THE CAMBRIDGE NATURAL CAPITAL LEADERS PLATFORM

The best use of UK agricultural land

UNIVERSITY OF CAMBRIDGE
INSTITUTE FOR SUSTAINABILITY LEADERSHIP

Contents

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CISL's Natural Capital Leaders Platform convenes companies wishing to better understand and manage their impacts and dependencies on natural capital. By valuing these impacts and dependencies, our members are able to make better decisions, identify new business opportunities and contribute solutions to natural capital loss and ecosystem degradation.

The UK agricultural land use collaboratory, led by the Cambridge Natural Capital Leaders Platform, served as a vehicle for engaging industry in a review of the demand and supply of UK agricultural land use and potential responses.

Our particular thanks go to Mark Reader, Department of Land Economy (University of Cambridge) for his research into agricultural land demand and supply options.

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Executive Summary

The demands on UK agricultural land are escalating. Meeting the needs of a growing population, providing greater food and energy security, increasing woodland coverage and offering better environmental protection are just some of these demands. But where will this land be found?

While our land resource is clearly finite, there is much that can be done to optimise its use. Sustainable intensification initiatives*, a reduction in food waste and changing diets are some of the opportunities that could release land for other uses. Understanding this supply-demand balance for land is critical.

To date, there has been insufficient work undertaken to analyse this. But it is vital that it is reviewed if we are going to think more strategically about how land is used. The industry needs greater clarity on what agricultural land is expected to deliver if it is to make sound investment and supply chain decisions, minimise environmental impacts, manage social impacts, and deliver the greatest value to stakeholders and society more widely. In addition, industry needs to see clearer direction from Government on what it sees as the priorities for UK agricultural land, and a supporting policy regime to accompany these priorities.

Given this, the Natural Capital Leaders Platform convened a group of industry companies and organisations in 2013 to examine the demand and supply of UK agricultural land and discuss potential industry responses. In the absence of any UK Government vision on land use, there was a strong consensus that industry needed to take a leadership position in the development of a simple, clear vision for UK agricultural land use and a set of principles to aid future land use decision making. Accompanying this, industry also wanted to propose some key actions for policymakers which will help to provide greater clarity on future land use.

The initial demand-supply analysis findings were startling. There is potential additional demand for up to 7 million hectares of land to meet a growing UK population's food, space and energy needs while increasing the area needed to protect and enhance the nation's natural capital. This is more than 35% of the UK's existing agricultural land, and compares with a possible maximum of up to 5 million hectares that might be released from a range of identified supply side initiatives, including sustainable intensification opportunities and reductions in household food waste. While there is very significant uncertainty around many of the assumptions and targets used in this initial analysis, and it assumes no significant change in the global market's ability to supply food to the UK, this potential supply-demand gap is a significant concern and warrants more detailed research. It also highlights the need to look at all UK land, not just agricultural land, through the same demand and supply lens.

*Sustainable intensification refers to initiatives which aim to deliver production and/or productivity increases while enhancing environmental, social and economic impacts.

Mitigating this, it is recognised that there will be opportunities to meet multiple demands with the same land. For example, increased woodland and certain bioenergy crops can provide carbon storage, wildlife habitats and flood mitigation benefits. The scope for this also needs further investigation and the analysis needs to be revised accordingly. However, if this does not close the supply-demand gap, then difficult choices will need to be made.

With this as a backdrop, the industry group developed a simple land use vision to act as a rallying point on this issue. This vision is:

"By 2030, UK agricultural land will be optimised to support the multiple needs of a 70 million population and deliver an improved and sustainable natural environment."

Any vision needs to be supported by a set of key objectives that will define what constitutes success in achieving this vision. Given this, the participants proposed the following key objectives:

- **Improved UK food security** through a focus on import substitution and export growth where UK agriculture has a competitive advantage;
- **Increased UK energy security** from appropriate land based renewable energy as part of a broad mix of UK energy supply solutions;
- **Better protection of nature** and its services, and the reversal in the decline of key ecosystems;
- **Improved competitiveness** and more diversified income sources for farmers and UK agricultural land based businesses; and
- **Enhanced recreational space** and amenity value to UK society.

Participants then developed an initial set of principles to guide future land use decisions. These included the need to ensure that:

- The full range of market and public goods and services delivered by land are understood and valued using appropriate methodologies;
- Opportunities to deliver multiple benefits from the same land are identified and encouraged;
- Cost-benefit analysis is undertaken to aid trade off decisions; and
- Landscape, recreational, climate change and future generation impacts are taken into account in land use decisions.

Finally, this led to the identification of some key actions for policymakers. The key proposals from this industry group are that Government should acknowledge and endorse this industry vision, and use the principles to develop a clear decision making framework with industry for the optimisation of UK agricultural land. In addition, Government should develop an integrated action plan across all key Government departments to consolidate existing agricultural land use policies and actions, and develop new actions where gaps exist. This plan should also highlight the key land use decisions that are needed to address climate change, while the land use analysis should be used to inform future CAP negotiations.

We now hope that this land analysis and the associated vision, decision making principles and proposed actions kick start a much needed debate on UK agricultural land use, and catalyse greater action and joined up thinking in this area. To take this forward, the proposed next step is that a joint Industry and Government group is formed to review and build on this analysis, and develop a decision making framework and action plan that integrates multiple existing targets, policies and research under one clear vision.

1 Setting the Scene

UK's agricultural land provides a wide range of essential goods and services, including food, fibre, timber, clean water, energy, wildlife habitats, carbon storage, flood management, employment and recreational opportunities.

