associated growth of environmental footprint in countries supplying UK.

The **opportunities** would be:

- Reduced cost of managing natural resources via incentive schemes, due to lower opportunity costs.
- Potential for substantial take up of well-designed schemes.
- Increased woodland and carbon sequestration and some increase in land availability for conservation if the resources to manage it are available.
- Potentially more rapid take up of newer technologies contributing to environmental goals following sharper governmental focus and smaller number of competitive farmers.
- Potentially faster uptake of low carbon systems and technologies and systems for similar reasons and because of the enhanced priority in government.
- Incentives to develop relationship with private sector along the supply chain and in land management may be enhanced.
- Stronger private sector engagement and expanded role for certification schemes.

The **constraints** are:

- Tension between unrestricted trade and environmental standards – there is likely to be significant pressure from stakeholders facing external competition to maintain environmental targets
- Tight budgetary constraints.
- Potential limitations in institutional capacity to operate effective and well-targeted incentive schemes within budget. There will also be many other demands on administrations to ensure reasonable continuity and operability during a time of change.
- Domestic progress in GHG emission reductions could be offset to some extent by more imports.
- Increased reliance on voluntary certification schemes may not be effective in addressing site specific resource management issues.

7.6.2 Implications for land use and farming patterns

The existing trend towards a smaller number of generally larger farms and increased contracting is likely to be exacerbated. Such farms will be capable of achieving a higher levels of productivity and surviving in competitive markets with much less support than today and much of the policy focus is on strengthening this component of the agriculture sector and increasing their environmental performance. The role of precision farming and lower input regimes on arable farms receives more prominence and qualifies for time limited but not insignificant support. Smaller farms might choose a variety of strategies, including greater co-operation, income diversification, specialisation in higher value

products (including organic and certified foods) the supply of leisure facilities and ecosystem services and other ways of utilising their resources and skills. As in Scenario B, some land seems likely to go out of agricultural production and into a range of different uses.

Low margin systems will be under much greater pressure than today, which suggests a decline in those outdoor grazed livestock systems currently strongly dependent on CAP payments. The sheep sector is particular vulnerable to a potential lack of access (or costlier access) to its traditional export markets. These currently absorb up to 40% of domestic production, 96% of which goes to the EU (National Sheep Association 2017). Concern about this issue is already being expressed in certain parts of the UK (Welsh Assembly 2017). Under this scenario there is no FTA with the EU and there is significant potential for a major disruption to the sheepmeat market.

The extent to which the UK Government and the Devolved Administrations are ready to provide some form of generic support to the beef and sheep sectors is a key question. This might be at a much lower levels than those schemes currently in place and might either be made permanent, albeit carefully and more narrowly targeted, or available on a transitional basis. Livestock related interventions might be placed in a wider policy frame and relate to plans to build a lower carbon food system with an emphasis on high quality sustainable products with a well-established provenance for example.

This raises questions about the future readiness of these administrations to intervene if there is a severe dip in market prices. For example, what level and type of government support might be available in the face of a severe shock, such as UK producers being shut out of a major export market? The Treasury may be more inclined to provide time limited support for structural adjustment than for crisis relief but other authorities may have a different approach.

The assumption under this scenario is that there would no equivalent of the current direct payments system, albeit with the possible exception of a modest payment linked to a domestic successor to the CAP Greening measures. However, there would be expenditure on AECMs of different kinds and perhaps a version of the LFA/ANC regime (as currently deployed in Scotland but probably more targeted). Such measures would comprise a larger proportion of overall support for agriculture than at present but would not have a larger budget. They would be more selective in a number of ways and perhaps put more emphasis on collective as well as individual contracts. This would help to sustain a portion of the current population of grazing livestock, but some reduction in numbers would nevertheless appear likely.

Policy in the uplands will be influenced by the considerable concentration of protected landscapes and sites designated for nature conservation purposes that can be found there. The uplands Severely Disadvanted Area in England for example is the largest proportion of the overall LFA and extends to about 1,625,437 ha, of which 1,250,000 or 77% is thought to be grazed. About 27% of the whole SDA is designated as SSSIs and 18% as Natura 2000 sites. About 74% is protected either as a National Park or an AONB. In total 1,247,973 ha of the SDA, around 77%, is designated under one or more of these categories, which overlap in some cases (information from Natural England).

The LEI/Wageningen study trade liberalisation scenario (as summarised in Table 7) anticipates sizeable falls in the prices of sugar, pork and poultry as well as both sheepmeat and beef. By contrast, there would be price rises for grains and several dairy products (including cheese and skimmed milk powder) with production being adjusted accordingly (van Berkum 2016). Nonetheless, farm incomes fall for all sectors other than horticulture because of the sharp reduction in support.

Farms adjusting to the transition (and the likely fall in rents and land values) would be eligible for some support in relation to risk management and investment aid. This would have a significant environmental focus in scenario E. For example, selective investment in environmental management on arable and dairy farms would be supported, perhaps alongside the introduction of market measures to encourage the production of 'greener' milk. At the same time there would be more focus on the retention of grassland of conservation value by comparison with Scenario B, together with some tailored support for HNV farmland, focussed on the areas of greatest biodiversity value.

7.6.3 Implications for farmland management

Larger scale farms would predominate alongside an increased deployment of precision agriculture. More attention would be paid to soil and water management and climate mitigation measures than under Scenario B. Voluntary measures, such as sustainability protocols, would be developed within the food chain, exerting growing influence on farm management practice. The current standards for water protection and agrochemical authorisation would remain in place alongside schemes like the Pollinator Initiative. Private sector certification schemes would play a more important role in incentivising compliance with regulatory standards and developing good practice. The organic labels would remain a leading part of the certification system, but public support for organic farms would be adjusted downwards alongside other AECMs.

Under scenario E, the extensively grazed sheep and beef systems are supported by certification schemes and a selective quantum of agri-environment support, much of it focussed on key biodiversity sites and most valued cultural landscapes. A plan to reduce GHG emissions from agriculture would be established and backed up with aid for investment and management changes as part of a wider focus on innovation. The same would be true for ammonia emission reductions and IPM development, albeit all of these would operate on relatively small budgets.

Extensively managed stock eligible for AECMs on key nature conservation sites rather than the whole current LFA, (which may or may not survive as a designation in the UK outside the EU) might be one target for intervention because of biodiversity goals. However, the incentive system would need to be sufficiently attractive to farmers to achieve satisfactory participation in economically challenging circumstances. Over time there might well be a further retreat in the area of extensively grazed semi-natural vegetation and an expansion in woodland cover. The latter is likely to take place through natural re-generation as this Scenario assumes limited grant aid for afforestation, because of cost considerations.

Many farms would no longer qualify for public support and labour would be withdrawn from landscape management on a considerable scale, because of the reduced number of holdings, fewer farm families and less hired labour and, a reduced affordability for non-essential contractors. The result would be more signs of low maintenance in the countryside and extensive growth of scrubby vegetation, especially outside key sites, as referred to in precious scenarios.

7.6.4 Implications for the environment as a whole

Scenario E would be expected to see reductions in pollution from agriculture and progress towards a lower carbon food system taking place on a faster timescale than under Scenario B. More private capital would be deployed in agriculture for environmental purposes than under Scenario B and certification schemes would be more influential, reinforced by government support and a continued emphasis on the importance of regulation and targets. It would be difficult to raise some standards much above the current level, however, given reduced support and pressure on farm incomes arising from imports, which would seem likely to inhibit progress. With some overall increase in imports likely in a more liberalised trade regime, the UK's environmental footprint in source countries for these products would rise.

Funds for maintaining semi-natural grazing systems would be limited, but would be focussed on areas of the greatest biodiversity value. There would be more land available for NGOs and the public to acquire and utilise for extensive farming systems, but their response would be conditional on the resources available and these might be much more limited. The skills required to manage land in this way might also be in much shorter supply. Significant land use change would occur, affecting traditional landscapes in the lowlands as well as the hills. Taken together these factors suggest more pressure on farmland biodiversity outside key sites and less focus on maintaining landscape features in the countryside which would be potentially in danger of neglect or removal following farm amalgamation.

8 Reflections and possible next steps

The scenarios suggest a range of plausible futures related in different ways to the EU withdrawal process. Whilst already reasonably diverse, the field covered in the scenarios could be extended considerably by examining further pathways and possible shocks to the system, such as supply shortages, price spikes, disruption to trade, market perturbations and more environmental and agronomic events such as disease and crop failure. Depending on the scenario, the scale of change for agriculture and the environment could be quite dramatic in the coming years.

The likely pace of change is not entirely clear. Whilst some would argue that adjustments to agricultural policy should evolve over time, the alternative view is that there is no point in prolonging the inevitable and that public money would be better used in facilitating rapid change to a new paradigm and helping those that seem to have a future. Indeed, once the outcome of the negotiations with the EU concerning trade relations and other matters is known, the breadth of scenarios could be narrowed and more precisely defined options could be developed.

The analysis of these scenarios confirms that it would be prudent to prepare for a wide range of different patterns of agriculture and associated land use after the UK leaves the EU. The scenarios provide some pointers to the areas where a sizeable body of issues of environmental significance might be expected to arise and some of the factors that could be in play. They suggest that there are both major opportunities and substantial risks, with a strong role for policy in influencing the outcome, both for agriculture and the environment.

This may be helpful in preparing for unknown futures and accepting that some of the relationships between policies and related factors will be different once the UK withdraws from the EU and the CAP in particular.

Drawing on this analysis, a number of reflections and conclusions can be derived from the scenario exercise, whilst bearing in mind its inherently speculative nature. These might be useful to consider when starting to design future agriculture and land management policies in the different parts of the UK. They include:

Policy drivers: The scenarios illustrate the extent of change that could occur in many of the drivers that shape agricultural management and land use in the UK during and after the EU withdrawal process. This contrasts sharply with the relative predictability of several of these parameters, as currently influenced by the CAP.

Trade agreements and international relationships are likely to be important drivers, particularly in some sectors of agriculture, and under the more liberalised trade scenarios involving WTO rather than FTA trade assumptions. Price changes, including reductions, especially for livestock products, arise under certain of those scenarios, with consequences for farm incomes, restructuring and changes in land use. However, decisions on the UK's future trade relationships with the EU and the rest of the world may not necessarily be driven very significantly by agricultural, food or environmental concerns, especially given the prominence of other issues in the debate on EU withdrawal up to now.

These trade issues are particularly important for the agricultural sector because the status quo is that tariffs between the EU and its trading partners on agricultural and food products are much higher on average than for other sectors. Non-tariff, technical, sanitary and phytosanitary barriers, and attitudes to production techniques, crop protection and animal health products, and novel technologies are also all potentially very important for food and agricultural products. A significant part of the rationale for EU legislation under the single market and a range of other areas has been to harmonise such matters within the EU.

