Government Office for Science

Foresight

Land Use Futures:

Making the most of land in the 21st century

FINAL PROJECT REPORT

Land Use Futures: Making the most of land in the 21st century

This report is intended for:

Policy makers and a wide range of professionals and researchers whose interests relate to all aspects of land use. The report focuses on the UK, but will also be relevant to the interests of many other countries.

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The Government Office for Science (GO-Science) would like to thank the Project's Lead Expert Group who oversaw the technical aspects of the Project and who were involved in much of the work. They were:

Professor David Newbery – Professor of Economics, Cambridge University (Chair)
Professor Marcial Echenique OBE – Professor of Land Use and Transport Studies, Cambridge University
Professor John Goddard OBE – Emeritus Professor of Regional Development Studies, Newcastle University
Professor Louise Heathwaite – Professor of Land and Water Science and Co-Director, Centre for Sustainable Water Management, Lancaster Environment Centre, Lancaster University
Professor Joe Morris – Head of Natural Resources Management Centre, Cranfield University
Dr Wendy Schultz – Director, Infinite Futures
Professor Carys Swanwick – Professor of Landscape, Sheffield University
Professor Mark Tewdwr-Jones – Professor of Spatial Planning and Governance, UCL

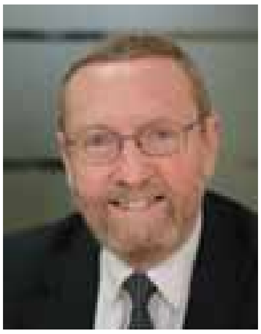
GO-Science would also like to thank Mr Chris Riley who contributed to this final report.

Particular thanks are due to the Project's High Level Stakeholder Group and the Expert Advisory Group, as well as the many experts and stakeholders from the UK and abroad who contributed to the work of this Project, who reviewed the many project reports and papers, and who generously provided advice and guidance.

A list of those involved is provided in Appendix A.

The Foresight Programme in the UK Government Office for Science is under the direction of the Chief Scientific Adviser to HM Government. Foresight strengthens strategic policy-making in Government by embedding a futures approach.

Foreword



Together with our human capital, land is possibly the UK's greatest asset. It provides the basic services that we need to prosper and flourish, the environment in which we all work and live our lives, and it forms the historical and cultural bedrock of the country. It is difficult to imagine a national asset that affects us all so profoundly.

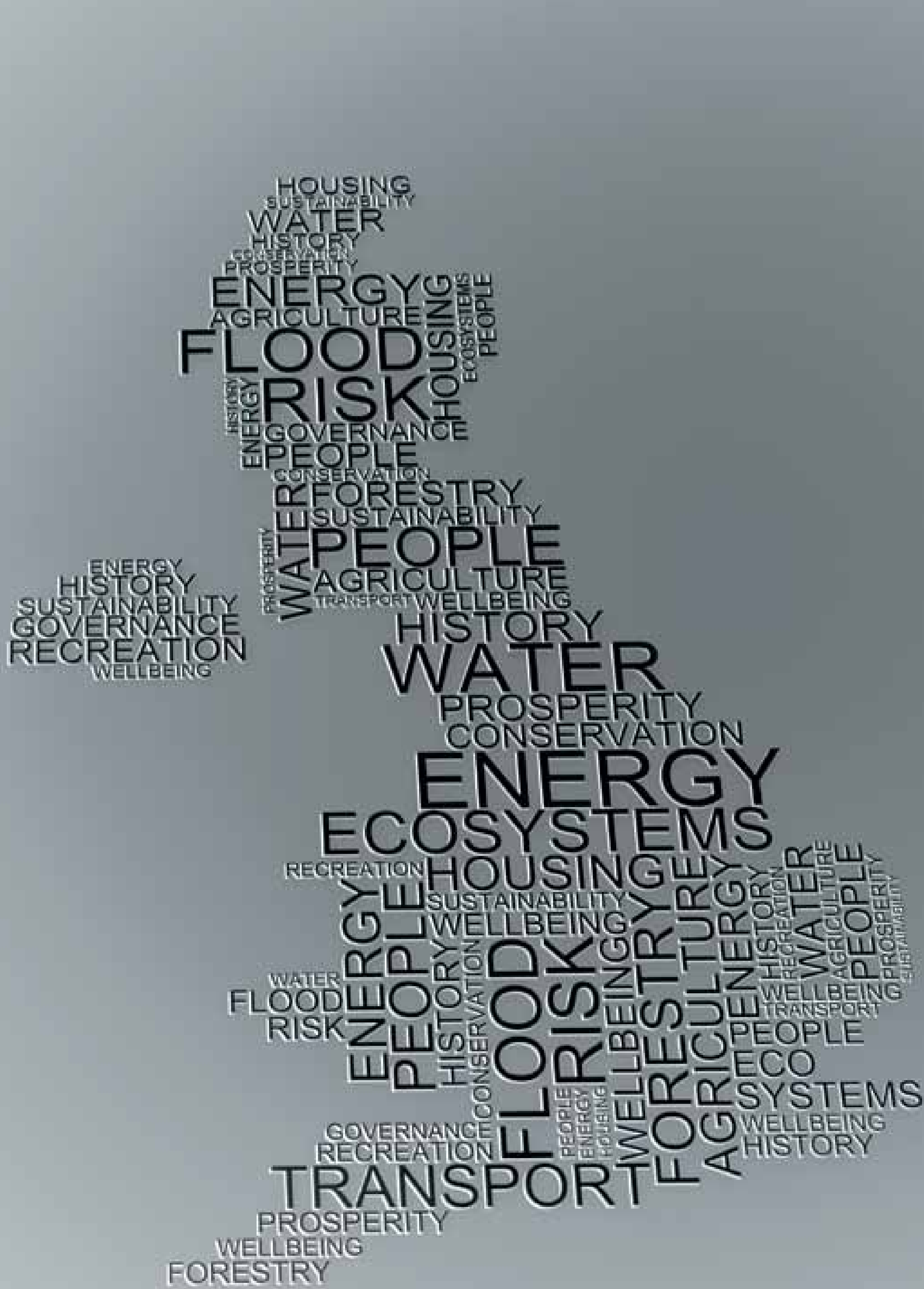
However, our land is a finite resource, and it is set to come under increasing pressure as the century unfolds. Factors such as climate change, demographic shifts, and changing patterns of work and habitation will all create major challenges. Also, as these pressures intensify, so will the demands we make on our land. This is already happening as we seek to maximise economic returns, and as we recognise its potential to yield benefits in diverse areas such as ecosystem services, mitigating climate change, and wellbeing.

Deciding how to balance these competing pressures and demands is a major challenge for the coming century, and one that is all the more pressing due to the time that may be needed to roll out new land use policies. For this reason, the Government Office for Science has spent the last two years undertaking a major Foresight project on the future of land use in the UK.

The work adds value by combining two aspects. Firstly, it has drawn on an exceptional breadth of cutting-edge science and other evidence – around 300 leading experts from diverse fields have been involved. Secondly, it has benefitted from the practical and pragmatic perspectives of leading stakeholders across the country: the public and private sectors, local and central government. However, a report of this breadth cannot aspire to consider every issue in fine detail. Instead, it aims to identify the strategic challenges for the future, and provide advice on how they can be addressed within a coherent and integrated framework.

I am most grateful to my predecessor, Professor Sir David King, who commissioned the Project, to the group of senior stakeholders who have advised on the work throughout, and to the many other individuals who have been involved. I am particularly grateful for the support of the Department for Environment, Food and Rural Affairs, and Communities and Local Government, both of which have sponsored this work. Therefore, it is with particular pleasure that I now hand the findings to Defra and CLG's Ministers for their consideration and make the findings publicly available.

Professor John Beddington CMG, FRS
Chief Scientific Adviser to HM Government and
Head of the Government Office for Science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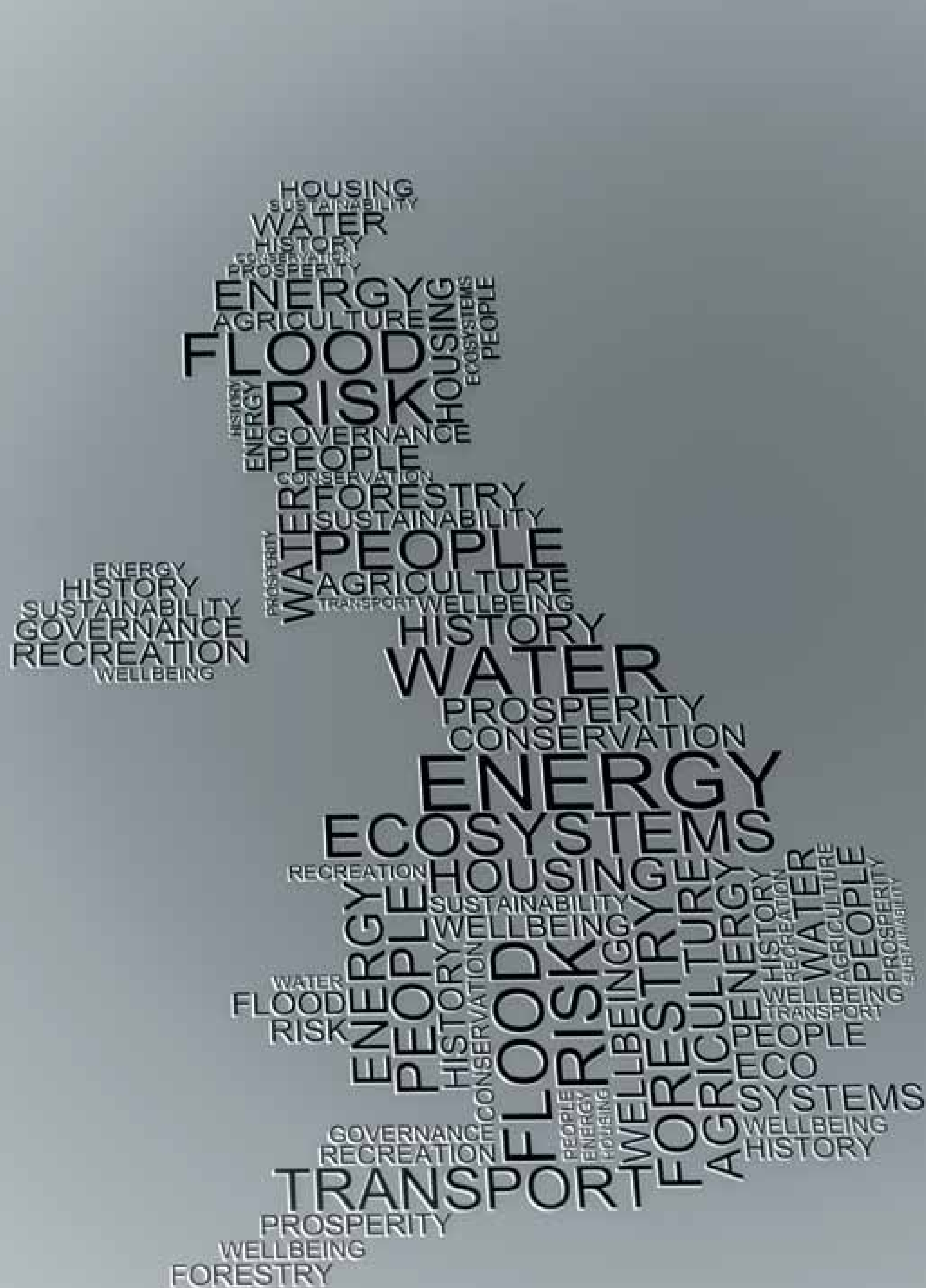

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Executive summary

1. The Foresight Land Use Futures Project

This Project has taken a broad and overarching look at the future of UK land use over the next 50 years. It demonstrates that there is a strong case to develop a much more strategic approach: to guide incremental land use change, incentivise sustainable behaviours, and to unlock value from land.

This report shows that a reappraisal is vital to help address major challenges ahead – for example, relating to demographic shifts, climate change, and rising demand for commercial and residential development in areas such as the South East of England. The challenge is to meet the rising expectations which will come with rising incomes; and to deliver a wider range of sustainable benefits from land. In particular, a more coherent and consistent approach is needed for managing the growing demands on land – at different levels of Government, and across the wider community of stakeholders involved in the many land use sectors.

The aims of the Project

The Project aims to use the best available scientific and other evidence to take a broad look at:

- The most important challenges and opportunities for land use in the UK over the next 50 years[1] – particularly those that merit decisive action; and
- What can be done to use and manage land more sustainably and to unlock greater value for people and the economy – now and in the future.

The Project has also sought to identify where incremental change would be desirable, and where a more strategic shift is needed.

A word of caution

It is not feasible for a project with such a broad scope to consider every issue in the same level of detail and complexity as the responsible government departments and the devolved administrations. Instead, the added value has come from taking a particularly broad and strategic view across the many sectors and interests relating to land use.

As with other Foresight reports, it is expected that detailed evaluation of the findings will need to be considered by policy-makers over the next 12 months.

1 In this report, 'the future' is generally taken to mean the next 50 years to 2060, unless otherwise indicated.

An independent look

This report provides an independent analysis of the challenges ahead and how they might best be addressed. As such, the findings do not constitute government policy. Rather, they are intended to inform the strategic and long-term choices facing government departments, the devolved administrations, business, and society as a whole.

How the Project adds value over previous work

The added value comes from a combination of three factors:

- The breadth of the analysis: the work looks across different levels of governance; takes account of spatial and geographic differences across the country; and reviews trends across the major land use sectors – including the built environment and infrastructure, natural resources, agriculture, conservation and leisure.

- Crucially, the analysis takes an even-handed view – it does not judge one type of land use to be more or less important than another. It also contrasts the perspectives which characterise different land use communities and different expert disciplines – acknowledging the reality that these viewpoints often conflict.

- The analysis lifts horizons from a short-term focus on narrow impacts, to looking at the strategic needs of the UK over the next five decades.

The Project's analysis is comprehensive. It has:

- Involved over 300 leading national and international experts and stakeholders[2] from diverse disciplines, ranging from economics, geography and planning to the environmental sciences, engineering, and multidisciplinary areas such as conservation and climate change.

- Drawn upon over 40 specially-commissioned papers[3], as well as a wide range of existing reviews and studies[4].

- Spanned the interests across Government and across a diverse range of organisations outside of Government.

- Primarily focused on England but the Project has implications for the whole of the UK.

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2 See Appendix A of the Final Project Report for a list.

3 See Appendix B of the Final Project Report for a list. All the Project's papers are freely available through www.foresight.gov.uk

4 See Appendix D of the Final Project Report for an illustrative list.

2. The importance of land use: the need for an integrated perspective

Land and its many uses provide the bedrock of the country and the foundation for our wellbeing, prosperity and national identity. The pervasive effects of changes in land use and management underline the need to take the broadest possible perspective in developing future policies and strategies on land. While much has been achieved over recent decades, there is a strong case to do more.

Land is one of our greatest assets. How it is used and managed affects everyone's prosperity and quality of life. Despite commonly held public perceptions, much of the land of the UK remains undeveloped[5] – around 90% in the case of England. However, the productive capacity of land underpins the whole economy through its provision of food, timber and other goods, and through its use for housing, business, transport, energy, recreation and tourism. Land also plays a critical role in providing services that are vital for the physical wellbeing of the population, such as clean air, water and healthy soils. Also, with some of the most beautiful and historic landscapes in the world, the landscape of the UK underpins our national identity, cultural heritage and mental wellbeing.

All of these benefits are important in their own right: a land devoid of green spaces for recreation, or semi-natural landscapes that support wildlife, would be as unthinkable as land that is not economically productive. In this context, the ability of given parcels of land or landscapes to deliver multiple benefits simultaneously – so called 'multifunctionality' – adds to its value and versatility. However, many land uses can conflict with each other: more land for one use can mean less for another. As explained below, in the future, greater pressure on land will mean that the requirement for land to deliver multiple benefits will also increase.

Whilst it is important to consider the impact of change within individual land use sectors such as conservation, agriculture and housing separately, the evidence in this report makes clear that progress on the most important challenges ahead will only be made by:

- Identifying how the various demands on land made by different sectors will interact, and evaluating the consequences of those interactions; and

- Taking a broad and overarching perspective across sectors and different levels of governance.

Government has already made progress in both areas, but a key conclusion of this Report is that there is a strong case to do more. Achieving a more coherent and consistent approach to guiding land use and management so that more sustainable and valued outcomes are delivered is a recurrent theme throughout this report.

5 "Undeveloped" in this context means land which has not been built on.

3. Why this project was undertaken: major factors driving change

Over the last 50 years, demand across many land use sectors has intensified in response to important factors such as population change and also rising incomes – which have fuelled increased expectations. However, the next 50 years will see even greater pressure on land use: continuing expected growth in population and incomes, the impact of climate change, new technologies, and changing public attitudes and values will all have profound effects.

A major issue for policy will be whether all the economic, social and environmental benefits of the land can continue to be delivered against a backdrop of greater expectations from the market and individuals, and the need to live within environmental limits. This Project has shown that major challenges and rising tensions will result unless action is taken: a key aim has been to identify where interventions in policy will be most needed.

Looking ahead just 20 years, there could be substantial changes affecting the country, and by 2060, the world is likely to be a very different place. Six particularly important factors will drive change over the next 50 years in the UK.

3.1 Demographic change

The Office of National Statistics[6] (ONS) suggests that the population could increase by approximately 9 million by 2031, and by 15 million by 2051, although there is considerable uncertainty associated with these projections as they are based on past trends and uncertain levels of future inward migration. Moreover, these changes are not likely to occur evenly across the UK. Whilst relatively high growth is projected to occur in England and Northern Ireland between 2008 – 2031, 16.7% and 13% respectively, projected increases in Wales and Scotland are lower at 11.2% and 7%.

Excluding the net effects of migration, the overall increases would be 3 million and 2 million for 2031 and 2051 respectively, due to the net effect of an ageing population and changing fertility rates. The number of people living alone is also rising: by 2031, 18% of the population are projected to live in single occupancy households; 42% of this increased number will be people over the age of 65.

Two major challenges will be:

- How to manage the associated significant increase in the demand for land for housing, recreation, transport, water, food and energy in the face of uncertain demographic change.

- How to manage the potential for uneven distribution of demographic change across the UK, for example, in the South East of England as compared with other parts of the country (see Section 4, below).

3.2 Economic growth and changing global economic conditions

Economic growth will alter consumption patterns: where land supply is constrained, the demand for additional living space as incomes rise will be an important determinant of house prices. As the future macro-economic situation and business structure of the UK will have a strong influence on where jobs and homes are located, pressures on land use in the South East of England are expected to intensify. Overall, the underlying trend

6 See Chapter 1.

of economic growth in the UK in the longer term is currently estimated to be 2–2.5% per annum[7], implying a continuing increase in the demand for land for development.

Future change in the global economy will also influence land use. For example, rising global demand for food and changing commodity prices will affect the amount of land that is brought into food production. Changes in the global financial system may also affect the stability of markets for land assets. Here land may be seen as an investment opportunity, irrespective of the benefits that it provides in use.

3.3 Climate change

The potential role of land and land use in both climate change mitigation and adaptation will be profound. The move to a low-carbon economy will increasingly influence land use decisions, settlement patterns, the design of urban environments, and choices on transport infrastructure. Agriculture, forestry and semi-natural habitats will have the potential to play important roles in mitigating the effects of climate change, but will also need to adapt to changing temperatures and precipitation patterns. Also, increasing flood risk will have implications for building on flood plains and vulnerable coastal areas.

A significant increase in renewable energy capacity is required. Meeting the EU 2020 target for renewables may lead to greater competition for land, and changes to landscape character. Also, areas of the UK with the greatest capacity for future renewable energy production may be spatially separated from the areas of greatest demand. However, the scale of the land-based effects will depend, for example, on the policy choices made on the 'energy mix'[8] and how much production capacity is on-shore[9]. Planning policies have a critical role in shaping incentives to ensure the required changes in land use occur. Delays could cause difficulties, or result in excessive costs, in achieving the 2020 targets.

A major challenge will be:

- How to make better use of the land across the UK for climate change mitigation and for supporting the transition to a low-carbon economy, as well as managing the impacts of changing climatic conditions.

3.4 New technologies

New products, processes and ways of working will enable us to increase the productivity of available land, and relieve some of the pressures associated with intensive land use. Developments in information and communications technology will enable people to live and work differently. Advanced information, engineering and biological sciences, including technologies such as 'precision farming' and anaerobic digestion, can help farming to reduce its environmental burden. Similarly, new energy, water and waste treatment technologies can lessen the environmental footprint of urban development. In many cases it will be possible to achieve multiple benefits simultaneously, as with sustainable urban drainage and habitat creation in towns.

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7 See Chapter 1.

8 The Department for Energy and Climate Change, for example, is producing a set of scenarios for 2050 to model the possible impact of different 'energy mixes' to inform the development of energy policy.

9 Rights have been granted for up to 6,400 additional off-shore wind turbines with the potential to generate an extra 32GW of clean electricity. See http://www.decc.gov.uk/en/content/cms/news/pn10_004/pn10_004.aspx

Whether technological innovations drive the evolution of sustainable land use in a socially desirable way will depend on incentives and governance structures.

3.5 Societal preferences and attitudes

People's preferences and attitudes on land use will interact with all the other drivers of change, such as rising incomes and the drive towards a lower-carbon society. Many people's desire to protect the natural environment, and preferences for home ownership, car usage, shopping patterns and other social trends are already changing how land is used, although these can sometimes result in conflicting demands. Markets are one important route through which preferences are expressed, through prices, along with the planning system and participation in decision-making.

A challenge for policy-makers will be:

- How best to reconcile conflicting public attitudes, and also, differences between the preferences of individuals and communties and societal needs – through the broad range of mechanisms for managing and influencing land use, such as incentives, the market, regulation, and formal decision-making processes.

3.6 The policy and regulatory environment

Government policies and regulatory measures relating to development control comprise a framework of planning acts based around the Town and Country Planning Act 1947, supplemented by other relevant legislation. Devolution to Scotland, Wales and Northern Ireland has also produced diverse responses to the management of land resources. In addition, a large proportion of UK land – used for other purposes – is regulated by a large body of national, EU and international legislation. Membership of the European Union (EU) has been a major driver of land use change, particularly in the agricultural sector, and has created binding targets in diverse areas such as water resource management and conservation.

Policies will inevitably evolve in response to climate change and other drivers. The responsiveness of the multi-layered system of governance in the UK will have a profound influence on how effectively land is used in the future to deliver sustainable social, economic and environmental goals.

A key challenge will be:

- How governance of the land system should respond to manage pressures on goods and services provided by land at national, regional and local levels.

The risks of inaction: some illustrative examples

Without significant policy changes, the drivers of change will interact to create growing tensions and conflict between sectors, with serious implications for the UK's wellbeing and prosperity. Without action, possible consequences include[10]:

- **Increasing demand for water as a result of expected population growth and urbanisation, occurring alongside reduced water availability.** Climate change impacts in the UK are expected to result in significant reductions in river flows and groundwater recharge[11], amid general patterns of rising demand through to 2050, with the highest increases expected in the South East of England.

- **Detrimental impacts on the state of the natural environment.** Declining bird populations are used as an indicator of the health of the natural environment. Since 2000 there has been deterioration in populations of breeding farmland birds, breeding seabirds, as well as in plant diversity in woodland and grassland and boundary habitats.

- **Potential vulnerability of farming communities in upland areas and abandonment of land, where viability is more dependent on income support.** This could result in a serious loss of the public goods and services provided by land mainly managed for food production, but where benefits relating to landscape quality, water resources and recreation also accrue.

- **Difficulties in achieving EU 2020 targets for renewable energy at reasonable cost, if there are delays in the development of on-shore wind farms and other forms of renewable energy production.** A significant increase in renewable energy capacity is required. Land use and planning policies have a critical role to play in shaping incentives to ensure the required changes in land use occur.

- **House prices resuming their rise ahead of general inflation with implications for affordability, and smaller homes.** Between 1969 and 2008 property prices rose at an average real rate of 3.5%, and rapid growth is expected to resume. Rising incomes drive real house prices increases where the supply of land is restricted. New, smaller houses in the UK are being built at higher densities than the average for the current stock.

- **The difference between the price of land with planning permission for development and other land will remain excessive in areas of high demand for development.** One study[12] shows that obtaining permission to change use from agricultural to residential use can increase the price of the land by as much as 600–700-fold, creating very substantial gains for the landowner and high costs for house buyers. Regional disparities in relative land scarcity between the South East of England and other parts of the UK could grow if existing patterns of development continue.

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10 The examples listed are intended to be illustrative rather than exhaustive. They are not presented in any order of priority.

11 See Chapter 4, Section 4.1.

12 See Chapter 5, Section 5.2.

4. Three particularly important cross sectoral challenges

The major drivers of change, identified in Section 3 above, will exacerbate existing tensions and challenges and also interact to generate new ones. This Project has identified three major cross-sectoral challenges for the next 50 years that require specific attention, as currently there is a danger that they will not be fully addressed. These are discussed below and are followed by Section 5 which considers individual land use sectors.

It is important to recognise that all three of the challenges detailed below will inevitably be subject to uncertainties that will increase into the future. Therefore, a major task for policy-makers will be to develop policies and approaches that are robust to a range of possible outcomes. In this context, the Project has developed three contrasting future scenarios as an analytical tool to help to evaluate possible policy changes[13].

4.1 Rising demand for land in and around the South East of England

In the South East of England demographic shifts, together with rising incomes and expectations, will combine to drive up demand for land, not only in the housing and commercial sectors, but also for local services and infrastructure, water supply, and land for recreation. Changing land use patterns and policies in the South East will also have wider implications for the rest of the UK[14].

There are important decisions to be made on the desirable balance between accommodating a rising population in the South East of England, or encouraging population shifts to other regions or countries in the UK.

This could involve:

- Ensuring that those who live and work in the South East bear (as far as possible) the full costs involved – including their footprint from housing, congestion, pollution, water resources, and on the natural environment; or incentivising demand in other regions (for example, through regional economic policies).

- Accepting increasing demand in the South East will inevitably lead to choices between:

  – Policies that either encourage living at higher densities; or

  – Making more land available for development.

The size of dwellings in many other developed countries already exceeds that in the UK, and aspirations for larger homes associated with rising incomes can be expected to continue. If land release policies are pursued, decisions will be needed on what types of land to release, in which areas, and what this implies for the present location and use of green belts. It will also have implications for the development of infrastructure in sectors making use of land, such as water supply, housing, transport, and public services.

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13 See Appendix E of the Final Project Report.

14 A more detailed discussion of the challenges facing the South East of England can be found in Chapter 6 of the Final Project Report.

4.2 Climate change and land use

As outlined in Section 3 above, land use will play a pivotal role in both mitigation of and adaptation to climate change. Further research into the complex interaction between the effect of climate change on land itself, and the use of land to reduce greenhouse gas emissions, is needed. It should be integrated into policy to avoid land use and management changes undermining emission reduction targets.

Because of the scale of the climate change challenge, together with the diversity and interaction of conflicting sectoral interests, there is a strong case for an integrated and coherent climate change adaptation and mitigation strategy which takes a broad view: across the land use system, and of the effect of a common and adequate price for carbon. Without such a broad perspective, it is possible that the many implications of climate change for land use may create unacceptably large tensions with other land use sectors.

4.3 Delivery of public goods and services

In a land system increasingly influenced by both global and domestic markets, it will be vital to ensure the continued delivery of public goods and services from land, a large proportion of which is in private ownership.

Goods and services from land include countryside amenity and ecosystem services in rural and urban areas – for example, relating to biodiversity, water regulation and carbon sequestration. Options include:

- Actively promoting and incentivising the 'multifunctional' use of land as an obvious and potentially sustainable response. However, it would require a combination of institutional and regulatory mechanisms and economic incentives to achieve this.

- Movement towards an area, or catchment-based approach to land use policy, rather than through the functional management of land within existing administrative boundaries. This could involve the creation of land management institutions and encouragement of stewardship covenants and partnerships to enable different aspects of individual tracts of land to be considered together by local communities and stakeholders in decision-making.

Workable area-based or functional approaches need to be predicated on incentive structures, and thus decisions will be needed on:

- How funding streams and charges can contribute. Given the unique nature of land, such incentives need to be tailored to individual areas or catchments, whichever approach is adopted.

- The necessary institutional arrangements – in particular, the balance between national, regional and locally-determined mechanisms.

The strategic management of those services that land provides where the source is distant from the end consumer, also needs to be considered: water supply and flood risk management are both areas where the combined effect of climate change and demographic shifts are likely to exacerbate existing pressures. Provision of these services cannot be left solely to local communities as there could be substantial cumulative effects.

5. Sectoral pressures

A theme running throughout this report concerns the multiple and growing demands we make on land. These arise primarily in nine sectors which make a major contribution to the wellbeing and prosperity of people living in the UK. They include land for water resources, conservation, agriculture, woodlands and forestry, flood risk management, energy infrastructure, residential and commercial development, transport infrastructure and recreation[15]. In this report, the current and future trends for each sector with regard to their impact on land use change are analysed.

Identifying the most important implications for policy within individual land use sectors is fundamental to reviewing the effectiveness of land use (see Sections 5.1 – 5.9). However, in considering these sectors, it should be stressed that they can all interact with each other in complex ways: as illustrated in Section 4 above, and discussed below.

5.1 Land for water resource management

Land plays a crucial role in the supply of water. Three key challenges over the next 50 years will include: managing land use to protect the future quality and supply of both surface and groundwater; the effects of climate change, which will affect both quality and quantity of supply; and population growth, which will drive demand. Meeting these challenges will require integrated and cross-governmental approaches to ensure sustainable water use.

Suggested priorities for action:

- *Developing a more integrated strategy for quality and supply – involving integrated catchment area management, water pricing, and demand management, particularly in areas of stress – and ensuring that the implications for water resources are factored more systematically into decision-making on land use and land management changes, nationally, regionally and locally.*

- *Developing a plan of action to reverse long-term degradation of aquifers due to ingress of nitrates and other contaminants.*

As both the supply and demand for water resources interact with a wide range of factors – such as soil protection, flood risk management, climate change mitigation and housing supply, developing an improved understanding of relevant interactions will be important in managing future water resources. There is therefore a case for further research in the following areas:

- **Pricing.** Sustaining a larger population will require a combination of increasing supply, which would be expensive (desalination, pipelines, reservoirs), and managing demand (e.g. pricing, metering). Getting prices right (i.e. taking account of the full cost of water supply including environmental consequences) can also play a central role in resolving availability problems.

- **Technological solutions such as re-use and recycling of water.** These have the potential to impact on the efficacy of water-related ecosystem services and are

15 Detailed discussion of all nine sectors of land use and their interactions, can be found in Chapters 4, 5 and 7 of the Final Project Report.

likely to be progressively deployed by treatment on-site and direct reuse, or by indirect reuse.

- **Cross-government investment in monitoring and modelling at appropriate temporal and spatial scales.** This is essential to deliver the evidence base on which to make informed choices on where land use and land management can increase the sustainable use of water in the long term.

5.2 Land use for conservation

In the UK, as elsewhere, few landscapes remain natural. Nevertheless, many of our distinctive semi-natural habitats and cultural landscapes are valued in terms of their importance to the country's identity and heritage, protecting wildlife, and for the contribution they make to people's wellbeing and prosperity. However, future effects of climate change and human-led changes in land use will present substantial challenges to the UK's semi-natural environments.

Suggested priorities for action:

- *Evaluate how protected areas for wildlife might become better connected to help species adapt to climate change and changing habitats.*

- *Review the effectiveness and operation of existing regulatory and other measures designed to ensure the quality and management of land within designated areas, to ensure they are fully utilised.*

- *Review possible future measures which influence land management beyond the designated area, together with those relating to the designated areas themselves – recognising that the effects of the two will interact.*

Wildlife is already responding to climate change through changes to seasonal events such as flowering, species distribution and species abundance. However, changes in land use have led to the fragmentation of habitats. Therefore, as climate change begins to affect land cover, some species may not be able to adapt to these changing conditions[16].

Specific implications for policy include:

- Biodiversity, landscape and historic environments are currently governed by separate systems, although there can be overlaps. There is a case to reconsider this sectoral approach, as the interactions between these different perspectives on the value that society attaches to land become clearer. The ecosystem services approach, supported by the National Ecosystem Assessment, provides a valuable way of dealing with this issue.

- The management of other land use sectors should recognise the value of biodiversity that resides in everyday surroundings. For example, in the urban environment, this means recognising the important role that gardens and green spaces can play. Local development schemes could aim to provide greater environmental benefits; for example, by creating areas of new habitats, and also by helping to deliver national-scale landscape networks.

16 See Chapter 4, Section 4.2.

- Biodiversity, landscape and aesthetic value, and other cultural services provided by land, are often not marketed. New incentives could be needed to ensure that managing land for this purpose is encouraged, particularly in urban areas.

5.3 Agriculture

As the global population grows and market conditions change, the role of land for food and energy production in the UK will also evolve. Agriculture is arguably the single most dominant influence on the landscape. It currently occupies over 70% of the UK land surface. Besides playing a role in the supply of food, it is an integral part of the food industry and contributes to the economy and wider environmental aims. However, many of the roles and services provided by the agriculture sector are not fully rewarded.

A suggested priority for action:

- *Review and redesign incentives and reward systems for managers of rural land – to reflect the cost of carbon and the wide range of ecosystem services the land can provide alongside the production of food, fibre and energy.*

There are three important drivers of change in agricultural land. First, international markets for agricultural commodities determine the incentives for farmers to produce food, either for domestic consumption or export. Secondly, agri-environment policy influences land use by requiring farmers to adopt good agricultural and environmental practices, rewarding them for environmental improvement. Thirdly, new technologies and innovations induced by markets and regulation provide new possibilities for sustainable farming.

- The productivity of agriculture must be enhanced while simultaneously reducing its environmental burden. This requires new investments in technologies, knowledge and skills to improve the future sustainability of agricultural land use. This will require diverse collaborations amongst many different stakeholders, public and private, with interests in the future of land and the services it provides.

- It is important to maintain critical capacity in high-quality farmland and the physical infrastructure that supports it, such as land drainage systems. These are important strategic assets that are likely to increase in value, but be subject to greater risk, in the advent of climate change and increased global demand for food and energy.

- It will be necessary to recognise and reward the multiple roles of agriculture, not only as a producer of food but also as a provider of many other, wider ecosystem services which, because they are non-priced 'public goods', can go unrecognised and unrewarded. These include climate change mitigation through carbon sequestration, flood risk management, protection of biodiversity, and recreation. These multiple benefits must be realised through new adaptive technologies and systems of governance, including incentives for low-carbon agriculture.

- The current arrangements for income support for farmers could be better targeted to help agriculture reduce its negative impacts and considerably enhance its beneficial impacts in the public interest. This can be done in ways that simultaneously support rural livelihoods and the economy, both in the uplands and lowlands.

5.4 Woodland and forestry

The land area covered by woodlands and forests has more than doubled since 1924 and now covers nearly 12% of the UK land area. Forests represent long-term investments for the nation, and together with woodlands, provide diverse benefits and services including commercial timber production and non-marketed services such as biodiversity, flood protection, climate change mitigation, recreation and amenity. However, the commercial value of forests, and the incentives provided to the new planting of forests and woodlands, are in most cases much less than the value of benefits provided. This poses a significant challenge to the future of this key national asset.

A suggested priority for action:

- *Decide how best to promote and encourage the careful use and positioning of forestry and woodlands to extend the range of benefits they provide in addition to timber.*

Further possible actions include:

- Service provision needs to be integrated by strengthening policies to promote multifunctional forests and woodlands, especially in England. The implications of forest and woodland management for flooding and water quality management needs particular emphasis.

- The need for improved soil carbon management and the integration of energy issues into both agriculture and forestry means that policies for these two sectors need to be better integrated. The introduction of carbon trading is likely to affect planting and harvesting strategies.

- The location of forests relative to centres of population can be a critical determinant of value. There is therefore a case to extend Community Forest and Farm Woodland initiatives.

- New research is required to enable forest and woodland to play a full role in climate change mitigation and adaptation – climate change will have spatially-distinct impacts on forest and woodland services.