However, the optimisation of land is severely hampered by the lack of market prices for many of these goods and services.

Land managers generally make land use decisions based on what they will be paid for, constrained only by legal requirements that are targeted at specific land uses, such as the CAP cross compliance requirements[1]. This is compounded by growing pressures on land including the demands of a UK population expected to reach 71 million by 2030[2], the need for improved protection of the natural environment given continuing degradation of some key ecosystems, concerns over food security particularly for commodities such as fruit and vegetables, the growing requirement for land to meet bioenergy needs and existing targets for increased woodland cover[3,4,5].

But there is hope. Technology improvements enabling efficiency, quality and yield benefits, reductions in food waste, changing diets and an emphasis on land delivering multiple benefits where possible, all provide opportunities to optimise land use. But will these supply initiatives be sufficient to meet growing demands? If not, difficult choices will need to be made, and a clear decision making framework will be vital to this process.

The UK Government is taking some steps to address this through targeting policies, incentives and research at specific land uses and demand pressures. For instance, agri-environmental schemes are being adjusted to provide for improved protection of key habitats, while research on sustainable intensification is being conducted by a Government funded Platform[6]. However, this is being undertaken piecemeal by different Government departments without reference to a single overarching land use vision or decision making framework, or an assessment of decisions on key trade-offs and how these should be addressed. Integrated policymaking in this area is vital.

This lack of direction impacts industry. Without a clear understanding of what land needs to deliver, or how Government policies fit together, or where supply chains need to be restructured to avoid resource degradation, business uncertainty is created, investment hindered and operating costs increased.

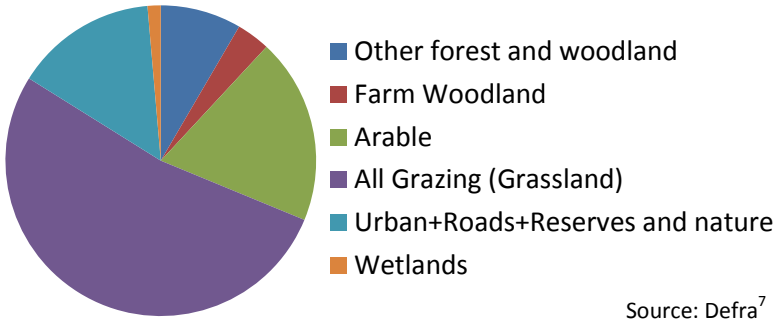
Given this, there is now an opportunity for industry to step up and show leadership by delivering its own "*vision, set of objectives and decision making principles*" to guide future UK agricultural land use. This could provide significant benefits through clarity on how land use will need to change and by providing greater investment and operational certainty for business. It will also improve society's understanding of nature's value, which will help to protect it from future challenges and threats such as climate change. Lastly, it will provide Government with a vision and set of principles to guide difficult land use choices and incentivise landowners and businesses to deliver a wider set of goods and services for the benefit of society.

2 Agricultural Land Today

The UK has a total land area of 24.2 million hectares[7], with over 75% of UK land utilised for farming purposes.

As shown in Figures 1 and 2, aside from grassland and livestock rearing, the main uses of agricultural land are for cereal crops (wheat, barley and oats) and oil seeds (oilseed rape and linseed). Other key crops grown include potatoes, peas, beans and sugar beet[8].

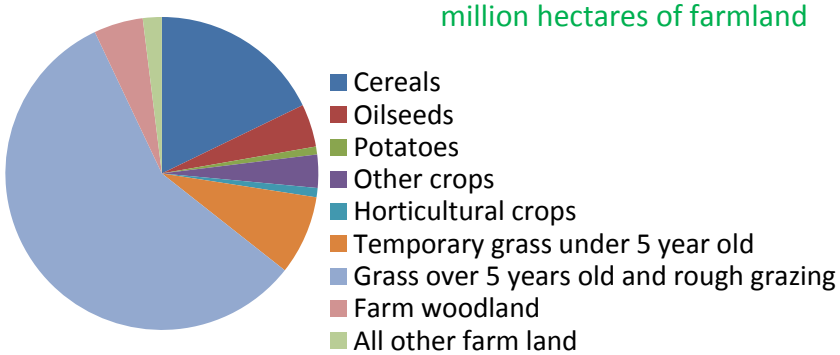
Figure 1: UK 2005 land use



Source: Defra[7]

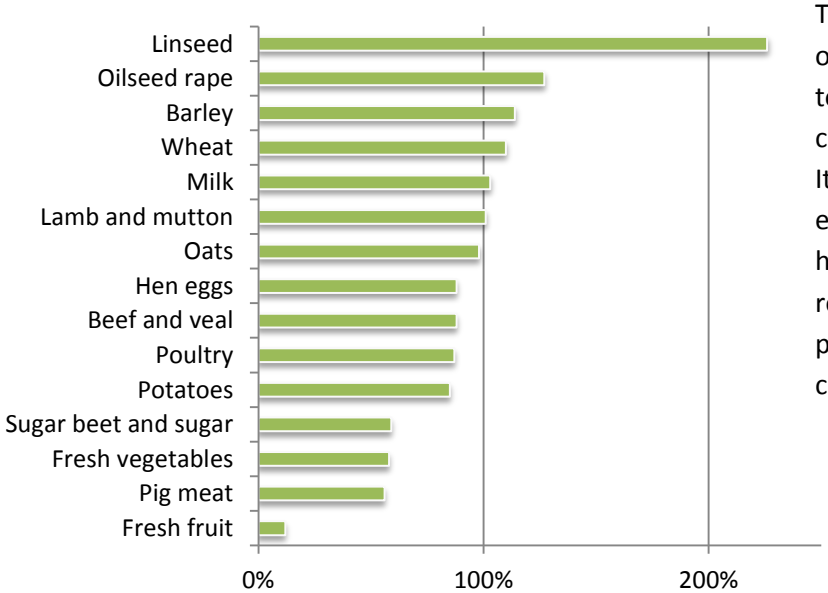
The UK's temperate climate and productive soils are well suited to growing many arable and horticultural crops as well as rearing livestock. Despite these competitive advantages, the UK is reliant on imports for many agricultural commodities[9], in particular fruit and vegetables, pig meat (Figure 3) and high protein animal feed, such as soya bean meal.