Both regulation and future support policies for agriculture and the farmed environment also emerge, not surprisingly, as key drivers. Lower support levels, as assumed in most scenarios, have a significant impact on farm incomes and potentially on farm structures and on management decisions. Outside the CAP, however, there will be more scope for governments and authorities in the UK to adopt their own mix of policies and to modify delivery and control mechanisms to suit domestic conditions. The role of agri-environment payments can be greatly expanded and targeted in different ways for example and the Pillar 1 direct payments modified or abandoned. There is now an exceptional opportunity for fresh thinking in policy design geared to the needs of different parts of the UK.

Uncertainty: A period of greater uncertainty for agriculture seems probable arising from reduced predictability in both policy and markets as well as external economic factors such as exchange rates. The impacts are likely to vary between sectors and parts of the country, potentially more so than previously, not least because of varying levels of dependence on CAP payments and on markets that may be disrupted under certain scenarios. Farmers will react to the escalation in uncertainty and increased pressure to be entrepreneurial and perhaps become more focussed on producing concrete environmental outcomes in different ways. Recent work in Wales confirms this heterogeneity, with farmers adopting diverse strategies in response to the same policy environment. The study highlights "tensions between maintaining a focus towards current on-farm activity or pursuing entrepreneurial diversification… " (Morris et al 2017).

Structural change: Under several scenarios the pace of structural change, resulting in a smaller number of larger farms, seems likely to accelerate. This has direct environmental implications, in relation to field size, landscape features and the scale of buildings and infrastructure but also affects the availability of labour and the farming methods employed. It is possible that labour availability on farms may be further reduced by restrictions on the movement of people from EU countries seeking temporary work, especially in horticulture.

Environmental implications: Whilst all of agriculture will be affected, the scenarios suggest that particularly large changes could occur in the grazing livestock sector because of its high dependence on CAP direct payments, low economic returns at present and vulnerability to market disruption under some scenarios, particularly 'Agriculture as a standard economic sector' (B) and 'Greener shades of Liberalisation' (E). Changes in livestock numbers, distribution and management could all lead to significant environmental risks, including the loss of permanent grassland, an accelerated decline in low intensity grazing systems and HNV farmland, potentially affecting SSSIs and Natura sites in some regions. These pressures could be particularly acute in Scotland and Wales where extensive livestock systems

represent a sizeable share of agricultural land use and there is a range of habitats dependent on the continuation of grazing for their biodiversity value. Environmental risks may also be heightened as a result of changes in land use, which may include more abandonment and afforestation, although there will also be environmental opportunities associated with such changes.

In the arable sector farms will need to adjust to the expected cut in support, even if crop prices rise, as they do under some scenarios. This may lead to larger units but also potentially more sparing use of nutrients, agrochemicals and other inputs. The likelihood of a decline in cropping in more marginal and diverse areas/fields will be increased while the scale of fallow may increase, with a range of environmental impacts. Management of landscape features and margins may be under pressure on many farms generating lower economic returns unless mitigating action is taken through policy and/or certification schemes. The risk of removal of features is greater under these conditions unless they are protected through policy mechanisms.

Trends towards more local intensification, especially in the housed livestock sector are already apparent in many areas, for example poultry units in Wales and Northern Ireland This may gather pace under certain scenarios, such as scenario A, 'Full steam ahead for UK agriculture' and D, 'A Territorial approach' and also those associated with structural change and specialisation such as scenarios B and E. Systems most likely to be affected include horticulture and non-ruminant livestock concentrated in larger units.

As well as the direct implications for the management of the rural environment, the extent to which farmers will wish to or feel able to prioritise environmental outcomes given other calls on resources and their risk management strategies may also change. Clarity about long term government policy, including commitment to environmental legislation and substantive agri-environment incentive schemes will almost certainly be necessary to reassure those who are concerned that priorities may have changed along with the withdrawal from the CAP and may be reluctant to enter new schemes in the coming years.

Policy measures: Turning to issues that will be close to the heart of agricultural policy formulation, the level of support available to farmers in general terms, as well as in relation to any voluntary environmentally focussed schemes, will both be important in influencing the direction and speed of anticipated change. The need to secure greater environmental results from public expenditure will be as great as it is now within the CAP and could be greater under many scenarios.

Depending on how the sector's profitability evolves and the nature of the support payments available, the economic attractiveness of voluntary agri-environmental schemes and longer term land management commitments could decline for many farms during this period unless these are made more appealing, for example in relation to their availability, the ease of entry and paperwork requirements, payment rates, the design of agreements etc. On the other hand, some farms will value the security of voluntary payments as a stable form of income and potentially a hedge against low market returns.

With a longer term perspective, the role and implications of a revised list of policy instruments, including more novel and experimental approaches to public goods delivery should be considered. The development of new ways of incentivising environmental management, for example through considering different ways to reward farmers for the production of ecosystem services, would be valuable. Shifting towards a more results based approach, linking public and market based instruments to purchase environmental and climate goods and services from agriculture and adopting better delivery and support arrangements for farmers are amongst the initiatives that could be developed more swiftly outside the CAP. This represents a substantial opportunity.

Pilot and experimental schemes, which have been inhibited because of the current CAP and state aid rules and risk of disallowance, would be a valuable contribution to inform the policy choices ahead. The results-based payments pilot currently being led by Natural England is a good example. Clearly this would require the will and the resources to exploit these opportunities.

To supplement public sector funding for the environment there is clearly a need to mobilise private sector initiatives, including certification schemes and direct incentives, potentially in new ways and at a faster pace. The existing experience with environmentally attuned catchment management undertaken by private water companies is one example but others will be required as well. This is important in all scenarios, but would take on added weight in Scenario B (full steam ahead) where the budget for agricultural support is significantly reduced.

The level of funding available for agri-environmental incentive schemes, whether innovative in approach or along the lines of more established models stands out as a critical issue for achieving environmental outcomes under all scenarios and whatever trade model is adopted.

Regulation: However, the new and perhaps unavoidably higher level of uncertainties surrounding the funding of voluntary measures and possibly reduced confidence about uptake levels suggest that alternative approaches for achieving environmental outcomes need to be included as part of a robust policy framework as well. The use of well-enforced regulation, to provide a strong baseline level of environmental protection continues to be attractive in terms of policy effectiveness, particularly if the influence of incentive schemes diminishes. However, stronger regulation would be in tension with the liberalisation and reduced administration themes emerging in scenarios A, B and E. So it would not be surprising if proposals were to be made to weaken it. If the longevity of some well-established environmental legislation becomes less certain, as it does under some scenarios, this would make the protection of the environment more challenging. It suggests that careful appraisal of the consequences of amending legislation in this field, for example concerning the regulation of agrochemicals is required before proposals are given serious consideration. If regulatory change creates a significant divergence from the requirements of EU the implications require even closer scrutiny.

Managing change: The scenarios are a reminder of the possibility of different policy responses emerging across the four UK countries and the need to anticipate what issues could arise as a result of this and plan as necessary.

Nonetheless, a number of actions would help inform the policy debate in all four countries in the short, medium and longer term. Undertaking impact assessments would be particularly useful in revealing the economic, environmental and social consequences of different policy options, both at the UK level and within the four constituent countries. This and similar exercises would be assisted by the availability of an up to date model of UK agriculture, land use and management together with a suite of associated data which brings together environmental information in a way that allows for more detailed analysis in relation to specific geographical locations.

Ensuring that an accurate baseline situation is established is essential to ensure that the potential impacts of future policy design can be assessed as accurately as possible and will be invaluable for measuring change once future policies start to take effect. A capacity to analyse and forecast future land management choices and their implications will be even more important than it is already in those agencies responsible for deploying measures such as voluntary schemes to meet key goals. The work of the Defra Agricultural Change and Environmental Observatory could provide an exemplar of the type of analysis that might be anticipated.

Finding cost–effective solutions to address the economic, social and environmental challenges facing the agricultural sector will be a clear priority. However, the resource implications of undertaking this preparatory work (as well as the longer term management of the rural environment) need to be recognised as part of the wider discussion on future policy choices outside of the CAP. Adequate provision amongst the relevant departments, and agencies and will form a key part of this. Similarly, the resourcing of high quality advice services and demonstration projects will help to encourage a transition to a more sustainable and resource-efficient agricultural sector; one that is equipped and sufficiently resilient to meet the challenges of the years to come.

A rather different challenge is to assess the best ways of engaging a wider range of actors in this arena in the next few years to ensure that future policy is embedded in domestic concerns and dynamics. This should include building on existing relationships with stakeholders at different scales, including the more local. Associated with this is the need to engage the private sector more deeply in addressing rural environment and sustainability issues, including those companies in the food chain on one side and those with an interest in land management on the other. The latter will include water companies, some leisure and sporting concerns and NGOs with land holdings. A revised framing of the challenges to be addressed and consideration of new approaches to engagement with a full range of stakeholders may be helpful here.

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Annex 1: Overview of the environmental impacts of agriculture in the EU

This Annex provides more detailed information supplementing Chapter 2 of this report which summarises the sustainability of agriculture within the UK.

Agricultural land use in the UK

A high proportion (71%) of the UK's land area is under agricultural use[19] (Defra, 2016). This figure has hardly changed over the past two decades. Broken down by country, the figures are even higher in Wales (~88%) and Scotland (~73%), with the utilised agricultural area (UAA) accounting for 69% in England and 69% in Northern Ireland. The UK figure is one of the highest proportions in the EU, on a par with Ireland where 72.5% of land area is used for agriculture. Most other countries have far greater proportions of forest area compared to the UK.

In the UK, the majority of agricultural land is made up of permanent grassland (58%), with a further 35% under crops, 5.5% classified as woodland and the remaining 1.5% either outdoor pigs or under non-agricultural use. The distribution of different types of land use vary significantly between the four UK countries, with arable cropping and horticulture constituting less than five per cent of UAA in Wales and Northern Ireland compared to 54% in England. This is despite significant increases in these sectors in Wales over the past decade (Estimates from Welsh Agricultural Survey, June 2015).

The total value of the UK's crop output amounted to €9.7 million in 2016 which ranked seventh in the EU after France, Italy, Spain, Germany, the Netherlands and Poland[20]. Given the significant proportion of land that is under permanent grassland (including rough grazing), the livestock sector, particularly beef, dairy and sheep production are an important part of UK agriculture. In comparison to the rest of the EU, the UK livestock sector was the fifth largest in terms of value of animal output in 2016, generating €14.97 million, after France, Germany, Spain and Italy[21]. Livestock numbers in the UK has greatly fluctuated over the years, however, all UK countries have seen an overall declining trend in livestock numbers over the past 20 years, except for the poultry sector where the number of birds raised has been steadily growing.

Some of these declines in the herd have been compensated for by increased productivity, with higher carcass weights, made possible through more intensive rearing practices in terms of feed as well as the way in which the grassland on which they graze is managed. This can lead to environmental pressures, particularly for water, soil and air quality as well as GHG emissions (see below).