A possible increase in demand for conventional wood products over the next 50 years will not be met from standing timber resources. The contribution of forests and woodlands to meeting this deficit could be increased, but new incentives are likely to be required given the long lead times involved.

5.5 Flooding

Where we build and how we manage land is intimately connected with flood risk due to surface, fluvial and groundwater sources. Climate change is likely to increase the frequency of flooding, with consequences for property, livelihoods, infrastructure, agricultural production, and ecosystems. It is estimated[17] that by 2035, the number of existing properties exposed to 'significant' risk of flooding in England alone could rise from about 500,000 to over 800,000 in the absence of any increase in expenditure on flood protection.

17 See Chapter 4, Section 4.5.

Suggested priorities for action:

- *Development of proposals for integrating the analysis of flood risk and management costs more fully into the appraisal of different land use options.*

- *The development of regulatory and economic instruments to provide appropriate incentives to enable increasing levels of flood risk to be managed. In particular, the full cost of long-term flood protection and increased risk needs to be taken into account when new developments are proposed in flood risk areas.*

There is broad experience in the UK in flood risk management but, given the prospects of increased pressure on land use and increased flood risk due to climate change, there will be much greater need in future for:

- **Better understanding of the relationship between land use and flood risk management.** The extent to which changes in land management can 'mitigate' flooding at the catchment scale for extreme rainfall events remains unclear, although it is likely that rural land can contribute to flood alleviation by retaining and storing floodwaters in vulnerable catchments. Across the range of urban and rural areas, cost-effective 'adaptive' measures to reduce flood damage costs, including controls on land use and development, are needed.

- **Better appraisal of options for flood risk management and for evaluation of the implications for land use.** In addition to engineered flood defences, the resilience of existing and new buildings and property to flooding need to be improved.

- **More proactive flood plain zoning can help to reduce future exposure to flooding in the built environment, using flood corridors in urban areas to help deal with peak flows.** The case for zoning of coastal floodplains is even stronger given the predicted rise in relative sea levels[18]. Achieving change in land use, including making more space for water, will require government to consider issues of incentives, compensation and social equity. A much stronger and integrated role in development and land use planning for agencies responsible for flood risk management is required.

- **Exploiting the broad scope for joining flood risk management with other land use objectives and benefits.** There is significant potential for changes in management of agricultural land to reduce runoff, soil erosion and water pollution simultaneously, and to combine flood storage and restoration of floodplain ecology both in rural and urban areas. A broader, integrated approach requires new and diverse collaborations amongst regulators, land managers, developers, the corporate sector and the insurance industry, as well as the integration of different policy areas and funding streams.

5.6 Energy

The land take associated with conventional energy production has been modest to date, although this could change substantially through the shift to low-carbon production. Increasing the low-carbon energy supply through the planning system, pricing and new technologies will be key.

18 See the Intergovernmental Panel on Climate Change (IPCC) 2007 Fourth Assessment Report and subsequent reports following the Copenhagen Summit in 2009.

Suggested priorities for action:

- *Identify and prioritise delivery of land-based measures needed to ensure the EU 2020 Renewable Energy Targets are met, including a step change in granting planning approval for on-shore renewables.*

- *Pricing of carbon in the energy sector and competing land uses (including agriculture and forestry) should be reviewed, so that better price signals guide land use changes.*

The implications of the energy sector for land use in the future will depend on both the growth of demand and trends in the pattern of supply.

- **Planning.** A major shift will be needed in granting planning approval for on-shore renewables and transmission lines if the UK is to meet its EU 2020 Renewable Energy Targets at reasonable cost. Recent changes to the planning system, including the establishment of the Infrastructure Planning Commission, should help in the resolution of conflicts between national priorities and local sensitivities, but remain untested. Land take for on-shore wind turbines in some scenarios to 2050 could be 1–4%[19].

- **Energy crops.** Unlike wind, energy crops could add substantially to the demand for land, potentially providing direct competition with food production. Supplying 8–12% of the 2050 energy demand from the UK-grown energy crops (rather than from imports) would need up to 25% of the land area. There is a case for further R&D support for developing energy crops, and for analysis to inform how best to incentivise the production of specific fuels, ensuring that fossil energy and carbon emission permits are 'correctly' priced.

- **Appropriate pricing.** Energy, carbon and potentially, ecosystem services[20] need to be appropriately priced to: guide the land use changes required to achieve renewables targets; recognise the value of ecosystem services; and to inform decisions on the design of incentives for growing different crops i.e. for food, energy or forestry, as well as peatland restoration.

5.7 Residential and commercial development

Despite popular misconceptions, land in the UK is relatively undeveloped[21] (for example, around 90% in the case of England). Projections of total household numbers in England suggest possible rises of 6.3 million (29%) between 2006 and 2031, or 252,000 households per year, with a large proportion of the growth in the South East of England. Managing these increases whilst meeting public aspirations for lower-density housing will be a significant challenge.

Suggested priorities for action:

- *The strategic policy options for meeting development needs in the South East of England and other high demand areas – including whether to make additional land available for development – will need to factor in the full impacts on the land system at*

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19 See Chapter 5, Section 5.1.

20 See Chapter 3.

21 'Developed' here means 'built on'. Nearly all land has been modified in some form.

an early stage in policy development. These include the range of ecosystem services, local services and infrastructure, public preferences, the appropriate mechanisms for delivery, and the present and future value of land in alternative uses.

- *Consider the need for a duty on local planning authorities to consult formally with local residents on options, benefits and trade-offs for new forms of development. This should be based on detailed analysis and evidence, as pioneered, for example, in the Cambridge Futures exercise*[22].

England is the most densely populated country in the UK. Housing densities are increasing (up from 25 dwellings/hectare in 2002 to over 40 in 2007), and houses are becoming smaller. New houses in the UK are now amongst the smallest in Europe, despite strong evidence that people generally dislike living at high density[23].

- Policy-makers need to find ways to accommodate future population growth whilst balancing public aspirations for lower-density housing and protecting the countryside. The analysis in this report suggests the balance struck must reflect the full value or strategic importance (including non-marketed services) of land in alternative uses.

- There is a strong economic case that planning controls on land in some areas, especially in the South East of England, are tighter than can be justified by current valuations of the net costs of development. Releasing land for development in areas of high demand can confer large social welfare gains and would require some relaxation of planning policy. The long-term social, economic and environmental costs and benefits will need to be carefully weighed.

- The allocation of housing and development land needs to pay appropriate attention to costs such as flood risk, and the real cost of water supply.

5.8 Transport

Transport-related infrastructure represents almost 25% of the total developed land in England, occupying 2.4% of the total land area. Transport infrastructure is essential for the efficient and healthy functioning of society, business and the economy. The transport network of Britain is well connected but suffers from creeping congestion. The annual cost of excess delays in English urban areas is currently estimated to be £17.5 billion in terms of lost time and resources. Unless ways are found of managing this congestion, including road investments, losses could increase by an additional £22 billion per year by 2025. By the period 2020 to 2030, there is also likely to be substantial overcrowding on the rail network, particularly on the East and West Coast mainlines.

22 See Chapter 7

23 See Chapter 5, Section 5.2 of the Final Project Report.

A suggested priority for action:

- *The development of proposals to ensure that provision of transport services is fully integrated into future land use strategies and specific proposals for change of use. For example, these would link future policies influencing settlement patterns with infrastructure provision and climate change.*

Failure to integrate transport into land use strategy over the next two decades will have serious consequences for congestion, pollution and managing climate change, and will lead to mismatches between the location of housing development and the availability of jobs.

- There is evidence that policies which seek to reduce the need of travel by increasing the density of development are unlikely to work in isolation, and may exacerbate congestion and environmental damage. Costs for individual householders in terms of reduced space and higher prices need to be taken into account.
- Evidence suggests that rationing road use in cities by pricing is economically and environmentally sound, but may accelerate the rate of decentralisation of economic activities to fringe locations ('Edge Cities').
- It is essential that the full costs of congestion and the need for new transport infrastructure are taken fully into account in decisions about the location of development, which should seek to take advantage of existing links.
- Increasing capacity for public transport to reduce inter- and intra-urban congestion is highly beneficial and would have small effect on overall land take.

5.9 Land for recreation

Leisure activities are a fundamental part to modern lifestyles and play a vital role in promoting health and wellbeing. The recreation and tourism or 'visitor' economy has been estimated to contribute £52 billion per year, or 3.7% of the UK economy[24]. Taking account of the wider indirect impacts, the sector is estimated to account for £114 billion or 8.7% of UK GDP. Despite short-term declines, tourism and recreation are predicted to grow in the future.

A suggested priority for action:

- *Ensure there is appropriate policy-relevant research into the value of different landscapes for recreation and tourism in urban, urban fringe and rural settings – including their contribution to individual and community wellbeing and prosperity, and to the UK economy.*

24 See Chapter 5, Section 5.4.

Some aspects of tourism and leisure activities require dedicated areas of land, while others are often managed through other primary land uses such as agriculture and forestry.

- Future pressures on land use from tourism will stem particularly from inbound visitors. It has been estimated that there could be a doubling of international tourism by 2020, with implications for land use in terms of provision of accommodation, facilities, infrastructure and transport, as well as management issues.

- Population growth and increased recreational participation rates could lead to demand for more facilities for sports and active recreation. If policies of urban containment and densification continue, competition with other forms of development in urban areas might intensify, resulting in loss of urban recreational facilities, gardens and green spaces.

The importance of green space in and near towns and cities is likely to grow as population densities increase. There are major challenges ahead in finding the right mix of development and green space, in achieving appropriate design of green spaces, and in securing proper long-term management.

- Rural recreation has been important for many people over the last 50 years, encouraged by the mobility brought by the car and opportunities to escape from the urban environment. Some drivers of change may serve to increase the number of visits, aiding the rural economy in many places. Others, especially ICT-related technological drivers and restrictions on car use, could drastically reduce the demand for access to the countryside in the medium to longer term.

Past and present land use[25]

Land use governance in its broad sense – including how land is valued and its use incentivised, in addition to formal governance structures – has evolved over the past 50 years in response to changing demands and expectations. However, whilst this has, to an extent, enabled land to deliver substantial benefits – for example, the containment of urban sprawl – there is now a strong case for reappraisal (see Section 7).

The way land is now used and managed is a legacy of historical priorities and incremental societal change. The purpose of managing the land use system has broadened substantially over the last 60 years. In the post-war period, the emphasis was on rebuilding cities and the economy, decentralising the population from overcrowded and bomb-damaged inner-city areas, preventing urban sprawl, providing sufficient quantity of housing, and controlling new development.

Most new housing has been built within existing settlements or in small rural developments; and more crop and grazing land has been turned over to woodland in the last 25 years than into housing. Change from agriculture to developed uses has been low in recent years, and is slowing down.

The UK has been generally successful in containing urban sprawl, but market pressures and changing socio-economic conditions strongly suggest the need to review the principles and practices built on historical perspectives of managing development. The processes of governance, divided between various agents and strategies, are complicated and have created uncertainty, for example, for land managers[26]. The rural-urban divide is no longer clear-cut, and the separation of governance responsibilities may not be helpful in tackling the challenges covered in this report.

Much urban land is now managed by a range of quasi-public, private or market-led management and delivery mechanisms. These sit alongside the local authority planning mechanisms, and are not easily coordinated. The systems and mechanisms that guide land use change in the future will need to reflect new priorities, new trends in patterns of use, and changing concepts of how land creates value.

25 A detailed discussion of past and present trends in land use can be found in Chapter 2 of the Final Project Report.

26 For example, see Natural England's 'Demonstrator Project' commissioned and reported in 2009.

6. The need for a better appreciation of value in land use governance

How we value land, and the services it provides, is at the heart of decisions on land use change[27]. However, as priorities for land use and land management shift (for example, to reflect long-term challenges identified in this report), these need to be reflected in how we govern land use today.

There is a strong case for decisions about land use – at all levels, and across different land use sectors – to reflect a much broader concept of the value generated by land. Only then will the greatest benefits be unlocked, and tensions effectively managed. A more sophisticated approach to valuing land needs to be embedded into policy cycles and into the governance mechanisms, including future incentives and regulation.

If the land system is to deliver best value for the country in a sustainable way, we need to estimate the value of land in alternative possible uses (including for future generations), recognising that planners, local authorities and the Government must act within existing laws that respect property rights. The appropriate concept of value is a broad one, encompassing the full range of ecosystem services, whether or not they are marketed.

The economic approach to valuation seeks to quantify values as far as possible, establishing monetary values (or ideas such as willingness to pay) as a widely understood basis for comparison. But some argue[28] that this approach is more difficult to apply to some services provided by land (for example relating to the value of the natural environment). As such, this could result in undue weight being given to values that are more easily measured. Foresight's analysis suggests that quantification and finding new ways to understand and measure value will remain important, but that there is scope for integrating both types of values more comprehensively into cost-benefit analysis through approaches that attempt to weigh the full impact of policies on, for example, public health and ecosystem services[29].

Given the growing demands being placed on land, and the sometimes conflicting needs of individual households, communities, regions and the country as a whole, it is important to ensure that mechanisms – economic or regulatory – are in place to deliver best value.

As pressures on land grow, activities that damage land and result in negative environmental impacts need to be discouraged, for example, through regulation by making the 'polluter pay'. Conversely, activities that enhance land quality and provide environmental services that benefit society should be encouraged and rewarded, through schemes that reward land managers for environmental services. This process itself may need to be part of a deliberative process of arbitration over particular decisions, but could be facilitated by a general review of taxes and subsidies or payment schemes.

27 See Chapter 3 of the Final Project Report for a discussion on the value of land.

28 See Foresight workshop report November 2008 – 'Valuing Land' (available at www.foresign.gov.uk).

29 The 'Ecosystems Approach'

7. Achieving sustainable land use

7.1 'Systemic' issues in managing land use that need to be addressed

Detailed analysis of how the present land use system operates for different sectors of land use, at different spatial scales and at different levels of governance, has identified a range of 'systemic' issues that need to be addressed[30]. This is necessary in order to meet future challenges and realise future opportunities more effectively and sustainably.

Section 6 above has already outlined the need to broaden our concept of the value of land and how that information should be used to inform land use policy and governance in its broadest sense. However, this report has identified a number of other broad issues relating to the present land use system that need to be addressed in order to meet the many challenges and opportunities over the next 50 years. The following illustrates some of these 'systemic' issues. Chapter 7 of the full Project Report provides a more detailed discussion of these and others. It also discusses options for addressing them.

The disconnect between institutional arrangements and private ownership

Institutional arrangements for land use policies can sit uncomfortably alongside private ownership of land and property rights. A balance needs to be struck between protecting the interests of landowners, local priorities, and the wider public interest; and between short-term priorities and possible future needs.

At present, private incentives, in local land markets and local planning institutions, are not always aligned with the declared objectives of land use policy. This makes conflict and delay endemic in the governance system. The fiscal system, particularly the local tax system, can also contribute to this misalignment of incentives. For example, new urban developments typically impose significant costs on the local community, including increased service usage, impacts on transport capacity, and local amenity degradation. However, central government revenue streams take time to adjust to changes at local level; and the central operation of business rates means that local authorities cannot increase local taxation to meet up-front costs without an undue burden on existing residents.

The need for an overarching perspective

Some local decisions relating to development are heavily controlled, and are guided by planning policy that requires important issues such as the effect on the natural environment to be factored in[31]. However, it can be unclear which issues take priority, whether the cumulative effect of such decisions is recognised, and how strategically important or unique the effect of a given change in that location may be.

The need to incentivise better the provision of public goods and services

For example, there is an inherent tension in the business needs of farmers and their ability to deliver a range of public goods and ecosystem services. While it is important that farmers protect natural resources and prevent environmental damage, they, together with non-farming rural landowners need to be rewarded for the continued provision of public goods and ecosystem services.

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30 Section 7.3 of Chapter 7 of the Final Project Report provides further discussion on these 'systemic' issues.

31 See Chapter 2.

Aligning incentives and policy objectives

In some areas of the UK, the misalignment of incentives and policy objectives is leading to very high differentials in prices for land in different uses; for example, between housing and agriculture[32]. Much greater effort needs to be made to ensure that property rights, prices and incentives are properly aligned with strategic policy objectives, so that these price differentials can be reduced. Also, where market prices convey important information about the general public's preferences and pent-up demand for land, there is a strong argument that this information should inform land use policy at a strategic level; as well as other means of reflecting preferences (for example surveys).

Tensions between different parts of the land use governance system

The structures in place to deliver land use change unrelated to built uses are subject to different governance arrangements (often at EU or international level, such as the Water Framework Directive), compared with those related to built uses. Furthermore, responsibilities for energy, transport, agriculture and environmental policy, and the land use implications involved, are divided between different government departments and involve different institutional arrangements[33]. All have an impact on land use or land management. Mechanisms for ensuring that a coherent and consistent approach to policy-making is taken across these different sectors are needed.

The need to improve how conflicts are addressed – between different sectors, spatial scales, and levels of governance

Growing competition for land means that individual parcels of land and landscapes will come under increased pressure to deliver a wider range of goods and services. As demonstrated in Sections 4 and 5, the land use sectors that deliver these can conflict with each other, so it is vitally important that the system that governs the allocation, use and management of land should be more coherent and consistent, both across different land use sectors and across national, regional and local levels of governance. This is important if tensions are to be managed effectively. Examples include managing the environmental implications of some intensive farming methods, land for food versus land for some energy crops, and inner city land for commercial development versus land for sports and leisure. Conflicts between current and potential land uses are frequently manifested in delays to the planning process and legal wrangling. Tensions have also arisen between the operation of the market and regulation of land use.

The planning system mediates between these conflicts, while taking account of national, regional and local expectations, and being responsive to the needs of landowners, developers, the state, and the public. More recently, in response to the prospect of climate change, damage to the natural environment and a national political commitment to sustainable development, the planning system has adopted a broader perspective on valuing land and in assessing the impact of land use change.

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32 See Chapter 3 and also Section 4.1.1 of the Final Project Report.

33 See 'Governance System' diagram in the Systems Maps Catalogue (this Project report may be obtained through www.foresight.gov.uk).

An overview

It is important that the governance system that regulates the allocation, use and management of land should be coherent and consistent. This is because the current system:

- Involves decisions taken at different spatial scales that do not always reflect the scale at which impacts are felt, or reflect how natural systems operate. For example, effective water resource management requires action across the whole catchment;
- Fails to properly account for the many external benefits and costs associated with land use with consequences for overall welfare;
- Combines market mechanisms and regulation in ways that can conflict, generating severe pressures in some sectors such as housing;
- Is in some respects a legacy of historical priorities which may not reflect the value of the land in different uses, influenced by new and future aspirations and priorities;
- Has different governance arrangements for urban and rural domains;
- Faces growing pressures as population and demands for goods and services from land rise, and as climate change poses greater challenges relating to both adaptation and mitigation.

7.2 A critical choice for policy-makers – towards a more coherent and consistent approach

This Executive Summary has identified challenges in three broad categories:

- *Three key cross-cutting challenges for the next 50 years (relating to the South East of England, climate change, and the delivery of public goods and services – Section 4);*
- *Challenges spanning nine sectors of land use – many of which also interact with each other – Section 5; and*
- *'Systemic' issues that are inherent in the system for managing land use and which need to be addressed – Section 7.1.*

The scale of these future challenges means that 'no change' is not an option as this could result in, for example:

- *Missed targets (e.g. housing and renewable energy);*
- *Further degradation of our natural environment (e.g. due to habitat fragmentation);*
- *A failure to adequately manage tensions between individual land use sectors and in geographic 'hot spots' such as the South East of England;*
- *Undersupply of public goods and services, such as water quality and urban green space; and*
- *A missed opportunity to realise greater benefit from land.*

A critical choice for Governments[34] is whether to address the future challenges in an incremental and piecemeal fashion, or whether to aim for a more coherent and consistent approach to managing land use – or indeed some combination of the two[35].

The key requirements are:

- Decisions that take account of the full value of land in alternative uses;
- Value is assessed on a consistent basis by decision-makers at different spatial levels and in different sectors;
- Private incentives are aligned as far as possible with social objectives and values – to minimise tensions in the system and deliver better outcomes;
- The identification and promotion of opportunities for multifunctional land use and benefits;
- The use of a combination of regulatory, institutional and economic mechanisms to enable best value to be delivered most efficiently and at least cost.

If these requirements are not met, there is a risk that incremental decision-making on individual project and land choices will continue to create unintended consequences and unsustainable outcomes, some of which may be irreversible. Certainty and direction for all the governance processes at different levels of decision-making are needed, whatever the balance between regulation and market mechanisms.

The guiding principle for a more coherent approach would be to combine a more sophisticated understanding of how land creates value for society with governance which more proactively incentivises achievement of better value and the delivery of a wide range of sustainable and valued land services. This approach would help to identify and manage:

- Land-related problems in urban and rural areas which, if left unresolved, are likely to get worse or dramatically reduce wellbeing;
- Vulnerabilities or systemic weaknesses on which external influences and forces could cause a spiralling of unintended and adverse consequences;
- Geographical 'pressure points' where a combination of influences have impact;
- Policy dilemmas where targets and commitments could lead to unintended consequences or produce conflicting outcomes;
- Drivers that produce uncertain outcomes over which we have little control.

34 In the Executive Summary, 'Governments' refers to any of the Governments of the United Kingdom and its devolved administrations.

35 Chapter 7 of the Final Project Report provides a more detailed discussion of the need for a more coherent and consistent approach to land use governance.

There is therefore a strong case for governments to develop an over-arching approach which: recognises the cross-cutting nature of land across different sectors; adopts a long-term perspective; and takes account of the impact of changing circumstances (notably relating to climate change, changes in population size and distribution, and incomes). This would encompass all land use and management change – including the built and natural environment – in a consistent way. By building upon existing systems, their contribution over past decades would be acknowledged, but the need for change would be recognised.

7.3 The components of a strategic approach to land use governance

The design of a strategic approach for land use needs to be framed by political decisions – for example, on the balance between national, regional and local powers; the relative importance of the various future challenges; and the relative roles of regulation, incentives and markets. Wider issues of resource availability and the inherent capacity of land would also be a major consideration, as would the appropriate balance between economic development, social progress and environmental protection.

The task of developing this shift in approach should not be underestimated. It will require the support and leadership at the highest levels of government to stand any chance of succeeding.

Spatial aspects will be important. There is a need to take account of spatial variations in the demand for, and supply of, land resources of given qualities, and in the comparative advantage that land (and other natural resources such as water) bestows on particular regions and communities. Such 'critical geographies' mean that, although there are common challenges regarding land management, they vary considerably between different locations. Examples include: responding to housing demand in the densely-populated South East of England; maximising the net value of investment and existing infrastructure in northern cities, Wales, Scotland and Northern Ireland; and supporting rural livelihoods in relatively remote upland areas.

The appropriate framework for land use decisions will depend respective weight given to regulatory, voluntary and market mechanisms. A decentralised style might provide a national framework, consisting of broad principles informing a common approach to decision-making and methodology. The detail of implementation would be the responsibility of regional or local decision-making bodies, sectoral administrations, and civil society, largely relying on market processes. A more centralised style would involve greater direction from a national government body charged with overall responsibility for achieving the strategic and sustainable management of land assets. Either way, the critical innovation would be to embody the requirements set out in Section 7.2.

In summary, the essential elements of such an approach could include[36]:

- Establishing and cascading UK-wide land use objectives and priorities – aspirational or mandatory – ensuring consistency and compatibility across policy domains, but respects devolution;

- Ensuring clarity on decision making at national, regional and local levels, so that there is a balance between delivering national and strategic objectives whilst respecting regional and local circumstances;

36 Further detail can be found in Chapter 7 of the Final Project Report.

- Ensuring decision-making is integrated and evidence-based. The aim should be to promote decisions that are based on a consistent approach, and which take better account of the full range of services and values that land could deliver in order to realise the greatest benefits. It also implies the need for guidance on valuation and other methodologies[37];

- Facilitating the collection and dissemination of better data and information flows on land use;

- Ensuring appropriate incentives to guide decisions on land use – particularly for landowners and land managers;

- Promoting decisions and policies that are robust in the face of changing circumstances and future uncertainty. This will involve being clear when future need should take priority over immediate concerns – for example, when the costs of delaying action might outweigh immediate savings;

- Promoting opportunities for multifunctional land uses and collaboration amongst potential beneficiaries;

- Periodic review of outcomes against national and local objectives, coupled with adjustments to incentives and governance;

- When developing new policies and interventions, it will be important to evaluate their robustness against future uncertainties. The scenarios developed by this Project (see Appendix E of the Final Project Report) should be used for this purpose.

7.4 Implementation: administrative and spatial considerations

The mechanism for enabling land's value to be taken into account within a more coherent and consistent approach lies in existing governmental structures and systems – it encompasses incentives and regulation, as well as more formal decision-making mechanisms. A key issue for Governments will concern the extent to which these should be refined, as opposed to working within the existing frameworks.

An underlying requirement will be the need to incentivise and 'mainstream' choices and decisions which can be expected to deliver better value in a sustainable manner, while retaining sufficient overall control to ensure that key objectives are met (such as avoidance of urban sprawl and adequate provision of accessible green space). In this context, it will be important to recognise that certain existing governance structures could militate against a more consistent approach. Examples include:

- The boundaries of administrative areas such as regions and local authorities do not necessarily relate to the functional and economic flows across the land.

- Some specific policies focus on networks, such as the transport system, which stretch across various governmental and geographical boundaries. These may not sit well with strategies and plans for the growth of towns and cities clustered in specific places.

37 Included here is the need for a better understanding of the value and function of ecosystem services in the formulation and adoption of local and strategic land use policies.

- The forces that drive change in and over the land interact in complex ways, and sector-specific policy responses (in housing, transport, or agriculture, for example), may not be sufficiently effective in addressing the range of different considerations relevant to land use decisions in particular places.

- Multifunctional land use explicitly requires integration of different and hitherto fragmented policy arenas and funding mechanisms. It also requires new collaborations amongst interested and influential stakeholders, and recognition of the diversity of the motivations of land owners and managers.

An important issue is whether a (central) body is necessary to oversee all aspects of land use policy and implementation, or whether a more decentralised approach would be sufficient. The essential requirement is that sufficient oversight should be established so that greater coherence and consistency is achieved.

8. Next steps

More detailed evaluation of the findings will be needed by government departments and the devolved administrations in the first half of 2010, with a view to developing a detailed way forward later in the year.

Consultation with stakeholders would be crucial to this process, as would be the sharing of information and experience between the four countries of the UK.


HOUSING
SUSTAINABILITY
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1 Introduction

Chapter 1 explains why the Project was undertaken, and sets out its aims and ambitions. It explains how the Project adds value over other work, both in the UK and abroad.

The technical approach to the work is outlined, including who was involved and how the work was structured. The subsequent chapters of the report are also introduced.

1 Introduction

The aims of the Project

The Project aims to use the best available scientific and other evidence to take a broad look at:

- The most important challenges and opportunities for land use in the UK over the next 50 years[38] – particularly those that merit decisive action; and

- What can be done to use and manage land more sustainably and to unlock greater value for people and the economy – now and in the future.

The Project has also sought to identify where incremental change would be desirable, and where a more strategic shift is needed.

The Project's scope

The Project's scope covers land across the UK (but not marine environments). While Foresight recognises the distinct characteristics of land are different between the regions and the four countries of the UK, as are the different governance arrangements and priorities, these cannot be fully reflected in a project of this nature. Similarly, difficulties in finding UK-wide datasets or national datasets which are consistent means that often the evidence and data presented in this report is for England only. However, it is hoped that the challenges, opportunities and courses of action suggested by this report are relevant for the UK as a whole.

1.1 Why the Project was undertaken

Land is one of our greatest assets. How it is used and managed affects everyone's quality of life, whether in urban or rural areas. The productive capacity of the land – the food produced, minerals extracted and timber felled – provides essential goods as well as jobs. The use of land – for residential and commercial purposes, for transport and energy infrastructure, and for recreation and tourism – underpins the whole economy. And land, and the biodiversity it supports, provides the vital services society relies on for survival, such as clean air, water and healthy soils.

These uses of land are often in competition. This is set to intensify as land is required to deliver a wider range of goods and services. For example, to:

- Meet steadily rising demand for housing.
- Create more high quality green spaces for recreation near and within population concentrations.
- Preserve and enhance landscapes.
- Store carbon for climate change mitigation.
- Store floodwaters as flood risk increases.
- Provide the food and agricultural products needed in a globalised world.

38 In this report, 'the future' is generally taken to mean the next 50 years to 2060, unless otherwise indicated.

- Connect habitats to help species adapt to climate change.
- Support low carbon energy production.

Changes in the size and distribution of the population, coupled with rising incomes, can be expected to drive demand for resources and space, unequally, across the UK. This will need to be managed in an increasingly carbon-constrained world, where the impact of changing climatic conditions will alter the physical characteristics of the land system, the nature of rural landscapes, economies and urban form. At the same time, improvements in living standards and the quality of life of UK citizens can be expected to remain a high priority.

The land system embodies the relationship between human activities on land, socio-economic conditions and the natural environment, and also the systems of governance which manage these interactions[39].

These societal challenges will create land use challenges. To realise greater benefits from land and secure its capacity to support the wellbeing and prosperity of future generations, land in the UK will need to be used and managed more strategically. Society in the UK will need to make informed choices between different land uses, and provide incentives for more integrated and adaptive land management.

Against this background, this Foresight Land Use Futures Project has explored:

- Important present and future challenges for UK land use; and
- The possibilities for using land differently – in ways which unlock its capacity to deliver greater benefit for society in a sustainable way.

1.2 The present situation

The best UK landscapes are a great source of pride. Visions of community and countryside are deeply entrenched in our culture. Historical objectives embodied in the Town and Country Planning Act 1947 to contain urban sprawl, to ensure enough land is available for food production, and to provide green spaces for people to enjoy, have largely been met. The quality of urban environments has been improved in many respects through good design, while the best historically and architecturally interesting landscapes have been retained and protected. And concern for the natural environment has remained a high priority for many people.

However, the UK now faces mounting challenges. It is over 50 years since the post-war settlement for land was implemented, leading to the patterns of use that exist today. Looking ahead just 20 years, there could be substantial changes affecting the country, and by 2060 the world is likely to be a very different place. The issue for policy will be whether all the economic, social and environmental benefits of the land in the UK can continue to be realised against a backdrop of greater expectations from the market, local communities and environmentalists in both the short and long term, and whether land can be used and managed to deliver better outcomes for society as a whole.

As demands on land grow, so too will tensions in the land system. Divergent beliefs and deep-seated conflicts could inhibit potentially valuable changes in use, or more sustainable practices being adopted. Those who take decisions about land use at local,

39 See the Glossary for a fuller explanation of the 'land system', and also the Foresight 'Systemic Perspective' report

regional and national levels will need to weigh up a growing number of considerations, inevitably creating winners and losers. And different approaches to planning and decision-taking across different sectors – such as housing, energy, agriculture and transport – can mitigate against a strategic perspective on the allocation of land to different uses which seek more beneficial outcomes.

While conflicts over land use have always existed, this report argues for a new perspective on land which goes beyond a simplistic understanding of the purpose of rural and urban areas. Instead, change in land use needs to be considered in the light of new challenges, possibilities and opportunities – rather than being constrained by historical tensions between the protection of the countryside and the natural environment on the one hand, and the need for new development and infrastructure that supports changing lifestyles and growth on the other.

These tensions have developed most obviously over the past 50 years: a period characterised by rapidly evolving societal and demographic trends, and growing personal mobility, allowing people to live and work in different locations. These trends have increased demand for housing, services and infrastructure, particularly at the edge of existing towns and cities. As demands have risen and land prices in urban areas have escalated, the planning system has continued to direct most urban development to existing urban sites or to 'brownfield sites'. Prices for land earmarked for development have risen sharply relative to prices for agricultural land over this period, particularly in the South East and other parts of England. One notable spatial effect has been for more land to be released for new housing development beyond existing large towns and cities, 'leapfrogging' the immediate urban fringe, in areas with lower demand for new housing. This has, in turn, created new patterns of urban growth and long-distance commuting, placing additional pressures on the infrastructure network.

The ways in which land is used, and proposals for changing it, can also lead to conflict. Examples include the environmental implications of increasingly intensive farming methods, the policy imperative for renewable energy production (such as energy crops) and critical transport infrastructure such as airports, rail and road links. These conflicts between current and potential land uses are frequently manifested in delays to the planning process and legal wrangling. Tensions have also arisen between the operation of the market and regulation of land use, and impact on the natural environment.

The planning system mediates between these conflicts, while taking account of national, regional and local expectations, and being responsive to the needs of landowners, developers, the state and the public. The planning system has recently adopted a broader perspective on valuing land and in assessing the impact of land use change in response to the prospect of climate change, damage to the natural environment and a national political commitment to sustainable development. These challenges are imposing new pressures on a system already straining under the burden of legal requirements relating to economic, social and environmental issues.

1.3 Drivers of change

While it is impossible to predict the future, major forces driving change can be identified. Globally, demographic shifts, climate change, the need to increase food production, energy and water availability could converge in a 'perfect storm'[40] by 2030, leading to serious conflicts over land use and accessibility, particularly in developing countries. Globalisation and shifts in the global economy are set to continue. All

40 http://www.dius.gov.uk/~/media/publications/P/Perfect-Storm-Paper

countries, including the UK, will be affected, each faced with its own particular challenges.

In the UK, some particularly important drivers of change include:

- **Climate change:** climate change will have an important influence on land use change in the medium to long term, affecting the physical characteristics of the landscape. But land use and land management policies will also need to play a pivotal role in both mitigation and adaptation efforts – in the rural and urban sectors. The potential role of land and land use in mitigation will be profound, not just through the use of land to produce low-carbon energy but also in how land is managed to maintain, for example, vegetation and soils. The move to a low-carbon economy will also influence land settlement patterns, the design of urban environments and transport policy. The agricultural and forestry sectors will have to adapt to changing climatic conditions but also have great potential to mitigate the effects of climate change. Semi-natural habitats and the diverse species they support will need to adapt to changing temperatures and precipitation patterns. And growing flood risk will have implications for building on floodplains and vulnerable coastal land.

  The UK, along with many other countries, faces stringent targets for reducing greenhouse gas emissions and increasing the use of renewable energy. The Government, recognising that 'business as usual' is unlikely to allow these targets to be met, has begun to develop new policies. Opposition to land use change designed to help meet these targets, such as the establishment of wind farms, is currently a serious obstacle which policy-makers are seeking to address through planning reforms. The use of land for energy crops has potential long-term implications, especially in the context of concerns about future food security and rising global population. Although the precise balance of renewable energy production that will be required is uncertain, meeting EU targets may require very different patterns of land use in the future. These issues of future food and energy security require detailed consideration of the wider implications for land use, including potential environmental consequences.

- **Economic growth and changing global economic conditions:** economic growth alters consumption patterns and therefore demands on land. For example, rising prosperity and higher disposable incomes increase the demand for leisure and recreation, and tend to drive demand for larger houses in less dense locations. When the availability of land for housing is constrained, the demand for additional living space as incomes rise is the single most important determinant of upward pressure on house prices[41]. The future economic and industrial geography of the UK will have a strong influence on where jobs and homes are located, potentially changing the distribution of demand for housing and transport.

  The underlying trend for economic growth in the UK projected to the 2050s is currently estimated to lie in the range 2.25–2.5% per annum[42]. The average over the past 150 years has been 2%, and over complete economic cycles growth has rarely fallen below 1.5%. It is likely that after recovery from the current downturn, underlying growth will resume in the range 1.5–2.5%. This implies a continuing and substantial increase in the demand for land and the services it provides.

  Continuing change in the global economy will also affect land use. Some sectors will be directly affected; for example, rising global demand for food and changing

41 Cheshire (2008)

42 http://www.hm-treasury.gov.uk/d/bud08_longterm_586.pdf

commodity prices will significantly affect demands on the agricultural sector and the amount of land that is brought into production. For other sectors the effects may be less direct as, for example, in the case of changes in the global financial system, which may affect the stability of markets for land assets.