Figure 2: What makes up the 18.2 million hectares of farmland



Source: Defra[8]

Figure 3: Self sufficiency ratios (2011)

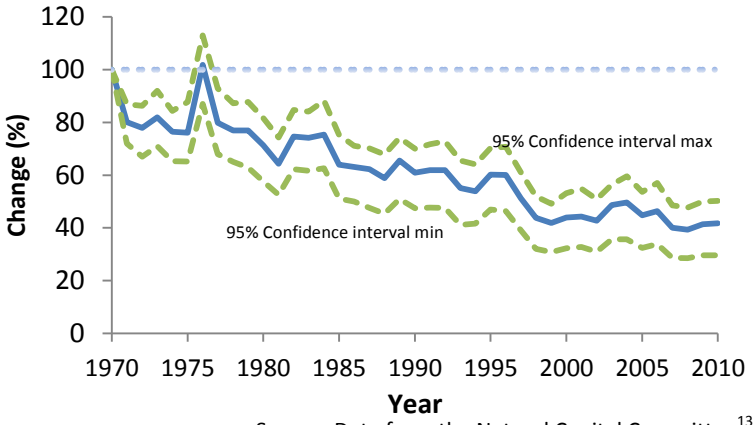


Source: Defra[10]

This represents both a threat and an opportunity. It is a threat if key supply routes to the UK are closed due to, for example, climate change induced droughts or conflicts. It could also be an opportunity if UK expands export channels for crops for which the UK has a competitive advantage, such as wheat, root vegetables and apples, as well as processed products such as yoghurt and ice cream.

However, this has to be set within a context where nature also needs greater protection. The UK's 2011 National Ecosystem Assessment (NEA) reported that 30% of ecosystem services are currently in decline, while many others are already degraded[11]. Examples of these impacts include the loss of pollinators, which have an estimated value to UK agriculture of £430 million per annum[12], and the decline in the abundance of priority species, as shown in Figure 4[13].

Figure 4: Change in the relative abundance of priority species in the UK (1970-2010)



Source: Data from the Natural Capital Committee[13]
Index represents 210 priority species
Index: 100 = 1970

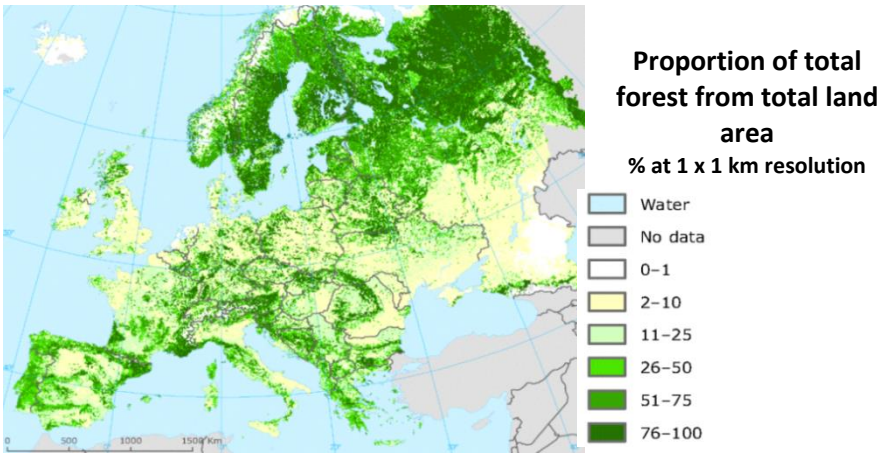
Efforts are being made to address this through agri-environmental schemes which pay farmers to manage land for biodiversity, healthy soil, water and landscapes, as well as through the current and future CAP reform, which requires land to be put aside for ecological focus areas.

However, it is not clear yet whether these will deliver the improvements needed to reverse declines.

Biodiversity impacts are exacerbated by the UK being one of the least forested countries in Europe, with approximately 12% of woodland cover versus a European average of 37% as illustrated in Figure 5[14].

Given that forestry provides many key functions including carbon storage, wildlife habitats, water and air purification, amenity value and a source of biomass, the value of additional woodland cover is being increasingly recognised. As a result, the Government's Forestry and Woodlands Policy Statement (2013) has already identified a target to increase woodland cover across England alone from 10% to 12% by 2060.