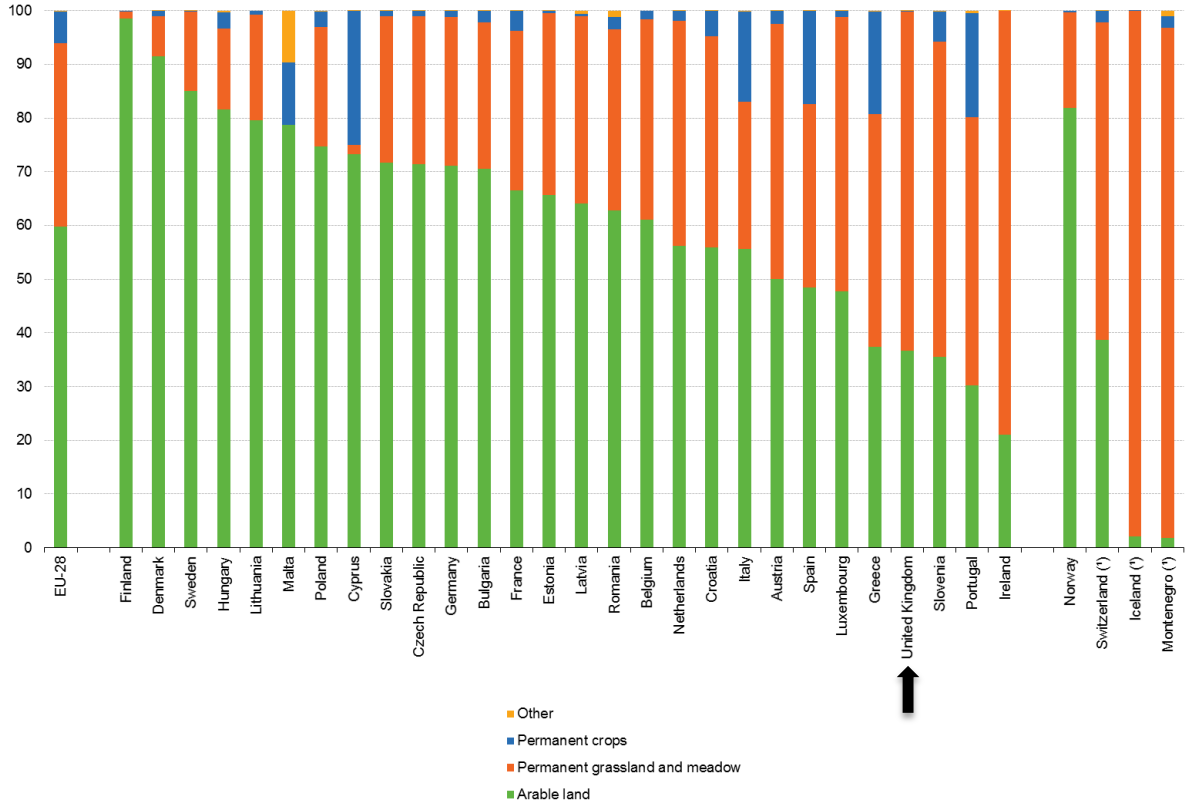
[19] The utilised agricultural area is made up of all arable and horticultural crops, uncropped arable land, land used for outdoor pigs, temporary and permanent grassland and common rough grazing.

[20] Eurostat Economic accounts for agriculture - values at current prices [aact_eaa01]- Crop output - basic and producer prices – accessed March 2017

[21] Eurostat Economic accounts for agriculture - values at current prices [aact_eaa01]- Animal output - basic and producer prices – accessed March 2017

In terms of UAA, the UK had the third largest share of the EU-28's agricultural land in 2013 at just under 10%, a similar area to Germany (Eurostat, 2013). France and Spain had the largest share, with 15.9 % and 13.3 % shares respectively. The way in which the UK distribution of land use compares with other EU countries is set out in Figure 3, which shows the far higher proportion of permanent grassland and meadow compared to all other Member States with the exception of Ireland. Its arable area as a proportion of overall farmland is only larger than that of Slovenia, Portugal and Ireland.

Figure 3: Distribution of utilised agricultural area, 2013 (%)



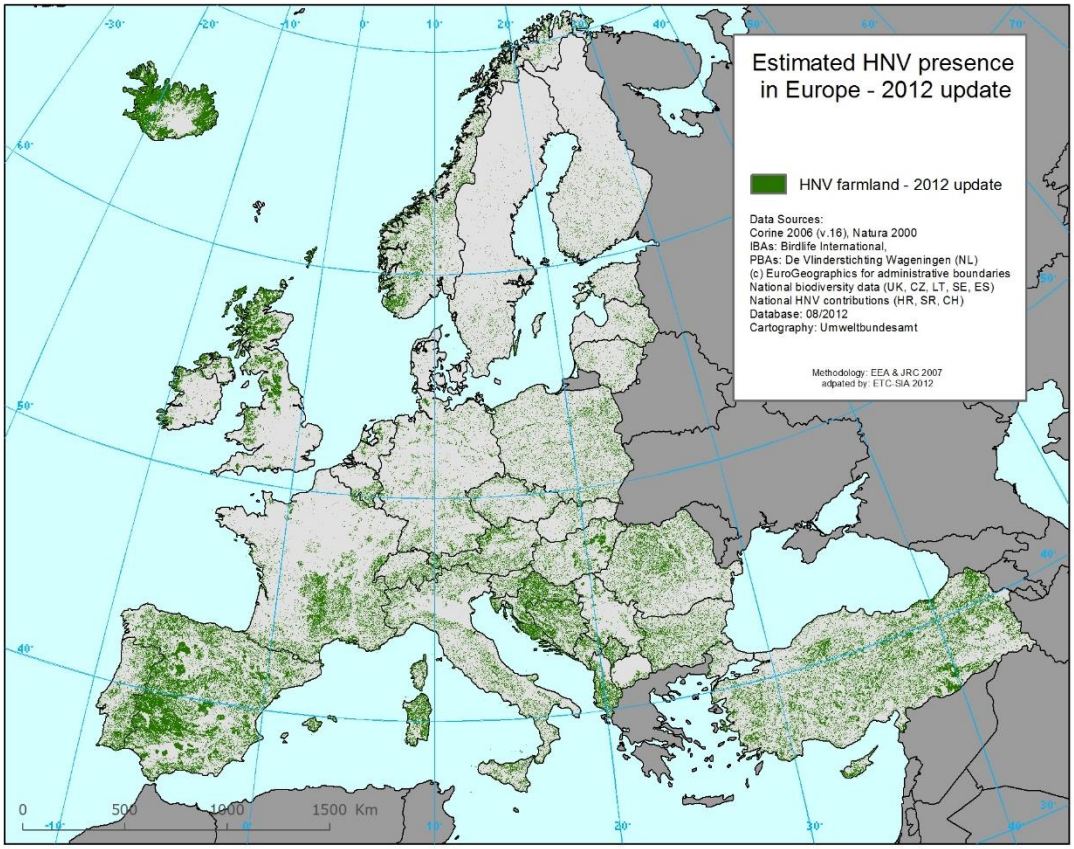
Source: Eurostat, 2013 Farm Structure Survey data

A large proportion of the agricultural area in Scotland (84%), Wales (80%) and Northern Ireland (~70%) is designated as Less Favoured Area (LFA) under the definition of 'areas in danger of abandonment of land-use'. This land is characterised by less fertile soils with limited agricultural potential and below average economic returns. Most of these areas are grazed. In England the proportion of UAA designated as LFA is only 16% of the total farmed area, but these areas cover significant tracts of the uplands in the north of England and some in the south west.

Many of these areas designated as LFA are extensive grazing systems of High Nature Value (HNV). The map below (Figure 4) shows the estimated distribution of HNV farming systems

across the EU[22]. In the UK, HNV farming is found principally in the Highlands of Scotland, in the north of England, in central Wales and in some areas of the north-east and north-west of Northern Ireland.

Figure 4: Estimated High Nature Value (HNV) farmland in Europe

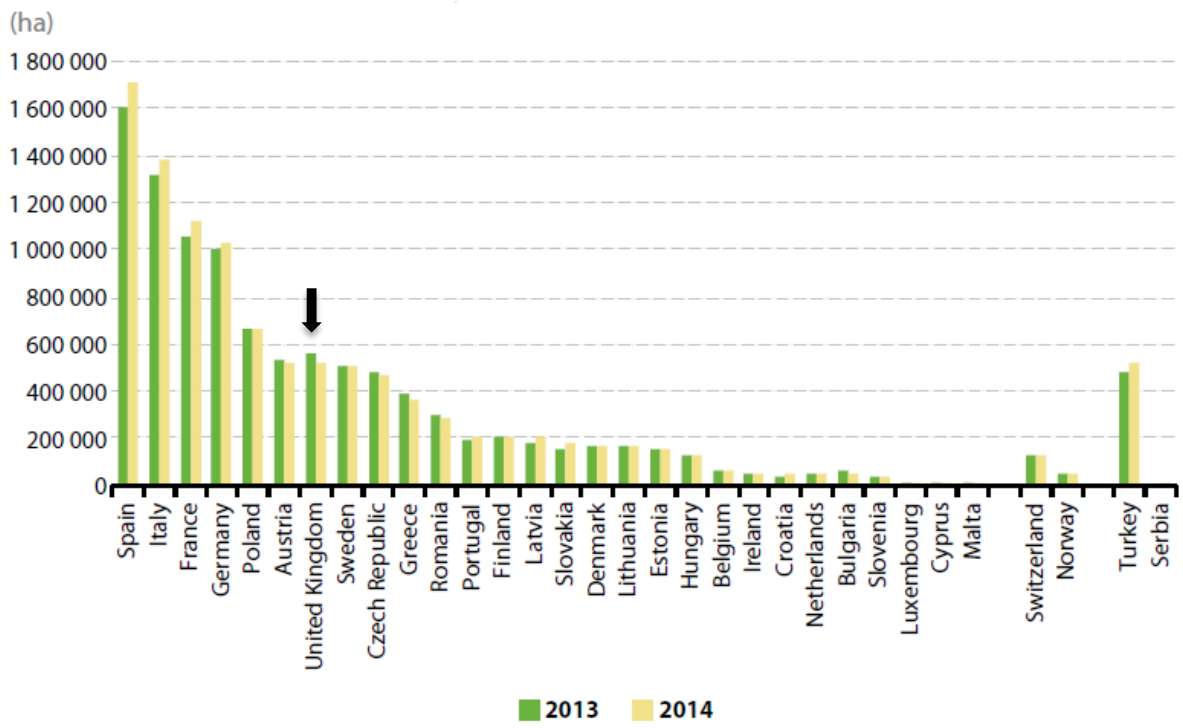


Source: CAP Context Indicators, 2015 update: http://ec.europa.eu/agriculture/cap-indicators/context/2015/2015-10-01-context-indicators_en.pdf

In relation to organic farming systems, the UK accounted for 5.1% of the total organic area for the EU-28 (fully converted and under conversion) in 2014 (see Figure 5). The area of UAA that is registered as organic is the seventh largest in the EU, at approximately 521,000 ha in 2015, a decline from 549,000 ha in 2014 (Eurostat, 2015). Since 2008 when the organic area peaked, the organically farmed area has declined by 30%. The organically farmed area represents 3.0% of the total farmed area on agricultural holdings in the UK (Defra, 2016c).