- **Demographic change:** The UK has already seen substantial population increases over the last century and current projections suggest that further increases are likely. The Office for National Statistics (ONS) suggests that the UK population could increase by approximately 9 million by 2031, and 15 million by 2051, although there is considerable uncertainty associated with these projections. A significant proportion of this increase reflects continuing high levels of net inward migration, which is particularly uncertain and depends on many factors including global economic and environmental conditions. With no net migration the increases would be 3 million and 2 million respectively[43].

  A high proportion of population growth is expected to continue in the South East of England. There are also important and continuing structural changes arising from an ageing population, and more people living alone. By 2031, 18% of the English population is projected to comprise single households. 42% of the average annual projected increase in one-person households between 2006 and 2031, is expected to be aged 65 or older[44]. While these projections are uncertain, likely demographic change can be expected to lead to a significant increase in the demand for land for housing, recreation, transport, water, food and energy.

- **Societal preferences, attitudes and motivations:** People's preferences and attitudes interact with all the other drivers of change in influencing land use. Market mechanisms such as prices are one important route through which preferences are expressed, along with other influences in the planning system. Participation in decision-making, whether through planning applications, local plan-making, representative organisations or community projects, is another route by which people directly effect changes in land use. A desire to protect and enhance the environment, and preferences for home ownership, car usage, shopping patterns and other social trends are also changing how land is used.

  A challenge for policy-makers is how best to take into account conflicting public attitudes, and differences between individual preferences and societal needs, in the land use and management system. In addition, land use and landscapes are transformed over time by the cumulative effect of hundreds of thousands of landowners and land managers taking decisions and acting according to diverse interests and goals. This diversity in motivation means that varied and unexpected responses to policy interventions in the land system can occur[45].

- **The policy and regulatory environment:** Today's landscape has evolved over centuries, influenced by the activities of people in their everyday lives, and by government policies and regulatory measures. The Town and Country Planning Act 1947 provided the first comprehensive basis for the control of land use, under which much development was effectively nationalised. The Act has evolved over the last 50 years and now consists of a framework of planning acts supplemented

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43 These figures are from the 2008-based ONS National Population Projections (October 2009). They are uncertain, particularly beyond 2033, and rely upon assumptions on fertility, mortality and net migration. The report is accessible at: http://www.statistics.gov.uk/downloads/theme_population/NPP2008/NatPopProj2008.pdf

44 From CLG's figures on Household Projections to 2031 in England, accessible at: http://www.communities.gov.uk/publications/corporate/statistics/2031households0309

45 Dis:2 (Appendix B refers)

by other relevant legislation. Agricultural policy, initially embodied in the 1947 Agricultural Act and since 1973 under the European Common Agricultural Policy (CAP), has also had a major influence on the rural landscape by promoting high levels of food production. Since the 1980s, however, environmental stewardship has become an important component of agricultural policy, more recently driven by European Directives such as the Habitats Directive and the Water Framework Directive. The Agenda 2000 CAP reforms, which removed the direct subsidies on farm production and introduced new schemes to reward farmers for environmental services, have influenced and changed the way the land is managed.

Policies will inevitably evolve in response to climate change and other drivers mentioned above, and will shape how rural and urban land are used in the future. A key question is how should land policies and systems respond to manage multiple demands, including national, regional and local decision-making, the allocation of property rights over land, and the regulation of land use and land use change. The responsiveness of the system of governance will have a profound influence on how effectively land is used in the future.

- **New technologies:** New technologies will affect land use both directly and indirectly. Technological developments in farming, in terms of the types of crops and farming practices, will continue to influence the rural landscape. For example, precision farming and technologies that monitor soil condition and water quality will enable farming to maintain high levels of productivity while reducing its environmental burden. Advances in information and communications technology will enable people to live and work differently, potentially affecting commuting patterns.

  New land management practices could blur the urban–rural boundaries, making possible the use of urban areas for food production, energy production or for provision of habitats for biodiversity. However, whether technological innovations drive the evolution of land use in a sustainable and socially desirable way will depend on incentives and governance structures to develop and promote their widespread adoption. The Horizon Scan[46] commissioned for the Project identifies some of the technological changes and innovation that could affect land use and management in the future.

The ways in which these drivers of change will manifest themselves in the future, and interact to create changes in land use and management, is uncertain. This is particularly the case from 2030 onwards, when the impact of climate change, population change and the direction of policy are more difficult to forecast. To help imagine alternative futures Foresight has produced a set of scenarios for the UK in 2060[47], which envisage drivers interacting in different ways to produce alternative land use and policy outcomes. They are not 'desirable' or 'undesirable' scenarios, but are based on recognition that the characteristics of the 'land system', including people's attitudes about land, could be very different in the future as pace of change accelerates. These qualitative scenarios were designed to help stimulate thinking about what desirable outcomes for the future use of land might be, and are not government policy or predictions of the future.

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46 Dis:4 (Appendix B refers)

47 See Appendix E

1.4 Key challenges for the future

The previous sections highlight significant potential for conflict in the way land use is evolving, and identify drivers for change that are likely to exacerbate current tensions. Evidence presented in this report suggests that the impact of these drivers will become more difficult to manage in the future, and that land use may not evolve sustainably in line with societal preferences and goals. In broad terms, there are a number of important challenges, discussed in more detail in later chapters, which land use policy needs to address:

- Increasing demands on the South East of England, leading to pressures on existing housing and land for further house building; decreasing water supply and quality; increasing congestion; greater pressures on the local environment; and wider implications for the rest of the UK.
- Making better use of the land across the UK for climate change mitigation and adaptation, and supporting the transition to a low-carbon economy.
- Ensuring the continued delivery of vital 'public goods and services', including ecosystem services, in a land system where a large amount of land is privately owned and is increasingly influenced by global and domestic market pressures.

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

This report sets out where conflicts can be expected across the land sectors, and the challenges and choices that these will create, and suggests priorities for change and improvement. Continuing with 'business as usual' will not be an acceptable or sustainable option. In the absence of significant policy changes, long-term trends can be expected to continue, including:

- **Increasing demand for water as a result of projected population growth and urbanisation, occurring alongside reduced water availability.** Impacts from climate change in the UK are expected to lead to significant reductions in river flows and groundwater recharge[48], amid general patterns of growing demand through to 2050. The greatest increases are expected in the South and East of England as a result of growth in population density, and agricultural demand for water. The combination of lower rainfall, groundwater pollution, and greater restrictions on abstraction will all contribute to reduced availability of water. While the chemical quality of surface water is improving overall, the upward trend in the volume of groundwater requiring treatment is unlikely to be halted without further measures to improve land management.
- **Detrimental impacts on the state of the natural environment.** For example, a recent study[49] which analysed 19 broad habitats, identified nine where changes in land use were having a negative impact on of the provision of ecosystem services, with only one showing signs of positive change. Declining bird populations are also taken as an indicator of the health of the natural environment. Since 2000 there

48 This analysis is based on the UK Climate Impacts Programme Scenarios, 2002. New scenarios were published in 2009.

49 Haines-Young and Potschin (2008)

has been a decline in populations of breeding farmland birds, breeding seabirds and wintering seabirds, as well as of plant diversity in woodland, grassland, and boundary habitats.

- **Potential vulnerability of farming communities in upland areas and abandonment of land, where viability is more dependent on income support.** A decline in upland farming could lead to a serious loss of the goods and services provided by agricultural land that has been managed for food production but where other benefits such as landscape quality, water resources and recreation benefits also accrue.

- **Flood risk and the cost of flood protection will continue to increase.** The impacts of climate change, combined with further urbanisation and building on flood plains, will ensure continuation of this trend without measures to improve rural land management processes and urban drainage systems. Further draining of floodplains for development will also reduce their potential for carbon sequestration.

- **Difficulties, or excessive costs, in achieving 2020 targets for renewable energy, if there are delays in the development of on-shore wind farm and other forms of renewable energy production.** Targets to increase the amount of energy produced from renewable sources will mean greater competition for land and possible changes to landscape character. However, the scale of the land-based effects will depend, for example, on the policy choices made on the 'energy mix'[50] and in the case of wind, how much production capacity is on-shore, given that off-shore wind is considerably more costly. Land use and planning policies have a critical role in shaping incentives to ensure the required changes in land use occur.

- **Rising house prices ahead of general inflation, quite possibly at increasing rates, and smaller homes.** From 1969 to 2008 property prices rose at an average real rate of 3.5% per annum, and with rising incomes, rapid growth is likely to resume after the current downturn. First-time buyers in 2008 were paying (on average) 4.5 times their income to buy a house, compared with roughly an average ratio of 2.5 between 1969–1989. With real price increases above the growth in average incomes set to resume, these multiples are likely to increase. New houses in the UK are being built at higher densities than the average for the current stock.

- **The difference between the price of land with permission to develop and other land will continue to grow in areas of rising demand for development.** One study shows that obtaining permission to change use from agricultural to residential use can increase the price of the land by as much as 600–700 fold, creating obvious gains for the landowner. Regional disparities in relative land scarcity between the South East of England and other parts of the UK could increase if existing patterns of development continue.

This report shows that in order to address the multiple challenges over the next five decades effectively, an integrated approach to land use policy development is needed. In particular, later chapters develop the case for the coherent and strategic development of all aspects of land policy.

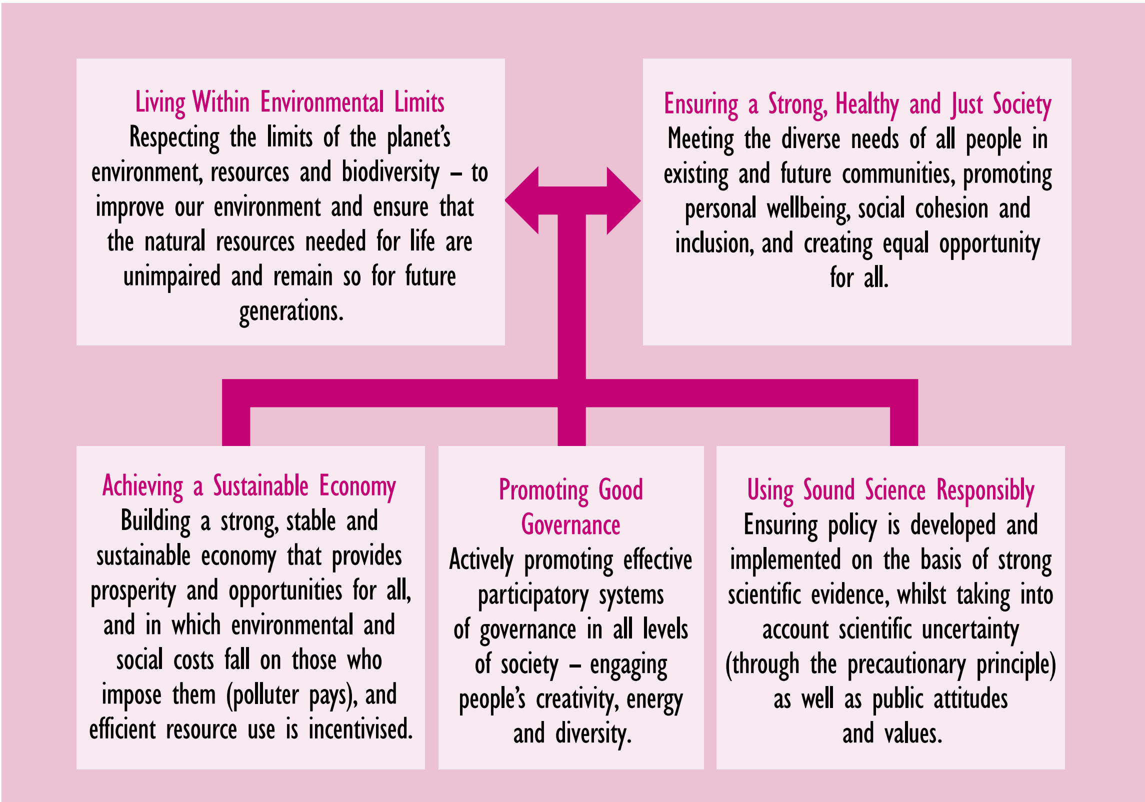
50 The Department of Energy and Climate Change, for example, is producing a set of scenarios for 2050 to model the possible impact of different 'energy mixes' to inform the development of energy policy.

1.5 Foresight's approach

Using land sustainably

The starting point for this report is the premise that policy should be directed to achieving the best possible value from the land in a sustainable way. Accordingly, sustainable land use policies should reflect the five principles adopted by the Government in its 2005, Sustainable Development Framework (see Figure 1.1). Indeed, each of these principles is fundamental to sustainable land use. The report sets out significant challenges and opportunities across the land system and sectors that use land. These challenges taken together span the five principles, reinforcing the importance of intervening in each domain to create sustainable policies. The report's conclusion focuses primarily on the 'Good Governance' theme.

Figure 1.1: The five principles of the Government's sustainable development framework



Source: Defra (2005)

By understanding how strategic changes in land use and management can create additional value for society, and what the wider and long-term impacts are, it should be possible to align governance processes and mechanisms to effect more desirable and sustainable outcomes.

The concept of value

The analysis is predicated on the understanding that the value of land is broader than its price. A completely unregulated land market is unlikely to deliver socially acceptable outcomes, because the use of any particular parcel of land has impacts not only on the owner of that land but also on the wider community and the natural environment. Value also flows from the less tangible and less easily quantified aspects of land, such as beautiful landscapes, the existence value of biodiversity, and the capacity of land to help regulate water quality or the climate, which are often not reflected in market values. By the same token, some changes in land use have adverse effects, such as pollution of watercourses or destruction of carbon sinks, which reduce value. It is this broader concept of the valuation of land in different uses that should guide the allocation, management and use of land. For the purposes of the report, this broader interpretation of value guides the analysis.

There are many different 'systems' at work that are creating value. Foresight has worked with academic and policy experts to understand and illustrate the interconnected nature of this system (see Chapter 3). To develop this analysis, Foresight made a number of assumptions:

- That existing short-term policy targets (up to 2020) and goals for land will broadly continue.
- That the overarching goal for the use and management of land is to enhance prosperity, quality of life and wellbeing for people in the UK, and that these features are dependant on economic, social and environmental conditions.
- That long-term strategies for land must address problems that already exist.
- That the combined effect of the market, the planning system and regulation will continue to guide the allocation of land to particular uses, but that the relative importance of each could change over time.
- That decisions by individuals, landowners, managers and businesses have a major influence on the use and quality of the land. Providing suitable incentives to guide choices at the 'grassroots' level must be central to strategies for changing land use.

These are, of course, assumptions. There could be quite fundamental shifts that undermine these assumptions in the longer term – for example a shift in the economic base of the UK away from financial services and in the weight that is given by the public to the long-term challenges raised by this report. Alternative scenarios have therefore been developed which cover some of the possibilities to 2050 (Appendix E). However, the report focuses on what the evidence suggests is likely given an extrapolation of current trends and in the belief that that this will be of greater value in guiding the choices of today's decision makers. Nevertheless, it needs to be recognised that short-term land use decisions could have irreversible long-term consequences and produce 'tipping points', which may lead to a less desirable scenario of unsustainable development.

1.6 The Project's report structure

The report structure is as follows:

Chapter 2 – Explores how patterns of land use have evolved, particularly over the last 50 years.

Chapter 3 – Considers how the value of land is currently understood and measured. How land use contributes both to prosperity at national, local and personal levels, and how it impacts on quality of life and wellbeing is discussed. A major issue is the difficulty of quantifying some of the diverse benefits of land use, and balancing economic and non-economic values in decision-making.

Chapters 4 and 5 – Set out what is driving change in the major land use sectors and the implications for policy. These chapters provide a detailed discussion of land for residential and commercial development, energy production, transport and its infrastructure, agriculture, forestry, conservation, and the role of land use in water resource management and managing flood risk. They also consider the role of land in recreation and wellbeing. In each case, past and present trends and possible future developments are reviewed. The richness and complexity of land use demonstrated in these chapters highlight the variety of factors and demands that policy-makers will need to balance at different spatial scales.

Chapter 6 – Provides insight into how societal and land use change is distributed geographically and the challenges and opportunities that arise. The intention here is not to identify the location of possible future problems. Rather it is to highlight the importance of the spatial perspective and signpost some regions where problems could be particularly severe. These could prove to be useful tests for evaluating new, integrated land use policies.

Chapter 7 – Synthesises the evidence and analysis in previous chapters, to identify the major challenges and opportunities for policy-makers. In so doing, it develops the case for an integrated and strategic framework for land use. Importantly, this chapter does not set out such a framework in detail – that is beyond the scope of this report, as it will need to be conditioned on political judgement, wider priorities and resource availability. Instead, guiding principles for developing such a framework are outlined.

Chapter 8 – Provides the conclusions for government and suggests the next steps in taking forward the findings.

1.7 Gathering evidence

Foresight has used a multidisciplinary, multi-perspective approach to develop an understanding of land use across the country, and has explored the effect of economic, social and environmental change in an integrated way. The following major pieces of work were involved:

- **Consulting with a range of stakeholders** – Over 300 academics, policy-makers, NGOs, agencies, businesses and individuals were consulted between January 2008 and February 2010. This work provided a rounded picture of the major challenges for the future of land use.
- **Collecting the evidence base** – In common with other Foresight projects, approximately 40 evidence based science reviews in a broad range of topics relating to land use were commissioned from leading academics. These reviews are the independent views of the authors and covered the current scientific thinking and trends. They also speculate on possible futures for the subject in question. They do not represent or anticipate current or future government policies[51] (see Appendix B for a list).
- **Providing a historical perspective** – The team commissioned work to gain an understanding of land use change since the early 20th Century.
- **Drawing on international evidence –** An analysis of how Japan, New Zealand, Germany, Sweden and the Netherlands have tackled land use issues has been produced. This work focuses on issues and responses that are more relevant and/or transferable to the UK.

51 See Section 1.8 for details of how to obtain these reviews

- **Taking a spatial perspective –** The geographical scope of the Project is UK-wide. The nature and severity of land use issues and pressure is not uniform and differs across the UK. Foresight has undertaken work to gain an understanding of where pressures on land are likely to be particularly severe in the future. A series of maps have been 'overlaid' to show possible 'hot spots' (Chapter 6). These are illustrative and are visual tools – they are not intended as concrete evidence of spatial issues.
- **Adopting a 'grassroots' level perspective** – Foresight has drawn on a series of case studies produced by Natural England that have adopted an integrated approach to land use and/or management to provide greater benefit for local areas, or that have used land to produce multiple benefits. These case studies provide qualitative evidence of the impacts and value of this approach to land use at regional and community level.
- **Taking a systemic perspective –** Using a broader range of evidence, a series of diagrams have been produced which conceptualise land use as a system of economic, social and environmental factors that interact to create outcomes on land. The Project refers to these interactions as the 'land system'. Taking a systems approach has helped to clarify the broad nature of both the drivers and the impacts of land use change.
- **Taking a futures perspective** – A set of scenarios for 2060 have been produced using the evidence base and drawing on the systemic understanding of land use. These are hypothetical, challenging narratives that explore the interaction and possible effects of different future drivers of change, cultural values, governance arrangements and the implications for land use (see Appendix E).
- **Commissioning analytical papers** – The Project commissioned analytical work on major thematic land use challenges, including valuation of the range of goods and services land provides, and how these are incorporated into the decision-making process. Analyses of governance issues, market failures and sustainable land use were also produced[52] (see Appendix B).
- **Drawing on related research, articles and reports** – The Project has drawn on a wide range of existing research, articles and reports from government sources, academia and the wider community around land use (see Appendix D and the list of references at the end of this report).

1.8 Publications

The Project's reports and commissioned documents are listed in Appendix B, together with their reference numbers which have been used throughout this report. The reports and documents are available as follows:

- Download through the Foresight website (http://www.foresight.gov.uk/);
- In pdf form on CD (available free through the same website);
- Certain hard-copy reports may also be ordered from the website (notably this Final Report, and a Systems Report); and
- Many of the evidence reports have also been published in a special edition of the *Land Use Policy* journal.

52 See Section 1.8 for details of how to access these reports.

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2 Current patterns of land use and historical drivers of land use change

This chapter provides an overview of current patterns of land use and reviews the many factors that have affected land use from 1900 through to the present day. It provides important perspectives on how governance has evolved in response to past pressures and aspirations.

Together, the present situation and the lessons from the past provide a springboard for later chapters, which consider the future.

2 Current patterns of land use and historical drivers of land use change

In the UK, changing land use does not necessarily conform to popular perceptions. Evidence shows, for example, that cities are not spreading out across the countryside; most new housing is built within existing settlements or in small rural development; and during the last 25 years more crop and grazing land has been turned over to woodland than into housing[53]. And, even if land appears to be idle, it is nevertheless working and delivering 'services' and therefore being 'used'.

The way land is now used and managed is a legacy of historical priorities and approaches to allocating use, conceptual frameworks and incremental societal change. This chapter therefore explores how diverse factors have come together, sometimes in unexpected ways, to influence the patterns of land use. Recognising that any historical perspectives may be open to challenge, it is nevertheless important to look to the past, although, as Chapter 1 has illustrated, future priorities are likely to be very different.

2.1 Current patterns of land use in the UK

This assessment of current patterns of land use, together with the review of the historical influences that have shaped patterns of land use in Section 2.2, forms a starting point for a discussion in later chapters, about how land use should be managed in the face of challenges over the next five decades. The chapter begins by briefly explaining how land use is classified before setting out current assessments of the distribution of land use across the UK. It then reviews trends in change of land use over past decades.

2.1.1 The difficulties of definition

Defining land use is not straightforward. It is widely acknowledged that 'land cover' and 'land use' are not the same thing[54]. 'Land cover' refers to the physical surface characteristics of land (e.g. the vegetation found there or the presence of built structures), while 'land use' tends to describe its economic and social functions. Clearly the two may be linked, but the linkages are complex. A single type of land cover, perhaps grassland, may support many uses, such as livestock production, recreation and turf cutting, while a single use, say mixed farming, may involve several cover types such as grassland, cropped and fallow areas. However, while the distinction between 'cover' and 'use' is accepted, they are often combined in classification schemes, so that resulting information on change is difficult to interpret.

Most definitions of land use give priority to 'function'. For example, the OECD defines land use as 'the functional dimension of land for different human purposes or economic activities'[55]. Historically, this functional aspect has been seen as the 'dominant concern'[56], for example agriculture or forestry. Other definitions take the traditional position that 'land use refers to the main activity taking place on an area of land'[57]. However, when particular areas are being used for multiple uses (which do not always relate to the

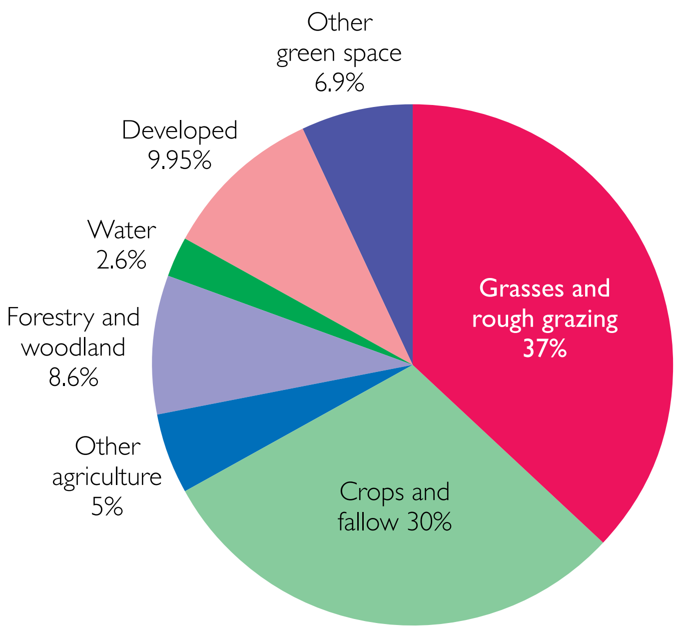
53 ER: 1 (Appendix B refers)
54 Jansen and Di Gregorio (2002); Comber (2008)
55 OECD (2007)
56 Stamp (1948); Best (1981)
57 Best (1981)

surface activity) such definitions are likely to be inadequate. Recent work for government departments and agencies[58] argues that satisfactory definitions of land use need to take account of several important and related factors, namely activity (including the intensity of activity), land cover, context and spatial scale[59]. While in this report the simple OECD definition of land use is generally adopted, in the following discussion of statistics on land use change a more complex definition is used to take account of these different factors. Further discussion on this issue can be found in Appendix F.

2.1.2 Statistics on the use of land

It is difficult to establish precisely how land in the UK is currently used. This is because estimates of the relative proportions which are used for agriculture or for development vary according to the type of classifications used. In statistical terms the most recent figures[60], taken from the Government's Generalised Land Use Database (GLUD), suggest that in England[61] only 9.95% of land is 'developed'(the first seven categories in Table 2.2), while Defra's statistics suggest that over 70% of land is used for agriculture. These datasets have been combined with statistics for forestry to offer an overview of land uses in England (Figure 2.1).

Figure 2.1: Estimated breakdown of land use in England



Source: Consolidation based on CLG Land Use Statistics: Generalised Land Use Database (2005), Forestry Commission statistics and Defra Agricultural Land Use Statistics (2005).

Table 2.1 expands on some of the data used in Figure 2.1 and focuses upon figures showing land use for agriculture[62] and forestry[63] across the UK . It demonstrates that agriculture is the dominant land use, accounting for just under 74% of the land, which is

58 Summarised in ER: 1 (Appendix B refers)
59 ER: 1 (Appendix B refers)
60 2005
61 The statistics are for land type, by census ward
62 The main source of information on agricultural land use is the annual agricultural and horticultural surveys carried out by Defra and the other UK Agricultural Departments.
63 Information on the area of forest and woodland in Great Britain is provided by the Forestry Commission, and for Northern Ireland by the Forest Service, an agency of the Department of Agriculture and Rural Development (DARD). Data covers both private and state-owned land.

reflective of long-term trends. Areas under forestry and woodland account for just under 12% and 'other land' – which refers to any land which is not used for agriculture or forestry/woodland, including water, semi-natural habitats and developed land – is approximately 14%. A recent report has also shown that, whilst there is considerable variation between Great Belts, the overall pattern of land use on Green Belts broadly corresponds with that of England as a whole;[64] for example, 7% of Green Belt land is classified as developed.

Table 2.1: UK land use statistics relating to agriculture and forestry

Geographic area	Percentage of country					Area ('000 hectares)	
	Agricultural land			Forestry and woodland[3]	Other land[4]	Total land (100%)	Inland water
	Crops and bare fallow	Grasses and rough grazing[1]	Other[2]				
England	30.05	37.08	5.13	8.59	19.15	13,028	76
Wales	3.17	72.29	0.96	13.80	9.79	2,073	13
Scotland	7.07	66.42	1.93	17.12	7.45	7,792	169
Great Britain	**19.80**	**50.26**	**3.66**	**11.97**	**14.32**	**22,893**	**258**
Northern Ireland	3.79	72.85	0.70	6.26	16.39	1,358	64
United Kingdom	**18.90**	**51.52**	**3.50**	**11.65**	**14.43**	**24,251**	**325**

Sources: Defra; Ordnance Survey; Forestry Commission; Forest Service (extracted from ER:1).
Notes:
1. *Includes grasses over and under five years old, and sole right and common rough grazing.*
2. *Set-aside and other land on agricultural holdings, e.g. farm roads, yards, buildings, gardens, ponds. Excludes woodland on agricultural holdings (included in 'Forest and woodland').*
3. *Forestry data for GB are compiled by the Forestry Commission and cover both private and state-owned land, based on the extrapolated provisional results from the National Inventory of Woodland and Trees for 1995–1999. Data for Northern Ireland is compiled separately by the Forest Service, an agency of DARD, and also covers both private and state-owned land.*
4. *Figures are derived by subtracting land used for agricultural and forestry purposes from the total land area.*

GLUD is based on Ordnance Survey maps and census reports[65] on total areas of land allocated to nine categories that relate primarily to land cover (see Table 2.2). GLUD also distinguishes residential from non-residential buildings, and domestic gardens from other green space, which is a catch-all category relating to land that is neither water nor developed[66]. These data subdivide developed uses into seven categories: domestic buildings, gardens, non-domestic buildings, roads, paths, rail and other land uses, which mainly refers to hardstanding, such as car parks in England. It is worth noting that almost half of all 'developed' land is in use as domestic gardens. While 9.95% of land is classified as developed, if domestic gardens are excluded this figure is 5.68%.

64 CPRE and Natural England (2010)
65 From Census Output Area data
66 See CLG (2007)

Table 2.2: Land cover in England according to CLG's GLUD categories

GLUD classification	Percentage of land cover
Domestic buildings	1.14
Domestic gardens	4.27
Non-domestic buildings	0.66
Roads	2.23
Rail	0.14
Path	0.11
Other land uses	1.4
Green space	87.47
Water	2.6

Source: CLG (2007).

2.1.3 Change in land use

Agricultural area

The overall demand for agricultural land will vary in response to many factors, including population growth and income, demand for foodstuffs, the extent of reliance on food substitutes, agricultural policy, and changes in production technology determining changes in agricultural land use. In the UK, two statistics are relevant: the area of land occupied by agricultural holdings and the area in actual use for agriculture. Over the past 25 years or so there has been very little change in either measure across the UK.

The June Agricultural Census shows that the total area of land in agricultural holdings in the UK fell on average by about 15,400 hectares per annum between 1983 and 2008. This was equivalent to a rate of 0.09% per annum, or about 1% per decade[67]. However, over the last ten years of this period the reduction in agricultural land area appears to have been minimal. While the extent to which holdings might have been omitted from the Agricultural Censuses is unknown, following the shift to a sample survey as opposed to a census, year-on-year change is small compared with the uncertainty associated with sampling error.

The overall reduction in the area of the UK actually in agricultural use (proxied by land in agricultural holdings other than in woodland) over the same period (1983–2008), fell more rapidly, reflecting the transfer of land into farm woodland. The annual fall in land in agricultural use was about 30,000 hectares per annum, equivalent to 0.17% per annum, or somewhat less than 2% per decade. Once again, the pace of change over the past ten years has slowed, with an apparent average fall in the aggregate area of the UK devoted to agricultural use of about 6,400 hectares per annum, or 0.7% per decade, lower than that typical of the years from 1961 to 1975 studied by Best[68]. However, the scale of reported change relative to the uncertainty arising from sampling error is such that it is difficult to draw firm conclusions from these apparent fluctuations.

67 ER: 1 (Appendix B refers)
68 Best (1981)

Change in agricultural products

While the area in agricultural use changes only slowly in the UK as a whole, the mix of agricultural outputs and land cover may change rapidly in response to price signals and subsidies. While the areas used for core crops such as wheat are stable over the long term, others can be quite erratic (Figure 2.2). One implication is that policy-driven pressure to produce new crops such as biofuels is very unlikely to lead to an increase in the total area used for agriculture in the UK. It is more likely that such crops will displace other crops to the extent that this is consistent with relative commodity prices, and if prices are favourable only in the presence of subsidy.

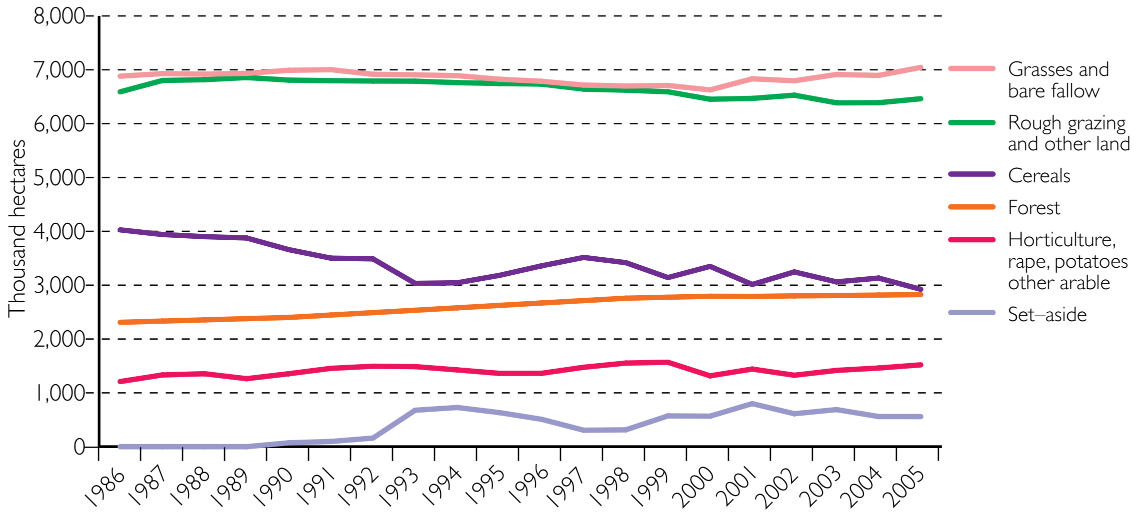
The balance between cropland and grass is perhaps the most enduring distinction. The area in agricultural use includes land that is cropped, land that is potentially croppable, and land used for grazing. The balance between crops and grazing can shift according to the demand for agricultural products, with the proportion used for crops tending to reduce at times of low demand. It is for this reason that the area of land given over to crops in 2008 is greater than at the time of Stamp's First Land Utilisation Survey in the 1930s.

The croppable area in England has proved remarkably stable. It has fallen by the equivalent of 0.5% per decade since the early 1980s (i.e. more gently than the decline in the agricultural area as a whole, and more slowly than the corresponding rate for the UK). The croppable proportion of England's agricultural area has remained at around 45% (plus or minus 2%) over the last quarter of a century. Thus a third of England's entire land area is actually cropped, which might be compared with the figure of 37% which typified the period from the 1940s to the 1970s[69]. In the UK more broadly, the croppable area has decreased more rapidly as grassland and woodland have increased.

The downward trend in the area actually used for crops appears to have been steeper (6.4% per decade) and has been driven by set-aside policy. Accordingly, a notable gap opened up between the croppable and cropped area after 1993, but closed in response to a reduction of support for set-aside. The capacity for rapid adaptation to changing incentives is evident in the fall in the uncropped area from 2006 to 2007, and the sharper fall from 2007 to 2008 when set-aside rates went to zero.

69 Best (1981)

Figure 2.2: Variability of area given over to selected agricultural products; UK, 1986–2005



Source: Defra (2006)

Woodland

The most obvious trend in land use change in the UK over the past quarter of a century has been the conversion of land from agriculture to forestry and woodland. Forestry Commission estimates of the area of forest and woodland cover in the UK imply an average annual net increase of 25,000 hectares since 1980, equivalent to 1.05% per year. There seems to have been some reduction in the pace of growth from 2000 to 2008 with the net increase in tree cover in this period being about 7,000 hectares per annum (or 0.24%). These recent patterns of woodland expansion continue a very clear upwards trend[70], which has led to a doubling of the area of UK woodland since World War II.

This growth, however, does not represent the outcome of shifts to commercial forestry in response to market signals. New planting has predominantly responded to subsidy and has involved the expansion of small broadleaved woodlands within agricultural holdings. The average annual increase in woodland on farms (14,500 hectares per annum) accounts for more than half of the net increase in the wooded area as a whole. The area of woodland within agricultural holdings has thus more than doubled since the early 1980s.

Built uses

Use of the Land Use Change Statistics (LUCS) allows the extent of development in England to be estimated and the pace of conversion of greenfield land to be gauged[71]. The conversion of previously undeveloped land accounted for about 5,000 hectares per annum between 2000 and 2006. This is equivalent to 0.04% of England's land area, and about one-third of the average annual flow of 15,700 hectares estimated for the period 1945–1975[72]. This is unsurprising, given the very different levels of annual housing construction typical of the two periods, and the direction of policy since 2000. Of all greenfield land developed between 2000 and 2006, roughly 57% was for

70 Best (1981)
71 ER: 1 (Appendix B refers)
72 Best (1981)

residential uses, with 20% being for industrial, commercial and related activities, and the remaining 23% for other developed uses, predominantly transport.