Figure 5: Forestry cover



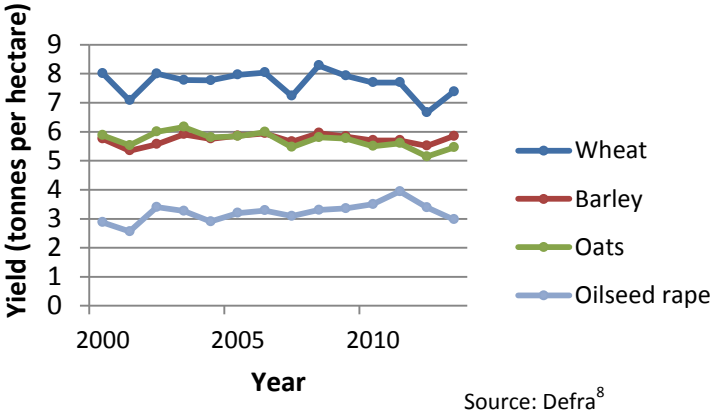
Source: Schuck et al[15]

With the UK population forecast to reach 71.4 million by 2030 from 62.6 million in 2012[2], the additional demands for food, living, working and amenity space will create further, significant pressures on land. New residential and commercial developments, transport infrastructure, food production, environmental needs and recreational space will be competing for land. This may make the UK more dependent on imports and worsen the UK's existing food, feed and drink trade deficit of £18.6 billion[16] even further.

At the same time, land is also being targeted to deliver bioenergy crops, such as miscanthus as a biomass feedstock. These could make a significant contribution towards the UK meeting its targets to deliver 15% of the UK's energy consumption from renewable sources by 2020[17] and reduce greenhouse gas emissions by at least 80% by 2050[18]. The Department for Energy and Climate Change (DECC) 2050 pathway scenarios[4] are a good source for understanding the related bioenergy crop land requirements.

Many of these pressures could be alleviated by significant improvements in arable yields. However, these have proved elusive in more recent years as shown in Figure 6[8] in part due to a focus on cutting costs, suboptimal nitrogen applications[19] and insufficient investment in, and uptake of, new technologies.

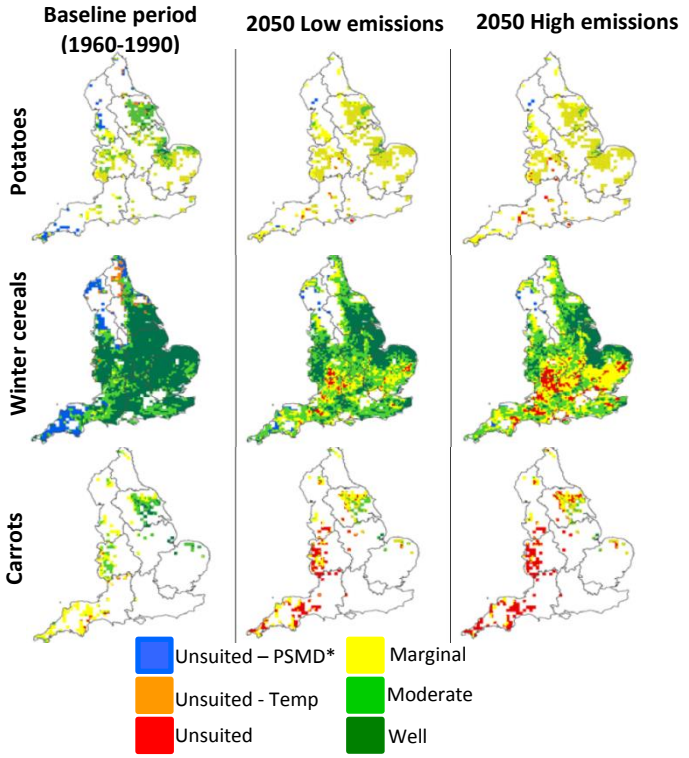
Figure 6: Main crop yields (2000-2013)



Source: Defra[8]

Finally, land use is likely to be impacted by climate change, which could see changes in the types and extent of crops grown. For example, winter cereals, potatoes and carrots could all see areas suited to their production diminish under high emissions scenarios (Figure 7)[20].

Figure 7: Agricultural land suitability for crops under scenarios for areas where crop is present in 2010



Source: ECI, HRW, Climate Resilience Ltd and Forest Research[20]

*Potential Soil Moisture Deficit

Climate change also places a spotlight on agricultural land's role in helping to mitigate its effects, with the strategic planting of trees, the use of certain bioenergy material and land used for water storage providing some of the options available to farmers and policymakers. Looking forward, this could be one of the critical roles that agricultural land needs to play, and coordinated action will be critical.

3 Analysis:

Additional demand and supply of land to 2030

An initial analysis has been undertaken of the key demand pressures on UK agricultural land, and how this compares with potential supply options that could release land from existing use.

Its aim is to stimulate thinking on how UK agricultural land could be used differently in the future and, very importantly, whether it will be possible to meet all of the demands on land through some key supply side initiatives.

The analysis is based on projecting additional demands and supply options to 2030, with an assumption that UK population will grow from 62.6 million in 2012 to 71.4 by 2030[2] and that there is no significant change in the balance of UK food trade with global markets.

The following additional demands on land by 2030 have been assessed:

- Increased residential land needed for a larger UK population by 2030;
- Land needed to meet bioenergy targets under DECC 2050 scenarios[4];
- Improved UK food security through replacing some key imports where viable, such as apples, pig meat and some high protein animal feed; and increasing exports where UK has a competitive advantage, such as root vegetables, cereals and oilseeds;
- Improved wildlife and habitat protection through increased areas managed for nature;
- Greater woodland cover to deliver a range of benefits including carbon storage, wood fuel, flood management, increased wildlife and new amenity areas; and
- Land dedicated to improved water management infrastructure, such as increased wetlands and new reservoirs.