[22] The maps, updated in 2012, provide estimates of all three 'types' of HNV: Type 1 - Farmland with a high proportion of semi-natural vegetation; Type 2 - Farmland with a mosaic of low intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc.; and Type 3 - Farmland supporting rare species or a high proportion of European or World populations.

Figure 5: Total organic area (fully converted and under conversion), 2013 and 2014



Source: Eurostat (online data code: org_cropap)

The effects of the UK's land management on public goods and ecosystem services

The key challenges relating to the effects that farming has on the environment and climate, alongside the state of play of some key indicators are set out below and compared with the situation in other EU countries.

Biodiversity

Reversing historic declines, maintaining and restoring farmland biodiversity remains a key challenge in all UK countries. Despite progress made through the implementation of agri-environment schemes over the past three decades, the pressures on biodiversity remain significant.

Farmland birds are still in decline in all UK countries and often are declining at a significantly greater rate than other bird species. For example England data from 2014 showed a decline in the breeding farmland bird index of 56% since 1970 and, although the largest declines in farmland bird populations occurred between the late seventies and the early nineties, there has been a significant decline of 8% between 2008 and 2013 (Defra, 2016d). Despite this, there are some examples of where well targeted agri-environment-climate schemes have improved the abundance of rare species, such as cirl buntings and stone curlews as well as, in some regions, more widespread species such as grey partridge, tree sparrow, house sparrow, reed bunting and yellowhammer (RSPB, 2015)

In Scotland the index measuring the abundance of terrestrial breeding birds increased by 22% between 1994 and 2008, but declined by around 10% between 2008 and 2012,

followed by a modest improvement to 2015[23]. The overall decline since 2008 is linked to significant declines in upland and farmland species: the upland bird index shows a long term decline of 14% since 1994 (SNH, 2016); and although the farmland bird index increased between 1994 and 2008, it subsequently declined by 12% between 2008-12 and has since increased again and in 2015 was 22% above 1994 levels (SNH, 2016). Some of the recoveries in numbers for particular bird species, such as seed eating birds have been attributed to agri-environment climate measures.

Amongst the farmland birds to experience long term declines are arable farmland specialists, which have been affected by changes in farming practices, including loss of field margins, a tendency towards autumn sowing of cereals, and increased use of fertilizers and pesticides (SNH, 2016; RSPB, 2015).

Since 1990, **butterfly numbers** on farmland have also fallen by 27% in England, reaching a historical low point in 2012, with the underlying trend being on of significant decline since 2009.

In terms of **protected habitats and species**, despite improvements in the condition of habitats in protected areas and population increases in a number of species of conservation concern, it is those associated with farmland that continue to decline under pressures from pollution or inappropriate land management. In England, just over a third of grassland types (as defined in Annex 1 of the Habitats Directive) are in serious decline (England RDP, 2014-2020).

In Scotland SRUC reported in 2010 that 'these gains [improvements in favourable conservation status of habitats and species] have been offset by a continuing decline in the quality of much of Scotland's wider countryside, with resulting adverse impacts on habitats and species associated with Scottish farming.' The most recent assessment by SNH showed that more priority farmland habitats were deteriorating in conservation status (63%) than improving (13%) and the most recent Countryside Survey reported declines in plant species diversity in a range of Scottish habitats, including improved grassland, hedgerows and streamside vegetation (quoted in the Scotland RDP 2014-2020). The recent State of Natural Resources Report (SoNaRR) for Wales (Natural Resources Wales, 2016) highlights that 78% of the total length of hedgerows in Wales is in unfavourable condition, although a small proportion (5%) has been restored or is planned for restoration under agri-environment schemes.

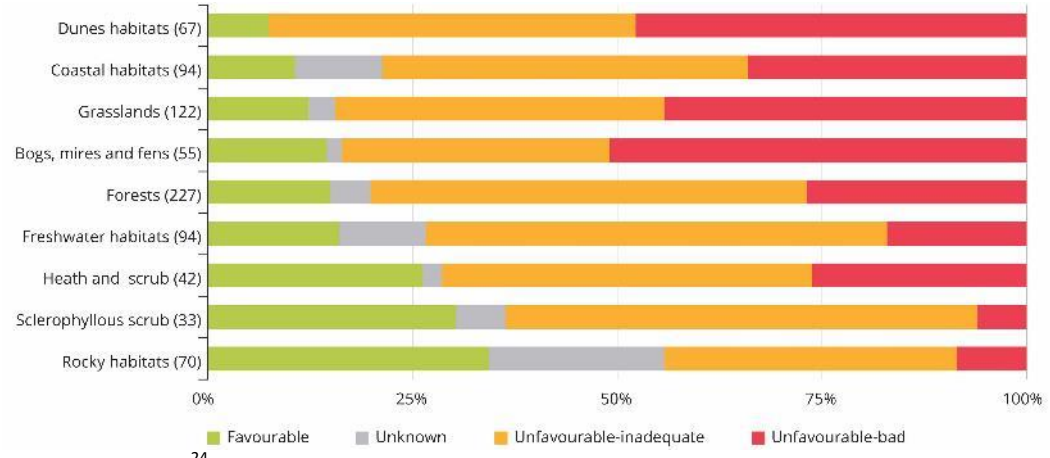
In Northern Ireland approximately half of designated Natura 2000 sites are not in favourable condition, with the intensification of farming and habitat fragmentation identified as a major contributory factor. Priority grasslands and their priority species such as breeding waders have declined greatly in recent years. Overgrazing of blanket bogs by upland sheep has been a problem in the past. However, despite sheep numbers declining in recent years, many peatlands have not shown any significant improvement. The majority of the total land

[23] Indicator 'Index of abundance of terrestrial breeding birds' can be found here: http://www.gov.scot/About/Performance/scotPerforms/indicator/biodiversity

area within ASSIs (~70%) and SACs (~80%) are at risk of damage from nutrient nitrogen, primarily ammonia emissions (Northern Ireland RDP, 2014-2020). The most commonly cited issue affecting Welsh Special Areas of Conservation (SAC) is agriculture and land management, with grazing (either under-grazing or over-grazing) being the largest cause for concern.

The 2015 State of Nature Report by the EEA (EEA, 2015) reviews the data provided by all Member States on progress towards meeting favourable conservation status of species and habitats related to the Birds and Habitats Directives. This showed that those habitats and species depending on agricultural ecosystems (including natural and semi-natural grasslands) are doing worse than general assessments and that agricultural pressures were identified as one of the key pressures facing biodiversity. At EU level, as shown in Figure 6, only 12.3% of these habitat types had a favourable conservation status as defined by the Habitats Directive and reported by Member States in accordance with Article 17 of the Directive. This is one of the lowest levels of favourable condition amongst habitats. The main pressures/threats affecting these grassland habitats according to the Members States' reports are from agriculture, and these are (in order of descending frequency of reported categories): abandonment of pastoral systems, lack of grazing, lack of mowing, fertilisation, modification of cultivation practices and agricultural intensification.

Figure 6 Conservation status of Annex I habitat types (2007-2012)



Source: EEA 2015[24]

Pollinators are also under pressure and in decline (National Ecosystem Assessment, 2011). In **Wales** the ranges of both bumblebees and solitary bees have contracted (Welsh Government, 2013). Declines in pollinators are thought to be a result of the ongoing trend towards more intensive use on enclosed farmland including greater use of agrochemicals, re-seeding, increased stocking rates, habitat loss and fragmentation. This may also be exacerbated by changes in the selection of crop types (Welsh Government, 2013)

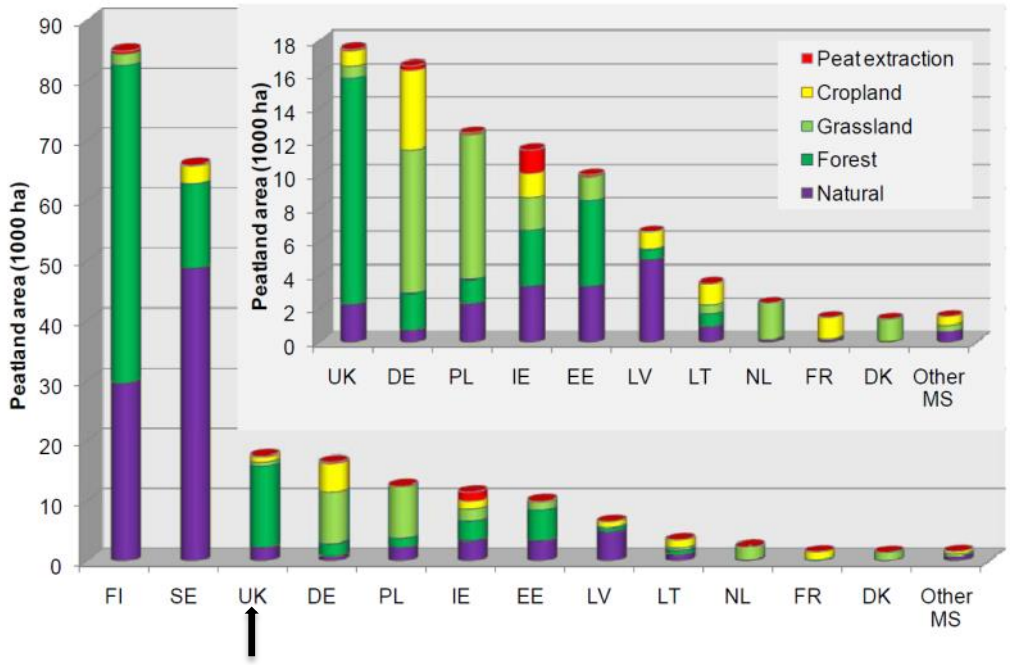
[24] EEA, 2015 State of Nature in the EU http://www.eea.europa.eu/publications/state-of-nature-in-the-eu