However, as previously emphasised, there is no simple relationship between the conversion of hitherto undeveloped land and the expansion of the contiguous urban area. The dominant style of developments in England during the period from 2000 to 2006 was not one of residential development on greenfield sites at the urban fringe. Fringe and peri-urban areas accommodated only one-quarter of the land subject to built development and only 30% of total greenfield development occurred within these areas. A total of 20% of greenfield development was sited in urban areas, partially on land taken from recreation areas, with the remaining greenfield development predominately occurring in smaller settlements.

These statistics show the impact of the recent emphasis in policy for urban house building, with a growing proportion of new residential units in cities, happening alongside an increase in the density of housing and an increase in the proportion of new units accommodated on brownfield land. Rural residential development, including house building within towns of less than 10,000 people and in smaller settlements, appears to account for about a quarter of all newly built dwellings. This includes dispersed residential development within small villages and hamlets, or adjoining isolated farms. Between 2000 and 2004 this form of development provided 10% of all newly built units but accounted for as much as 30% of all land notionally developed for housing, since it typically involves single dwellings within large curtilages. Most development within greenbelts is of this type. Between 2000 and 2004 some 2.8% of all new housing units were built on land subject to greenbelt controls.

In terms of new development, the most notable increase in numbers of dwellings between 2000 and 2004 occurred in city centres, which accommodated some 40,000 additional dwellings – both new build, and conversion and subdivision. More surprisingly, the number of dwellings built in villages in the same period was roughly equal to the number built in the city living quarters. The impact of such change in the broader countryside is more subtle than developments at the urban fringe and its effects are less well understood. In rural areas, some of the most marked growth has been in the very smallest settlements. Dwellings in isolated farmsteads increased by 5–6%, and in hamlets by almost 9%, between 1998 and 2003. The conversion of barns in areas of dispersed settlements close to centres of population has been a significant route for developments in rural areas.

In urban areas, there has been an increase in 'ambient dwelling density' (the overall density of dwellings across a settlement, as opposed to the density at which new housing is built). Between 2000 and 2004, ambient density in urban areas scarcely increased (from 32.4 to 32.6 dwellings per hectare, excluding parks, open spaces, industrial areas etc.). However, the highest increases in ambient density have been in inner London where densities rose by more than one dwelling to the hectare in five years through varying mixes of new development and intensification of the use of existing property. The intensification of high density suburbs proved crucial, accommodating 69% of all new dwellings in London. In other more northerly cities, with some exceptions, the ambient density fell in absolute terms, despite the scale of new building. In general, the highly visible regeneration of the cores of northern cities was offset to varying degrees by de-intensification in their suburbs.

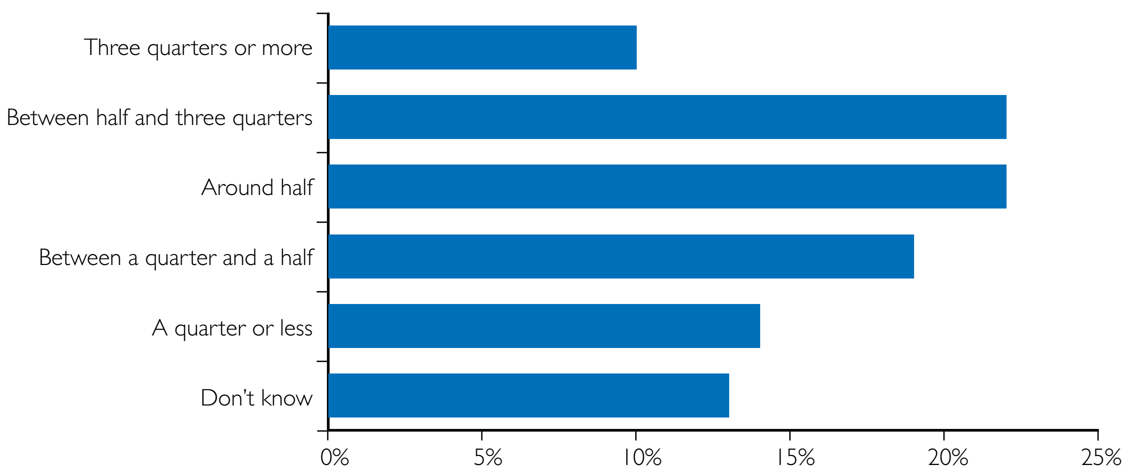
2.1.4 Public perceptions and attitudes to changing land use

Public perceptions of, and attitudes towards, land use and land use change are recognised as vitally important for the future. Evidence is quite patchy for the UK but has recently been reviewed both in evidence reviews for this project[73] and in wider studies, such as the research synthesis on public attitudes prepared under the Living with Environmental Change Programme[74].

There is evidence that most people think that Britain is more urbanised than it is. This was examined for the Barker Report, using figures from a MORI survey based on interviews with 1,724 adults. The full question read: '"Developed land" (broadly, land which has been built upon) is defined as land in towns, cities and villages (including gardens but excluding parks) and all additional land used for infrastructure such as roads, paths and rail. What proportion of land in England do you think is developed?' The question equates to the percentage of land occupied by the first seven GLUD categories in Table 2.2, which adds up to 9.95% of land cover. In comparison the survey showed that the public considered the level of development to be much higher, as shown in Figure 2.3, with only 13% believing that less than a quarter of the land in England is developed and over 30% believing that more than half is developed.

It was suggested[75] that this misperception may be caused by most of the population living in towns, and by the fact that when people travel between towns they travel relatively rapidly, but they move more slowly within built-up areas and so perceive urban areas as being bigger. In responding to the Barker Report the CPRE[76] pointed out that the figures could suggest that people think that very little of the country is unspoilt or that development has already reached desirable – or even tolerable – limits. It is also apparent[77] that a proportion of the population do not visit rural areas at all, or do so only infrequently; so many people will only be exposed to urbanised environments and therefore inevitably think that high proportions of the country are developed.

Figure 2.3: Responses to the question: 'What proportion of land in England do you think is developed?' as percentages of those asked



Source: Ipsos Mori poll for the Barker Review of Land Use Planning (2007).

73 ER: 12 (Appendix B refers); ER: 13 (Appendix B refers)
74 Upham et al. (2009)
75 Evans (1991)
76 Levett (2007)
77 ER: 12 (Appendix B refers)

Paradoxically, the majority of people aspire to a suburban or rural house with a garden[78]. This gap between perceptions of an over-built England and the desire for low-density living has been termed the planning paradox[79].

Social attitude surveys have consistently reported[80] concerns about urban sprawl and the need to protect the countryside from development. Green Belts are widely supported by up to 85% of respondents, although most people thought their function was to protect the environment and wildlife and only a quarter believed that they were to prevent urban sprawl and coalescence.

More generally, this type of research has found that people are uninterested in strategic land use issues but are very concerned about local land use issues, notably when a change or development is proposed. The public still believes that the main land use of Britain should be rural for food production, recreation and conservation, with urban areas being contained.

The review of research for the Living with Environmental Change Programme throws some light on attitudes to other aspects of land use change, reporting for example, that 71% of people say that they would like to have more woodland in their part of the country. Another example is that public attitudes to wind as a source of renewable energy are almost wholly positive in general but such developments are seen as inefficient, spoiling the landscape and requiring large amounts of land. Resistance is largely based on concern about visual impacts and noise. These are just two examples of the wide range of perception and attitudinal surveys relevant to issues of land use change.

The evidence suggests that perceptions and attitudes are complex and influenced by a great variety of factors including age, socio-economic status, where people live, where they were brought up, levels of educational attainment, overall environmental attitudes and life experience. It also seems likely that attitudes and perceptions change over time and between generations. Looking back over history it is possible to identify several periods of major land use change that caused considerable disquiet among some segments of the UK population – including, for example, the enclosure movement, the coming of the railways and the spread of suburban development around London in the 1920s, to name but three. And yet today it is hard to imagine the country functioning without the products of these major periods of change. Attitudes may change over the generations but in the short to medium term many people can be unsettled by significant land use change that alters their familiar local places and their relationships with their surroundings. The significance of this cannot be underestimated.

2.1.5 Key points

- Land use is a very complex area in terms of definitions, the variety of types of data available and their interpretation. It is difficult to establish precise data for the areas of land dedicated to the main uses of land; establishing accurate historical or current trends can also be problematic.
- Nevertheless it is clear that developed land, including gardens, generally accounts for some 9 to 10% of land cover in England. However, survey data indicate that many people think that the level of development is much higher, with over 50% believing

78 Town and Country Planning Association (2000)

79 Murdoch and Lowe (2003)

80 Sources of evidence summarised in ER: 13 (Appendix B refers)

that more than half of the land in England is developed. Given the influence of public opinion over some decisions affecting land use, there is a case for providing more accurate information to the general public.

- Evidence suggests that recent rates of change in land use have been slower than in the post-war period up to the 1970s. This contradicts general public perception, often fostered by media accounts, of relentless expansion of urban areas into the countryside. In reality, UK woodland stocks are now higher than 100 years ago, the area of land used for agriculture is declining only slowly and the growth of the urban area during the past two decades has been less rapid than in either the inter-war years or the first three decades after World War II.
- The changes that have been taking place in recent years are much more complex than a simple shift from greenfield land to developed uses as towns and cities expand. The real residential growth in recent years has been in city living developments in urban cores and in a variety of scales of developments in different rural locales. Government policy has been successful in focusing new developments on brownfield land and in cities, and in achieving an increase in residential density. This is not to suggest that new development has not had impacts on the land and life of Britain, but rather to indicate that the pattern of change is far more complex than is suggested by simple notions of urban sprawl.
- The reduction in extent of agricultural land in recent times (1983–2008) has been less than in the 1960s and 1970s and results mainly from transfer to woodland. The croppable area has remained remarkably stable in England, reducing at a similar rate to that for agricultural land as a whole, but more rapidly than in the UK as a whole. The area actually cropped in England has declined more steeply but this is mainly due to the effects of set-aside policy. Woodland has expanded at an average annual rate in the UK of 10% per decade since 1980, mainly due to expansion of broadleaved planting on farms in response to grant support schemes.
- Attitudes to land use change are a significant factor in considering how land use should change in the future. People's perceptions and attitudes are complex and influenced by a great variety of factors. It also seems likely that attitudes and perceptions change over time and between generations. Throughout history there have been major periods of land use change which have provoked strong reactions at the time, and yet in many cases the results of these periods of change are now an accepted part of our everyday surroundings.

2.2 Historical influences on land use change

2.2.1 The need to manage land use changes

The establishment of processes to manage land use change first emerged in the 19th century as a response to industrialisation and urbanisation. Poor public health, inner city squalor, and high density, poorly constructed housing development, led to recognition of the need for state intervention on the form and style of the built environment[81]. Town planning in the UK – the organised process of managing land use change – was introduced in the Housing, Town Planning etc. Act (1909), to improve urban conditions. This was to be achieved first through the principles of the garden city movement led by Ebenezer Howard that combined the best features of towns and countryside as future design frameworks for new building, and later through the modern movement in the design of new housing. Following World War I, acknowledging the sacrifice people

81 Hall (2002)

had made in the years 1914–18, Prime Minister David Lloyd George made a commitment to clearing the slums and providing 'homes fit for heroes'. Town planning had the effect of building on cheap undeveloped land on the edge of existing urban areas, creating suburbs around towns and cities through the use of better quality housing and space standards, tree-lined avenues, separation from heavy industry and links to major roads and railways.

In the 1920s and 1930s, as towns and cities expanded into surrounding areas thanks to railway, tram and trunk road improvements, concerns were raised by the public over the effects of suburban house building[82]. Attention focused on the impact on the countryside of urban expansion, the monotony of housing design, and the functional relationship between different towns and cities in the same region[83]. Over 4 million houses had been built in the inter-war years (a quarter of these were council housing), so that by 1939 one-third of the country's total housing stock had been built after 1918[84]. The impact on land use patterns and existing urban areas was immense, with the built-up area of London five times what it had been in 1918, and the wider impact of a policy intended to create better quality housing in rural settings, designed to improve 19th century urban conditions and public health, had in turn created other pressures for land use change[85]. Although the process of creating suburban housing improved the housing conditions of the population, suburban sprawl was seen as a threat to the future protection of the landscape and agricultural land[86]. Town planning's original purpose was shadowed by a new role that was designed to control, regulate or stop development interests as they may be affecting a rural way of life and rural values[87]. New legislation passed under the Town and Country Planning Act 1932 and the Control of Ribbon Development Act (1935) changed the objectives of the planning process. Planning became a much more comprehensive process, for the development of new garden cities, the encouragement of employment, and the creation of Green Belts. From the late 1930s, the idea of Green Belts around major cities also gathered momentum[88].

Since the 1930s, the management of land use change has needed to undertake two significant roles: to plan housing, transport and economic development to accommodate the long-term needs of our towns and cities; and to control development pressures that might affect the countryside and other interests. Therefore, new plans produced after the 1930s had to accommodate the development pressures of towns, controlling urban and suburban sprawl, while channelling growth into those English regions that were suffering from the effects of the Depression[89]. Tensions began to arise, however, about the role of planning and of the state in addressing economic problems through a market or command economy, and of the relationship between planning and land and property interests[90]. These policy regimes have been an enduring feature of managing land use change through the planning system: to allow development in the right locations and to protect the environment from inappropriate development. The policies have created their own legacies where the market and regulation can often seem to be in conflict.

82 Willams-Ellis (1928)
83 Schoon (2001)
84 Reade (1987)
85 Hall et al. (1973)
86 Newby (1979)
87 Newby (1979)
88 Ravetz (1986)
89 Ashworth (1954)
90 Pinder (1981)

As the town and country planning process attempted to achieve a balance in delivering growth in the 1930s, cities were undergoing rapid change due to the decline of heavy industry and the growth of the service sector. These changes created their own impacts and demands on land and land use patterns. In some larger urban areas, rising car ownership and the desire to accommodate the car was achieved through trunk road building programmes and ring roads around city centres. People began to be more mobile and could live and work in locations some distance apart. This made the planning of new patterns of land use much more difficult to achieve. Individuals could live and pay taxes in one area, but work and use the services and facilities of another.

2.2.2 Agricultural land use

The Agricultural Revolution of 18th century Britain was achieved through major advances in animal breeding, crop rotations and mechanisation, and was encouraged by expanding markets for food in a rapidly industrialising economy that also attracted labour away from the land. Even in this early period, Britain was a major food importer from Europe and the Americas. Disruption to trade during the Napoleonic Wars in the early 1800s resulted in high farm commodity prices that continued under the protection offered by the Corn Laws. These were repealed on grounds that they compromised the principles of free trade and comparative advantage and artificially kept food prices high for urban workers. British agriculture and the rural economy then entered the period known as the Great Agricultural Depression that lasted until the beginning of the 20th century and World War I. Once again, international conflict and trade disruption strengthened markets for UK farmers, but was followed in the 1920s by renewed competition from imports and then general economic depression. By the 1930s, British agriculture had experienced alternating periods of 'boom and bust', mainly as a result of widely fluctuating conditions on world markets, mostly associated with the consequences of international conflict.

The 1930s marked a major change in agricultural policy characterised by a period of recovery from depression. For example, the Land Drainage Act (1930), supported by grant aid, facilitated large-scale public works to improve agricultural productivity by alleviating flooding and establishing arterial drainage networks to evacuate excess water and control field water levels. Perhaps the most important government intervention was the establishment under the Agricultural Marketing Acts (1933) of producer-managed marketing boards that controlled production (areas and quantities) and prices for a range of commodities including milk, meat, eggs, cereals and potatoes. The Boards exercised a major influence on agricultural production and land use for over 50 years through to the 1980s. The War Years (1939–45) witnessed further public support for agriculture, as part of the war effort, with large areas converted from pasture to arable land as part of a programme of 'digging for victory'.

2.2.3 Establishment of the post-war land use patterns

By 1939 the town and country planning process had to mediate between conflicting pressures and expectations regarding land use change. Government responses tended to be related to the historical locations of services such as towns and cities within existing administrative boundaries. Urban areas adopted a proactive policy regime that sought to allow development opportunities but limit the possibility of urban sprawl into the surrounding countryside. Agricultural land and landscapes were protected from the expansion of towns. The urban and the rural began to be treated separately in the provision and implementation of land use policies[91]. They also reflected differing

91 Blacksell and Gilg (1981)

preferences towards either growth or anti-growth, apparent in the attitudes of different social groups. These tensions were compounded by new and continuing patterns of land use that tended to operate beyond administrative boundaries and the prevailing planning policy responses. As society and the economy changed, it became more difficult to find adequate and appropriate planning responses to changes in land use that integrated positively all the demands placed on it, both real and attitudinal.

The impact of World War II on the economy of the country and the need to rebuild towns and cities in the aftermath of war devastation necessitated a new central role for planning in coordinating land use change, improving economic growth and organising space. One-third of the total housing stock had been damaged or destroyed by enemy action, and other buildings such as factories, schools and hospitals had also been targeted. Many of Britain's cities had been blitzed.

The post-war government implemented a process of public ownership of services and industry and was committed to introducing a welfare state. The Bank of England, civil aviation, coal, transport, electricity, gas, and iron and steel were all nationalised, and a National Health Service was created to provide free health treatment. There was an urgent requirement to replace bomb-damaged homes and, between 1945 and 1951, over 1 million public sector (council) houses were built. In 1947, a new planning system was created with the introduction of the Town and Country Planning Act (1947), which allowed individual towns and cities to draw up development plans for their area, and local authorities to control new developments.

The UK post-war policy for land use was determined to a large extent by policy reviews which took place during the war years. The 1940 Barlow Report (on the Redistribution of the Industrial Population) led to an attempt to plan a more balanced distribution of the country's economic activity. The 1942 Uthwatt Report attempted to consider the financial problems of introducing more centralised forms of land use planning, while the Scott Committee on Land Utilisation in Rural Areas provided a guiding rationale for both the subsequent 1947 Agriculture Act and the 1949 National Parks and Access to the Countryside Act, with the establishment of the Nature Conservancy and National Parks Commission. Finally, the Reith Report reported on the need for new towns[92]. The wartime experience also assured the continuance of a post-war public estate (for the explicit purposes of forestry and defence), and the provision of financial support to both agricultural modernisation and the retention of farming in marginal areas (the hill cow and sheep subsidies, first introduced in the 1930s).

Urban and industrial development was to be mainly confined to predetermined geographical areas, most commonly around existing settlements, and specific policy initiatives would ensure the provision of adequate natural habitats to meet scientific objectives, and rights of way in areas of open countryside for the promotion of wider enjoyment by the general public. To a significant extent, this vision and its principal policy instruments were the dominant policy influences upon land use throughout the 1950s and 1960s, and continue to have a significant impact on aspects of policy towards land use today[93].

However, during the 1960s the negative impacts of some aspects of the policy framework had begun to be recognised. Between 1951 and 1969, real wages had risen by 55%, there was a reduction in the official working week, and affluence was

92 Hall (2002)

93 Kynaston (2009)

measured by the acquisition of consumer durables. By 1965, 88% of households possessed a television and 98% had refrigerators. The number of cars on Britain's roads increased from 2.25 million in 1951 to 8 million in 1964, and home ownership rates doubled during the same period[94]. The motorway network, planned and developed by the Government outside the new 1947 planning framework, created new conditions and contexts for development patterns that had localised effects and allowed people to live and work in different locations, thereby undermining some of the assumptions behind development planning. The rise of air travel and the expansion of airports led to major patterns of new growth in the urban periphery, not just for land for runways and terminal buildings but also for airport services and logistics[95].

Changing political attitudes towards central planning from the early 1950s led to the abolition of the financial controls intrinsic to the introduction of the comprehensive post-war planning system[96]. Socio-economic conditions and changing infrastructure needs began to outstrip the 1947-style development plans and their projections, leading them to be eclipsed[97]. Town planning was criticised for its over-optimism and its inability to update plans quickly, perhaps partly because the development plan visions were not realised in the way planners and people had imagined, and also because economic and social prosperity had been achieved beyond expectations[98].

Conflicts with other areas of policy increased during the 1960s. Advances in environmental and ecological science, as well as a perceived growing public demand for recreation and greater appreciation of the landscape, led to concern that intensification of land use, including agriculture, was not a benign process. An expanding population and preferences for country-living by a growing share of middle-income workers and managers, placed strains on processes to control local development and the nature of rural settlements.

Even under the relatively restrictive post-war regime, development outside urban centres continued but in planned locations. Growth around existing urban areas was supplemented by the creation of a series of 'new towns' on land that had previously been agricultural, in rural locations around England and Wales. But some policies for which there was often very strong local support, such as Green Belts around major conurbations, began to see creeping development on either side of these 'green bands', which were also cut through with major transport infrastructure (e.g. in the development of the M42 around Birmingham and, later, the M25 around London) [99]. In respect of the social impacts of post-war development, there was also growing criticism of the often poor quality of urban and peri-urban housing design and its impact upon communities[100].

In an attempt to provide more proactive processes for land use management change, further legislative changes to town and country planning occurred in the 1960s, with attempts to modernise and improve statutory development plans, the development of regional plans, the introduction of public consultation into planning for the first time, the promotion of corporate planning, and an attempt to reorganise the boundaries of

94 Starkie (1982)
95 Caruana and Simmons (2001)
96 Westergaard (1964)
97 Reade (1987)
98 Healey (1983)
99 Gallent and Tewdwr-Jones (2007)
100 Young and Wilmott (1957); Goodman (1972)

local government to reflect changing inter-urban social and economic trends[101]. The Government sought to address infrastructure issues through a policy of accommodating the rise in car ownership, leading to the introduction of transport planning and comprehensive redevelopment of towns and cities to remove the remaining slum housing, build high-rise flats and create urban motorways[102]. This policy, combined with the employment of modern architecture, had the effect of dramatically changing the physical appearance of urban areas[103].

Many of these features proved useful in combating land use conflicts and coping with evolving and fluid trends, but some were too ambitious in scope, and medium to long-term plans were often compromised by political arguments over housing numbers[104].

2.2.4 Changing patterns of employment locations: the 1970s onwards

In terms of the impact on the land caused by changes in employment, the decline in UK manufacturing reached its most extreme in older industrial regions in the 1970s[105]. A subsequent wave of industrial and service reorganisation led to movement of employment to the regions, to metropolitan cores outside London, and later to global locations. Critically, face-to-face activities continue to be concentrated, both in absolute and in relative terms, in London. The South East has had a massive effect on national labour markets as it has drawn in regional migrants[106]. London continues to be a net beneficiary of the regions, and international migration. Migration has mainly focused on metropolitan centres, and London in particular[107].

At an aggregate level, the UK population has become wealthier, although social and spatial distribution of wealth is little changed[108]. Thus, the population has more disposable income and this has in turn had major impacts on other sectors, notably a growth in retailing and personal transport. The number of cars on the roads has increased dramatically, creating pressures on transport infrastructure and a massive modal split in favour of the car[109].

Interwoven in this process has been the reorganisation of retailing and distribution[110]. The first supermarkets appeared in the 1960s and out-of-town superstores, located at edge-of-centre locations and at major road intersections, arrived in the 1980s. Big-box retailers have been facilitated by changes in logistics; namely, as in manufacture, the adoption of just-in-time systems and regional and national warehouse hubs. In spatial terms this has led to the progressive abandonment of city centre locations, first of 'big-box' goods, then of major city centre retail stores. In part, this has led to a further 'hollowing out' of city centres, and pressure on motorway intersections to take on the role of new employment hubs. Both processes have created new challenges for the land use system that have emerged in the last 25 years as a consequence of taking policy decisions in other areas[111].

101 Cullingworth and Nadin (2006)
102 Buchanan (1963); Bruton (1974)
103 Bullock (2002)
104 Holmans (1987); Reade (1987)
105 Goddard and Champion (1983)
106 Fielding (1989)
107 ER: 21 (Appendix B refers)
108 Dorling and Thomas (2004)
109 Vigar (2002)
110 Fernie (1997)
111 Guy (2006)

On a national scale, warehouse development has been concentrated in the main English motorway corridors and strategic hubs such as London, Bristol, Leeds and Manchester since the 1970s. These developments have occurred despite the continued existence of elements of a post-war policy regime aimed at urban containment, greenbelt protection and a concentration of services. London is one of the main centres for warehousing development in the UK and has approximately 10.5% of total warehouse floor space in England and Wales[112]. More recently, the focus for logistical and distribution services has been towards the provision of intermodal freight terminal, large hard-standing areas adjacent to rail sidings for short-term holding and transhipment of intermodal units[113]. These terminals are also becoming a strategic location for distribution centres, receiving and despatching a proportion of their throughput by rail. Several of the intermodal terminals were set up in the early 1990s to handle Channel Tunnel freight traffic at places such as Daventry, Wakefield, Trafford Park and Mossend near Glasgow.

During the 1980s, large parts of the planning process were deregulated in favour of the market[114]. The state's role in strategic planning and regulating land was rolled back in favour of employment creation and enterprise, with the provision of enterprise zones and urban development corporations to regenerate inner city areas but led by business interests rather than local authorities. The planning system was amended to permit out-of-town shopping centres and housing developments on the urban fringe and any other employment-generating activities as a way to combat high unemployment[115]. The pattern of housing and retailing consequently changed in the 1980s and 1990s to allow a more flexible approach to the provision of developments. This process continued through the 1990s and 2000s but has been accompanied by greater environmental awareness and commitments, a return of some authority to local government and statutory planning, and enhanced interest in achieving urban sustainability[116].

Since the mid-1990s, in the light of growing concerns of towns and cities to compete with new out-of-town and retail warehouse development at major suburban road intersections or on the urban fringe, there have been attempts to revive towns and cities with a relaxation of regulatory controls in favour of 'mixed land uses'[117]. Planning responses have attempted to bring employment back into towns and city centres through the provision of new retail spaces, cafes and restaurants, leisure and tourism developments, and new residential apartments as part of an urban renaissance[118]. This policy has also attempted to respond to desires for economic development within urban areas, but additionally has improved the urban design quality of public places and cities[119]. A net effect of this has been a replacement of inner city manufacturing with (mainly) single-person housing, reflecting demographic trends towards smaller households.

112 Brown (1990)
113 Lowe (2005)
114 Thornley (1991)
115 Allmendinger and Thomas (1998)
116 Tewdwr-Jones (2002)
117 Evans and Foord (2007)
118 Urban Task Force (1999)
119 Carmona et al. (2005)

2.2.5 Changing patterns of housing demand and development

During the last 60 years, housing has been under extreme pressures at a regional scale, and within London in particular. However, it is important to note the structural changes in housing supply, namely the shift from public to private, and from rental to ownership. Whereas the state was able to manage labour supply and minimise transport problems through housing supply in the post-war period, this is no longer possible[120]. Rates of employment participation have changed in concert with rising house prices (especially in the South East). Thus, households increasingly require multiple incomes to sustain home ownership. In practice, the turnover rate for jobs and locations means that home and work have little relationship, aside from the use of a car to mediate it. New build housing has fallen below demand, in part due to lack of building land, especially in London. These processes have been mixed with social change that has, alongside female participation in the workforce, and multi-earner households, included smaller family sizes, the end of extended families and the rise of single-person dwellings. In short, the existing building stock is asynchronous with demand. Furthermore, over the last 50 years people have sought to have more space in their homes. Of course, all of these issues have a regional dimension; these trends are led by London and the South East, but by no means confined to it. Moreover, there is considerable vacancy and oversupply of housing in the North of England.

The evolving pattern of residential development observable in the UK today is, in large part, the product of the planning process. This process has been underpinned by a specific means of predicting growth. These predictions have been derived from trend-based population projections. Because the projections 'build upon' the current population distribution (and therefore use the prevailing distribution of physical development as a spatial reference), they invariably reinforce existing patterns of concentration (but also reflect the 'spatial fixity' of past development). The biggest in situ growth is always in those regions – especially the South East or the West Midlands – which are already built-up or which will be the potential recipients of overspill, including London's regional neighbours[121].

The key references for these trend-based projections are long-term, established patterns of population change: those deemed to provide a reliable basis for future planning. Less credence is given to short-term patterns. This trend-based approach to projecting future change fits well with the broad rationale for planning that has evolved during the 20th century. Essentially, existing urban areas are viewed as the most suitable recipients of future development, while development in rural areas is seen as broadly undesirable, in line with the pre-war policy regime of urban containment and countryside protection[122].

While there has been a strong tendency for development to be concentrated within urban areas, development has not been entirely confined to existing footprints or to existing urban areas over recent years. However, London's Green Belt has restricted such development around the capital, and another Green Belt has had a similar effect around Birmingham. But 'belts' of greenfield development are also identifiable between West Yorkshire and the West Midlands, within the Mersey Belt and in the North East. These areas have not been no-go areas for development but have rather created a

120 Gallent and Tewdwr-Jones (2007)

121 Abram and Murdoch (2002)

122 Gilg (1996)

presumption against new building; arguably they have also caused development to leap-frog the Green Belt into towns much further afield from the metropolitan area[123].

2.2.6 Changing agricultural trends

In the immediate post-1945 period, as food rationing continued, there were clear priorities for domestic food production. The 1947 Agriculture Act promoted 'efficient' agriculture to maximise production, minimise imports and ensure cheap food. 'Deficiency payments' were made to farmers when prices fell below guaranteed levels; fertiliser subsidies, ploughing grants and capital grants for improvement of farm assets, including field drainage, were introduced to ensure food supply at reasonable prices and to provide fair rewards to farmers. The National Agricultural Advisory Service was established in 1948 to provide technical assistance to enhance farming productivity.

In 1973, the UK joined the European Economic Community (EEC) and the UK Government's 1975 White Paper 'Food from Our Own Resources'[124] continued to emphasise agriculture's import-saving role. Since joining the EEC, now the European Union (EU), UK agricultural policy has primarily been determined by the European Common Agricultural Policy (CAP). While the CAP covers the key agricultural commodities, it does not apply to the poultry, pig, egg and horticultural sectors as agricultural policy had previously in the UK.

As with previous national UK policy, the CAP was devised to increase agricultural productivity, stabilise markets, assure the availability of reasonably-priced food, and ensure a fair standard of living for all those involved in farming. These objectives were largely met by the support of internal prices and incomes, through direct market intervention, and through border protection by imposing tariffs or levies on food imports.

The 1980s and 1990s were characterised by structural adjustment in agriculture in the face of concerns about environmental damage, over-production and excessive costs of agricultural subsidies. By 1984, the surplus production of milk led to the introduction of marketable milk quotas. This placed a ceiling on growth in national milk production but individual farmers could expand their production by purchasing quotas from farmers who were reducing their milk output. In 1992, the MacSharry Reforms of the CAP led to constraints being placed on beef and sheep sectors with 'compensation payments' being subject to regional ceilings and maximum stocking rates. At the same time 'compensation payments' in the arable crop sector required the compulsory withdrawal (or setting-aside) of up to 10% of arable land from arable production, reaching almost 740,000 ha in 1995 (see Table 2.3). By contrast, at the same time the EU was still importing large quantities of vegetable oil and vegetable protein. Therefore, the CAP reforms created additional incentives for farmers to grow oilseed and protein-rich crops, such as oilseed rape, linseed and pea and bean crops.

123 Elson, M. (1986); Selman (2006)
124 HMSO (1975)

Table 2.3: Uncropped land ('000 ha) in the UK from 1985 to 2008

	1985	1990	1995	2000	2008
Bare fallow	41	68	43	37	195
Set-aside	0	72	734	495	0
Total uncropped	41	140	777	532	195
Farm woodland	–	–	–	500	750

Source: MAFF (1989); Defra (2008).

During the 1970s and 1980s, numerous commentators highlighted the negative environmental effects of intensive farming methods associated with loss of habitats and wildlife, soil erosion and water pollution. In response, the European Community accepted the concept of Environmentally Sensitive Areas in 1985, and a broad suite of 'accompanying measures' was introduced in the CAP reform of 1992 to promote the agri-environment and farm woodlands. The current post-2000 agricultural reform period witnessed major changes in farm income support, and measures to enhance environmental stewardship, including restoration of floodplain habitats, the protection of soils and the improvement of water quality.

Through a range of schemes, participating farmers were paid for managing a proportion of their land to produce wider ecosystem services, other than food. This included support for farmers to move land from productive agriculture into management practices that supported local biodiversity, such as the Environmentally Sensitive Areas (ESA) and Countryside Stewardship (CS) schemes. Incentives were also offered for farmers to switch to organic systems, and for the afforestation of agricultural land through initiatives such as the Farm Woodland Scheme (FWS), Woodland Grant Scheme (WGS), Farm Woodland Premium Scheme (FWPS) and English Woodland Grant Scheme (EWGS).

Since 2000, EU support for the rural sector has been delivered through two main mechanisms: 'Pillar I' involves support for agriculture and 'Pillar II' support for rural development, including agri-environmental interventions. In 2003, the CAP reformed key agricultural subsidies under Pillar I[125]. Decoupled direct payments, while not linked to a particular type of production, required 'cross-compliance', adherence to EU environmental, food safety, animal welfare standards and regulations, and the need to keep farmland in 'Good Agricultural and Environmental Condition'. This is partly defined at a national level, and includes soil protection, maintenance of soil organic matter and soil structure, and maintenance of habitats and the landscape. Agricultural commodity prices for some agricultural products in the UK, are now largely determined by world market conditions, and farm and rural income support is largely decoupled from farm production levels.

Pillar II of the CAP relating to rural development includes agri-environment and afforestation measures. Since 2005, in England the agri-environment measures include 'Environmental Stewardship', which is steadily replacing the ESA and CS schemes. Total land area under agri-environmental schemes in the UK was about 8 million hectares, compared with only 175,000 hectares in 1992. In England, in 2009, over 6 million hectares were covered by agri-environment agreements, covering 66% of the utilisable agricultural area, involving payments of £360 million per annum (see Box 3.2).

125 Such as the Arable Area Payment and the Beef and Sheep Premiums in England, which were linked to production with a Single Farm Payment (SFP)

Over time, the proportion of total agricultural funding allocated to the Single Farm Payment is being reduced by the 'modulation' of funds to the rural development measures, from Pillar I to II. Farmers are now paid to manage their land according to a set of rules, regardless of what or how much is produced on-farm. This clearly marks a shift in public financial support from production of food and fibre to the conservation of natural resources and the environment.

2.2.7 Dealing with uncertainty and fragmentation

Historically, land use management has focused on containment of urbanisation, suburbanisation and urban sprawl. Since the 1980s, new patterns of urbanisation (which has often been located at the urban edge, in peri-urban or fringe locations), mean land use management is also now concerned with externalities arising from 'polycentricity'[126]. This means that each urban location (whether it is a city, town or even a motorway intersection) competes for development, services and infrastructure, and caters for externalities caused by changing living, commuting and migrating patterns, technological change and new faster transport links[127].

The UK has largely been successful in containing urban development, but market pressures and changing socio-economic conditions are beginning to 'out-manoeuvre' the principles and practices built on historical perspectives of managing development[128]. The processes of governance, divided between various agents and strategies, have difficulty in anticipating change and the consequences of change over shorter time periods, as well as collecting the right evidence base, causing perceptions that the processes themselves are inadequate, slow, and bureaucratic or fail to respond to market drivers.

Even if individual land parcels are under single ownership, the responsibility for managing change on land may reside with a number of different agencies, reflecting a shift from government to governance over the last 25 years[129]. Much urban land is now managed by a range of quasi-public, private or market-led management and delivery mechanisms, such as development corporations, enterprise zones and business improvement districts. These sit alongside the local authority planning mechanisms, which mean attitudes towards how urban land should be managed and developed or protected strategically cannot be coordinated with ease because of conflicting interests[130].

To ensure land use matters are addressed consistently, the Government has released a series of national Planning Policy Statements (PPS) and Minerals Planning Statements (MPS) since the late 1980s (there are separate versions in Scotland and Wales). These are prepared by Government after public consultation to explain statutory provisions and provide guidance to local authorities and others on planning policy and the operation of the planning system. They also explain the relationship between planning policies and other policies which have an important bearing on issues of development and land use. Local authorities must take their contents into account in preparing plans, and the content may also be relevant to decisions on individual planning applications and appeals.