On the supply side, there are a number of initiatives that may help to reduce the land needed for arable and livestock production:

- Sustainable intensification opportunities, including precision farming and improved seed varieties. This could deliver higher yields that enable arable land to be released for other uses;
- Likewise, livestock yield increases, including improved husbandry, collection and use of performance data, and better feed conversion ratios. These will allow the same meat and dairy production to be delivered from less land. Current Government and industry cooperation on Agritech research is helping to advance these types of opportunities;

- Reductions in food waste, which enable less land to be used to feed the same population. Approximately 19% of household food and drink is currently wasted in households[21]; and

- Change in UK eating habits, with a move from meat to non-meat based diets in line with the UK trend over the last 20-30 years. With livestock requiring up to 10 times the area to produce the equivalent amount of protein for human consumption as arable crops[22], a reduction in meat consumption could release a significant amount of land for other uses (except where livestock are being reared for the global market).

These additional demands and potential supply initiatives have been brought together in the picture below. Given the lack of data, and associated uncertainty over many of the assumptions made in this analysis, low and high cases have been shown for both demand and supply (Figure 8).

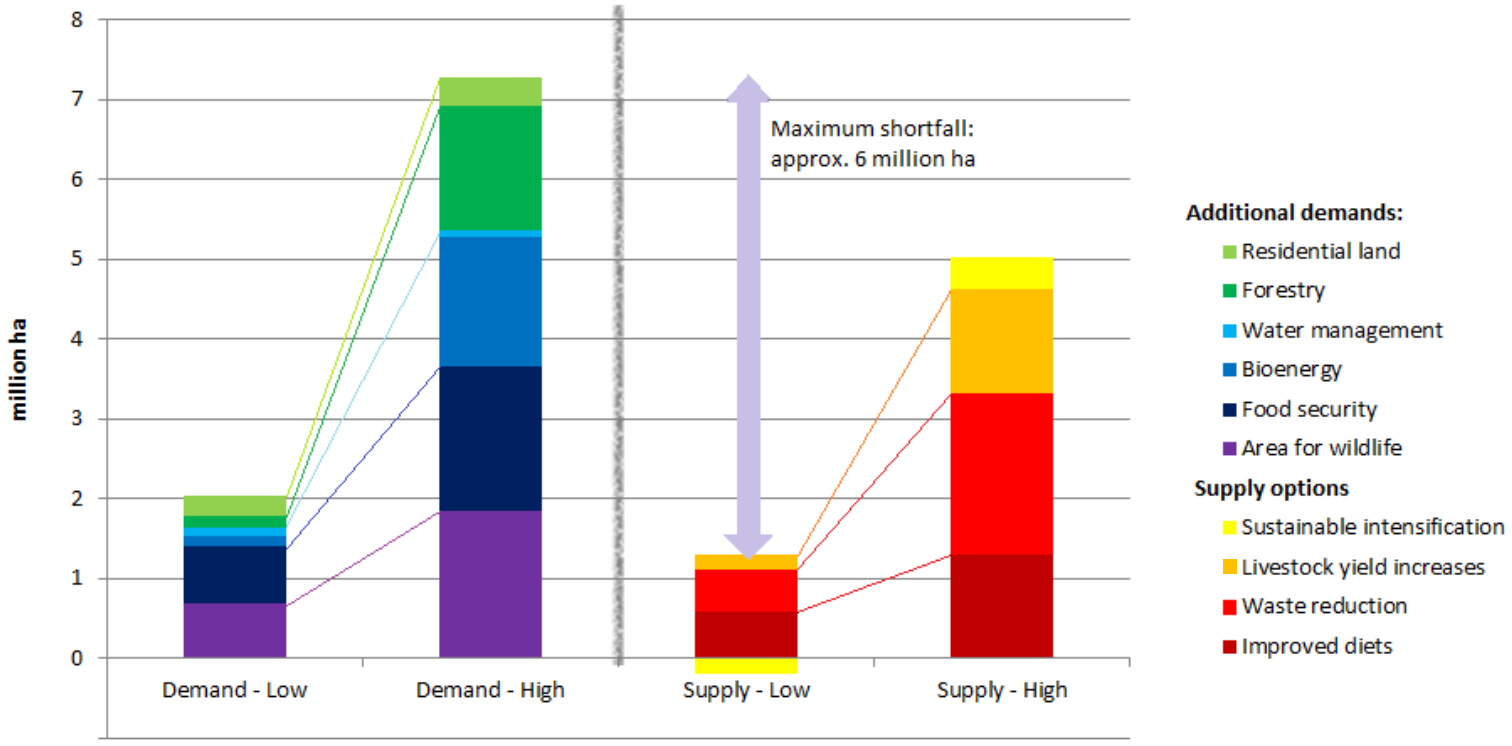
The low case mainly reflects the increasing needs of a growing population, the recent CAP reform impacts, a continuation of current productivity, waste reduction and changing diet trends, and less ambitious targets established to improve food security.

The high case reflects a set of bolder targets based on the DECC 2050 Pathway analysis[4], the NEA's Nature@Work scenario[34], adoption of new arable and livestock sustainable intensification technologies[6], WRAP targets[21], the Eatwell plate[24] and more ambitious food security targets.

A full list of assumptions for each demand and supply category is contained in the Appendix.

It is important to note that the impacts of an increased UK population are embedded in each of the categories shown below (where appropriate).

Figure 8: Additional land demand uses versus supply options



The key conclusion from this initial analysis is that there is a very significant risk that the additional demands on UK agricultural land might not be met through land released from identified supply side initiatives.