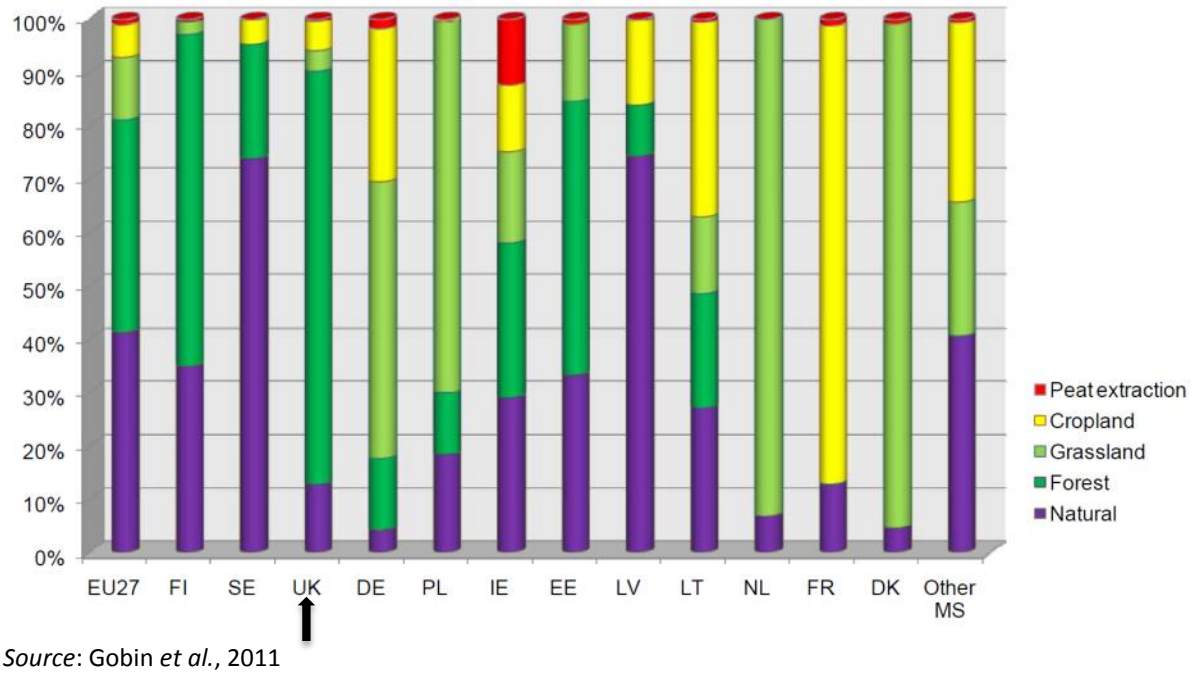
In Scotland, **upland habitats** are particularly valuable for biodiversity. A key issue facing these habitats is inappropriate grazing management on High Nature Value farmland. Continuing reductions in livestock numbers are leading to undergrazing in some areas or even land abandonment. Other pressures include overgrazing in areas with high densities of red deer, poorly managed burning of heather and other vegetation (muirburn) and historic peatland drainage.

Peatlands are a very important habitat in the UK, with the UK having some of the most extensive areas of the EU's peatland area after Sweden and Finland. Only a small proportion of these areas are under agricultural use (around four per cent – about half under arable and half under grassland). These figures mask the fact that, in some regions of some countries, the proportion of peat soils under cultivation is extremely high. For example, around 80% of England's peatlands are drained and used mainly for intensive farming in the lowlands and extensive farming and grouse moors in the uplands. These activities reduce the extent by which these lands may act as carbon sinks. Emissions associated with agriculturally used peatlands are higher than in forest peatlands. This has to do with regular tillage and the high carbon release linked with relatively higher SOM levels in agriculturally used peat soils. Indeed, CO_2 emissions from drained peats in East Anglia are recognised as one of the largest land use related sources of CO_2 in the UK. Although in many places large scale restoration projects have been put in place, still large tracts of this habitat continue to face pressures, including from agriculture. Drainage, peat-cutting for fuel and over-grazing are major factors in the reduction of the extent and quality of peatlands in Northern Ireland.

Figure 7 shows the extent of peat soils under agricultural use in twelve countries in the EU, including the UK.

Figure 7: Peat soil area in Member States having more than 1,400 ha of peat soils, including the breakdown for grassland and cropland





Source: Gobin *et al.*, 2011

Changes in **lowland grassland management** or enclosed grassland management in Wales and Scotland continue to impact upon biodiversity. Although the improvement of semi-natural pastures and hay meadows and the move to silage instead of hay has been taking place over a long period of time, data from Wales suggests that intensification of grassland use continues, illustrated by the increase in the area of grass leys (grassland less than five years old) over the period 2005-15 - from 115,056 ha to 157,778 ha (Welsh Government, 2016).

Hedgerows are a priority habitat for biodiversity associated with farmland, providing a valuable habitat for many species. Hedgerow removals have declined in England and Wales since the introduction of the Hedgerow Regulations in 1997 and existing hedges adjacent to agricultural land must be protected under CAP cross-compliance rules. In addition, most agri-environment schemes in the UK provide funding for the management of existing, and the establishment of new hedgerows. However, although Northern Ireland has the highest density of hedgerows in the UK, significant boundary removal has taken place and many traditional hedges or banks have been replaced by post and wire fencing. Poor hedge management remains an issue in most countries, with hedges trimmed either too often or not enough, or at the wrong time of year. In Wales poor condition of the ground flora around hedgerows has been noted, resulting from the effects of fertilisers and pesticides being applied to adjacent land (NRW Biodiversity Team, 2016). Figures in Wales from 2007 showed that approximately 78% of hedgerows were in unfavourable condition (Countryside Survey, 2007). The management, gapping up and planting of hedgerows has been a major focus of agri-environment schemes in all UK countries which should have improved the situation somewhat over the last decade.

Water quality

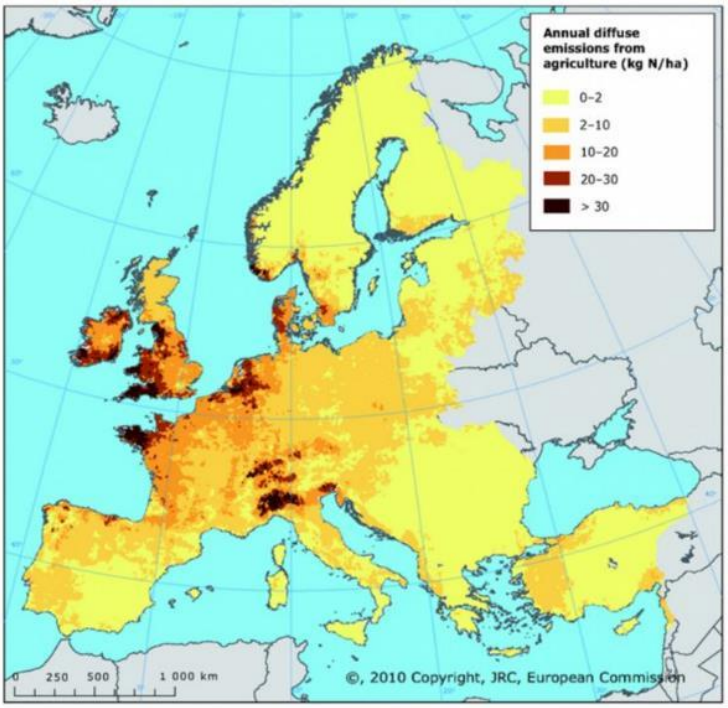
Rivers, lakes, estuaries, coastal areas, wetlands and groundwater provide many different benefits to society; from supplying drinking water and supporting fisheries to providing an essential resource for business and agriculture, transport routes and a source of recreation that promotes wellbeing. Pollution from rural areas comes from the combined effects of numerous sources, including agriculture, roads, recreational land use such as golf courses and forestry activities. It is mainly caused by nutrients, contaminants and chemicals such as pesticides and sediment entering water bodies as a result of land management activities.

Agriculture is considered the greatest contributor to pesticide, nitrogen and phosphorous surpluses in European surface and groundwater. The management and application of manure and of chemical fertilisers and pesticides on agricultural land can lead to nutrient and contaminant leakages into water bodies which deteriorate water quality. A range of factors influence the extent to which these agricultural practices affect water quality, such as nutrient spreading application conditions and equipment, quantities applied, stages of crop growth, type of crop, nutrient levels already present in soil, topography, type of soils, soil structure, soil microbial activity, distance from watercourses, etc.

According to the EEA, about 40% of UK's groundwater bodies were in a poor status in 2012, which was a higher proportion than a majority of other countries that provided data in the EU25. In England, 30% of water bodies are not achieving good status specifically from agriculture with many more contributing to poorer quality waters. Diffuse pollution from agriculture is a significant cause of poor status, particularly nitrates and phosphorous. The main causes of diffuse pollution are: nutrient enrichment from excess phosphorus and nitrogen on agricultural land and farming practices; sediment loss caused by livestock poaching and river bank erosion by livestock; diffuse pollution arising from farmyard runoff. Although the loss of phosphorus to water bodies, as a percentage of the total applied on agricultural land, is very small (1-10%), the EA estimates that it still accounts for 20-30% of the phosphorus in rivers (Environment Agency, 2012). In comparison to other EU countries, Figure 8 shows that the UK has amongst the highest levels of diffuse nitrogen emissions from agriculture to freshwater (2010 figures), particularly in the South West and North West regions of England and Wales, where there is significant dairy farming, as well as parts of Northern Ireland.

[25] Data from the EEA indicator 'Chemical status of groundwater bodies', last updated in November 2012, based on data from the EU WISE-WFD database – see: http://www.eea.europa.eu/data-and-maps/figures/chemical-status-of-groundwater-bodies

Figure 8: Annual diffuse Nitrogen emissions from agriculture to freshwater, in kg N/ha



Source: Eurostat, 2010

This diffuse pollution also affects important river, wetland, coastal and estuarine habitats and species, with a number of river SSSIs in unfavourable condition as a result of agricultural pollution.

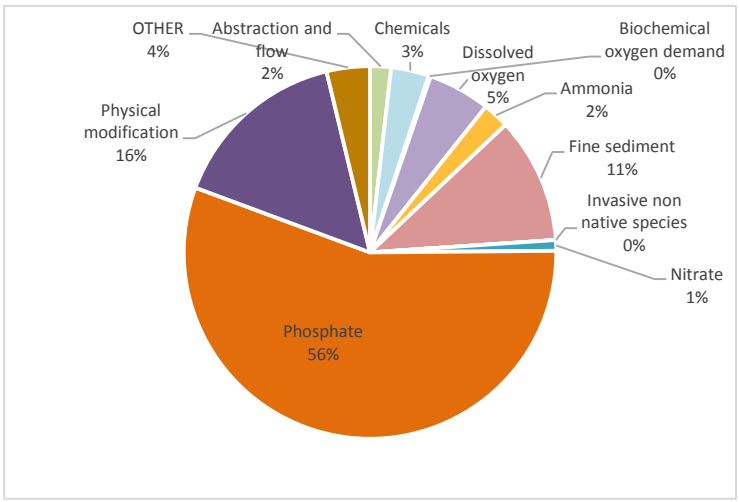
Some of the key facts and figures for the UK countries are set out below:

- Good Ecological status of surface water bodies has declined over recent years, with only 17% of surface water bodies assessed in England in high or good status in 2015 compared to 25% in 2010 (although much of this decline is from the changes made to monitor and assess the condition of water). In 2015, 47% of groundwater bodies were considered to be in poor status, with agriculture thought to be responsible for 75% of those failures. Pollution from agriculture is cited as the likely cause in 30% of known failures to achieve Good Ecological Status for water bodies in England – see Figure 9. Nitrate is also the biggest single water quality issue in groundwater drinking water protected areas (DrWPAs).
- Across England and Wales, agriculture is estimated to account for 50-60% of nitrate in water bodies (Hughes et al, 2008), 75% of sediment (Collins and Anthony, 2008) and pesticides and 20-30% of phosphorus (May et al, 2011, White et al, 2009).
- English farmers have been calculated to be losing 120,000 tonnes of nitrogen and 2,300 tonnes of phosphorus every year (although these figures vary significantly with local circumstances).
- In England, 80% of drinking water failures are due to agriculture, mainly pesticides; the cost of removing nitrate and pesticides from surface and groundwater drinking supplies is estimated at £133m/yr (Defra, 2006).
- Metaldehyde slug pellets account for 83% (96 of 115) surface drinking waters identified as being 'at risk' of the pesticide related issues.
- In Scotland (2012) around 2,050 of the 3,200 water bodies in Scotland met the EC's Water Framework Directive standard of 'good status' with regards to ecology (63%), up from 61% in

2008. However, of those water bodies that are not in 'good status', in around 18% this is as a result of diffuse pollution from agriculture (Scotland RDP).