126 Hall and Pain (2006)
127 Gallent et al. (2006)
128 Tewdwr-Jones (2008)
129 Bevir and Rhodes (2006)
130 Cochrane (2007)

These statements do not provide overarching statements on issues of national importance, but rather guide local planning decisions on what considerations to take into account when assessing policy options and development decisions for predominantly local matters.

Since 2009, under the provisions of the Planning Act 2008, the Government has also commenced consulting upon and releasing separate National Policy Statements (NPS). The NPS are intended to become the primary policy document for the Infrastructure Planning Commission and other relevant parties in the assessment of applications for projects of major significance. At the time of writing (February 2010), two draft NPS have been released: 'Ports' by the Department for Transport, and 'Energy' by the Department of Energy and Climate Change.

2.2.8 Governing land use

Despite changing immensely since the early years of the 20th century, the planning system today provides valuable democratic forums for the public to express a voice in change in their surroundings. However, the last 40 years has witnessed society becoming increasingly pluralist, with a concomitant shift from representative government to participatory governance, enhanced public participation and involvement mechanisms in policy development, and enhanced vocal rights within decision-making structures[131]. There have also been increasing opportunities within government and governance to challenge, protest legitimately, appeal, and seek legal redress within the formal decision-taking processes regarding land and property interests[132].

How the pressures on land are managed is also affected by uncertainty in ownership of responsibility for decisions, and at what scale of policy-making. Land use management is increasingly complex and there are now important distinctions and tensions between land use planning operating as a set of governmental, public, private and participatory processes. There is also a distinction to be made between land use planning policy, planning regulation and spatial planning. In addition, there are overlapping relationships, interlocking and co-dependencies between land use commitments at European, UK, devolved administration, regional, sub/city-regional and local levels of government and policy-making, each with its own planning level and degree of discretionary judgement[133].

Land use planning, for example, has been broadened in scope over the last 15 years beyond its regulatory role into three tasks, as:

- A facilitator and regulator on a host of measures.
- A coordinating or choreographic tool for regional and local public bodies.
- An access point for wider stakeholders to become involved, not only in planning but also in local and regional governance and strategy-making.

Managing land use change in England appears to be fragmented in ways that suggest both continuity with the past (dealing with planning applications through development control, for example) and changed requirements of the 21st century (spatial planning that emphasises public participation, place shaping and wellbeing agendas). The

131 Healey (1997)

132 Webster and Lai (2005)

133 Tewdwr-Jones and Allmendinger (2006)

problems with these emerging forms of managing land use change and their interrelationships rest on a number of core issues, the most prominent of which concerns the rights and responsibilities of national governments to shape and resolve nationally significant issues. Within a changed government structure that emphasises devolved, regional and local governance, how can the UK Government lead the management process(es) to assist in action on national land use priorities? The provision of national infrastructure is a good example of where new management processes are needed to deal with so-called 'wicked problems'. Under the provisions of the Planning Act 2008, the Government has established the 'Infrastructure Planning Commission' to determine development projects of major national and regional significance. However, the principle applies equally well to questions of national policy on a range of land use issues and the means whereby this filters down to other layers of policy and decision-making that are based on enhanced local and regional participation, discretion and subsidiarity[134].

2.2.9 Coping with disjointed governance

A further problem concerns the relationship between statutory planning and environmental protection. These are separate legal disciplines and are governed by distinct legislation. Questions of sustainable development and climate change tend to fall between the two areas because of the legislative separation. The Government provides planning policy guidance on issues such as flood risk and climate change, but these are policy advisory tools, and take their place alongside a range of other policy advice issued by government on such matters as infrastructure provision, housing development, retail change and economic development. In many ways, this is the crux of the problem; over decades, decisions at the local level need to take account of a range of national policy statements in formulating strategies, but with little guidance on which issues take priority. Similarly, imposing a direction in a particular substantive policy could be seen as riding roughshod over other democratically elected tiers, an issue made even sharper as mechanisms for land use change have embraced stakeholder participation at the grassroots level.

A final tension concerns the relationship between the formal land use planning system (government policy-making at all tiers, and their associated plans and strategies) and other governance or delivery bodies. This is especially so in urban areas or where governments have created new delivery mechanisms in specifically targeted areas that stand outside the formal planning tools to provide expedited arrangements for change. Examples include the new towns, urban development corporations, enterprise zones, urban regeneration companies and business improvement districts. As a consequence, since they are outside the planning system, there is a danger that these governance bodies fail to address the broader policy issues that planning authorities are required to consider (e.g. sustainable development or climate change).

134 Tewdwr-Jones (2002)

There is also the danger that these new delivery mechanisms create different types of land use management processes, leading to a patchwork of governance systems that citizens and businesses may not be able to identify with. Some of these processes are shaped and led locally, but others are established nationally, regionally, or sub-regionally. The result of this patchwork system is a multitude of governance mechanisms that frequently lead to local contentions over who should set visions and directions for change, and which set of political priorities should prevail. To manage this fragmentation and disjointed set of arrangements, the term 'spatial planning' was devised to describe the process of balancing and integrating the various competing aims and policies[135].

Since 2000, significant changes have been legislated for to manage this fragmented governmental structure. The Planning Green Paper of 2001 and the subsequent Planning and Compulsory Purchase Act (2004) created a new planning process with new types of strategies and development documents ('Regional Spatial Strategies' and 'Local Development Frameworks'); these will be prepared by regional and local planning authorities and will act as overarching strategic documents. Local government legislation also created 'Sustainable Community Strategies (SCS)', intended to set the overall strategic direction and long-term vision for the economic, social and environmental wellbeing of a local area – typically 10–20 years – in a way that contributes to sustainable development in the UK. SCSs tell the 'story of the place' – the distinctive vision and ambition of the area, backed by clear evidence and analysis. The Local Government Act 2000 charged local authorities with preparing a local community strategy with their partners in the Local Strategic Partnership (LSP). The LSP brings together at a local level the different parts of the public sector as well as the private, business, community and voluntary sectors so that different initiatives and services support each other and work together. It is a non-statutory partnership which provides a single overarching local coordination framework within which other partnerships can operate. LSPs are tasked with preparing the Sustainable Community Strategies and it is from these that Local Area Agreements (LAA) are developed that pool public spending budgets in each local area.

Since 2004, the Sustainable Community Strategy takes primacy over the content and shape of Local Development Frameworks (LDFs), meaning that the uniqueness of place, its range of services and the objective of wellbeing are placed as primary considerations in the preparation of the local planning document of the local planning authority. The planning framework also has to identify and release the land for a range of public services, based on evidence gathered as part of the LSP's work. This also relates to the need for and delivery of infrastructure. Local 'Infrastructure Delivery Plans' set out infrastructure and asset management of places. They possess a 15 year timeframe and are dependent on agreed partnership and courses of action through the SCS and the LDF. For some issues of more than local importance, sub-regions are becoming more important, with new initiatives being rolled out to generate cross-agency and cross-boundary working and the pooling of resources, including Multi-Area Agreements and city regions. In the last five years, local planning authorities have also been required by central government policy to establish 'local landowners' forums' to consider land, planning and infrastructure issues.

These initiatives are intended to address the fragmentation of policy and delivery in local areas and to match up place needs and assets with infrastructure provision over a long-term basis, resting on the support and involvement of a range of delivery bodies. Since the Local Government and Public Involvement in Health Act 2007, a range of

135 Davoudi and Strange (2008); Morphet et al. (2007)

public bodies now have a statutory duty to cooperate with each other and consult, and integrate the evidence bases. This is occurring presently but is at an early stage in the legislative period. Furthermore, under the provisions of the Local Democracy, Economic Development and Construction Act 2009, Regional Spatial Strategies are being abolished and replaced with integrated Regional Strategies that combine the regional spatial planning focus with the economic strategies of the Regional Development Agencies. This is part of a process intended to simplify governance processes and streamline the delivery of strategies. More recently, to consider aspects of places and the place-shaping agenda, the Government has announced a pilot 'Total Place' initiative: a 'whole area' approach to public services intended to lead to better services at less cost. This seeks to identify and avoid overlap and duplication between organisations operating in the same place with the intention to deliver a step change in both service improvement and efficiency at the local level.

Significant 'big solution' interventions in land use problems have been introduced historically, for example, motorways, nuclear power stations, and high rise housing. However, land use change in the latter half of the 20th century can be characterised as 'incremental' and increasingly participatory. This presents governance challenges in terms of societal constraints on implementation, resistance to change, and conflicting policies that seek to achieve consensus across and between tiers of governance. As governance has promoted and introduced new forms of locally based participation mechanisms, policy fora and spatial planning, the tension has grown between privatised and decentralised decision-making with the promotion of collective action and need.

2.2.10 Conclusions from historical perspectives

There can be little doubt that the purpose of managing the land use system has broadened substantially over the last 60 years. In the post-war period, the emphasis was on rebuilding cities and the economy, decentralising population from overcrowded and bomb-damaged inner city areas, preventing urban sprawl, providing sufficient quantity of housing, and controlling new development.

The purpose of managing land use change in 1947 was:

- Ensuring equality of opportunity, prosperity and standards.
- Getting urban areas into shape.
- Ensuring a sufficient and economic transport system for people and goods.
- Conserving natural resources.
- Conserving the nation's heritage.

This purpose took root in the 1940s when increasing centralisation of decision-making, and the wartime task had brought the desire for more management and control to a head. But it was the need to tackle the economic and social conditions within a strong regional and national planning framework that catalysed formal land use planning. Gaps in this system opened up in the 1960s and 1970s, particularly in relation to authoritarian prescriptions (which were increasingly questioned), and community needs leading to a variety of planning styles and local responses.

The changing patterns of development caused by socio-economic drivers as well as international trade and transportation needs challenged the post-war policy framework for the management of land use. Many of the purposes of the late 1940s remain in place, but have been accompanied increasingly by policies such as those which have sought to address other emerging land use problems. These policies, which sit alongside policies to promote economic growth and infrastructure services outside existing urban settlements, challenge the way land use has been approached and may also be seen to cloud the governmental and policy mechanisms used to manage land.

Planning remains one of the mechanisms that used to manage land use change but one that has been transformed by the market and a more pluralist state. Over the last 20 years, there has been a greater reliance on 'framework approaches' in policy, coupled with devolution in the detailed design and implementation of policy instruments. Increasingly, the process of land use planning and management has become one of stakeholder partnerships being used to help set and oversee strategic directions in policy, with the Government as an enabler in that process.

Aspects of the policy regime intended to facilitate the management of land use change emanate from the post-war years. Other policies have emerged incrementally over time in response to emerging problems, or because the original policies created new patterns of land use problems and behaviour that, in turn, require new responses. These drivers of change have generated a mix of complex and sector-specific policy frameworks that may not provide the necessary strategic direction for the land or may be ill-suited to challenges for land use in the 21st century.

The key messages on the historical and future drivers of land use change are:

- Historical policy responses to understanding and managing land use change have occurred within existing administrative governmental structures and specific policy sectors; they have created legacies for current and future forms of decision-making in land use.
- Land use policies have attempted to shape and channel conflicting demands on the land through the adoption of a balanced approach to growth and protection interests, but have also created uncertainty.
- Policies that are sector specific, or only deal with specific types of land use, such as 'urban' or 'rural', are often unable to consider the broader consequences of those policies for other types of land use.
- The historical separation of rural and urban areas is becoming less clear cut.
- Long-term policy responses to changes in land use have been mirrored by the emergence of incremental policy responses over time that build up the policy framework in geographically distinct areas, leading to further uncertainty for land users.
- Changes in societal patterns and behaviour and in economic patterns of development and growth often transcend existing administrative, governmental and planning boundaries; the policy process can often be reactive.
- Fragmented and duplicated governance processes in the same place are being addressed through recent legislative and policy changes in order to take account of, and build upon, 'unique places'.
- An overarching higher tier response is needed to integrate the demands on land and the mix of historical and incremental policy responses; this should recognise the suitability and capacity of land in specific areas for particular purposes.

- Policies to address land use challenges of London have had a significant impact on the South East region and the rest of the UK, but have often been developed in isolation from wider geographical and governmental policy and decision-making bodies.


HOUSING
SUSTAINABILITY
WATER
HISTORY
PROSPERITY
ENERGY
AGRICULTURE
HOUSING
ECOSYSTEMS
PEOPLE
FLOOD
RISK
HOUSING
GOVERNANCE
ENERGY
PEOPLE
CONSERVATION
WATER
FORESTRY
SUSTAINABILITY
PEOPLE
AGRICULTURE
TRANSPORT
WELLBEING
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RECREATION
TRANSPORT
PROSPERITY
WELLBEING
FORESTRY

3 The value of land and the framework for land use decisions

How land is valued, both by society and by governments, is fundamentally linked to the process for making decisions on land use. Both of these, and their relationship, are the subject of this chapter.

Economic and non-economic valuation are discussed, and their strengths and weaknesses compared for different land uses. In so doing, the case is made for building upon existing valuation methods by improving and combining different approaches.

3 The value of land and the framework for land use decisions

3.1 Introduction

Land, the terrestrial surface area, is a finite naturally occurring resource. From a human perspective it is valuable because it has potential to provide a diverse range of benefits to people and communities, now and into the future.

There are competing demands for the use of the limited stock of land, and for the services it provides. A better understanding of how land contributes to prosperity and wellbeing can help guide how best to use the limited land resources available, and whether changes in land use or land management are desirable. For the most part, land is privately owned, although most changes to or in non-agricultural use require planning permission, and are therefore subject to public control. Private property rights are well entrenched in law[136], so that changing the way land is used requires careful thought as to how best to achieve any desired changes.

This chapter examines the conceptual framework for making decisions about land use, including the design of policies that affect it. It also explores the valuation of the services land provides in different uses. It starts by recognising the importance and complexity of the relationship between people and land, and how this can vary considerably between different social groups, situations and over time.

The chapter then argues, in line with the Government's *Green Book on Appraisal and Evaluation*[137], that decisions on land use should reflect the balance of costs and benefits associated with different possible land uses and changes in use, and it is this balance that determines the value of land in different uses. In practice, not all of these costs and benefits can be measured precisely, still less expressed in monetary terms. It is important, however, that they are broadly defined so that the concept of value provides a comprehensive measure of the social, economic and environmental benefits that land provides.

The ecosystems approach provides a useful framework to represent and attempt to value the diversity of potential benefits from land use, but the key requirement is that the approach should be comprehensive. Drawing on evidence, examples of valuation are explored that indicate some of the challenges involved, highlighting especially the failure of existing market arrangements and systems of governance to accommodate values adequately, and the implications of this for the future.

Valuing the broad range of land services and how they interrelate is a first step. These values must be captured and embedded in decision-making processes and policies if land use is to be efficient, just and sustainable over the long term.

136 ER: 25 (Appendix B refers)
137 HMT (2003)

3.2 Society's attitudes and values towards land and landscape

The relationship between society, land and landscape is deeply complex[138]. Attitudes and values are reflected in behaviour, notably patterns of consumption through home ownership and recreational activity, as well as in expressed preferences. Society attaches great importance to land, even though a relatively small proportion of people own or actively manage land outside their homes. The vast majority of the public in the UK have become increasingly separated from direct involvement with the land. However, a significant and growing proportion of the population engages directly with land through gardening and involvement in the management of allotments, community gardens and other public spaces.

In terms of rural land, people attach value to it, not as land itself but as landscape, nature or other 'constructs' such as place, environment and countryside. Society's attitudes and preferences concerning land have traditionally been dominated by expert or professional views rather than those of the wider public. Expert and professional attitudes have progressed from an early emphasis on judgements of natural beauty to the development of more transparent criteria to judge the importance of landscape and, more recently, to a growing emphasis on understanding the character and distinctiveness of all landscapes. This change has seen increasing recognition of the value of 'the rest' as well as 'the best' – the wider everyday landscape as well as the special and the designated.

Although historically the emphasis has been on rural landscapes, there has been an upsurge in concern for green space in and around urban areas, including the development of green infrastructure. The attitudes of the general public indicate that over half of people think that the countryside is crucial or very important to their quality of life. Two-thirds think it is important to have green space nearby and the majority think parks and public spaces improve quality of life. It is also the case that many people in England think that land is much more occupied by urban development than it really is[139].

Public attitudes are shaped by a number of different factors. Age, social and economic status, ethnic origin, familiarity, and place of upbringing and residence (particularly whether urban or rural), are especially significant. Perhaps most important are environmental value orientations. At present, society seems to be polarised. At one end of the spectrum are older, relatively affluent, well educated, environmentally aware people, often in social grades AB, who are often the most active users of the countryside and green spaces. In contrast, younger age groups, ethnic minorities, and those who are in the DE social grades, are often far less engaged.

These various groups have very different values and attitudes. But most people need to access and enjoy different types of landscape at different times and for different purposes, accessing what has been called a 'portfolio of places' that is particular to each person. However, it is by no means clear how the various factors that influence people's attitudes and preferences will play out in the future. Society may continue to become more detached from nature and landscape, and less caring about its future. Or there could be a rekindling of a need to engage with the land and an increased desire to ensure that all sectors of society can benefit from green spaces and rural landscapes. This is likely to require interventions through education and campaigns to change attitudes and behaviour. Whether such initiatives can be effective in the face of competing drivers of

138 ER: 12 (Appendix B refers), ER: 13 (Appendix B refers)

139 Barker (2006), chapter 2, p20

attitudinal and behavioural change, and over what timescale, may well determine how society's relationships with land and landscape evolve over the next 50 years.

The complexity of the attitudes, preferences and values that people hold towards land can pose problems in applying valuation techniques to land use decision-making. The remainder of this chapter discusses approaches to valuation. Some[140] have reservations about whether purely economic techniques can fully capture the diversity of values that people hold, and research[141] has suggested that people want to contribute meaningfully to decisions concerning their local natural environment. They would prefer to do so collectively rather than as isolated individuals, and in forums where they can deliberate issues such as standards, equity, rights and responsibilities, and in this way complement the role that economic value should play in determining decisions. The role of deliberative decision-making is discussed in a later section of this chapter.

3.3 The land value system and the approach to decisions

The land system is complex (see Figure 3.1)[142]. Land is imbued with inherent characteristics derived from natural processes associated with soils, topography, altitude, hydrology, and living systems. From a human perspective, it is the way that land, along with other resources such as physical infrastructure, technology and human knowledge, can be used to provide a range of benefits for people and communities that makes it particularly valuable.

In a well-functioning competitive market, value can be measured using prices determined in that market by willing buyers and sellers. The market itself will generate outcomes that fully reflect the preferences of the individuals affected. However, the land market does not conform to this idealised paradigm. There are various *market failures* which mean that, left unaided, the land market would be unlikely to generate outcomes that are acceptable. This is because land use generates some costs and benefits that are not captured by any market, affecting not just the owners of the land but also the wider community, ecosystems and the environment. These market failures, when sufficiently important, provide the justification for intervention by the Government, through regulation or other means, to produce more acceptable outcomes. In this case, the aim is to realise the best value from the land after all the non-market impacts, positive and negative, are taken into account. In practice, however, this is by no means guaranteed because of possible failures in the governance system – *institutional failures*.

The systems diagram (Figure 3.2) demonstrates how land provides a wide range of economic, social and environmental benefits that support human wellbeing. But some uses of land can impose costs on people and the environment. The value of land is the value of the flow of all these benefits *less* the costs incurred and imposed.

Some of the benefits and costs are obvious and are represented in market prices for land – reflecting, for example, the value of crops it can produce or the value of houses that can be built in a particular locality. Some are much less obvious, such as the services of land in the regulation of water flows, which otherwise would cause flooding of crops and houses located elsewhere, or the costs of using farming methods that pollute the water bodies.

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140 See Dis:14 (Appendix B refers)

141 Clark et al. (2000)

142 The systems maps are illustrative ways of displaying complex information. Whilst some may dispute the detail, their value is added through being able to display complex systems in a visually simple manner. A catalogue of all the Project's system maps has been published (Appendix B refers).

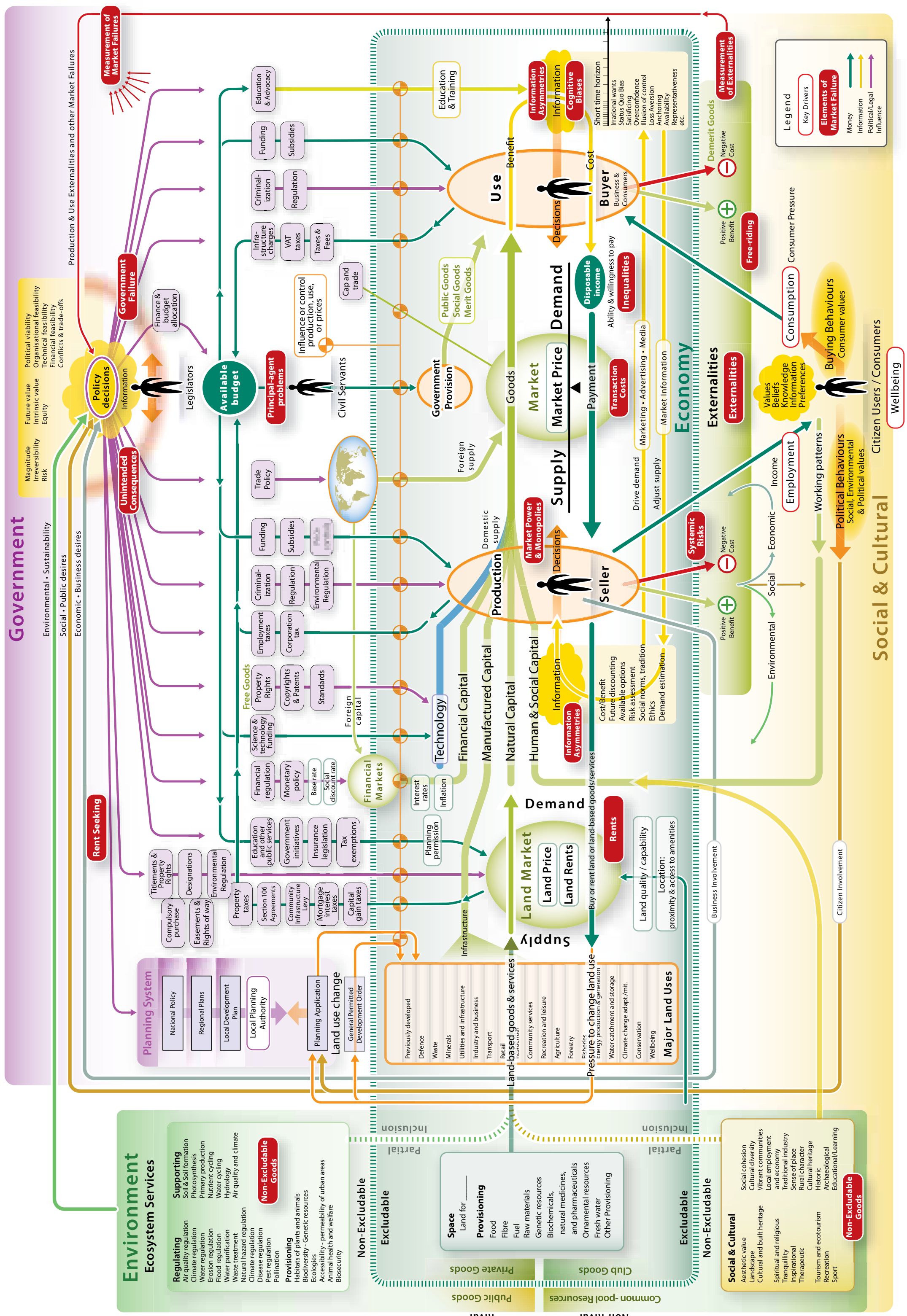
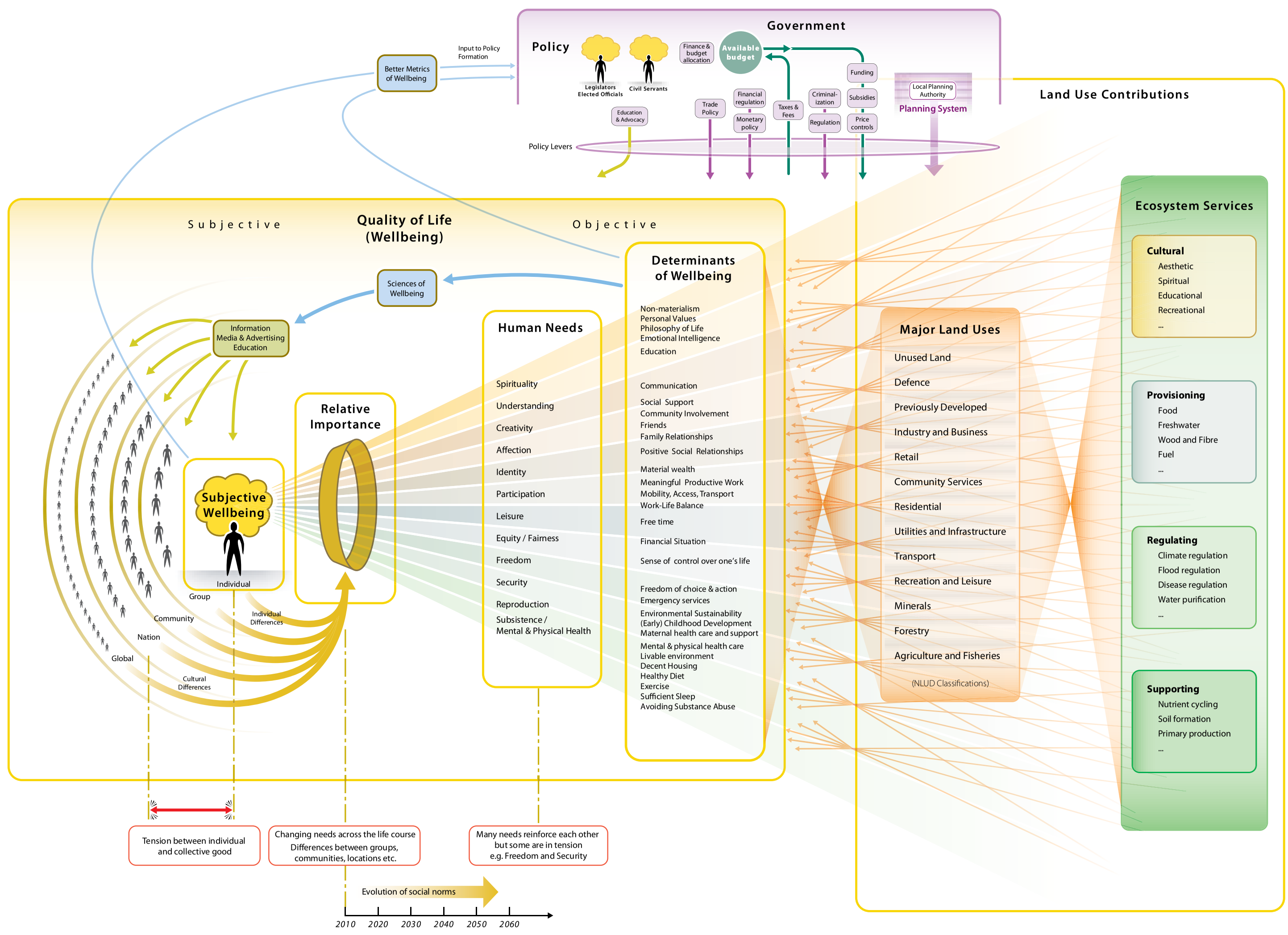


Figure 3.1: Land system valuation diagram

Figure 3.2: Land and wellbeing systems map



3.4 Concepts of value

3.4.1 What is value and how does land create it?

From a human perspective, value implies worth and utility. The presence and use of land has potential to add value and create wellbeing for society – it has 'instrumental' value. It is meaningless to attempt to measure the total value of land services, since it is impossible to imagine living without land, and in any case it is unnecessary. The choices to be made involve changing the use of land, and it is the value created or destroyed in such changes that is relevant.

From an economic perspective, in deciding how much land to reallocate from one use to another, it is the 'marginal' social value (that is, the value of changing the last hectare or square metre) that matters. In this context, 'social' is shorthand for the inclusive measure of value that includes the impacts on everyone whose welfare is affected, directly or indirectly. Generally, the scarcer the resource and the services it provides, the greater the gain or loss in value when that resource is increased or reduced. As the supply of land for a particular use falls increasingly short of demand or need, so we would expect its marginal value in this use to increase. The central question is: how could changes in the use of particular pieces of land and associated services enhance welfare? If no improvements are possible for a land use, then that use is the best possible; otherwise changes are potentially desirable.

It is, however, important to distinguish between value and values, and between value and prices.

3.4.2 Values

Whereas value implies worth, 'values' imply a broad set of principles and preferences that underpin the attitudes and behaviour of people and communities. Values shape preferences and hence the relative value given, for example, to private versus public space, to wild or managed landscapes, and to local or regional identity. Land and its associated inherent natural properties, such as coastal or floodplain ecosystems, may have 'intrinsic' value in themselves, for their own sake, independent of any human perception of value. These 'intrinsic' values shape a moral obligation felt by humans to protect other living systems and their habitats from damage or extinction. Intrinsic and instrumental values associated with land are difficult to disentangle. Both may be important for making decisions on land use, but intrinsic value is especially difficult to define and measure.

The relationship between land and people is central to establishing societal values, as it is people who must make decisions on alternative land uses. And yet it is a common source of tension, especially when there are trade-offs between different sources of value. Rapid changes in land use driven by pursuit of commercial gain, such as urban development or intensive farming, may jeopardise other sources of value, such as amenity, ecosystem resilience and environmental quality. Conversely, changes in livelihoods, lifestyles and values may expose the failure of existing land to deliver its potential value given the new demands made upon it by a growing and more prosperous population. Tensions may arise between societal preferences for increased public access to the countryside and property rights that grant exclusive use to the landowner who may accord sole priority to agricultural production. There can also be conflicts between intensive farming and maintaining ecological diversity.

The way these tensions and conflicts are resolved will depend on the methods available for influencing choices. Where there is an opportunity to intervene and influence landowners' decisions (to grant or require access, to pay for or require certain ecological standards), these interventions should be guided by society's values. Science has an important role to provide evidence about the consequences of alternative actions, thereby informing public opinion and motivating interventions.

3.4.3 Value and prices

The term 'value' also needs to be distinguished from 'price'. Prices, whether set by market forces or government regulation, can value goods and services incorrectly for a number of reasons. First, market prices reflect what buyers actually pay for goods rather than the true benefit they derive; 'true' value is closer to what they would have been willing to pay. Second, there may be benefits to others that are not reflected in the price paid. Thus market prices can underestimate the true value of the benefit derived.

Conversely, in situations where prices are artificially high – whether due to restrictive practices, taxes or regulation – some would-be purchasers who would have been willing to pay the lower price may be deterred from buying at the inflated price, and thus are denied the benefit that would have been enjoyed. It has been argued that planning restrictions can result in; the price of urban land and houses becoming higher than can be justified by the value of that land in alternative use, deny those on lower incomes access to the housing market, and raise the costs of living for key workers (and others)[143]. In addition, some land uses may impose costs on others, for example, where intensive farming causes groundwater pollution that raises the cost of clean water and hence lowers the standard of living of society as a whole.

It must also be remembered that market prices, and hence price-based values for land, are a product of prevailing income levels and distribution as well as restrictions such as planning controls on supply and use. Change these, and values may change absolutely and/or relatively.

It is widely argued that whether prices provide a good indicator of the value of land depends on how far intervention – for example, through taxes, subsidies or regulation – adjusts market prices appropriately to take into account the market failures involved, or instead has the effect of moving prices further away from their socially optimal value. Getting prices right helps the system to realise the best value from the land and reduces the need for compulsory regulation. Greater harmony can then be achieved by aligning incentives with wider social objectives so that individual choices are less obviously in conflict with collective decisions. If the system is allocating land efficiently, the value of marginal plots of land in particular locations should be similar in different potential uses, otherwise improvements in value could probably be obtained by changing use.

3.4.4 Market and non-market benefits from land

Although many of the goods (e.g. crops, timber, livestock) and services (e.g. housing, water supply) that land provides are traded in the market place, and thereby determine the commercial value of land as an economic resource, many are not. These non-market services have no obvious price, many are not subject to clear property rights or entitlements, and may not be adequately reflected in market values, yet bestow

143 Dis: 2 (Appendix B refers)

value to society at large. The fact that these non-market services lack a market price results in market failures that justify intervention.

Some of the non-market services from land are *public* goods, in that their supply is not exhausted by individual consumption (as wheat is when bought and consumed). Landscapes and open space can be enjoyed equally by individuals or large numbers of people (provided they do not cause congestion). Other non-market goods impact on particular individuals: such as the way that land absorbs the storm water run-off that would otherwise flood a downstream property, or purifies the water that is subsequently abstracted by a water company and that would otherwise need expensive treatment. In both cases the value of these services may not be automatically included in the decisions of individuals as they pursue their private interests: their value is external to the markets on which that individual trades and for this reason they are referred to as '*externalities*'.

From a societal viewpoint, because markets fail to identify and value non-market goods and reward their production, their supply is more at risk than it would be if markets were working properly. Similarly, markets often fail to value public 'bads', such as pollution from landfill sites, fertiliser run-off, or carbon release from land. Their incidence is likely to be greater than it would be if the costs of pollution were borne, for example, by those responsible.

To give another example, the sealing of soil surfaces associated with infrastructure and housing development can contribute to flooding, which results in damage to third parties without redress. In the absence of specific measures to do otherwise, those affected by off-site flooding have no entitlement to be protected from floods generated by the newly developed land. These real external costs, and the rights to protection or compensation that they should imply, were not the subject of the transaction when land was sold for development. This represents a failure of the market system that needs to be corrected by policy intervention, although – as with all interventions – one needs to balance the costs of that intervention against the benefits of remedying the market failure.

To date, most interventions to correct for negative externalities have involved regulation – placing bans or limits on potentially polluting activities and processes. These have been commonly applied in the industrial sector, and more recently for land services under European environmental regulations such as the Water Framework Directive, the Nitrates Directive, and Integrated Pollution Control[144]. Increasingly, however, market-based methods and voluntary agreements, such as payments to farmers to adopt environmentally beneficial practices, have replaced regulatory methods[145]. The principle that 'the polluter pays' reflects this shift to market-based mechanisms. There is considerable scope to create new markets in land-based environmental services, such as carbon sequestration and storage, flood risk management and supporting biodiversity. Set in a regulatory framework that determines overall environmental standards and targets, this will encourage land managers and developers either to reduce their external effects themselves, or to offset them by purchasing permits from service providers, whichever is cheaper. This should lead to the delivery of the targets and standards at least cost. Science and

144 http://ec.europa.eu/environment/water/water-framework/index_en.html; http://ec.europa.eu/environment/water/water-nitrates/index_en.html; http://europa.eu/legislation_summaries/environment/waste_management/l28045_en.htm

145 Environment Agency (2007)

technology clearly have a role to play in the design, implementation and monitoring of such arrangements.

With respect to urban development, Section 106 agreements and the forthcoming Community Infrastructure Levy (CIL) are funding mechanisms that could be used to offset or compensate for the negative environmental effects of development, as well as to fund additional public infrastructure and services.

3.4.5 The non-use value of land

Whereas some of the benefits of land, including some non-market benefits, are 'user' benefits associated with actually using the land (for example, viewing an attractive landscape, or the use of floodplains to store flood waters), other benefits are associated with its non-use value – leaving land and its properties untouched. In its unused condition, land can provide benefit to other living beings (altruistic value), may be intrinsically valuable in itself (existence value), and can be left for future generations (bequest value). By not irreversibly changing its use now, there is also an option value to use the land resource differently at a later date. Thus the values generated by land are diverse, and widely distributed amongst people both geographically and over time.

3.5 Sources of value

3.5.1 Land as a resource and a supplier of goods

The value of land is driven, in part, by the demand for the goods and services that land provides. The following points are important:

(i) The potential for land to create benefits, i.e. the potential asset value, depends not only on the inherent quality of the land itself, described by soil, climate and topography, but how it is managed (e.g. farmland, National Parks), its location with respect to major centres of population and economic activity, and accessibility to transport routes.