Taking the high demand case and low supply case as an extreme, a land shortfall of approx. 6 million hectares could occur, equivalent to a third of current UK agricultural land. Prima facie, this could lead to some very difficult choices having to be made on UK land use.

Nevertheless, it is acknowledged that there is a high degree of uncertainty over the extent of this demand-supply imbalance, particularly given the lack of data and associated targets for the majority of the demand and supply categories shown.

In addition, there are opportunities for the same land to provide multiple benefits (discussed further below) which could reduce the potential supply-demand gap significantly.

More detailed analysis needs to be taken as a matter of priority to better understand this picture and explore how these demand pressures could be met. Without this understanding, and as also highlighted by the 2010 Foresight Land Use Futures report[25], key land use decisions will continue to be made on a reactive basis without reference to any overarching vision, direction or decision making framework.

Looking at the findings in more detail

Additional demand on land exceeds additional supply in both the low case (by 0.9 million hectares) and the high case (2.7 million hectares).

- In the low demand case, the primary contributors to additional demand are the impact of CAP reform, with its requirement to put aside 5% of arable land for ecological focus areas, and efforts made to improve UK food security by producing the equivalent of half of our vegetable, fruit and high protein animal feed consumption in the UK. This is likely to require a mix of increased UK exports and reduced imports depending on the specific crops grown. This will deliver greater food security through a reduced UK food trade deficit;
- In the high demand case, a much greater land requirement originates from a wider set of needs, including additional woodland and land set aside for nature in line with the NEA's 2011 Nature@Work scenario, bioenergy growth in line with DECC's 2050 Pathways scenario D and more aggressive UK food security targets;
- In the low supply case, sustainable intensification improvements are shown as a negative amount as incremental yield improvements are outweighed by the need for an increased area to feed a larger UK population. In other words, productivity improvements do not keep pace with population growth.
- In the high supply case, faster adoption of new varieties and technologies enable faster productivity gains (1.7% per annum) which then allow land to be freed up for other uses;
- Likewise, livestock productivity increases do not translate into a significant release of land in the low case but have a much more significant impact in the high case with the more rapid adoption of new technology;
- Food waste reduction has the potential to release significant land for other uses, with the high case showing up to 2 million hectares of land released if the UK can reach zero "avoidable waste" in line with WRAP targets[21];
- Dietary changes could also have a significant impact (over 1 million hectares) if a change in consumption is achieved in line with the Eatwell Plate[24]; and
- Both food waste and dietary changes, however, remain heavily dependent on public attitude towards waste and diet initiatives as well as Government action taken to reduce waste and improve eating habits through education, research and appropriate fiscal incentives.

Given the difficulty in assembling data for the above demand and supply impacts, this initial analysis has not yet included opportunities to maximise the delivery of multiple benefits from the same land. For example, increased woodland or bio-diverse perennial energy crops can also be used to alleviate flooding downstream. Biofuels production can deliver greater energy security and a high protein animal feed co-product. The use of agri-environmental schemes can enable some level of food production to continue while protecting key habitats and food sources.

It is possible that these multiple use opportunities could reduce the additional demands on land significantly. But it is likely that a material supply-demand gap will still remain, particularly if significant progress on yield improvements, food waste reduction and dietary changes are not achieved.

As a result, difficult choices on land use will need to be made, and these can only be undertaken with a clear vision and set of objectives for UK land use, accompanied by a practical decision making framework to assist with these choices.

4 Land Use Vision & Key Objectives

Land Use Vision

A powerful vision has the potential to become a rallying point for industry and policymakers on the need for better understanding and improved management of this finite and critical resource.

Drawing together views from across the value chain, this industry group's vision is as follows:

By 2030, UK agricultural land will be optimised to support the multiple needs of a 70 million population and deliver an improved and sustainable natural environment.

Key Objectives

Any vision needs to be supported by a set of key objectives that will define what constitutes success in achieving this vision. Given this, the participants proposed the following key objectives:

Improved UK food security through a focus on import substitution and export growth where UK agriculture has a competitive advantage

Increased UK energy security from appropriate land based renewable energy as part of a broad mix of UK energy supply solutions

Better protection of nature and its services, and the reversal in the decline of key ecosystems

Improved competitiveness and more diversified income sources for farmers and UK agricultural land based businesses

Enhanced recreational space and amenity value to UK society

5 Decision Making Framework principles

The mechanism for turning this vision and set of objectives into practical action on the ground is through the development of a decision making framework that can be applied by industry and policymakers.

To aid the development of such a decision making framework, the participants offered the following **principles** as the basis for such a framework**:**

How it should be used

Its purpose should be to **guide industry and policymaker decision making** around the improved use of UK agricultural land in line with the vision and objectives

It would recognise that different individuals may have different legitimate interests in, and priorities for, the use of individual areas of land, and also that the main factors influencing land use and land use choices can vary considerably from area to area. The framework should **not be intended to dictate** how each parcel of land should be used

It is recognised that there are existing policies for specific aspects of land use, including those related to forestry, agri-environmental schemes and bioenergy. The intention is that **this framework sits above these policies**, guiding the broader decisions around land use but remaining aligned with these more specific policies. The aim is to encourage a more holistic and integrated approach to making plans about land use

What it should contain

- **A requirement that the full range of market and public goods and services are reviewed before key land use decisions are taken**: Given that agricultural land can provide a very wide range of goods and services, it is vital that all of these are recognised and quantified. This includes provisioning services (such as food, fibre, fuel and water), regulating services (such as carbon storage, water purification, flood protection and clean air), cultural services (including education, recreation and aesthetic value) and social impacts (such as rural livelihoods and employment);