- In Wales, increased production on dairy and beef cattle units creates particular issues in terms of slurry storage and management: 90 water pollution incidents related to dairy and beef farming, out of a total of 139 attributed to agricultural premises, were recorded in 2015 (Natural Resources Wales, 2016)
- In Northern Ireland, the main concern for the waterbodies is the eutrophication of rivers and lakes caused primarily by phosphorous and sedimentation. In relation to phosphorus, 72 % of river monitoring sites had annual average phosphorus (SRP) concentrations in excess of 0.02 mg/l, the level above which is considered to be at risk from eutrophication. 17 % of these sites had concentrations above 0.1 mg/l SRP - indicative of nutrient enrichment. 100 % of river sites showed a decrease or stabilisation in annual average SRP concentrations since the previous reporting period 2004-2007.

Figure 9: 2016 WFD Agriculture and Rural Land management sector (England) Reasons for Not Reaching Good Status (RNAG) – causes of failure in surface waters

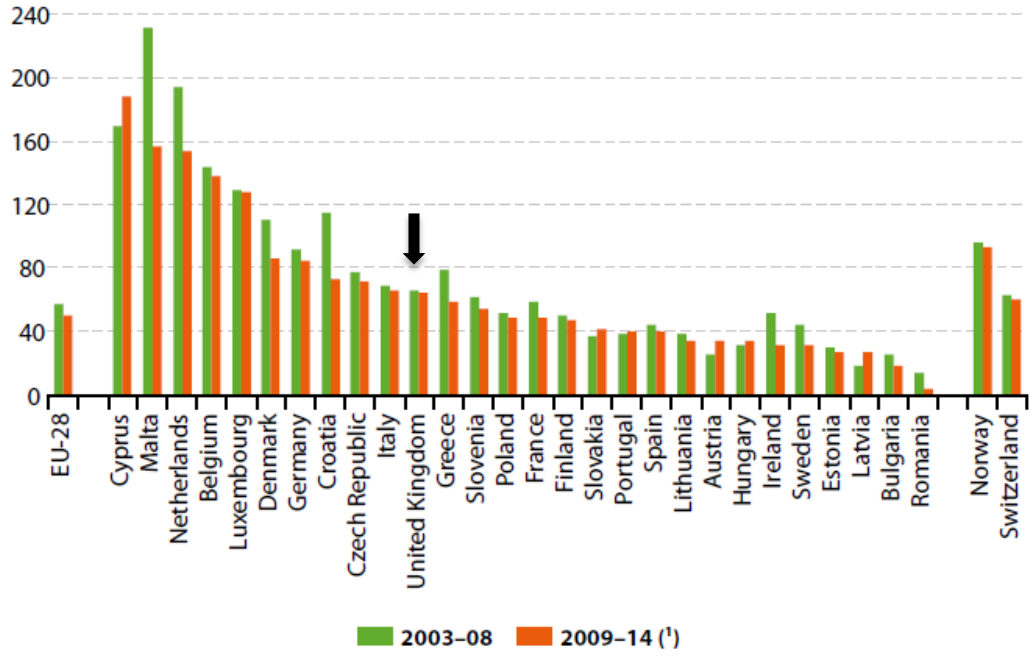


Source: Unpublished data from the EA's River Basin management plans data report, 2016

Two indicators of gross nutrient balance[26], showing the potential threat of surplus or deficit of nitrogen and phosphorous can give an indication of the potential risk to the environment (water quality as well as for air and soils). Figures are collected for all EU countries which enables the UK to be viewed in comparison to other EU Member States. This shows the gross nutrient balances for the UK to be in the middle range, but slightly above average compared with other countries.

[26] The input side of the balance includes all nitrogen and phosphorus supplied to the soil. The output side of the balance presents the nutrient uptake by harvested (and grazed) crops and fodder and crop residues removed from the field

Figure 10: Gross nitrogen balance, averages 2003-08 and 2009-13 (kg N per ha of utilised agricultural area)

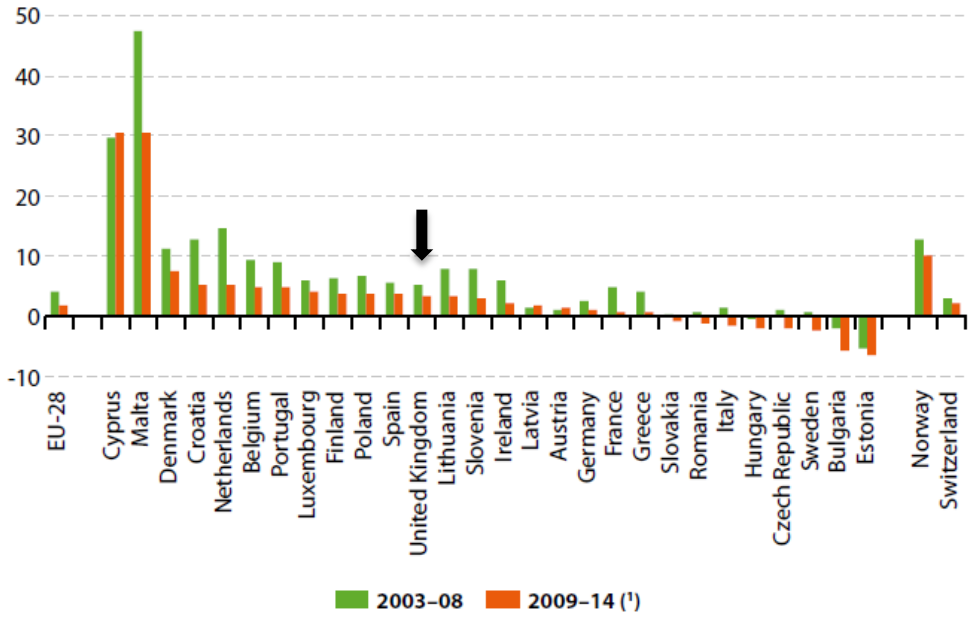


Note: Eurostat estimates for EU-28, Belgium, Bulgaria, Denmark, Greece, Spain, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Austria, Romania and Slovakia. Estimates for 2012–14 for Sweden.

(1) EU-28, Germany, Ireland and Switzerland: 2009–13.

Source: Eurostat (online data code: aei_pr_gnb)

Figure 11: Gross phosphorous balance, averages 2003-08 and 2009-14 (kg P per ha of utilised agricultural area)



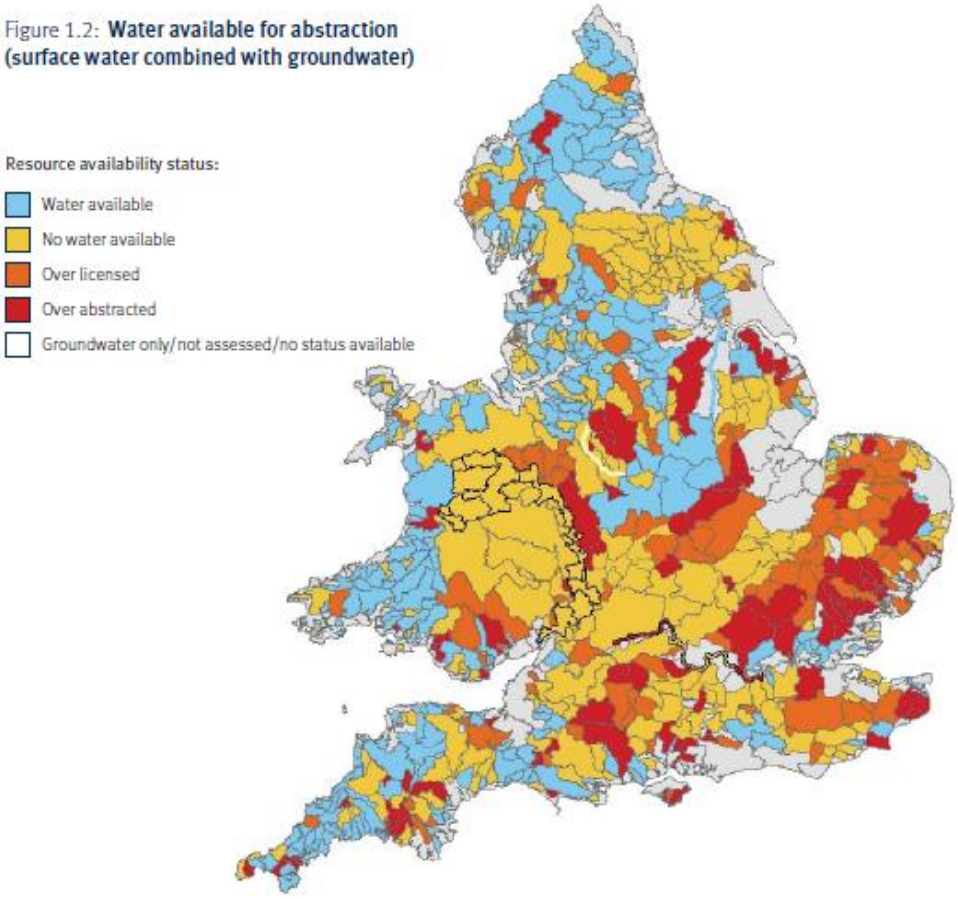
Note: Eurostat estimates for EU-28, Belgium, Bulgaria, Denmark, Greece, Spain, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Austria, Romania and Slovakia. Estimates for 2012–14 for Sweden.

(1) EU-28, Germany, Ireland and Switzerland: 2009–13.

Source: Eurostat (online data code: aei_pr_gnb)

Water abstraction is likely to become a more significant issue over time. A report by the Environment Agency in 2014 concluded that current levels of water abstraction in some areas, particularly the south and east of England and some parts of Wales (see Figure 12), are already harming nature and becoming unsustainable.