(ii) The value of land can be significantly enhanced by combining it with other resources such as infrastructure (e.g. drainage), technology (e.g. farming systems), and human knowledge and endeavour (enterprise), making it fit for purpose, overcoming some of its inherent limitations, and increasing the supply or value of services from an otherwise fixed resource.

(iii) The value of land, at least in theory, is determined by the present value, discounted over time, of the future flows of benefits generated by the land. Thus the present value of land used for agriculture should reflect likely future profits from farming and the value of the ecosystems services it provides. The value of residential land should reflect the present value of benefits from house construction and use, including its location with respect to good schools, transport facilities and green space, as reflected in the house price. Land that is currently used for farming may increase in price in the future if development becomes attractive (through population growth, new transport infrastructure or planning permission). The market price of land is, however, frequently distorted by market imperfections or policy interventions, such as agricultural subsidies or restrictions on development.

(iv) As an asset, land offers a means of storing wealth. Given its central place in cultural values, it also provides a store of value associated with social status and influence. Land, particularly in certain locations, can be a positional good[146], whose value depends on its relative desirability compared with substitutes, and which is in limited supply so that its owner can demonstrate superior wealth, taste or status.

(v) Land prices indicate the value of the services provided by the land in its permitted use. Large differences in land values in different uses (e.g. agriculture and development) that cannot be explained by differences in the inherent and locational properties of land and the services it supplies, suggest, from an economic perspective, that some re-allocation of land amongst uses would probably increase overall benefits obtained.

(vi) Land is a strategic resource. Not only does it define a country, region or community, and the people that occupy it, it also provides a critical capacity to meet essential needs, such as food and energy supply. It does this especially in times of crisis when international trade has been compromised. In this respect, part of the value of land resources is the assurance and security that it can provide to nations and communities as they face uncertain futures. This may include the maintenance of critical capacity in land-based industries such as agriculture and mining.

3.5.2 Multifunctional land use

Land provides, or could provide, a range of different benefits simultaneously to a range of different stakeholders, and this is often referred to as *multifunctionality*. Rather than using land for a single dominant purpose, such as food production or housing provision, multifunctional land use involves multiple activities within the same space, such as farming and nature conservation, or gardens and biodiversity, forestry and carbon sequestration. In this respect land use produces 'multiple outputs and, by virtue of this, may contribute to several societal objectives at once'[147].

The concept is not new. Many traditional landscapes, especially those associated with common ownership, were in essence multifunctional, providing a range of services to meet the needs of local communities. Modern trends in land ownership and management, however, have tended to promote a single main purpose to the exclusion of others, often in response to dominant market or policy drivers. One example is production-oriented farm subsidies, which have until recently encouraged intensive agriculture in the EU, often at the expense of biodiversity. Hence many landscapes have become less varied in appearance, in the services they provide and in the values they generate.

The potential advantage of multifunctional landscapes is that they can create more value for people and communities than single-function land uses by offering various services valued by others in the community than just the landowner. Multifunctional landscapes, and the communities that relate to them, are also likely to be more resilient and sustainable in the long term[148]. The challenge is to recognise the value of multiple flows of services and build these into market or policy instruments that reward the provision of services, or penalise their loss.

146 Hirsch (1976)

147 OECD, (2001); Swinton et al. (2006);

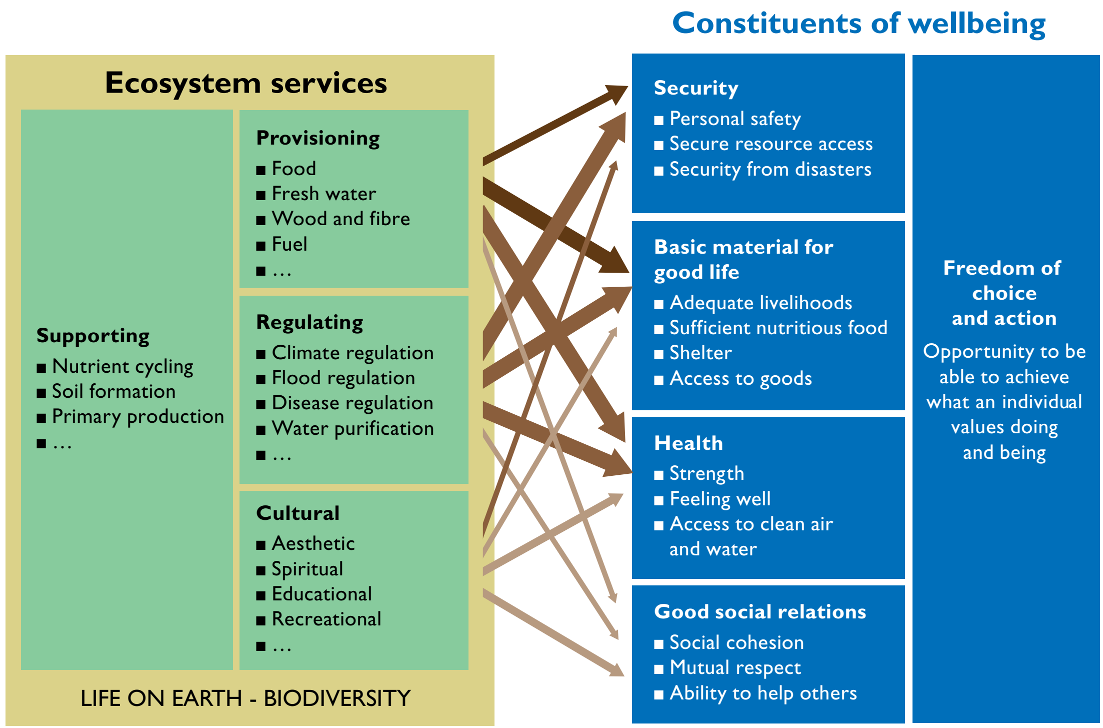
148 Banks and Marsden(2000); Dis: 1 (Appendix B refers)

3.5.3 Ecosystem functions, services and values

The concept of multifunctionality is consistent with the ecosystems approach[149] that has gained recent popularity as a means of both representing the diverse flows of services that are generated by natural resources such as land and, more importantly, appreciating the relationship between these services and social wellbeing[150].

Figure 3.3, taken from the Millennium Ecosystem Assessment, links natural attributes (such as land, water, air and living systems) to human wellbeing through the provision of flows of ecosystem services. These are classified in terms of *provisioning* (such as supply of food and fibre), *regulating* (such as hydrological and atmospheric cycles), *cultural* (such as landscapes and recreation) and *supporting* services (such as soil formation and habitats) that facilitate the overall working and integrity of the ecosystem as a whole.

Figure 3.3: The Millennium Ecosystem Assessment shows the links between ecosystems and social wellbeing



Source: Millennium Ecosystem Assessment (2005)

Land is a main agent of all of these ecosystem services; the type, quantity and quality of services vary amongst different landscapes such as mountains, farmland, woodlands, wetlands and urban areas[151]. Changes in ecosystems, either due to natural processes or as a result of human activity, can cause changes in the services provided and the benefits to people. Furthermore, there are potential synergies and trade-offs between the different services. Conflicts can arise between farming and biodiversity, for example, or urban development and flood regulation, unless measures are taken to address these. There is an important role for science and technology to understand and manage these relationships, exploiting opportunities for synergy where possible,

149 Millenium Ecosystem Assessment (2005); de Groot, (2006); Zhang et al. (2007); UNEP-UK NEA, (2009)

150 Millenium Ecosystem Assessment (2005); Defra, (2007).

151 http://uknea.unep-wcmc.org

The ecosystems framework can provide a holistic approach for the identification and valuation of diverse services from land, whether marketed or non-marketed, and whether associated with use or non-use. In this respect it can help to identify the 'final' goods and services provided by land that are of value to people and communities (as discussed below).

3.5.4 Land values, stakeholders and property rights

The ecosystem framework also makes explicit the link between flows of goods and services and stakeholder values, covering a range of ecological, socio-cultural and economic dimensions. Here, stakeholders are individuals, groups or organisations with an interest in, and who derive potential benefit or loss from, a change in ecosystem services. They might also be distinguished according to the degree to which they can influence service flows, through property rights, entitlements and the control of resources[152].

A given land area may deliver a range of different beneficial services, the rights to which may be vested with more than one individual stakeholder[153], such as rights held by a farmer under an Agricultural Tenancy, and rights held by the public to access land under Public Rights of Ways Regulation. However, property regimes sometimes fail to recognise and value the 'external' effects of land use, whether positive or negative, with consequences for welfare. For example, the contribution of managed landscapes in upland areas to tourism may go unrewarded; so that land managers are less inclined to enhance the landscape, encourage more visitors and hence benefit the rural economy as a whole. In recognition of this, an Uplands Entry Level Environmental Stewardship Scheme scheduled for introduction in 2010 will provide upland farmers with payments for managing land for environmental benefit[154].

It is important to note that 'entitlements to benefit' are not absolute, but rather derived in accordance with dominant societal preferences and priorities, and these vary spatially and temporally[155]. Historically, property regimes have given precedence to provisioning services such as farming and fishing for food, evident, for example, in the award of agricultural land tenure or riparian fishing rights[156]. As other land services become more important, such as floodwater regulation or cultural heritage, new property regimes will be required to reflect changing priorities[157]. In future, agricultural or development land may be subject to conditions of use that secure a wide range of ecosystem services of benefit to a wide range of stakeholders in response to changing preferences and priorities.

3.5.5 Assessing ecosystem uncertainty: pressures and tipping points

The management or policy interventions in land systems are often made against a backdrop of considerable uncertainty[158], especially about the response of ecosystems and the consequences for service flows and welfare. The valuation of land use options should allow for the inherent uncertainty of ecosystems, particularly as they can behave in complex ways. It may be that a small change in land management practices or land

152 Turner et al. (2003); Reed et al. (2009)

153 Bromley (1991); Adger and Luttrell (2000)

154 http://www.defra.gov.uk/rural/documents/countryside/uplands/els-summary.pdf

155 Tawney (1948); Bromley and Hodge (1990); ER: 25 (Appendix B refers).

156 Bromley and Hodge (1990); Hodge (2001)

157 ER: 16 (Appendix B refers); ER: 25 (Appendix B refers)

158 'Uncertainty' is where the identities and/or probabilities of outcomes are not known, compared with 'risk' where they are known.

use has a correspondingly small change in outcomes (the flow of ecosystem services), but in other circumstances that small change may set in motion a chain of events that leads to a large and possibly irreversible change in outcomes – a regime change[159].

Sudden regime shifts are hard to anticipate, and disturbances may cause a rapid change in ecosystems, such as the rapid decline of wetlands that previously appeared resilient[160]. It then becomes difficult to estimate how the value of land and its services may change in response to changes in use or external disturbance such as climate change.

It is important that economic appraisal of land use options explicitly considers uncertainty, and guidance is available on how best to deal with this[161]. Where land use change results in non-marginal impacts, then Cost-Benefit Analysis (CBA) using values based on marginal changes may not be an appropriate guide for policy-making. Recent work[162] suggests that, in these circumstances, some form of asset check might be an appropriate addition to appraisal. The option for mitigating or compensating actions may also be necessary, as well as designating land for special protection.

Where perceived uncertainty is high and potential impacts are significant, a precautionary approach can be adopted to secure 'safe, minimum standards' of service and welfare. Participatory methods such as Multi-Criteria Decision Analysis (MCDA) and scenario analysis[163] can help to clarify the issues and major sources of uncertainty. Selecting land management options now that can help to mitigate and adapt to future climate change is a case where such a participatory approach, involving a range of stakeholders and informed by scientific understanding, is clearly important.

3.6 Value, wellbeing and decision-making

The Government's *Green Book*[164] requires that government decisions, in this case on the use and allocation of land resources, should be taken using the criterion of overall social welfare. To quote from the introduction: '*This guidance is designed to promote efficient policy development and resource allocation across government. The guidance emphasises the need to take account of the wider social costs and benefits of proposals, and the need to ensure the proper use of public resources.*' The Treasury, Defra, devolved administrations and other government departments and agencies are required to ensure that their own manuals or guidelines are consistent with *Green Book* principles, providing supplementary guidance on their specific areas[165].

Guidance is also provided on how to take account of price distortions and external effects, as well as distributional issues within and between generations. It is recognised that the quality of data and information may sometimes be poor, and should be reflected in the confidence placed in the results derived: '*The results of sensitivity and scenario analyses should also generally be included in presentations and summary reports to decision-makers, rather than just single-point estimates of expected values. Decision-*

159 Holling (2001); Limberg et al. (2002)

160 Scheffer et al. (2001); Scheffer and Carpenter (2003); Walker and Meyers (2004); ER: 3 (Appendix B refers)

161 HMT (2003)

162 Defra and GES (2009)

163 Dodgson et al. (2000); Chee, (2004); de Groot et al. (2003); Hein et al. (2006); Peterson et al. (2003); Wilson and Howarth, (2002); HMT, (2007)

164 HMT Treasury (2003)

165 Examples include Defra's Project Appraisal Guidance for Flood Risk Management, (MAFF, 1999); DfT (2009); Defra (2007); Environment Agency (2009)

makers need to understand that there are ranges of potential outcomes, and hence to judge the capacity of proposals to withstand future uncertainty'[166].

It is sometimes claimed that this approach does not necessarily provide a complete and reliable indicator of wellbeing and value. Other approaches such as those contained in the UN Human Development Index and the UK Government Sustainability Indicators can be used to represent non-economic measures of welfare. But this is entirely consistent with the *Green Book*, which acknowledges that not all elements of value can be measured formally in money terms, recommending that 'supplementary techniques (should) be used for weighing up those costs and benefits that remain unvalued'[167]. The key is that costs and benefits should be covered comprehensively, using the best available methods to measure and weight them alongside monetary measures.

Recently, more attention has been given to measures of the value of land that are independent of material consumption and market factors. Developments in psychology, anthropology, and neuro-science, combined with behavioural economics that are not predicated on a consumption-based view of utility, are providing new insights into environmental valuation. These seek to provide a better understanding of how values, such as sense of place and belonging, are constructed, and how values vary in response to changing circumstances and external factors, such as perceptions of threat or opportunity. They also explore how values vary with knowledge and experience, and how they are constructed by individuals alone or by groups working collectively. Values from standard economic CTA can thus be augmented by other measures within a comprehensive framework for decision-taking[168].

A condition for sustainable land use is that the stock of land assets and its ability to provide a flow of services over time is maintained to a sufficient extent. Sustainability for each piece of land may be impossible or undesirable as, for example, in the case of mineral extraction[169], and difficult for others such as vegetable farming on peatland. Defining what is 'sufficient' is not straightforward, but the aim would be to prevent 'excessive' degradation, or to ensure that 'profits' from existing land uses are reinvested to provide offsetting gains in the land system or elsewhere.

These various concerns are evident in the use by Government of Public Service Agreements (PSAs), especially PSA 28 that aims '*to secure a diverse, healthy and resilient natural environment, which provides the basis for everyone's wellbeing, health and prosperity now and in the future, and where the values of the services provided by the natural environment are reflected in decision-making*'. It is clear that more work is needed on how best to factor environmental limits into appraisal methodology, and the Government Economic Services are currently reviewing the way sustainable development is treated in appraisal[170].

3.6.1 Valuation techniques

Table 3.1 sets out a classification of land services from an ecosystem perspective, together with examples of valuation techniques used in each case.

166 HMT (2003) p6

167 HMT (2003) p4

168 The approach to transport appraisal used by DfT (2009) is an example in which the appraisal summary table includes a mix of costs and benefits measured variously in monetary terms, in physical units and in descriptive form.

169 Though note possibilities for disused quarries discussed in Chapter 4.

170 Price and Durham (2009)

Table 3.1: Land-based ecosystem services and valuation

Ecosystem service	Examples of services	Benefits to people	Techniques of valuation*	Examples of valuation
Provisioning of material goods and services	Agricultural production; mineral extraction; water supplies; land for development	Agricultural commodities; minerals; energy; water use; housing	Adjusted market prices; changes in productivity; revealed preference	Market prices of: agricultural commodities; farm land values net of subsidies to farmers
Regulating ecosystem processes	Flood control; erosion control; carbon storage; water purification; waste assimilation	Flood damage avoidance; social cost of carbon; water use; waste management	Productivity; costs & income based methods; replacement goods	Value of floodplain storage: savings in urban damage costs; saving in flood defence costs
Cultural non-material services	Heritage; landscape; amenity; recreation; social relations	Heritage sites; landscape features; countryside walks; tourist visits	Revealed preference; stated preference	Willingness to pay for: heritage preservation; green space; access to the countryside
Supporting other processes and services	Soil formation; habitats; biodiversity	Crop yields; habitat and species	Productivity; revealed preference; stated preference	Willingness to pay for habitat and biodiversity protection and enhancement

Table based on, amongst others: Dis: 6 (Appendix B refers); ER: 40 (Appendix B refers); O'Gorman and Bann (2008); Defra, (2007)
** See text for description of methods*

Valuation methods that can be used to measure changes in land services can be broadly classified into two groups: economic, and deliberative/participatory methods[171].

3.6.2 Economic valuation methods

Methods to measure the economic monetary value of changes in the amount and quality of services provided by land include:

(i) ***Changes in outputs and inputs measured in market prices***, adjusted to remove the effects of taxes and subsidies and non-competitive market practices such as the market value of agricultural output net of subsidies.

(ii) ***Costs of replacing a service or avoiding a loss*** because a service is no longer available, such as the cost of building flood defences to guard against flooding because floodplains have been developed.

(iii) ***Revealed preferences (or hedonic methods)*** evident in actual spending on particular aspects of service quality such as on higher prices for houses in quiet environments or on travel costs to enjoy areas of outstanding natural beauty.

(iv) ***Stated preferences*** that express a willingness to pay for a particular good or service, such as payments for public parks, or a willingness to accept compensation if such services are lost.

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171 Dis: 6 (Appendix B refers)

The expense of carrying out surveys to elicit values for the wide range of services provided by land has encouraged the use of *value transfer* methods, whereby values derived from completed studies are 'transferred' for use elsewhere[172]. To be helpful, the dependence of these values on their key determinants (e.g. the characteristics and size of the population affected) needs to be estimated, so that the values can be re-estimated for different levels of these determinants.

Although these methods are subject to estimation bias of one kind or another, significant progress has been made on the valuation of non-market land (and related water) services for inclusion in decision-making. This is the case for urban areas, where active housing markets reveal considerable information on revealed preferences, and in rural areas where, although there are fewer active markets to observe, a good deal of stated preference work has been done to establish environmental values[173].

3.6.3 Deliberative/participatory methods

Deliberative/participatory methods attempt to elicit preferences for environmental goods and services through discourse and exchange amongst various stakeholder groups. These include unstructured interviews, focus groups, panels, citizens' juries, discussion fora, learning schools, away-days and 'walkabouts', game playing, and various forms of interactive visualisation[174].

Participatory approaches attempt to understand the process of decision-making itself, and to support individuals and groups as they seek to determine and achieve desirable and socially just outcomes. These methods develop criteria for appraisal based on the preferences and judgements of the stakeholders involved, rather than just accepting the *Green Book*'s focus on total welfare as the sum of individual preferences. A further difference is that, whereas economic methods tend to treat preferences as pre-existing and stable constructs, deliberative and participatory methods attempt to form preferences through a process of deliberation. Many of the methods involve knowledge exchange between all participants, including 'experts' providing information in response to requests.

This deliberative approach has been argued to be consistent with the principles of sustainable land use, which treats land in its entirety, and operates at the scale of the whole landscape with citizens exercising both private and collective rights on the use of land in order to achieve overall social and cultural wellbeing[175]. People thereby engage in a process of shared commitment to living within the environmental limits, and creating a strong, fair and robust society. This requires a responsible, participatory democracy in which decisions on land use are not dominated by economic factors, but based rather on agreed, typically more local, criteria and preferences[176].

Such deliberative methods of valuation and decision-making can conflict with the use of 'impartial' cost-benefit analysis by democratically elected governments acting in the general public interest. Deliberative methods and the decisions that follow could be biased to serve the interests of dominant groups. Indeed, all valuations and the decisions that follow are liable to bias, suggesting the need for quality control[177].

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172 ER: 40 (Appendix B refers)
173 Dis: 6 (Appendix B refers)
174 HMT (2007)
175 Dis:1 (Appendix B refers)
176 Marshall (2005)
177 Söderqvist and Soutukorva (2009)

3.6.4 Integration

Economic and deliberative methods are not incompatible – deliberative methods may, in some circumstances, be the best way of determining otherwise hard-to-value non-market services. Further applied research integrating economic valuation with deliberative methods to support decision-making on land use would be very helpful[178]. New developments in 'hybrid' deliberative methods seek to combine different types of knowledge, monetary and non-monetary, and qualitative and quantitative data[179]. They can provide a means of (i) encouraging public and stakeholder participation in decision-making, thereby avoiding possible future conflicts; (ii) providing opportunities for learning during the appraisal process; (iii) achieving transparency in decision-making, including agreement on what can and cannot be reliably measured in money terms; and (iv) considering how to deal with uncertainties and issues of social justice, including impacts on future generations. Box 3.1 contains an example of such an integrated approach applied to the English uplands.

BOX 3.1: Deliberative approaches to rural valuation

The Sustainable Uplands project funded by the **Rural Economy and Land Use** Programme (RELU) explored the value of different future scenarios for UK uplands. Scenarios were initially developed through interviews and a series of moorland site visits that enabled stakeholders and researchers to discuss likely futures. Scenarios were ranked by stakeholders in terms of perceived likelihood and potential impact using 'multi-criteria evaluation'. This ranking was then discussed by participants to derive a short list of scenarios, which were then explored in greater depth using simulation models. Multi-criteria evaluation was used as a qualitative tool in this context to make the assumptions and decision-making criteria of participants explicit, so that this could inform the deliberation that led to the final short list. Qualitative information arising from this deliberative process was then integrated with quantitative information arising from models, to develop narratives that were then made into short films to communicate the value of the different scenarios to stakeholders[180].

Photos: (top) site visits were used to discuss possible futures facing UK uplands and (below) workshop participants mapped scenarios to evaluate their likelihood and potential impact.

3.7 Valuation studies

The majority of valuation research uses economic methods – especially contingent valuation in rural areas and hedonic methods in urban areas. The standard approach

178 Graves et al. (2009); Posthumus et al. (2009); Marshall (2005)

179 Stagl (2007)

180 Hubacek et al. (2009); ER: 11 (Appendix B refers)

to making decisions is CBA that makes systematic use of these monetary values. The use of deliberative methods has grown more recently, typically associated with large funded multi-agency research programmes, where the aim is to secure better estimates of ecosystem service values for wider use.

A number of projects are developing data and methods that are potentially relevant for policy management. Some projects are particularly oriented towards end-user support. The Environmental Valuation Reference Inventory (EVRI), for example, provides a classification and information base that supports the transfer of primary benefit estimates to secondary applications. Other projects[181] include: the European Rubicode project which, amongst other things, is exploring how human preference and values for ecosystem services change through time, and the EU TEEB project which is evaluating the costs of biodiversity loss commonly associated with land development and the costs of effective conservation and sustainable use.

Other projects, such as the Rural Economy and Land Use Programme for the UK (RELU – see Box 3.1) adopt an interdisciplinary approach which aims to bring about integrated solutions that can deliver multiple benefits from land use. Reviews undertaken by RELU on behalf of the Foresight Land Use Futures Project[182] showed considerable need and scope for integrating economic and non-economic methods within an ecosystems framework to support decisions on land management.

3.7.1 Examples of valuation

A number of examples serve to show how to value the services that land provides, with the caution that distortions in land markets mean that land prices may not adequately represent the value of services rendered. Thus agricultural land prices may not be a reliable indicator of the real value of land employed in agriculture because of agricultural subsidies and income support, limited offerings of land for sale each year, strong demand for small parcels of 'agricultural' land by urban dwellers, and the various tax advantages of land ownership. In recent years these factors have kept agricultural land prices above their agricultural income-earning capacity, measured at unsubsidised prices[183].

External costs and benefits also need to be taken into account when valuing different land uses. Table 3.2[184] contains estimates of the external benefits associated with different types of land use, including wildlife, landscape, recreation and other benefits, based on surveys of willingness to pay to keep land in its present use. The significant differences in extra value between inner city urban parkland and urban fringe, and between intensive and extensive agricultural land, are particularly illuminating, suggesting that some reallocation of land to provide higher-value services would increase overall welfare.

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181 Rubicode – www.rubicode.net/rubicode/index.html; The EcoValue Project – http://ecovalue.uvm.edu/evp/doc_research_team.asp; TEEB – http://ec.europa.eu/environment/nature/biodiversity/economics/index_en.htm;
Rural Economy and Land Use (RELU) Programme – http://www.relu.ac.uk;
The Natural Capital Project – www.naturalcapitalproject.org/about.html;
The Nature Valuation and Financing Network – http://topshare.wur.nl/naturevaluation;
MIMES – http://www.uvm.edu/giee/mimes;
Valuing the Arc – http://valuingthearc.org

182 Dis: 3 (Appendix B refers); Posthumus et al. (2009); Dis: 19 (Appendix B refers)

183 ER: 28 (Appendix B refers)

184 Barker (2006)

Table 3.2: The external benefits of land use

Land Type	Present benefit[1] (per hectare per year, 2001)
Urban core public space (city park)	£54,000
Urban fringe greenbelt	£889
Urban fringe forested land	£2,700
Rural forested land	£6,630
Agricultural extensive	£3,150
Agricultural intensive	£103
Natural and semi-natural wetlands	£6,620

1 These values were assessed by using contingent valuation methods. This asks a cross section of people how much they would be willing to pay to maintain a piece of land in its existing use.
Source: Barker (2006)

These values are taken from a review of the economic literature on external benefits of undeveloped land published by the Office of the Deputy Prime Minister (ODPM) in 2002, and much further work has been undertaken since then. Furthermore, the coverage and quality of the various studies surveyed varied considerably, and so the values should not simply be taken at face value. However, they do illustrate the types of valuation information that are available, and the directions in which they may point for the implementation of land use policy.

Market failures in the pricing of land create private, as well as social, costs. An example of this is provided by Cheshire and Sheppard[185], who reported an increase of the price of land from just over £6,100 per hectare for agricultural land, to at least £4,900,000 per hectare for land with planning permission at Reading's urban boundary in 2000. Some increase in the price of land with planning permission is justified, as the land left undeveloped may deliver non-marketed services[186]. Similarly when land is developed it frequently imposes costs on the community (such as congestion of various transport links and other services) that should be included in the cost of making that land available. However, Cheshire and Sheppard argue that such very large differences between urban and non-urban agricultural land prices arise, not because of a real difference in land value, but because of constraints on development. Figure 3.4 shows many locations where the value of land with permission for residential development was well over £6,000,000 per hectare in 2007 (although this includes the necessary infrastructure needed before building can start, which might cost £200,000 or more per hectare). Thus obtaining permission to change use from agricultural to residential can increase the price of land some 600 to 700-fold. The highest priced locations are in the South East of England, as would be expected since pressures for urban growth there are strongest, but there are a number of areas in the South West, West Midlands, North West and North with housing land prices estimated to exceed £3,000,000 per hectare.

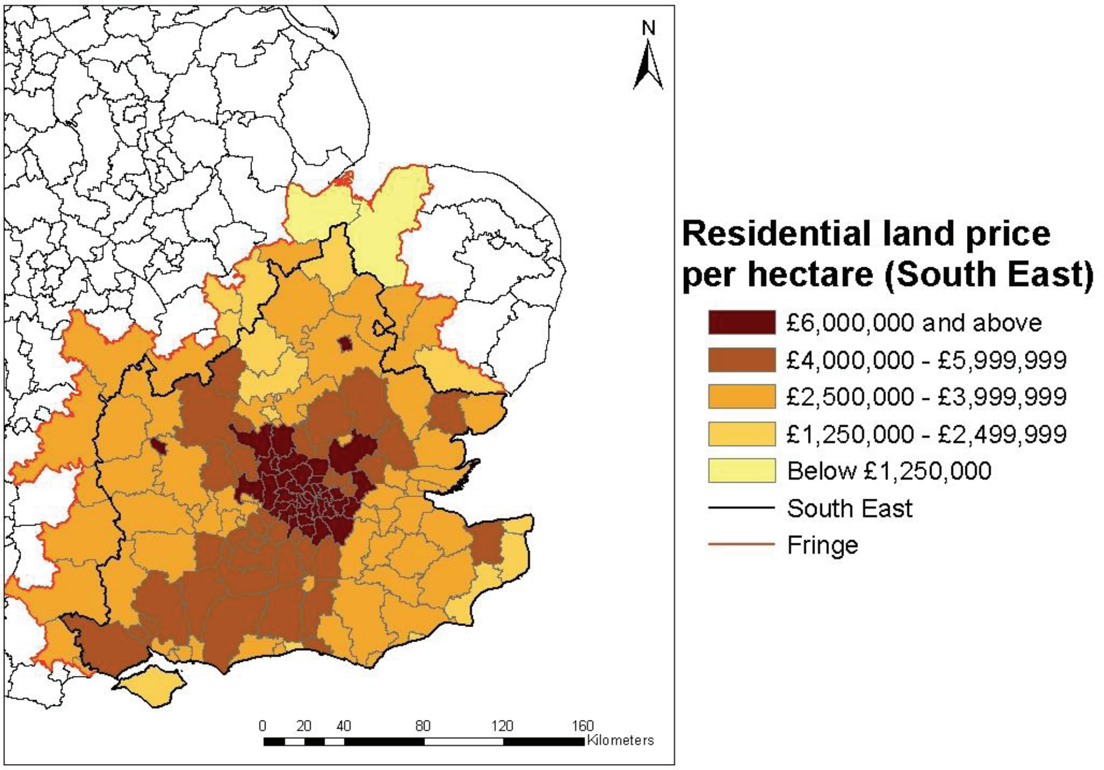
On top of the private benefits illustrated above, a study[187] of house prices in Reading showed that increasing the amount of residential land made available within and beyond the existing containment boundary of the town would produce substantial net social gains, mainly due to reduced prices of land and houses, and the ability to enjoy

185 Cheshire and Sheppard (2005)
186 See https://statistics.defra.gov.uk/esg/reports/housing/default.asp
187 Cheshire and Sheppard (2002)

more personal space. The study first calculated the gross benefits of planning, assuming that without planning there would be no open space and far more space allocated to industrial use. These amounted to £4,550 per household on average, but increasing with income levels. They then considered the effect of relaxing planning constraints as a means of driving down the price of land at the urban boundary to either £30,000/acre (modest relaxation = £74,000/hectare) or £25,000/acre (significant relaxation = £62,000/hectare). The net effect of the planning constraints in restricting the amount of housing that residents could afford was to impose annual costs equivalent to a tax of 3.9% on household incomes (calculated net of the loss of benefits from reduced open space) so that in 2008 prices, when the average Reading household income was about £39,400/year, this would represent an annual cost of £1,540.[188]

The above examples should be taken as illustrative. Prices of land for development are highly dependant on their location, size and the condition of the property market and such case studies would be likely to produce different ratios in other parts of the country and at other times. What this does demonstrate though, is the discrepancy between value and price and the negative social and private impact that this can have.

Figure 3.4: Residential land prices in the South East of England



Source: Dis: 2

Agricultural land use is known to have important positive and negative external effects, which until recently have not been accounted for. *The Environmental Accounts for Agriculture*[189] gives some, albeit incomplete, estimates of the positive and negative environmental externalities associated with agricultural land use. These have been recently revised and extended by Defra[190], suggesting that the net environmental costs of agriculture in the UK have been decreasing in real terms since 2000 (see Table 3.3).

188 Dis: 2 (Appendix B refers). Cheshire and Sheppard's figures for household income in Reading were £10,577 at 1983 prices; they have been uprated here by the increase in wage income since 1983.

189 Jacobs et al, 2008

190 At https://statistics.defra.gov.uk/esg/reports/envacc/default.asp

In 2007, the estimated environmental externalities of UK agriculture amounted to a net cost of about £830 million/year (equivalent to £14/head of population). Annual environmental benefits were about £1.74 billion (about £29/head of population), mainly associated with agriculturally managed landscapes and habitats. This probably underestimates the real value of managed landscapes, especially for tourism and recreation[191]: the impact of the travel restrictions on tourism and the rural economy due to the 2001 Foot and Mouth epidemic, for example, was estimated at £5 billion.[192]

Annual environmental costs were about £2.57 billion in 2007 (about £45/head), mainly associated with soil related emissions to air at about £2 billion and water related damages at about £0.5 billion. These estimates need cautious interpretation, being based on many assumptions and a somewhat unrealistic comparison of the situation 'with' and 'without' agriculture in the UK. Estimates of the extra environmental benefits and cost of marginal changes in agricultural land use and practices would be more useful. These figures are, however, indicative of substantial positive and negative externalities that should be accounted for in decisions that concern agricultural development. The figures can also be compared with farming's net value added at market prices of about £2.8bn given in 'Agriculture in the UK'[193] and gross value added from the *Blue Book*[194] of £5.5 billion.

191 The recreation and tourism or 'visitor' economy has been estimated to contribute £52 billion or 3.7% of the UK economy (2007 figures), see Section 5.4.

192 http://www.fmd.brass.cf.ac.uk/

193 https://statistics.defra.gov.uk/esg/publications/auk/default.asp but note that subsidies amounted to £2.9 billion giving net value added at factor cost of £5.7 billion

194 HM Treasury. The Blue Book, (2008)

Table 3.3: Summary of results of environmental accounts for UK agriculture, 2007

Annual flows	£ million	£ million
Positive		
Landscape	616	
Biodiversity	1,088	
Waste services	37	
Total		**1,741**
Negative		
Flooding	244	
Fresh water	144	
Drinking water	160	
Soil erosion	11	
Waste	7	
Sub-total		-566
Net benefits excluding emissions to air		**1175**
Costs from emissions to air		
Climate change	1,371	
Air quality	634	
Sub-total of emissions to air		-2,005
Total benefits less damages		**-829**

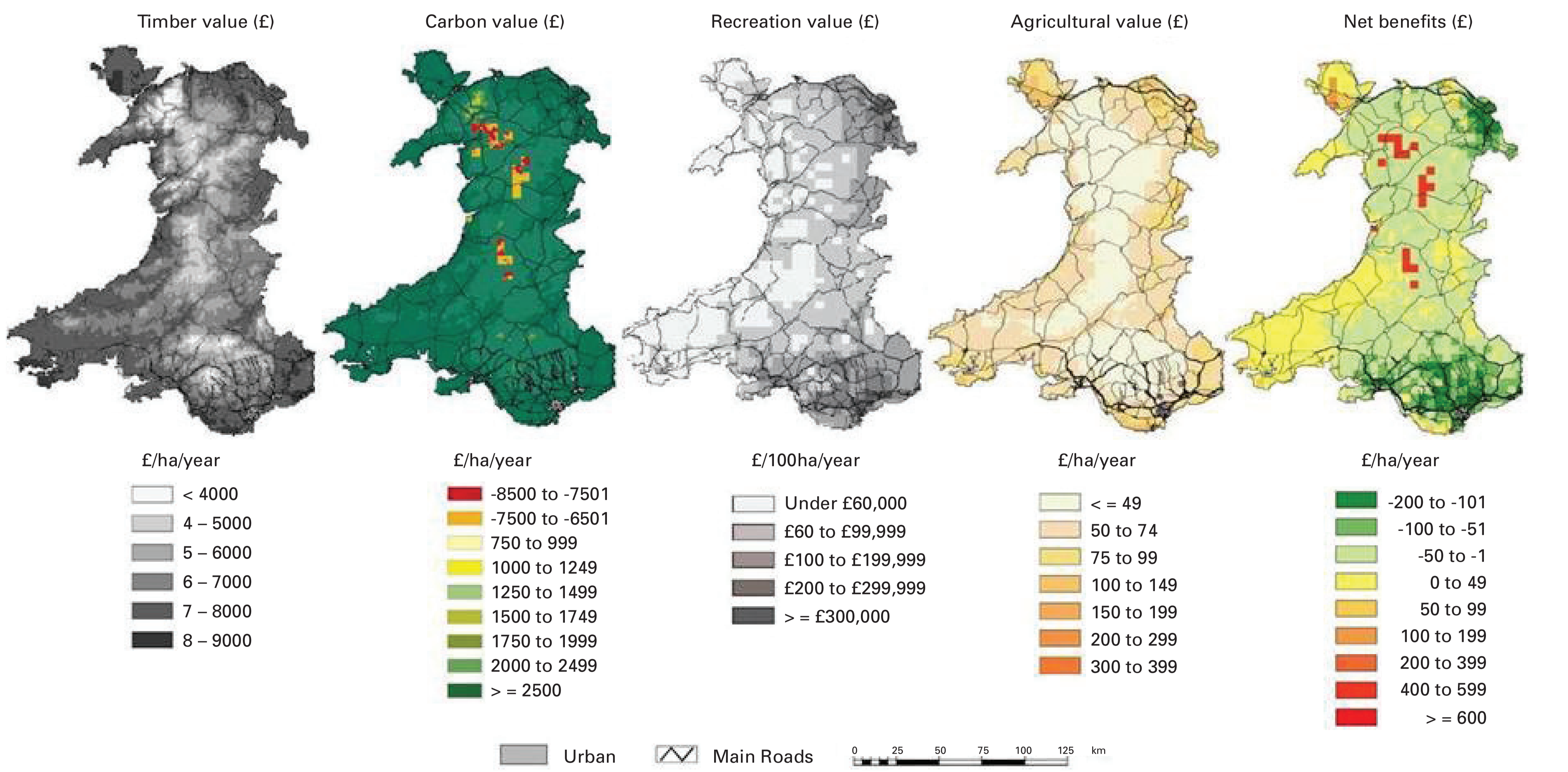
Source: Defra Environmental Accounts for Agriculture[195]

Valuation can help to show the economic consequences of particular types of land use on ecosystem services. For example, the economic costs of soil degradation are estimated at between £250 and £350 million/year for England alone[196], mainly associated with soil erosion, carbon loss and the costs of dredging rivers and water treatment. The value of flood regulation and land drainage services, and the risks of building in floodplains, were evident in the £3 billion economic damage costs incurred in the 2007 summer floods in England[197].