- **Support for the delivery of multiple benefits**: Where land can deliver multiple benefits - such as forestry or perennial crops providing both a source of timber and energy as well as water management, carbon storage and wildlife benefits - all of these should be understood, valued and their multiple delivery actively encouraged and rewarded;

- **Cost-benefit analysis:** Decisions should be aided by a simple cost-benefit analysis which assesses the full range of goods and services as listed above. There is increasing support and research to assist agricultural land managers, businesses

and policymakers to place financial values on many of these goods and services, which should be used, where possible, to aid decisions on trade-offs between different uses of land;

- **Landscape change:** Where significant land use change is proposed, it is essential that the general impact on landscape is managed positively and sympathetically given the importance of landscape to the UK's sense of identity and individual and social wellbeing;

- **Climate change impacts:** Land use decisions should also be informed by the impact of land use change on greenhouse gas emissions as well as by an understanding of the opportunities and threats for land brought about by a changing climate. It is expected that agricultural land will need to contribute more actively to helping the UK meet climate change adaptation and mitigation objectives;

- **Public access:** With population growth and an increasing interest in the recreational opportunities provided by land, public access is a key benefit that can often be provided in conjunction with other outputs, such as crop or timber production. As above, this is an area where multiple benefits can often be delivered, particularly in the provision of accessible green space close to where people live. This will also provide important health and well-being benefits;

- **Unused land:** Where land has ceased to fulfil a useful function because it is derelict or vacant, it represents a significant loss of economic potential and amenity for the community concerned. There may be good economic reasons why it is not utilised. Nevertheless, it should remain a priority to examine options for restoring all such land for economically, socially or environmentally productive uses; and

- **Future generations and option values**: Consideration should be given to the value of land for future generations and ensuring that this is maintained through sustainable use today. It is also important to understand where land has significant option value in the event that land use needs to change quickly to meet an unanticipated but pressing need. For example, land should not be built on if it may have to play a vital role in the future for flood management.

How it could be supported

Regulation and fiscal incentive design

These should be designed to protect essential public goods and services which are not fully rewarded by the market, but with an additional aim to place as light a burden on businesses as is consistent with the provision of public goods

Public understanding

In making decisions about land use, it is important that the general public have opportunities to contribute to debates and decisions about land use and management decisions which affect their lives and their future. Coupled with this, Government and industry should encourage greater understanding by the public of the links between land use and daily living

6 Proposed Actions for UK Government

Currently, there is no UK Government vision, set of objectives or decision making framework that is used to guide the optimal use of UK agricultural land and link together the many existing policies and initiatives that address specific land use issues.

This is due in part to the devolution of powers to individual nations within the UK. The one exception is Scotland which has developed its own land use vision and decision making framework, though the extent to which this is influencing land use decisions is unclear.

Given this backdrop, this industry group believes that the **UK Government should acknowledge and endorse the above industry vision, key objectives and decision making principles**, and work with industry to use these as a basis to develop a clear framework around the best use of UK agricultural land.

Existing policies and fiscal regimes can then be connected to this vision and framework, and where this leaves gaps or policy conflicts, these can be identified and addressed. This will deliver a more coherent and integrated approach to land use decision making. However, it is also likely to necessitate much greater connectivity across different Government departments on policymaking, notably the Department for Environment, Food and Rural Affairs (DEFRA), the Department for Energy and Climate Change (DECC), the Department for Business, Innovation and Skills (BIS), the Communities and Local Government (CLG) and the Treasury.

Given this, participants believed that there are four key actions that Government should take as a matter of priority. These are:

1. **To develop an integrated action plan** that will detail how Government departments will be brought together with industry to develop the framework above, address gaps in policies and targets, and resolve potential conflicts;

2. **To identify the key land use decisions** that need to be made as a matter of priority to help UK adapt to **climate change**;

3. **To support research** into the further analysis of land use demand pressures and potential supply options, and develop an agreed forecast of the demand-supply balance; and

4. To use the land use analysis, vision, objectives and decision making framework principles **to inform future negotiations on CAP reform**.

There are a wide range of other Government actions that could also be taken. These include the following:

i. Government and industry to support further research into actions that can be taken to deliver the vision and address any supply-demand gap, including development of fiscal incentives and reward structures that drive greater wellbeing and structural change, such as waste reduction and dietary initiatives;

ii. Government to encourage farm managers and businesses reliant on agricultural land to take actions in line with the vision, objectives and decision making framework;

iii. Government to support the further development of research on valuation of agricultural land services to facilitate land use and trade-off decisions, to demonstrate how this approach can be applied in practice by public bodies, and to provide practical guidance to land managers; and

iv. Government to identify and publicise effective ways for communities to contribute to land-use debates and decision-making.

Adoption of some or all of the above actions will start to create much greater clarity on what UK agricultural land needs to deliver and how this will be achieved.

Furthermore, greater integration of policy and decision making across key Government departments will become increasingly important if UK agricultural land is going to meet the mounting demands of a growing population and deliver the maximum value from this critical resource.

7 The Next Steps

This initial analysis and proposed industry vision, objectives and framework principles have the potential to kick start a much needed debate on how UK agricultural land could be used differently, and catalyse greater action and joined up thinking in this area. This work also highlights areas where greater research is required and more coordinated policymaking needs to happen.

To achieve this, the key next steps will be

To share these findings and industry vision, decision making principles and proposed Government actions with a wider audience. This includes raising awareness of this report across a wider cross section of the UK agricultural land based value chain and within the key Government departments that are involved in land use decisions.