Figure 12: Water available for abstraction (surface and groundwater)



Source: EA, 2009

Soils

Soil erosion affects the whole of the UK, albeit to varying degrees and is estimated to affect 17% of land in England and Wales. The EEA indicator estimating soil erosion by water[27] shows that most of the UK's farmland could be losing between 0.5 and 15 tonnes of soil per ha per year due to rainfall (2012 data) with most fields experiencing less than 1 tonne per hectare per year. Erosion by water appears to be more severe in England (in particular in the South-West where it could be between 5 and 10 tonnes per ha) and in central Scotland, where annual soil losses per ha could be as high as 20 to 50 tonnes. It has been estimated that around 2.2 million tonnes of topsoil is eroded annually in England and Wales. Soil degradation costs England and Wales an estimated £0.9bn - £1.4bn per year. In terms of

[27] http://www.eea.europa.eu/data-and-maps/figures/estimated-soil-erosion-by-water#tab-based-on-data

degradation, about 45 % of total annual soil degradation costs are associated with loss of organic content of soils, 39% with compaction and 13% with erosion (Graves et al, 2011).

Soil erosion by wind is estimated to be a serious problem in parts of eastern England and especially on the peat soils, but less so in other parts of the UK[28]. However, work in the South West of England has demonstrated that 38% of surveyed holdings have soil structural degradation to produce observable features of enhanced surface runoff in the landscape (Palmer and Smith, 2013).

Compaction is also an issue as it reduces agricultural productivity and water infiltration, and increases flood risk through higher levels of run-off. Climate change is likely to add to this through increased flooding and more heavy rainfall events which will result in erosion and runoff. A recent study examining grassland compaction in England and Wales found approximately 10% of soils to be in poor condition (ADAS UK Ltd, 2014). Compaction is also an issue in Northern Ireland despite the majority of agricultural soils being under grass due to the fact that 57% of soils are gleys with poor levels of drainage (Northern Ireland RDP).

The National Ecosystem assessment found that many agricultural soils have elevated nitrogen (N) and phosphorus (P) levels and are a source of these nutrients to surface waters. Although there have been improvements in soil phosphate levels in recent years, there is still a major surplus in many soils, especially those under intensive grassland (UK NEA, 2011).

GHG emissions

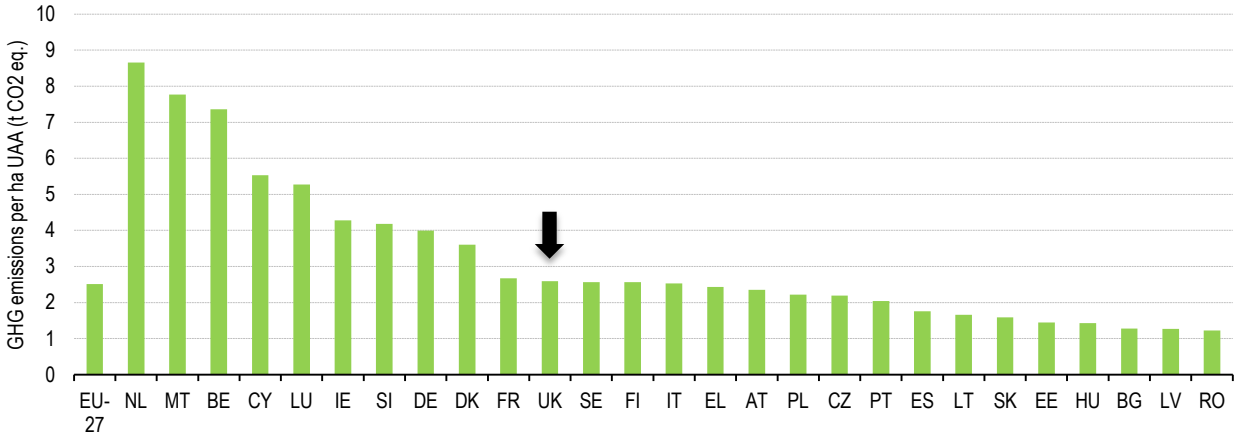
Between 1990 and 2014 total greenhouse gas emissions (GHG) from agriculture fell by almost 20% in the UK[29]. Unlike the majority of other EU countries, where emission reductions are slowing over time, in the UK the rate of decrease in agricultural emissions has increased in this period compared to 1990-2000. Nonetheless, agriculture is the UK's major source of both nitrous oxide and methane emissions accounting for 84% of total nitrous oxide emissions and 43% of total methane emissions (Defra, 2016e). These mainly come from fertiliser application, enteric fermentation by livestock, agricultural combustion and agrochemical use. Significant reductions in the numbers of cattle and sheep and substantial reductions in the overall application rate for nitrogen fertilisers (particularly on grassland) have been the main drivers for the reductions in these emissions.

In 2012, the UK agricultural sector emitted 51.8 Mt CO2e. Some 15.5 Mt CO2e were methane emissions from enteric fermentation, 9.3 million tonnes methane emissions from manure management and 27.1 million tonnes were nitrous oxide emitted by agricultural soils (EEA, 2015). The UK agricultural sector was the third largest emitter in the EU, after France (89.3 million t CO2 eq.) and Germany (69.5 million t CO2 eq.). However, when comparing emissions per hectare of UAA the agricultural sector in the UK performed better than a number of other EU countries, with an average 2.59 tonnes of CO2 eq. emitted per ha. The UK ranked 11th in 2010, just above the EU-27 average (2.51).

[28] http://www.eea.europa.eu/data-and-maps/figures/estimated-number-of-erosive-days

[29] Data from CAP Context Indicator 45 'Emissions from agriculture' - https://ec.europa.eu/agriculture/sites/agriculture/files/cap-indicators/context/2016/c45_en.pdf

Figure 13: Aggregated emissions of CH_4 and N_2O per Utilised Agricultural Area (tonnes CO_2 equivalent per ha), 2010, EU 27



Source: EEA, 2010

Information provided in the country RDPs for 2014-2020 show that the contribution made by the agricultural sector to total GHG emissions varies by UK country, from 20% in Scotland and Wales to 29% in Northern Ireland. The higher figure in Northern Ireland is a result of its dominant livestock sector and the lack of heavy industry or significant fossil fuel generation seen in other regions. Significant declines have taken place since the 1990s (27% in Scotland and 21% in Wales, but only 8% in Northern Ireland) largely due to a decrease in livestock and a decline in nitrogen fertiliser use, but there is thought to be further potential to reduce emissions from the sector through the uptake of mitigation measures that also benefit air and water quality and biodiversity as well as increasing the carbon stocks in soils and biomass. Despite this, Welsh figures show that emissions from the agricultural sector have increased by 3.0% since 2011, compared with 2012. This is a result of both a reduction in the land-use sink of 22% between 2011 and 2012 and an increase of agricultural emissions of 1% driven by changes in sheep and cattle numbers.

Air quality

In the UK there has been a long-term decline in the emissions of sulphur dioxide, ammonia and nitrous oxides. Despite the declines in emissions, 97% of sensitive habitats exceeded the critical load for eutrophication from air pollution in the period 2006-2008. Information from In Northern Ireland the majority of the total land area within ASSIs (ca. 70%) and SACs (ca. 80%) in NI shown to be at risk of damage from nutrient nitrogen, primarily ammonia emissions (Northern Ireland RDP 2014-2020). The total UK deposition of nitrogen is currently equally derived from emissions of nitrous oxides (NOx) and ammonia (NH3). In the UK, 86% of ammonia emissions were attributed to agriculture in 2011, compared with 93% in 1990. Emissions from synthetic fertilisers have reduced by 38%, 14% from cattle and reduced by 87% from field burning.

Information from Rural Development Programmes for 2014-2020 shows that Wales accounts for 9% of the UK total ammonia emissions and Northern Ireland for 11% (2012 figures), although emissions have declined 15% and 6% respectively since 1990. In Scotland agriculture is not a significant source of ammonia emissions, largely due to the extensive

nature of Scottish farming systems. Agriculture is the main source of NH3 emissions in the UK, mainly from agricultural activities, such as manure and slurry storage, handling and spreading as well as grazing and use of synthetic nitrogen fertilisers.

Annex 2: International environmental conventions and agreements signed by the UK

Table 6 Selected international environmental conventions and agreements signed by the UK, by environmental issue and relevance to agricultural policy

General theme	Organisation	Short name of Treaty of Convention	Full name of Treaty or Convention	Year of signature	Theme(s) covered	Significance for agriculture and land management
Biodiversity	IUCN	CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora	1973	Trade in wild species	**x**
	Council of Europe	**Bern Convention**	Convention on the Conservation of European Wildlife and Natural Habitats [Council of Europe No.104]	1979	biodiversity/wildlife conservation	**X**
	UNEP	**Bonn Convention or CMS**	Convention on the Conservation of Migratory Species of Wild Animals, including: *- 1991 Agreement on the Conservation of Populations of European Bats* *- 1992 Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas* *- 1996 Agreement on the Conservation of Cetaceans in the Black Sea, the Mediterranean Sea and the adjoining Atlantic* *- 1996 Agreement on the Conservation of African-Eurasian Migratory Waterbirds* *- 2001 Agreement on the Conservation of Albatrosses and Petrels* *- 2003 Memorandum of Understanding (MoU) concerning Conservation Measures for the Aquatic Warbler*	1980	biodiversity/wildlife conservation	**X**

	Ramsar Convention	Ramsar Convention	Convention on Wetlands of International Importance especially as Waterfowl Habitat, including: *- 1982 Paris Protocol to amend the Ramsar Convention*	1971	Wetlands	**Certain localities**
	UN	**CBD**	Convention on Biological Diversity, including: *- the 2010 Nagoya Protocol ('ABS') on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*	1992	biodiversity conservation	**X**
Landscape	Council of Europe	Florence Convention	European Landscape Convention	2000	landscape conservation	**Provisions not strong**
Air pollution	UNECE	**CLRTAP**	Convention on Long-Range Transboundary Air Pollution, including in particular: *- 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution To Abate Acidification, Eutrophication and Ground-Level Ozone ('Multi-Effect Protocol or Gothenburg Protocol'). The Gothenburg Protocol was revised on May 4th 2012*	1979	air pollution	**X**
Seeds/plants genetic resources	FAO	IPPC	International Plant Protection Convention	1951	Prevention and control of the pests of plants and plant products	
	UPOV	UPOV	International Convention for the Protection of New Varieties of Plants, including: *- 1991 Act amending the International Convention for the Protection of New Varieties of Plants*	1962	Plant breeding	**x**
	FAO	International Seed Treaty	International Treaty on Plant Genetic Resources for Food and Agriculture	2001	conservation, exchange and sustainable use of the world's plant genetic resources for food and agriculture (PGRFA)	
Marine conservation / environmental	IMO	Marine Dumping	Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter	1973	marine dumping/environment	

protection	UN	UNCLOS	United Nations Convention on the Law of the Sea	1984	rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.	
	UN	UN	Convention on the Law of the Non-Navigational Uses of International Watercourses	1997	Water protection / to help conserve and manage water resources for present and future generations.	
	OSPAR Convention	**OSPAR Convention**	Convention for the Protection of the Marine Environment of the North-East Atlantic	1998	marine environment protection in North-East Atlantic	**X**
Climate change	UNFCCC	UNFCCC	United Nations Framework Convention on Climate Change	1992	establishing the UNFCCC	
	UNFCCC	**Kyoto Protocol**	Kyoto Protocol to the United Nations Framework Convention on Climate Change, including: - *2006 Doha Amendment to the Kyoto Protocol*	1997	Climate change convention	**X**
	UNFCCC	**Paris Agreement**	UNFCCC Paris Agreement	2015	Greenhouse gases emissions mitigation, adaptation and finance starting in the year 2020	**X**
Environment		Aarhus Convention	United Nations Economic Commission for Europe (UNECE) Convention	1998	Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters	
Wastes	Basel Convention	Basel Convention	Convention on the control of transboundary movements of hazardous wastes and their disposal	1989	Deals with the correct management of wastes and hazardous waste when moved between countries	
Agricultural and food trade agreements	UNECE	ATP agreement	Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be used for such Carriage (ATP)	1971	transport of foodstuffs	
	GATT	GATT agreement	General Agreement on Tariffs and Trade Multilateral Trade Negotiations Agreement on Technical Barriers to Trade	1979	trade commitments	