In understanding value it is important to consider not only the diversity of benefits from land use but also the way they are *spatially distributed* across the landscape. Figure 3.5[198], for example, shows the values of market and non-market benefits from multi-purpose woodland in Wales compared with retaining land in agricultural grassland. Woodlands can deliver timber, carbon storage and recreation benefits. The analysis shows that an increase in woodland cover, substituting for sheep grazing, would be cost-beneficial in many parts of Wales. Indeed, the cost-benefit analysis showed that existing forests are not optimally located to fulfil their potential; the ideal places would

195 https://statistics.defra.gov.uk/esg/reports/envacc/default.asp
196 Defra (2009)
197 Chatterton et al. (2009)
198 ER: 40 (Appendix B refers)

Figure 3.5 Spatially-explicit cost-benefit analysis of a potential land use change: retaining agriculture as opposed to converting to multi-purpose woodland



Source: ER: 40

be adjacent to population centres where recreational benefits are highest. This type of spatially-specific economic analysis, identifying the potential to simultaneously achieve multiple objectives, has considerable scope for future applications.

There is growing interest in the use of 'payments for environmental services' (PES) as a means of converting external non-market values of the environment into real incentives for land managers. PES involves voluntary transactions to exchange well-defined environmental services between service buyers and service sellers[199]. Most PES schemes operate through specific land uses capable of producing the required environmental service, such as forests or wetlands, rather than focusing on specific outcomes such as carbon sequestration or wildlife numbers that are more difficult to measure.

Some PES schemes are financed by users for commercial gain, such as water companies wishing to secure water supply and quality, or by governments providing public goods such as biodiversity and public access in the countryside (see Box 3.2). The operation of PES clearly demonstrates the value of ecosystem-type services provided by different land uses and the willingness to pay. In most cases, however, payments are based on the perceived cost of delivering a service, including allowance for income foregone by service providers, rather than on the value of the service itself.

199 Engel et al (2008)

Box 3.2: Paying for environmental services – UK agri-environment schemes

The Environmental Stewardship programme in England is a government-funded scheme that pays farmers for environmental services. Environmental Stewardship comprises two main schemes.

The **Entry Level Scheme** (ELS) is a 'whole-farm scheme' open to those who farm conventionally in England. It encourages farmers to deliver environmental services through the selection of simple land management measures that aim to improve conditions for wildlife, and that protect landscape features and natural resources such as soils and water quality. Farmers are awarded points for each measure. They are required to obtain an average of 30 points per hectare over the farm as a whole, for which they are paid £30/hectare/year over a five-year period. A Farm Environmental Record is compiled for the purpose.

The **High Level Scheme** (HLS) is a competitive scheme where applicants, who are already ELS/OELS (Organic Entry Level Scheme) members, are judged on the quality and cost-effectiveness of their environmental plans. It seeks to achieve high standards of wildlife conservation, enhancement of landscape character, protection of natural resources and increased public access to the countryside. Farmers receive annual payments for switching to land uses and management practices that are known to enhance environmental services, as well creating particular habitat and landscape features.

About 66% of utilisable agricultural land in England is now registered under Stewardship Schemes, with about 50% of farm land under ELS. Take-up of HLS (6% of the agricultural area) has been limited given the considerable changes in land use required and the administrative burdens involved. Although the attractiveness of HLS payments has increased since decoupling in 2005 of income support from agriculture production, future take-up will be dependent on the strength of farm commodity prices and the relative profitability of commercial farming. A new Upland ELS in 2010 replaces the Hill Farm Allowance in Severely Disadvantaged Areas, paying farmers to provide environmental and landscape benefits.

Examples of Entry Level Stewardship options	Units	£ Payment
Hedgerow management (on both sides of hedge)	100 m	22
Enhanced hedgerow management	100 m	42
Stone wall protection and maintenance	100 m	15
Management of woodland edges	Ha	380
Protection of in-field trees on arable land	Tree	12
Examples of High Level Stewardship options		
Creation of wood pasture	Ha	180
Ancient trees in intensively-managed grass fields	Tree	25
Restoration of traditional water meadows	Ha	350
Arable reversion to unfertilised grassland to prevent erosion or run-off	Ha	280
Creation of wet grassland for breeding waders	Ha	355
Creation of lowland heathland from arable or improved grassland	Ha	450
Creation of inter-tidal and saline habitat on arable land	Ha	700

Source: Defra/Natural England (2008); Dobbs and Pretty, (2004)

3.8 Valuation and the land system

If the UK land system is to deliver best value for the nation in a sustainable way, it will be important when guiding land use change, to estimate the value of land in alternative possible uses[200]. The appropriate concept of value is a broad one, encompassing the full range of ecosystem services whether or not they are marketed. This approach to land policy is in line with the Government's *Green Book on Appraisal and Evaluation*, which is designed to ensure that no policy, programme or project is adopted without first having answered the questions: are there better ways to achieve this objective? and are there better uses for these resources?

The debate on land policy has two important dimensions: the extent to which the Government or its agencies should intervene to influence land use and land change decisions (via authorisations, prohibitions, standards, taxes and subsidies), and the ways in which legitimate interventions should be made. In both contexts, valuation is critical; whichever approach to decision-taking is adopted, a view on value has to be taken, implicitly or explicitly. This chapter has therefore focused on the sources of value that land provides and the methods available for establishing them in order to guide decisions on land use and management.

The economic approach to valuation seeks to establish monetary values where possible, and a range of techniques is available to do this. But some argue that this approach: (i) attempts to do the impossible by expecting that people can provide meaningful answers to the valuer's questions; (ii) is biased in favour of 'development', underestimating costs and overestimating benefits; and (iii) entrenches conflict by seeking 'to *capture*, in monetary form, the values of the contending parties at the start of an argument, and settle the dispute by computation'[201].

These concerns are of varying cogency. The first two points suggest more careful valuation is needed, rather than abandoning the whole approach. And as already noted, valuation sometimes has to be relatively informal. The third point raises the question whether overall social value should be established impartially by taking full account of differences in preferences and attitudes within society, and weighting them appropriately, or by seeking to establish a consensus view. The latter approach is reflected in deliberative and participatory methods, but these too have their critics who argue that such approaches can too easily be hijacked by particular interest groups and so do not adequately or objectively reflect the diversity of views within society.

Nevertheless, there is scope for integrating these two approaches within the comprehensive approach to appraisal set out in the *Green Book*, which recognises that not all sources of value can be measured adequately and monetised. It is widely recognised that the techniques in the *Green Book* need to be developed further in order to capture better the diverse values that define the quality of life, especially in the context of sustainable development. But that does not call into question the fundamental role that the estimation of value, in its broadest sense, should play in making land use decisions.

Much empirical work has been conducted into land use valuation, and in particular the non-marketed services that it provides. More is certainly needed, particularly in relation to modeling location-specific land values. However, the valuation studies cited in this

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200 Recognising that planners, local authorities and the Government must act within laws that respect property rights.
201 Adams (1994)

chapter suggest that it is far from clear from the available evidence that land use management is currently delivering best value for the country.

3.9 Implications for governance

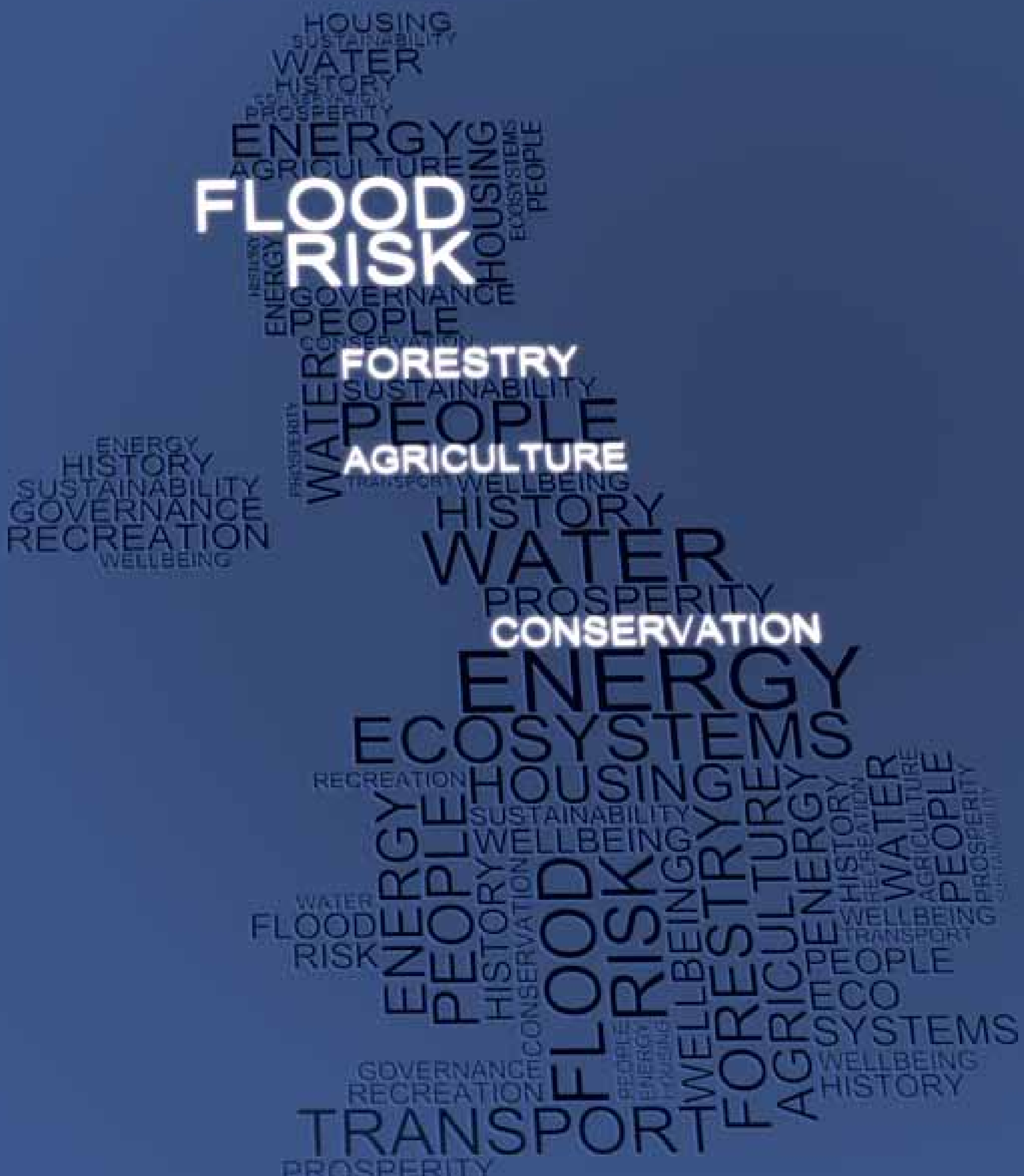
Studies of the value of land indicate that often, substantially greater value might be obtained by modifications to existing regulatory, market and governance arrangements. In some parts of the urban housing market, for example, increasing the allocation of land for urban development could enhance overall social welfare in the long term. However, future choices relating to land release would need to factor in the wider costs and benefits on the land system, including net social welfare gains and also the effect on the range of ecosystem services. It is likely that a mix of regulatory and economic instruments to safeguard environmental and social standards at risk would still be required, to enhance and improve the quality and accessibility of environmental services.

In the agricultural sector, targeted use of support measures could be used to further reward environmentally and socially beneficial land use and management practices, taking advantage of the change in emphasis of the CAP away from favouring production, and towards environmental objectives.

In terms of governance, over the long term, there is an opportunity to develop forms of land ownership, use and entitlement that can help realise the potential, and otherwise untapped values of multiple services for individuals and communities. It is clear that a useful policy direction for the future is to: (i) recognise and exploit opportunities for multiple benefits from land use; (ii) develop systems of land management that will support multiple services; and (iii) develop new reward systems, through, for example, market creation and fiscal measures that incentivise new and multiple uses.

In this context, given the greater pressure to derive more value from available land, there are likely to be increased tensions between stakeholders operating at different scales: between individual households, communities, regions and the nation as a whole. The demands for infrastructure to support options for new rail transport links and renewable energy are cases in point; local communities carry much of the environmental burden. Clearly, this will call for much greater collaborative working between stakeholders operating at different spatial and temporal scales, and motivated by different priorities. It will likely call for greater integration of economic and deliberative/participatory methods, as judgments are made about alternative types of development and land use. As pressures on land grow, there will be greater need to reward and penalise particular land uses, in order that those who benefit from the wide range of services that land provides are required to compensate those who lose. This process itself may need to be part of a deliberative process of arbitration over particular decisions. It may also be facilitated by a general review of taxes and subsidies or payment schemes.

The issues raised in specific sectors and contexts, and the implications for land use policy, are discussed in the chapters that follow.



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4 Major land use sectors – past and future: part I

The purpose of this chapter and the next is to develop a detailed understanding of diverse aspects of land use. Uses of land for water resources, conservation, agriculture, woodlands and forestry, and the role of land in managing flood risk, are considered.

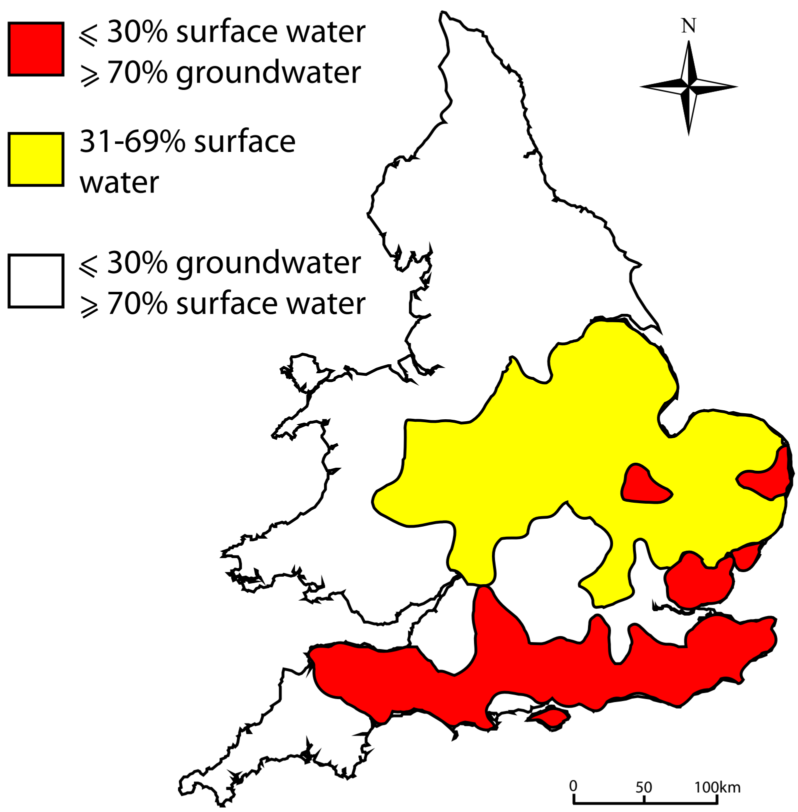
In each case, past and present trends are reviewed, and important future challenges and uncertainties are then assessed. Finally, the implications for policy are summarised.

4 Major land use sectors – past and future: part I

4.1 Land for water resource management

The land surface of the UK provides the catchment area that, together with the underlying geology, influences the quantity and quality of surface water and groundwater resources. Land and water resources are intimately connected. The way in which we use (e.g. housing, industry, agriculture) and manage (e.g. fertiliser applications to agricultural land) the land surface and subsurface (e.g. mineral extraction) has both a direct and indirect impact on the quantity and quality of water resources. Direct and often rapid impacts occur through runoff from land to surface waters such as rivers, streams and lakes – the 2009 surface water flooding in England is an example of such effects. Indirect impacts occur through percolation to groundwater, and there may be a significant time delay between a land use activity and detection of a change in groundwater resource – the 'nitrate time bomb'[202] is an example (see below).

Figure 4.1.1: Relative importance of surface water and groundwater resource in England and Wales



Source: redrawn from Environment Agency

Figure 4.1.1 demonstrates the importance of groundwater as a water resource in England and Wales[203]: the upper layers of aquifers alone contain over 20 times the volume of water stored in all our reservoirs. In some regions (e.g. the South and East)

202 NERC (2006); Addiscott (2005); Howard and Burt (2009)
203 ER: 7 (Appendix B refers)

groundwater provides over 70% of our potable supply requirements. Surface and groundwater resources provide water for people, industry, livestock and irrigation, as well as maintaining ecosystem services. Changes in water availability are increasingly likely to influence land use in the future.

4.1.1 Water resource management – patterns and trends

Water use

The volume of water abstracted in England and Wales has increased substantially over the last five decades, although it has been broadly stable over the last 10 years at about 60,000 megalitres (ML) per day, despite a significant increase in population growth[204]. Almost a third of abstraction is used for the public water supply, and half is used for cooling in the generation of electricity and providing hydropower. Industrial and commercial use (of the public water supply and by direct abstraction) is generally declining as society moves to a more service-based economy. Agricultural irrigation amounts to about 1% of total abstraction in the UK (compared with 70% globally). Although currently low, the use of water for irrigation in the UK is nevertheless significant because abstraction is often concentrated in the drier regions in the driest months and years. Irrigation has been growing at about 2% per annum, mainly for high-value crops such as vegetables and soft fruit[205].

Household use is the main component (52%) abstracted from the public water supply and has increased by over 30% since 1970. Government targets for the UK aim to reduce current per capita consumption of 150–180 litres per person per day (l/p/d) to 130 l/p/d or even 120 l/p/d by 2030[206]. The UK person's average annual water footprint is 700 litres for drinking, and 60,000 litres for household and garden use. However, 'embedded' water (i.e. water used in food, products and services) can amount to more than one million litres per person per year, and its contribution to wellbeing and prosperity is often overlooked. The UK has become the sixth largest net importer of embedded water in the world. In a recent report, the World Wildlife Fund suggest that only 38% total UK water use is actually derived from UK water resources[207]. For example:

- The water footprint for production of a car is nearly 400,000 litres;
- Each 300mm silicon computer chip requires 8,622 litres of deionised water;
- 550 litres is required to produce enough flour for one (400g) loaf of bread.

Water availability, water stress and land use: impacts on water resources

The average annual water availability per person in the UK is approximately 2,465 cubic metres, which is less than Spain (2,794 cubic metres), Italy (3,325 cubic metres) and France (3,439 cubic metres)[208]. Average annual rainfall in the UK is unevenly distributed (see Figure 4.1.2a). In southeast England, the lower effective rainfall (740mm rainfall minus 480mm actual evaporation = 260mm effective rainfall) combined with a high population density gives an average of 610 cubic metres of water per person per year[209].

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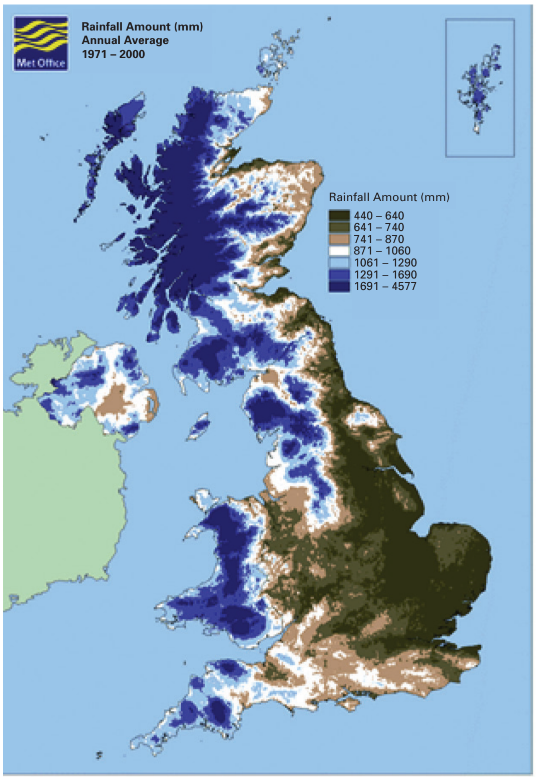
204 ER: 5 (Appendix B refers)
205 ER: 5 (Appendix B refers)
206 Defra (2008)
207 World Wildlife Fund (2008)
208 FAO (2005)
209 Rodda (2008)

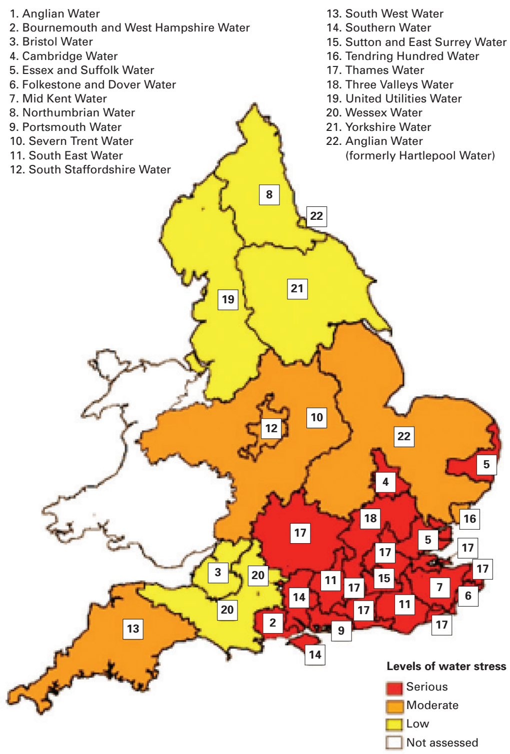
Net water abstraction may be approaching environmental limits in many areas, particularly during summer low-flow periods, and many water utilities are experiencing moderate to severe water stress[210] conditions (Figure 4.1.2b).

Figure 4.1.2a: Average annual rainfall (mm) 1971-2000



Source: Met Office (2000)

Figure 4.1.2b: Levels of water stress in water utility regions in England and Wales



Source: WaterUK

The Environment Agency (2008a) classifies many of the catchments in England and Wales as over-licensed or over-abstracted (Figure 4.1.3). Whilst figures for gross abstraction can overestimate the net impacts on river flows, since much of the abstraction is subsequently returned to water sources, the Environment Agency CAMS (Catchment Abstraction Management Strategies)[211] process takes this return flow into account. The risks presented in Figure 4.1.3 are therefore realistic. What the CAMS process does not do is take account of the *water quality* of the return flow. So, while the public water supply (PWS) returns an estimated 80–90% of flow, the water quality of the return flow may be reduced and the water is returned at a different point from where it was abstracted.

Fish farms, mineral washing, hydro-electric plants and through-flow cooling for electrical generation return almost 100% of abstracted water, usually near the abstraction point; but again, the quality is often degraded, for example, through increased temperatures of returned water and through contamination (e.g. with endocrine disrupters[212]). Where the point of discharge is more remote from the source of abstraction (and sometimes to a different water body), return flows can result in a net increase in flow. Returning

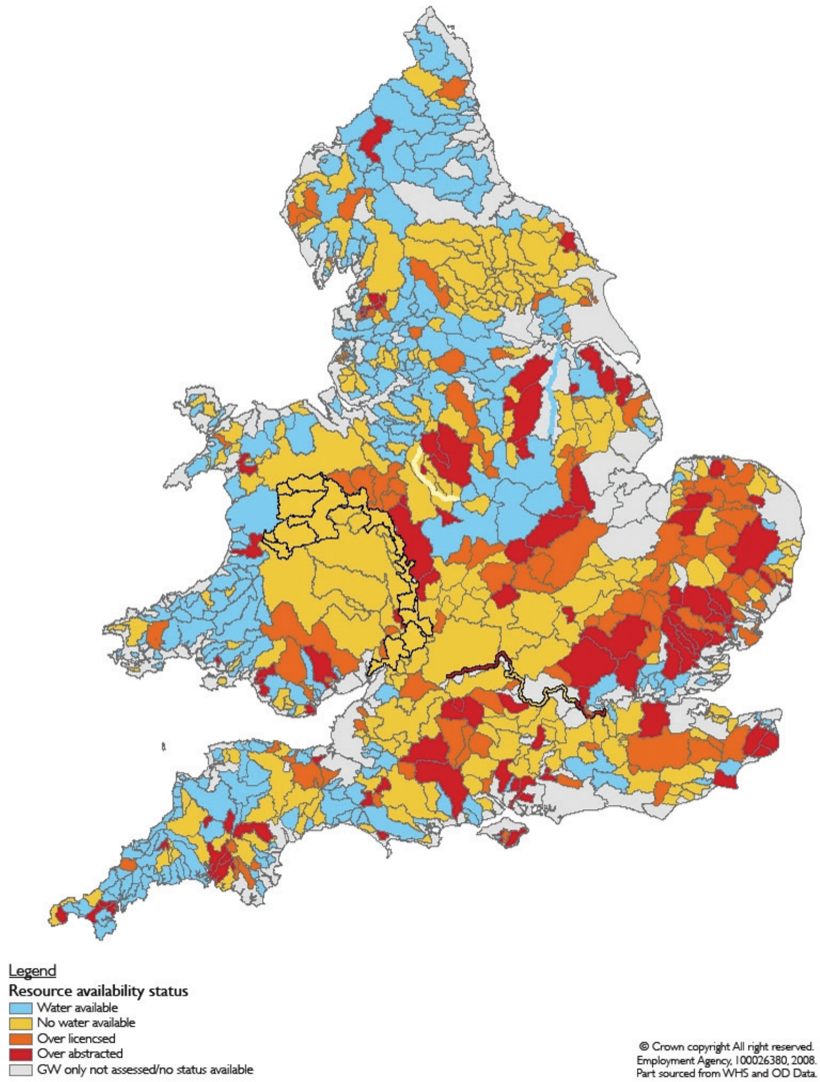
210 Water stress refers to when demand exceeds the supply of good quality water.

211 http://www.environment-agency.gov.uk/research/planning/33576.aspx

212 Endocrine-disrupting substances are naturally occurring or synthetic substances that interfere with the functioning of the endocrine (hormone) systems.

groundwater to surface waters may increase summer flow at the expense of winter flows. This is important for managing the variability of flows over the year. Unlike the public water supply, spray irrigation and evaporative cooling for electrical generation are effectively 100% consumptive.

Figure 4.1.3 Catchment water resource availability status in England and Wales



Source: Environment Agency (2007)

When new legislation is introduced, it may conflict with existing arrangements to regulate water resources. For example, previous over-licensing of water for abstraction has generated additional pressures in the adoption of the EU Water Framework Directive[213]. In another example, the Habitats Directive[214] has changed the burden of responsibility to one of demonstrating 'no significant impact', despite the fact that scientific evidence to meet this requirement is sometimes lacking. Consequently, on the basis of the precautionary principle, locations that have high biodiversity value (i.e. Natura 2000 sites[215]) have been required under the Habitats Directive to reduce water abstraction by c.250 ML/day (see Table 4.1.1). Whilst the overall reduction in abstraction is small in terms of public water supplies, the impact of the legislation is

213 http://ec.europa.eu/environment/water/water-framework/index_en.html
214 http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm
215 http://ec.europa.eu/environment/nature/index_en.htm

unevenly distributed; currently Anglian, Midlands and Thames regions bear the greater burden, and it is in these regions where the greatest water stress exists at present.

Table 4.1.1: Reduction in water abstraction (Ml/day) required to meet the EU Habitats Directive

	Water required to meet Habitats Directive in Ml/d	
	2010	*2025*
Anglian	42	210
Midlands	110	200
North East	25	25
North West	0	0
South West	14	14
Southern	20	80
Thames	46	187
Environment Agency Wales	0	0
Total	**257**	**716**

Source: Environment Agency data

The way land is used has a direct impact on the amount and timing of water reaching surface waters: a recent example of the consequences of this connection was the 2007 summer floods in the UK. Surface water flooding is difficult to predict and is usually localised, for example, in urban areas where there is little open ground to absorb rainfall, and where man-made drainage systems may be overwhelmed.

Land use and land management can also have a direct impact on surface waters where the infiltration capacity of the land surface is reduced – for example, through surface compaction that may result in surface runoff and erosion on a field-wide scale[216]. This is known as infiltration-excess surface runoff. However, in the UK, rainfall intensities are generally low and the soil infiltration capacity is unlikely to be exceeded[217], except where the land surface has been poorly managed[218]. However, the incidence of infiltration-excess surface runoff may alter under a changing climate if storm events become more frequent and intense. In the UK, saturation-excess surface runoff is more common and occurs where the soil water table rises to the ground surface through convergent flow into hillslope hollows or where rising stream water levels lead to saturation of riparian areas. Such zones provide an important ecosystem service by buffering water loss to streams and rivers, and have traditionally supported wetland habitats. Insensitive land use may, over time, have reduced their function.

The way land is used also affects the availability of groundwater by affecting recharge rates (depending on whether cover is vegetative or urban), and also when water is required for abstraction, as for example, in irrigation.

216 ER: 6 (Appendix B refers)
217 Kirkby (1988)
218 Heathwaite et al. (1990)

The impacts of land use on water quality

In general, the quality of water in UK rivers, lakes and streams is improving (Environment Agency data). For example, between 1990 and 2006 the percentage of rivers of good biological quality in England rose from 60% to 71%. However, most environmental monitoring is focused on statutory requirements (c.70% of the total monitoring spend), and these requirements are largely linked to discharges from sewage treatments works and from industry. In terms of governance, these discharges are relatively easy to detect and deal with through environmental regulation. Diffuse sources are more intractable because attribution is difficult and the impact of the polluting activity may occur some distance from the source[219]. The challenge is two-fold: obtaining adequate measurements to model appropriately the sources of water quality problems in catchments, and making predictions about the impact of investments in achieving improvements[220].

Currently, there are major gaps in our knowledge of the spatial variation in the delivery and the impact of diffuse pollutants on freshwater ecosystems. Consequently, although water pollution might be regarded as a market failure, it has proved exceptionally difficult to demonstrate to policy-makers the extent to which diffuse sources of pollution are responsible for water quality in particular locations or habitat deterioration in parts of river reaches[221]. This makes it more difficult to introduce accurately targeted 'impact-fee' or 'polluter-pays' systems. The implications of this market failure have been brought into sharp focus through a proliferation of stringent EU directives on freshwater and estuarine quality. Particularly important regulatory drivers designed to protect and improve water quality are the EU Bathing Water Directive[222]; the Urban Waste Water Treatment Directive [223]and the Nitrates Directive[224].

Probably the most critical recent legislation is the EU Water Framework Directive because this is a new type of legislation that moves away from chemical indicators as the main risk indicators of environmental harm. The main objectives of this Directive are the achievement of 'good ecological status' (GES), with no deterioration in surface waters, and a 'good' status for groundwater by 2015. Defining and subsequently measuring appropriate metrics of 'good ecological status' has been a particular challenge for science and regulation. The Directive requires member states: to identify water bodies in poor ecological status; to determine the causes for poor status; and to put in place cost-effective mitigation within timelines that would, by any policy standard, be very hard to meet. Diffuse pollution is regarded as a major barrier to the achievement of GES. Current statistics[225] suggest that over 84% of rivers, 85% of lakes, 97% of estuaries and 58% of coastal waters by length in England and Wales are failing to meet GES. Defra currently estimates that £5 billion will need to be spent over the next six years to improve this figure by 5% by 2015[226].

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219 Lane et al. (2006)

220 Heathwaite (2010); Stevens and Quinton (2008)

221 Heathwaite (1999)

222 http://ec.europa.eu/environment/water/water-bathing/index_en.html

223 http://ec.europa.eu/environment/water/water-urbanwaste/index_en.html

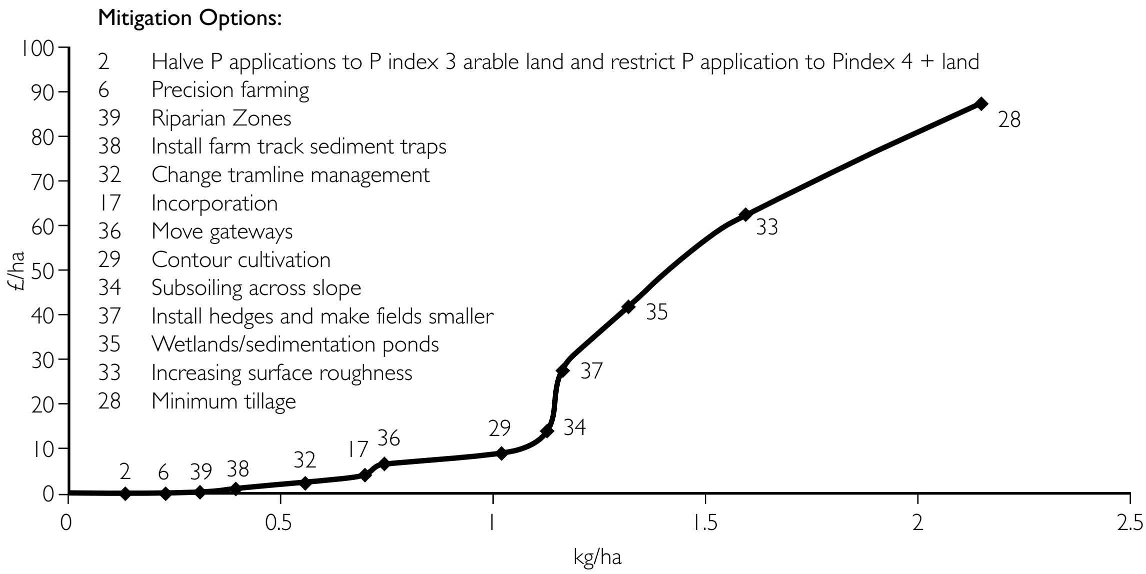
224 http://ec.europa.eu/environment/water/water-nitrates/index_en.html

225 Environment Agency (2008a)

226 Measures to address land use impacts on water quality are also built into the Common Agricultural Policy. They include, for example, voluntary measures contained in the Codes of Good Agricultural Practice for Air, Water and Soil; the requirement to maintain land in GAEC (Good Agricultural and Environmental Condition) in order to receive Single Farm Payment; advisory systems such as the Whole Farm Approach; and indirectly through the environmental stewardship schemes such as the Entry Level Scheme.