To propose the formation of a joint Industry and Government Group to review and build on this report's analysis and develop a decision making framework and an action plan that integrates the plethora of existing targets, policies and research under one clear vision.

Through this process, it is expected that many questions will be raised on this demand-supply analysis and how it needs to be improved. This is entirely appropriate as land use remains a very complex area where different views need to be listened to carefully and modelled where possible.

Furthermore, a sharper, more engaging vision might be proposed, or a new set of objectives or framework principles developed. These are all welcomed as long as it ultimately leads to improved understanding and clear direction on how the management of this finite and critical resource will be achieved.

Appendix: Key assumptions

It is assumed that the UK population grows by 12.1% from 2012 (and 18.9% from 2005) to 71.4 million in 2030[2].

Additional Demand by 2030

Category	Current Land (2005)* In million hectares	Scenario	Change by 2030 In million hectares	Assumptions	Reference
Residential land†	1.35	Low	0.3	Land used increases in line with population growth forecast (from 5.5% in 2005 to 7% of total land).	DEFRA[7] ONS[2]
		High	0.4	Increased area of land for settlements as per DECC 2050 scenarios.	DECC[4] (all scenarios)
Woodland	3.1	Low	0.2	Current trend of increasing UK woodland continues at same rate into the future (from 11.6% in 2005 to 12.2% of total land by 2030).	DECC[4] (scenario A)
		High	1.6	Increased UK woodland cover from 11.6% in 2005 to 18% by 2030.	NEA[11] (Nature@work Scenario)
Water management	0.32	Low	0.1	Increase in water management areas to cope with climate change e.g. increased wetlands and reservoirs.	Cambridge estimate
		High	0.1		
Bioenergy	0.1 #	Low	0.1	Additional biofuels production already online in 2013.	NNFCC [26]
		High	1.6	DECC Pathway's maximum domestic bioenergy production growth scenario.	DECC[4] (scenario D)
Food Security	0.9	Low	0.7	UK to increase percentage of high protein animal feed produced in UK from 28% to 50% through substitution by oil seed rape, and produce 50% of fruit and vegetable consumption by focusing on those fruit and vegetables where UK has a competitive advantage e.g. apples, pears, plums, and summer berries (currently 9.8% of fruit is home produced).	DEFRA[9] DEFRA[27]
		High	1.5	UK to produce the equivalent of 100% of its fruit and vegetable consumption by increasing production of fruit and vegetables where UK production has a competitive advantage, and UK to utilise new technology/ varieties to enable home grown high protein animal feed to replace 70% of imports. (Note: Biofuels production will also generate the equivalent of an extra 0.3 mt of high protein animal feed).	DEFRA[9] DEFRA[27]
Area for wildlife	13.9 #	Low	0.7	Additional 5% of agricultural land is taken out of food production in line with Ecological Focus Areas required under agreed CAP reform. Note: This may increase to 7% in 2017 subject to further CAP negotiations.	CAP Reform[28]
		High	1.8	Additional 13% of agricultural land is taken out of food production and set aside for nature as per NEA projections.	NEA[11] (Nature@work Scenario)

*Base year is 2005 due to the lack of UK data for all categories for 2012

† Total built environment including dwellings, private gardens, transport infrastructure and commercial land.

Base year for Biofuels and Area for Wildlife is 2012 as HLS information and Biofuels capacity not known/available in 2005

Additional Supply / Land released by 2030

Category	Current Land (2005) In million hectares	Scenario	Change by 2030 In million hectares	Assumptions	Reference
Sustainable intensification	4.6	Low	-0.2	A negative number because it assumes a continuation of the long term trend of improving crop yields (1% per year) is outweighed by increased crop demand from population growth.	HGCA[29] Sylvester-Bradley & Wiseman[30]
		High	0.4	Faster adoption of new crop varieties and technology, including hybrid crops and precision farming, delivers yield increases of 1.78% per year.	Xu et al[23] Edgerton et al[31]
Livestock yield increases	12.5	Low	0.2	Continuation of current trend of increased dairy, pig and broiler production (1.5% per year) which outstrips increased demand from population growth.	DairyCo[32] Sylvester-Bradley & Wiseman[30]
		High	1.3	Adoption of new technology, including sustainable intensification, increases yields by an additional 0.78% per year (i.e. total gain of 2.3% per year).	Xu et al[23] Edgerton et al[31]
Waste reduction	N/A	Low	0.5	Continuation of the current trend of reductions in household food waste, with waste declining from 18.5% to 15.4% by 2030. Note: there is a wide range in food waste from 5% for cereals to 50% for some fruits and vegetables.	WRAP[21]
		High	2.0	UK achieves zero 'avoidable' household food waste, i.e. a reduction from 18.5% to 6.6% by 2030.	WRAP[21]
Improved diets	N/A	Low	0.6	Meat currently constitutes 12% of the current average diet. The low case assumes a continuation of the trend over last 30 years of falling meat consumption, with a further 5.9% reduction by 2030 (this is being replaced by greater vegetable & fruit consumption). Note: meat requires very approx. 10 times the area of land to produce the same protein as arable crops.	DEFRA[33] Pimentel & Pimentel[34]
		High	1.1	A more dramatic change with average diets moving in line with UK Government's healthy eating advice, which would reduce meat consumption by 11% and dairy consumption by 30%, with this offset by a 69% increase in grains and a 38% increase in vegetable & fruit consumption.	Eatwell Plate (2013[24]

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