	WTO	*WTO SPS agreement*	*AGREEMENT ESTABLISHING THE WORLD TRADE ORGANISATION Agreement on the Application of Sanitary and Phytosanitary Measures (GATT Uruguay Round)*	1994	relates to a range of food safety, animal and plant health requirements with reference to traded products	
	Rotterdam Convention	Rotterdam Convention	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	1998	Imports of hazardous chemicals	
	UNECE	Aarhus Convention	Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, including: *- 2003 'Kiev' Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters*	1998	Public rights regarding access to information on matters concerning the environment. . Aarhus Convention builds on the 1972 Declaration of the UN conference on the human environment, the 1980 Declaration of Salzburg and other initiatives in this field	

Source: compiled by IEEP from UK Treaties Online and IEEP 2010 (Manual of European Environmental Policy)

The international environmental conventions and agreements in bold are those considered most relevant to future environmental obligations on the UK agricultural sector.

Box 11: Provisions of international conventions with respect to biodiversity, air pollution, marine and climate change

Biodiversity related international conventions:

- Signed in 1979, the **Bern Convention** is the predecessor to the EU Birds and Habitats Directive. The Convention aims to ensure conservation of wild flora and fauna species and their habitats, especially endangered and vulnerable species, including migratory species. As a signatory to the Bern Convention, the UK committed to take all appropriate measures to ensure the conservation of the habitats of the wild flora and fauna species. Such measures should be included in planning and development policies and pollution control, with particular attention to the conservation of wild flora and fauna. The Parties also committed to promote education and disseminate general information concerning the need to conserve species of wild flora and fauna and their habitats.
- The Convention on the Conservation of Migratory Species of Wild Animals (CMS) or **Bonn Convention** was signed by the UK in 1980 and aims to conserve terrestrial, marine and avian migratory species throughout their range, i.e. their habitats at a global scale. The CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range. The commitments made as part of CMS of most relevance to the UK agricultural sector include the daughter Agreements on the Conservation of Populations of European Bats, on the African-Eurasian Migratory Waterbirds and in the south of England, the Memorandum of Understanding (MoU) concerning Conservation Measures for the Aquatic Warbler.
- The **Convention on Biological Diversity** (CBD) was signed by the UK in 1992. It is a global agreement addressing all aspects of biological diversity: genetic resources, species, and ecosystems. Following several updates of national plants, a revised and updated Strategic Plan for Biodiversity was adopted at the 10th Conference of the Parties in 2010, for the 2011-2020 period. All signatories agreed to translate this overarching international framework (which includes the Aichi Biodiversity Targets) into revised and updated national biodiversity strategies and action plans by 2012. This, alongside the EU Biodiversity Strategy of 2011, led the UK to adopt its Post-2010 Biodiversity Framework. Commitments made by the UK engage the country to take action on biological diversity at least until 2020 and very likely beyond this.

Air pollution:

- The 1979 **Convention on Long-Range Transboundary Air Pollution** (CLRTAP) aims to gradually reduce and prevent air pollution, including long-range transboundary air pollution. Issue-specific Protocols were signed by the Parties, one of which is the 1999 Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone which includes, among other pollutants, emissions of ammonia (NH_3). The 1999 Protocol, or Gothenburg Protocol, engages its Parties to reduce deposition and concentrations below critical loads and levels. To implement the Protocol, the EU adopted the National Emission Ceilings Directive (EU Directive 2001/81/EC) in 2001 which requires Member States to develop and maintain national programmes with the aim of meeting fixed ceilings of national emissions of five air pollutants by 2010 and thereafter[30]. The EU Member States committed to jointly cut ammonia emissions by 6% between 2005 and 2020[31]. The UK has its own ceiling of 279 k tonnes of ammonia emissions by 2020. By 2013 emissions had fallen to 271k tonnes, 82% from agriculture.
- The NEC Directive was revised under the EU Clean Air Policy Package adopted in 2013, which increases the level of environmental ambition in this area of policy in response to the revised targets set out in the May 2012 revision to the Gothenburg Protocol. As part of this, Directive 2016/2284/EU adopted in December 2016, updated the emission reduction targets for the period 2020-2030 for the five air pollutants. For ammonia, the new reduction target for the UK is set at -19% by 2030. It is uncertain how the policy response to this target for the UK will evolve in a post EU context. For example, while it can be assumed that the provisions of the NEC Directive would be captured in UK law immediately after the UK leaves the Union, the UK government and the devolved authorities may pursue a different regulatory course

[30] http://naei.defra.gov.uk/about/why-we-estimate?view=necd

[31] The other emissions reduction targets for the period 2005-2020 agreed as a result of the Gothenburg Protocol in the EU are: sulphur dioxide by 59%, nitrogen oxides by 42%, volatile organic compounds by 28% and particles by 22%.

subsequently. However as a signatory of the Gothenburg Protocol, the UK will have to take action to fulfil its commitment on ammonia and other air pollutants with a significant agricultural component by 2030.

Marine protection:

- The 1998 Convention for the Protection of the Marine Environment of the North-East Atlantic, or OSPAR Convention, governs international cooperation on environmental protection in the North-East Atlantic. There are 15 signatories to the Convention, one of which is the UK. Whereas the focus of the 70+ Decisions and Recommendations agreed under the Convention is on marine pollution from various types of wastes or sea-related activities, three recommendations relate to reducing agricultural nutrients and pesticides inputs. These will continue to apply to the UK after its exit from the EU.

Climate change:

- Finally, commitments made to reduce greenhouse gas emissions under the Kyoto Protocol of the UNFCCC and more recently, the Paris Agreement, were agreed and signed by the EU as well as individual Member States. The ambition of the Paris Agreement is to hold '*the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels'.* To achieve this, every country is to submit intended nationally determined contributions (INDCs) which set the level of GHG emissions reductions that the country commits to deliver in order to meet the global target. The EU committed to reducing by at least 40% its domestic emissions of greenhouse gas by 2030, compared to 1990 levels.
- The EU's Climate and Energy policy framework provides added value to the Paris agreement by setting national emissions reduction targets linked to specific sectors, i.e. those under the Emissions Trading System (ETS), non-ETS sectors (including agriculture non-CO_2 GHGs), and the Land use Land Use Change and Forestry (LULUCF) sectors. While the current framework is the 2020 Climate and Energy Framework, the EU is in the process of negotiating the details of the 2030 Climate and Energy Framework, which will set new emission reduction targets for member states and for the ETS in line with the Paris INDC and will revise the underlying policy architecture. The departure of the UK from the EU will impact the current distribution of the reduction effort across the EU. Depending on the outcome of the negotiations, the UK may need to submit an individual INDC and continue its effort to reducing GHG emissions outside the EU framework.
- While the UK has well established domestic targets for the reduction of GHG emissions following the Climate Act, and so is not necessarily driven by the targets agreed at EU level for 2030, many of the policy measures introduced for achieving these domestic goals are built on EU law. The Emissions Trading Scheme is a good example; legislation on vehicle emissions and on the energy efficiency of domestic appliances are other examples. Departure from the EU will have consequences for climate policy in the UK as a result.

Annex 3: Evidence on the implications of UK withdrawal from the EU for agricultural prices, production, trade and income

Table 7: Evidence from van Berkum et al, 2016 on agricultural prices, production, trade and income implications of UK withdrawal

Trade Policy assumptions	Ag policy assumptions	Price, production, trade effects	Farm income effects	Relevant Scenarios in our analysis
FTA with EU, (Includes a TRQ of 55k tonnes lamb to EU), the effect is 5% rise in trade facilitation costs	**100%, 50% and zero DPs**	Farm gate prices rise 5% except for sheepmeat (because of the TRQ). So, small increases in UK production, and small decreases in consumption, and quite big % cuts in some imports (e.g. beef).	**With 100% DPs**: Significant *rises* for most sectors, except sheep. **At 50% DPs** most incomes fall ~10%, (hortic, pigs & poultry less), and bigger drop for sheep. **At 0% DPs**: 30% fall for crops, livestock, mixed, less for milk. Hortic, P&P not affected. Incomes in Scotland fall more than others.	The **FTA option** (3) is possible under Scenarios **B, C and D** Cuts in domestic support are significant but not as drastic in our scenarios
WTO default: MFN tariffs on all trade including with EU, no TRQs, (so we don't have the NZ lamb coming in at zero tariff). 8% trade facilitation costs plus the tariff effects.	**100%, 50% and zero DPs**	Wageningen study argues that UK prices increase 8% (by assumption) higher for some e.g. sugar. Most domestic production increases, small reductions in consumption. Big cuts in some imports, including from EU.	Incomes increase in the less supported sectors (hortic, P & P) even with 50% or 100% cuts in support. 100% cuts mean 20%+ incomes cuts for cropping, livestock and mixed farms. Less for dairy. Scotland & Wales feel bigger cuts with 50% or 100% DP cuts.	The **WTO option** (4) might be under our scenario **B and E** Again, income effects would be smaller compared to their larger cuts in DPs.
Trade liberalisation scenario: EU applies its CET to imports from UK, UK unilaterally cuts all (implicitly MFN) tariffs to EU and RoW by 50%. 8% trade facilitation costs.	**100%, 50% and zero DPs**	Big price falls for sugar, beef, sheep, pork poultry, price rises for grains, cheese, SMP, WMP). Corresponding changes in production and consumption[32]. So significant changes in trade: increases in grain and dairy exports, big reduction in sheep exports. Big rise in beef and poultry imports.	Incomes fall for all sectors (except hortic) under all DP assumptions and for all regions – especially Scotland which always shows larger negative effects than the other territories.	**Trade liberalisation is our Scenario B and the green liberalisation scenario E**

[32] Note: the model specifies normal responses to price changes: so if prices rise, production rises, consumption falls and vice versa.