From the perspective of future needs, the Environment Agency has little quantitative evidence of the cost-benefit of land-based environmental stewardship schemes under the Directive's river basin management plans. Figure 4.1.4 gives an example of the cost-curve approach designed to evaluate the relative cost to benefit (in terms of pollutant removed) of different land-based mitigation options to address – in this example – diffuse phosphorus pollution from arable land. There are huge uncertainties around the estimates and significant problems remain in scaling up from small-scale experiments to large-scale areal estimates.

Figure 4.1.4: Cost-curve of selected phosphorus mitigation options for arable land



Source: After Cuttle et al. (2007)

There has been less emphasis on protecting the quality of groundwater resources, even though this provides approximately 70% of the piped water supply in the EU. The Environment Agency estimates that over 90% of groundwater bodies are at risk of failing to meet GES under the Directive by 2015, primarily as a result of diffuse pollution. In the UK, at least 50% (c. 2,450 ML/day) of the groundwater used for public supply shows significant deterioration in water quality since 1975 and has cost the UK water industry over £750 million since 1975 (87% capital investment with £436 million spent on treatment schemes; £134 million on blending and £184 million on replacement[227]). The costs reflect a combination of deterioration in groundwater quality and more stringent regulatory standards for drinking water.

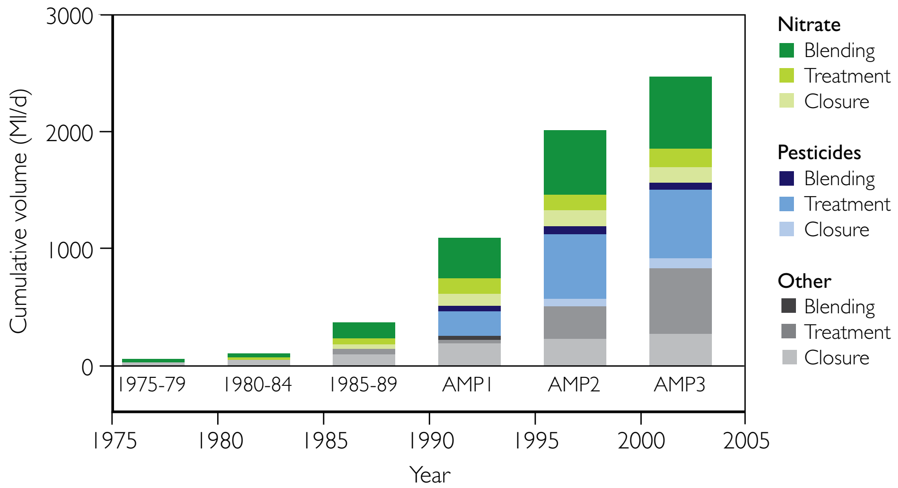
This degradation in groundwater quality has been driven by intensification of agricultural, industrial and human [sewage] uses of land[228]. Since 1975 an increasing volume of groundwater has required treatment or blending to ensure potable supplies (Figure 4.1.5). Where this has not proved practicable, closure of public water supplies has been necessary in some areas (especially in relation to nitrate and pathogenic or organic pollutants).

Part of the solution to halting and reversing this trend lies in developing appropriate land use measures to minimise further impact. However, historical pollution can only be addressed through retrospective action. The main sources of degradation come from

227 http://www.groundwateruk.org; Chilton et al. (2004)
228 Addiscott (2005)

nitrate, pesticides and 'other' pollutants such as *Cryptosporidium*, arsenic and hydrocarbons/solvents. All have implications for human health.

Figure 4.1.5: Change in the cumulative volume of groundwater requiring treatment, blending or closure of public water supplies over time due to degradation of the quality of the groundwater resource



Source: After Chilton et al. (2004)

Land and land management practices can cause chronic and long-lasting surface and groundwater quality problems[229], of which the most widely know is nitrate pollution[230], sometimes referred to as the 'nitrate time bomb[231]. Even if nitrate leaching was stopped through immediate changes in land use, it would take many decades or even centuries for most nitrate concentrations in UK groundwater to drop and hence for the impacts on surface waters to dissipate[232]. About 70% of England and Wales is designated as 'Nitrate Vulnerable Zones' where the rate and timing of applications of nitrogen are controlled.

Unfortunately, application of livestock-derived fertilisers such as livestock manures, if based solely on their nitrogen content results in over-application of phosphorus because crop nutrient requirements are satisfied by nitrogen to phosphorus ratio in the region 7–11:1, whilst manures generally fall in the range 2–6:1. Around 119,000 tonnes of phosphorus are returned annually to UK agricultural land as manures. Part of the explanation of the current UK phosphorus surplus (ca. 10 kg ha^{-1}) may lie in phosphorus enrichment of surface soils because livestock manure is undervalued. Elevated nitrogen and phosphorus compromise ecosystem services through the degradation of natural resources (soils, freshwater) and loss of biodiversity; they affect human health through poor drinking water quality and for nitrogen, through reductions in air quality.

229 Heathwaite et al. (1996)
230 Burt et al. (1993)
231 ER: 7 (Appendix B refers)
232 NERC (2006)

4.1.2 Future challenges

Important factors affecting future water supply, demand and quality include:

- Population levels: according to ONS projections, by 2031, there could be a need to provide water for an additional 9 million people, although there is significant uncertainty in this figure.
- It is estimated that by 2020, increasing population and housing growth will increase water demand on the public water supply by 5% or an extra 800 ML of water per day[233].
- Climate change impacts.
- Greater emphasis on the use of land for carbon sequestration through afforestation or enhanced peatland protection with implications for downstream water balances.
- Increased emphasis on the use of land to support ecosystem services such as buffering against flood risk and natural filtering of water in wetlands.
- Changes in agricultural practices including further reform of the Common Agricultural Policy (CAP).
- Urbanisation – affecting groundwater recharge, surface water flooding risk, and as a source of non-agricultural diffuse pollution, such as urban transport and construction activities.

South East England is likely to be a particular area of future water stress for both public water supply and agricultural food production. Already most of the region is classified as being under either moderate or severe water stress[234]. This could be exacerbated by future population growth and the impacts of climate change on water availability.

The impact of climate change on water resources

Hotter, drier summers are predicted to reduce summer river flows by the 2050s in the UK by up to 50–80% according to one scenario[235]. Wales and the North West of England are predicted to see significant reductions in river flow throughout the summer months. According to the scenario, the South and East of England will experience similar reductions later in the year – with river flows in November frequently dropping to almost half their current volume[236].

One UK study[237] that modelled three catchments found reductions in recharge from 7% (Paisley, Scotland) to 40% (Gatwick, South East England) by 2080 under 'high' greenhouse gas emissions scenarios. Groundwater recharge is predicted to reduce by 5–15% and 'will increase stress on local and regional groundwater resources that are already under ecosystem and water supply pressures'[238]. The impact of such reductions in recharge will be very variable. For example, for an aquifer that fills early each winter, a reduction in winter recharge may have no significant impact. However, small changes in the case of a partially-filling aquifer could require cessation of all abstraction, with substantial impacts if, for example, it fed an environmentally-sensitive wetland. With less recharge, the same loads of pollutants will have less dilution and so concentrations will

233 Environment Agency (2009)
234 Environment Agency (2007)
235 ER: 5 (Appendix B refers)
236 Environment Agency (2008b)
237 Herrera-Pantoja and Hiscock (2008)
238 ER: 7 (Appendix B refers)

rise, with potentially adverse effects on ecosystems and on the quality of water supplies.

The Climate Change and Demand for Water project[239] combined the UK Climate Impacts Programme 2002 (UKCIP02) scenarios[240] with the Environment Agency's water demand scenarios[241] and estimated increases in water demand resulting from mean climate change by the 2020s as:

- Domestic (household) demand up 1.8% (4% by the 2050s);
- Industrial use up 2.8%; and
- Agricultural use increasing by 20% in 2020 and 30% by 2050 – with the highest increases in south and east England.

Overall, the main message is that climate change is likely to reduce groundwater resources in some areas (critically in the South East), and make groundwater quality worse. This is before any account is taken of land use and land management changes. However, because there is significant time delay between a change in land use and an impact on groundwater owing to the time it takes for water to percolate to the groundwater table, any measures to alter land use to protect groundwater resources may take decades before delivering benefits.

Policy options relating to managing water supply and demand in the future

Usable water resources could be conserved by:

- **Disincentivising land uses** that either increase evapotranspiration in water-stressed areas or lead to rapid water loss to surface waters at the expense of recharge of soil moisture through the subsurface or to groundwater, or rewarding those land uses that can demonstrably conserve water.
- **Encouraging infiltration** through land uses that include urban infrastructure, land management, and farming practices that encourage infiltration, decrease surface runoff and reduce surface water flooding and soil erosion, to benefit groundwater and maintaining summer flows.
- **Continuing current policy linked to agriculture** e.g. Catchment Sensitive Farming (CSF) and the Whole Farm Approach[242] – because it may protect both water resources, by maintaining good soil structure and hence infiltration rates, and water quality, by minimising diffuse pollution.
- **Developing appropriate technologies and food crops** to minimise the use of water for irrigation where possible. The Royal Society (2009) describes decisions on the use of water for irrigated agriculture as 'increasingly moral and ethical choices, as well as economic ones'.
- **Investing in natural water storage** through restoring or creating wetlands, and planned flooding.

239 Downing et al. (2003)

240 Hulme et al. (2002)

241 Environment Agency (2001)

242 These are both programmes funded by Defra. The CSF seeks to manage the levels of diffuse pollutants entering water courses; the Whole Farm Approach offers a more efficient administrative system for dealing with regulatory requests respectively.

- **Investing in better connections within catchments** to achieve more flexibility to share between water supply zones, provided ecosystem services are not degraded as a consequence.

Managing water quality

Both surface and groundwater resources are highly vulnerable to human activities on the land surface. Point sources of pollution can, in principle, be removed. Potable water supplies can also be treated, but with significant monetary and energy-related costs. Whilst the greenhouse gas emissions of the public water companies are less than 1% of the total UK emissions, they are rising and many of the more advanced treatment options are energy-intensive. More extensive treatment through land management may, therefore, become the preferred option.

Critically, although potable water supplies can be treated, it is not possible to treat the environmental and ecological implications of pollution in this way as the effects are diverse and are difficult to approach systematically relative to drinking water, which is regulated. There is, therefore, a strong argument for prevention over treatment of diffuse pollution, and this is the basis for more recent legislation, notably the Water Framework Directive. The real challenge is to demonstrate success where the measures to improve ecosystem health take a long time to be detectable and where other changes (e.g. climate) are also influencing the link between land use and water.

Whilst land use can play an important role in managing the future water *supply* and in protecting quality, other options are also available to manage water *demand* e.g. through metering and licensing. Issues relating to how we cost and value water are critical, including the appropriate valuation of water-related ecosystem services. Other potential measures include increased storage – new reservoirs, additional capacity in existing reservoirs, and desalination, although this is currently expensive and has a high energy demand.

The 2006 House of Lords report on Water Use[243] concluded that a 'twin track' policy dealing with both demand and supply for water was necessary. In particular, the need for a clearer understanding of the water demands of new housing was emphasised. The demand for water presents a substantial current (and future) challenge when deciding the location of new housing. A particular example was establishing the feasibility of making the 120,000 new homes planned for the Thames Gateway water-neutral (i.e. building new housing developments without increasing an area's total water usage).

Data and monitoring of water quality

Continued investment in data collection and validation remains important. A review by ADAS for the Environmental Research Funders' Forum[244] found major gaps in the UK environmental monitoring of water quality, with a lack of baseline data and long-term trend data. A limited choice of indicators and measurements may be giving unreliable results. A new UK Environmental Observation framework (UK-EOF)[245] has been launched that may help fill this gap.

243 House of Lords (2006)

244 http://www.erff.org.uk/publications/index.aspx

245 http://www.erff.org.uk/activities/uk-eof.aspx

4.1.3 Summary of key implications for policy

How we use land to manage water resources will be severely affected in the future by factors such as population growth, climate change and changes in urban and peri-urban area and agricultural practices. These drivers will exacerbate the challenges on water supply that we face today. Even today, before the impacts of climate change begin to be clearly identified, with one scenario predicting a drop in water availability of between 50% and 80% by 2050, how we begin to adapt will be crucial. Understanding and managing land use will influence the future quality of both surface and groundwater. Management of land to protect and maintain water resources may increasingly come into conflict with other land uses. A better understanding of the relationship between water and biodiversity, soil protection, flooding, climate change adaptation and housing supply will be crucial. Using integrated catchment management and cross-government approaches to making water use sustainable will be essential.

- **Land and water management need to be integrated better** because decisions about land use cannot be separated from decisions about water resources, water quality and public supply. The Water Framework Directive has made progress in dealing with management of the water environment in an integrated way; a greater focus on the interaction of land management with water will help to meet the targets set by the Directive and address future requirements in a climate change context.

- **Policies and decisions on the allocation of land for development should consider water availability, and current and predicted water scarcity should be fully reflected in prices,** taking account of the full cost of water supply, including environmental consequences. There are lessons to be learnt from others, most pertinent are with regard to water trading in Australia[246].

- **The best available strategies need to be deployed to achieve sustainable water use.** This will require flexibility across traditional policy boundaries involving land and water decision-making. There is a need to re-examine arrangements for the management of water resources and water quality with the aim of developing a more integrated strategy that builds in current and future land use and land management options. Governance arrangements will need to ensure that groundwater and surface water management are fully integrated, to prevent efforts made in one area being undermined by decisions in another.

- Compartmentalisation of responsibilities of water resource management may lead to decision-making at catchment and river basin scales not being fully integrated. This strongly suggests that **the work of Defra, the Environment Agency, Natural England and water utilities needs to become more joined up, building on initiatives such as catchment sensitive farming.** The evidence supports the implementation of integrated catchment management in this context. Other relevant strategies include prioritising land-related options such as: integrated management of water from source to sea; tackling water pollution at source; and making space for water to aid water conservation and minimise flood risk.

- **Technological solutions will have a role to play.** For example, reuse and recycling of water is likely to become more important in the future, possibly involving on-site treatment and direct reuse, or ensuring return flows are returned upstream of other river abstraction points for indirect reuse. These may have impacts on the efficacy of water-related ecosystem services. An important question is whether to invest more

246 http://www.myoung.net.au/water

heavily in improving the quality groundwater resources or to place greater reliance on technological solutions such as desalinisation.

- **Investment in monitoring and modelling at appropriate time and space scales is essential** to provide the evidence base on which to make informed choices about the future use of water and indicate where land use and land management can increase the sustainable use of water in the long term.

4.2 Land use for conservation

In the UK, as in many countries, few landscapes remain natural. However, many of our distinctive range of semi-natural habitats and cultural landscapes are valued by society, both in their own right and for the contribution that they make to people's wellbeing and prosperity. Over the last century this has led to a system of designations[247] and measures to ensure the conservation of a range of habitats, species, landscapes, buildings and other features, to ensure their survival in the face of land use change. In the case of wildlife, the unequal spread of semi-natural habitats and therefore the species that depend on them, has meant that conservation of a small proportion of the UK land area has enabled the protection of a large proportion of the remaining species and habitats. This section briefly sets out the main designations and considers the possible future direction that land use for conservation may take.

4.2.1 Conservation past and present

Conservation is a land use in its own right, especially where land is owned and managed specifically for that purpose, for example a publicly-owned or managed National Nature Reserve. More commonly, land is interpreted variously as habitats, ecosystems or landscapes, where the primary land uses such as agriculture and forestry also provide additional land services such as biodiversity, tranquillity or aesthetic value. However, unless land is owned or specifically managed for these additional purposes, conservation may need to be achieved by indirect interventions using designations[248] and the related measures that may be attached to them.

The current system of designations for conservation originated approximately 60 years ago in response to prevailing issues, and cultural and political aims. Since then, it has evolved in response to a range of emerging issues through the second half of the last century, including, for example, the effects of intensification of agriculture. The designation system is considered to have been successful in achieving its aims[249], but over the next 50 years additional action is likely to be required as the context for conservation changes. The effect of human-led land use change combined with changing climatic conditions will be significant. For example, wildlife is already responding to climate change through changes to seasonal events such as flowering, species distribution and species abundance. However, changes in land use mean some habitats have become fragmented. As climate change begins to affect land cover (e.g. the type or quality of the vegetation), some species may not be able to move to adapt to these changing habitats[250].

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247 'Designation' is used in this section to cover any measure involving the identification of areas of land for special treatment, recognising that technically Sites of Special Scientific Interest are 'notified' not 'designated'.

248 ER: 8 and ER: 18 (Appendix B refers)

249 Donald et al. (2007)

250 Natural England (2009a)

Complexity

The relationship between land use change and the functioning of ecosystems is not straightforward. Land cover is directly affected by many factors, including the changing use and management of land, climatic conditions and soil quality. The range of potential activities land is capable of supporting may also be constrained by the physical characteristics of the land and environmental conditions. Changing a habitat will often affect the diversity of species contained within it, and conversely a change in the number and assemblage of species may affect the nature of the habitat. These interdependencies mean it can be difficult to anticipate the subsequent effects of land use change, the consequences of which may not be experienced until much later.

Designation and protection of tracts of land, landscapes or whole ecosystems is a policy response which is intended to preserve the integrity of the character of the landscape or the health of complex ecosystems. Certain habitats, for example, if reduced in size or divided into separated fragments, may no longer be able to support certain species. The interrelationships are complex but reduction in area, for example of woodland, may lead to local extinctions, while increased isolation of the remaining areas may further threaten long-term viability[251]. A crucial test of the 'health' of a local environment is the state of the wildlife community appropriate to that area or habitat. Equally, even small changes in land use in an Area of Outstanding Natural Beauty could in some cases significantly alter the character and quality of the landscape and its value to people.

The designation approach has a statutory basis. Land is selected on the basis of criteria, identifying boundaries based on legal–administrative instruments, and applying controls and incentives within that area. The creation of specialist planning or management agencies is sometimes involved. Usually there is an implication that without special protection, conditions would deteriorate. However, external conditions may change to such a degree that the protected area is compromised, requiring alternative or complementary approaches.

Approaches to designation vary from conservation of nature and biodiversity, to protection of cultural landscapes and areas of geodiversity interest, to protection of the historic environments, including archaeology, historic buildings and settlements. There are at least 10 relevant international or national area-based land designations, as well as those that relate to specific features such as trees or to the historic and built environment. Moreover, there are different designations in the devolved countries, different layers of influence of European and international law and different mechanisms that apply in each designation. The result is a complex and multilayered system of land designations that usually overlie primary land uses and which can sometimes be layered over each other.

Designations serve a vital purpose and any changes in the status of protected areas could have profound unintended consequences. There is, however, a strong case for reassessing whether the operation of the current system is fit for purpose and sufficient on its own to respond to new pressures and changing circumstances, including the adequacy of "representative coverage."[252]

251 Watts et al. (2005)

252 Designations for biodiversity, for example, were established to be representative rather than comprehensive.

Conservation of biodiversity

Governments, including the UK Government, have ambitious targets to halt biodiversity loss by 2010. Land use change and the way land is managed now and in the future will have significant implications for such objectives.

The 20th century saw heavy losses in natural and semi-natural habitats for wildlife. While the precise causes and effects linked to biodiversity decline are unclear, the England Biodiversity Strategy[253] argues that increasing demands on natural resources and systems, the pressures of urbanisation and the intensification of agricultural production all contributed to declines in the extent and quality of wildlife habitats and to declines in the population of many wildlife species. Effects documented in the biodiversity strategy for England include:

- Farmland bird populations fell by almost half between 1977 and 1993 – though were relatively stable from 1993 up to 2002.
- By the 1980s, unimproved lowland meadows had declined by 97% over the previous 50 years. Declines continued up to 2002 at a rate of 2–10% per year.
- By 1980, over a quarter of upland heathland had been lost in England, with losses of 36% in Cumbria. Widespread declines in the condition of the remaining habitat still continue.
- Between 1978 and 1998 the diversity of plants in infertile grasslands in England and Wales declined by 20%.
- Disappearance of water voles from 94% of the places where they had previously been recorded.

Areas of land are designated across the UK to conserve remaining semi-natural habitats that support biodiversity, and these are widely regarded as having been successful in helping to improve habitat conditions, in slowing or preventing further biodiversity losses and in safeguarding sites from potentially damaging activity[254]. In addition, proactive measures are increasingly being taken to restore degraded habitats (e.g. degraded peatlands in upland areas[255]) and to manage areas of re-created habitat[256].

Estimates for land cover relating to broad habitats used in the Biodiversity Action Plan (BAP) are shown in Table 4.2.1, drawn from the UK report of the Countryside Survey[257].

253 Defra (2002)
254 Dodd et al. (2009)
255 ER: 11 (Appendix B refers)
256 For example the Great Fen Project http://www.greatfen.org.uk/
257 Carey et al. (2008)

Table 4.2.1: Estimated percentage of semi-natural (broad) habitats in Great Britain since 1990. (Note: because of changes in definitions that have been applied retrospectively, the estimates from 1990 are not fully consistent with later surveys)

	Great Britain					
	1990		1998		2007	
Broad Habitats	'000s ha	% area of GB	'000s ha	% area of GB	'000s ha	% area of GB
Broadleafed, Mixed and Yew Woodland	1343	5.8	1328	5.7	1406	6.0
Coniferous Woodland	1239	5.3	1386	5.9	1319	5.7
Linear Features	581	2.5	511	2.2	496	2.1
Arable and Horticulture	5025	21.6	5067	21.7	4608	19.8
Improved Grassland	4619	19.8	4251	18.2	4494	19.3
Natural Grassland	16669	7.2	2007	8.6	2176	9.3
Calcareous Grassland	78	0.3	61	0.3	57	0.2
Acid Grassland	1821	7.8	1502	6.4	1589	6.8
Bracken	272	1.2	315	1.3	260	1.1
Dwarf Shrub Heath	1436	6.2	1299	5.6	1343	5.8
Fen, Marsh, Swamp	427	1.8	425	1.8	392	1.7
Bog	2050	8.8	2222	9.5	2232	9.6
Standing Open Waters	200	0.9	196	0.8	204	0.9
Rivers and Streams	70	0.3	65	0.3	58	0.2
Montane	na	na	na	0.2	42	0.2
Inland Rock	76	0.3	111	0.5	101	0.4
Built–up Areas and Gardens	1256	5.4	1279	5.5	1323	5.7
Other land	659	2.0	762	3.3	731	3.1
Unsurveyed urban land	482	2.1	452	2.1	482	21
Total area	23313		23313		23313	

Source: Carey et al (2008)

Biodiversity[258] embraces not only the overall richness of species present in a particular area but also involves measures of the diversity of genotypes, functional groups, communities, and ecosystems that might be identified. Estimates have been made of the total stock and the change in different land cover types, which can in turn be related to semi-natural habitats and hence to biodiversity, although the relationships are often complex[259]. Data from successive Countryside Surveys in Great Britain reveal patterns of stability in recent decades. Only 6% of the land surface area has changed its cover between 1998 and 2007; a similarly slow rate of change was recorded in Countryside Survey 2000[260].

A representative selection of the best areas of semi-natural habitat are usually notified as Sites of Special Scientific Interest (SSSIs), but this national notification may be overlaid by other UK and European designations: National Nature Reserves (which bring the habitats concerned into direct conservation management), and Special Areas of Conservation or Special Protection Areas (which seek to protect particular species and habitats[261]). In England, just under half of the remaining areas of semi-natural habitat are included in SSSIs[262]. The total land area in the UK covered by designations related to biodiversity has increased from just over 2.3 million hectares in 1996, levelling out at around 3.5 million by 2008[263]. However, inclusion in an SSSI does not in itself guarantee appropriate management of the land to maintain its special qualities and interest although owners of such land are required to notify the responsible authorities of any proposed operations that may cause damage. Among other measures to strengthen protection of these sites, the Countryside and Rights of Way Act 2000 provided for refusal of consent for such operations without compensation. There is also a government target to make sure that 95% of SSSIs are in 'favourable' or 'unfavourable but recovering' condition by the end of 2010.

In the UK, considerable effort has been devoted to monitoring trends in individual species since the Convention on Biodiversity (CBD) was introduced in 1992: this made a commitment to achieve, by 2010, 'a significant reduction of the current rate of biodiversity loss at the global, regional and national level'. As part of its national approach to meeting this target the UK Government has identified 1,150 priority species and 65 habitats for which conservation action is required.

It is apparent that there are still significant challenges facing biodiversity in the UK. For example, among the 45 Biodiversity Action Plan habitats, trend data for 2008[264] suggest that 42% are declining to some degree, 20% are stable and 20% are increasing to some degree. A similarly mixed picture emerges in terms of species, but there are particular concerns about the more common species. In England, for example, recent assessments[265] suggest a decline in populations of birds, and especially farmland birds, and also farmland butterflies, both of which are believed to be good indicators of the state of wildlife and the countryside more generally.

The decline of common species means that the everyday surroundings of gardens and urban green spaces will play an increasingly vital role as reservoirs of wildlife. This is

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258 This section draws on ER: 8 as well as other sources that are referenced separately (Appendix B refers).

259 ER: 8 (Appendix B refers)

260 Haines-Young et al. (2000, 2003a, 2003b)

261 See ER: 18 (Appendix B refers) Appendix 1 for details of all designations.

262 Natural England (2008a)

263 JNCC (2009). Figures may vary depending on the method used for measuring coverage.

264 Biodiversity Action Reporting System (BARS), http://ukbap-reporting.org.uk

265 Defra (2009a, 2009b)

especially so as agricultural intensification has in many areas reduced the value of farmland as habitat[266]. Research has shown[267] that gardens support a surprisingly diverse range of wildlife, making important contributions to biodiversity conservation if appropriately managed. Similarly the importance of 'creative conservation' is growing. This concept, which has been understood for some time, recognises that many land uses offer opportunities for creating new habitats for wildlife. For example, proposals for restoration and for follow-on uses for mineral workings (such as quarries, sand and gravel pits) can make specific provision for habitat creation and at a scale that can contribute to Biodiversity Action Plan national habitat extension targets. At a more local scale urban development schemes can, for example, incorporate green roofs, which can be designed to benefit both people and wildlife. Creation of new habitats will never be a substitute for measures designed to protect valued semi-natural habitats and species, but it does show the role that different land uses can play. More generally, habitat restoration and expansion by creation of new habitats and habitat networks will have a vital role to play in adapting to the impacts of climate change on biodiversity[268].

Conservation of landscape

Landscape designations tend to be large and cover a substantial proportion of the UK. They cover tracts where natural and cultural factors interact to create distinctive areas that are valued not only for their scenic qualities but also for their broader natural heritage values. Designations include:

- *National Parks:* These protect areas of relatively wild land, mainly in private ownership, with dedicated National Park Authorities who have a range of planning and management powers. In England and Wales they are responsible for conserving and enhancing natural beauty, wildlife and cultural heritage and improving opportunities for public understanding and enjoyment. If there is a conflict, greater weight is given to conservation than recreation. The recently introduced National Parks in Scotland have a similar role but the purposes and aims are expressed differently. National Parks cover just over 9% of the land area of England, nearly 20% of Wales and just over 7% of Scotland.

- In England and Wales *'Areas of Outstanding Natural Beauty'* (AONBs)[269]: These are designated for their landscape and scenic beauty, on which basis they are considered equivalent to National Parks. However, they do not have a statutory recreation purpose. They cover 15% of the land in England and 5% in Wales.

- In Scotland, *National Scenic Areas* (NSAs): These are designated to provide examples of the range of typical Scottish natural beauty. They cover nearly 13% of the land in Scotland.

- *Heritage Coasts:* These cover 33% of the English coast, but do not have the same status as the other landscape-scale designations and may overlap with them[270].

The concept of natural beauty has a long history, and recently has been debated and tested in public inquiries and legal cases relating to the designation of the New Forest and the South Downs as National Parks in England. There has been a move towards designations being based on clear and transparent criteria, including landscape quality defined in terms of intactness and condition of the landscape, scenic quality, relative

266 Defra (2002)
267 Gaston et al. (2004)
268 Natural England (2009a)
269 This section draws on ER: 12 (Appendix B refers)
270 Natural England (2009b)

wildness, tranquillity, natural and cultural heritage features, and association with specific people or events.

Recent but generalised evidence from the Countryside Quality Counts project in England[271] suggests that the character of designated landscapes is being maintained or enhanced, certainly compared with other parts of the country. However, there is some concern, supported by mainly anecdotal yet plausible evidence, that designations may have a displacement, or 'halo', effect in diverting development – wind farms being a prime example – just outside their boundaries[272].

4.2.2 Future issues and challenges for the conservation of biodiversity[273]

Critical issues for policy-makers relating to the links between biodiversity and land use include adapting to climate change, valuing biodiversity, integration, protected landscapes and integrated approaches to conservation. These are covered in the sections below, and are followed by a summary of key implications for policy.

Adapting to climate change

Geographical shifts in suitable climate conditions have been identified as one of the most noticeable of climate change impacts on wildlife[274]. For example, Huntley[275] predicted that, by the end of the century, the majority of European breeding bird species' ranges are likely to have shifted northwards and to the northeast by 500 to 1,000 kilometres, with wide variation between species, and a large number suffering declines in range.

It will be important for future land use policy to reflect the complexity of conserving biodiversity in the face of a changing climate. Simplistic approaches which result in abandonment or moving designations could threaten long-term conservation objectives. For example, protected areas are not just important for the species that reside within them but also for maintaining the environmental conditions which are the foundation for diverse ecological communities[276]. These conditions, such as low-nutrient soils or high water quality, can develop over hundreds of years. Once lost, many of these environmental conditions cannot be recovered. Where recovery is possible, the timescales may be long or costly. In the Biodiversity Action Plan it is argued that 'Diverse environmental systems normally enhance the resilience to cope with ecological stresses and perturbations, such as climate change'. It is further argued that 'our understanding of ecosystems is insufficient to be certain of the impact of removing any component'. Given these challenges it is noteworthy that an independent panel has recently been established that will review England's wildlife sites and explore whether this collection of wildlife areas represents a coherent and robust ecological network that will be capable of responding to the challenges of climate change and other pressures.

Habitat creation can play an important role in providing replacement habitats for vulnerable species, especially for relatively simple habitats, but others such as ancient woodland, which are older and more biologically specialised, are difficult to replace. As our understanding of ecological systems grows, habitat creation within or outside

271 Haines-Young (2007)
272 ER: 18 (Appendix B refers)
273 ER: 8 (Appendix B refers)
274 Cliquet et al. (2009)
275 Huntley (2007)
276 Dodd et al. (2009)

protected areas will be an important part of society's response to preventing further loss of biodiversity, but it should not be viewed as a panacea.

Valuing biodiversity

Evolving perspectives on how biodiversity and ecosystem services are valued will influence conservation policy. Although biodiversity has intrinsic value, it is argued that conservation can also be justified by more utilitarian arguments that emphasise its role in securing the output of ecosystem services. The Biodiversity Action Plan argues that 'biodiversity should be maintained because future practical needs and values are unpredictable'.

The report *The Economics of Ecosystems and Biodiversity* (TEEB)[277] notes that if society is to sustain the benefits that ecosystems provide then there is a need to rethink the way market systems operate, and to ensure that the contribution of nature to human wellbeing is fully recognised. While market-based approaches involving payments for ecosystem services are likely to shape the management of land and the transactions that surround it, monetary valuation of biodiversity and ecosystem services is only likely to take us so far in shaping future policy interventions[278]; the success of market-based approaches will depend on having appropriate institutional infrastructure, incentives, financing and governance.

It is possible that different decisions would be made if these new perspectives on the values associated with biodiversity are factored into decision-making. The balance of arguments between conserving an area of semi-natural habitat or changing to a new form of land use or land cover might be very different if the losses and gains in economic value can be accurately weighed up.

Integration

Human and climate change impacts taken together pose significant policy challenges. For example, the capacity of species to adapt to climate change impacts can be hampered by land use change which results in the fragmentation of habitats. Finding novel ways to respond to such challenges, for example, connecting habitats by creating 'green corridors' or 'green infrastructure', will require new ways of thinking about land which do not conform to an urban/rural divide. The 'sum of influences' acting on a species or habitat over the long term needs to be looked at in an integrated way, and in some instances will require landscape-scale responses. This principle is reflected in the 'Nature Directives'[279], which provide an integrating framework that seeks to maintain species and habitats at a level that is at 'favourable conservation status'. It has been argued that there is more scope for measures implemented under these directives to adopt this approach[280].

Such 'systemic-level' responses will require gaps in our understanding of the relationships between landscape structure, biodiversity and the output of ecosystem services at different spatial and temporal scales to be addressed. There will also be a need for comprehensive monitoring systems. The scope of indicators might also need to be expanded so that the consequences of biodiversity change for ecosystem services and human wellbeing can be better understood.

277 European Communities (2008)

278 See Chapter 3

279 Including the Birds and Habitats Directives

280 Dodd et al. (2009)

Protected landscapes[281]

The protected landscape designations which have existed over the last 50 years in the UK largely responded to the threat of development spreading into the countryside, and also to the desire to provide an outlet for physical exercise in natural surroundings for urban populations. In the next 50 years, there will also be a range of new issues, including climate change and the role of agriculture in a global economy, which will influence conservation policy.

There is a case for future policy to focus on ensuring good condition of existing areas and the effective involvement of communities and stakeholders, as opposed to significantly expanding the quantity of land under protection. In England and Wales, there is unlikely to be any significant expansion in the number of Areas of Outstanding Natural Beauty although there may be debates about specific areas. A review of National Scenic Areas in Scotland concluded that the emphasis should now be on improving the management of existing areas while not precluding possible additions in the future[282]. The addition of new National Parks in England and Wales is unlikely now that the original emphasis on the uplands has been balanced to some degree by designations in the Norfolk Broads, the New Forest and the South Downs. The long-standing anomaly of Scotland's exclusion from the national park family has been addressed with the Loch Lomond and Trossachs, and Cairngorms Parks. The only current national park proposals are in the Mourne Mountains in Northern Ireland and a proposal for Harris in Scotland.

The conceptual counterpoint to designation of special landscapes is the idea that the character and quality of the wider countryside also matters – encapsulated in Natural England's recent policy document *All Landscapes Matter*[283]. This has emerged as a significant area of policy in the last 20 years and has been given added impetus by the signing and ratification of the European Landscape Convention by the UK Government. The approach is based on recognition that landscape character (and indeed biological diversity, albeit unequally) extends across the entire countryside and, increasingly, into the urban 'green infrastructure' as well, and that this needs to be addressed through policy and other mechanisms.

It is widely argued that the 'protected landscape' and 'all landscapes' approaches are complementary rather than mutually exclusive. Thus, designation remains appropriate where areas are recognised as being of particular value, or because they are degraded and require more active management. But other landscapes and habitats, which are often nearer to clusters of population, may be valued for different reasons, and there will be growing efforts to manage change positively to ensure that landscape character and diversity are maintained. In future there are likely to be debates about the appropriate balance between the two approaches and ways in which they can be mutually supportive.

Integrated approaches to conservation

Land is valued for a number of different reasons. This section has concentrated on its environmental value for both biodiversity and landscape but, as acknowledged earlier in introducing the complexity of the system of designations, it also has value as a record of our history, through various aspects of the historic environment. The last 60 years have seen the development of largely separate policy, legislative, regulatory and

281 ER: 18 (Appendix B refers)

282 Scottish Natural Heritage (1999); Scottish Executive Rural Group (2006)

283 Natural England (2008b)

administrative systems for these different areas of conservation interest, even though all are concerned with the land and share a number of interdependencies. More recently, there have been steps to adopt a more integrated approach, mainly through establishment of new integrated agencies covering biodiversity, landscape and recreation, initially in Scotland and Wales and more recently in England, as well as a number of approaches to joint working. There has also been a degree of convergence in assessment methods, for example, through integrated characterisation projects, and integrated objectives, as in agri-environment schemes like Environmental Stewardship.

Nevertheless, there are still separate systems of designation and often separate communities of practice in these areas and considerable scope remains for more fully integrated approaches to the conservation value of land in both urban and rural areas. Development of the Quality of Life Capital Approach by the main environmental agencies in England in the 1990s was an attempt to develop a more integrated cross-cutting approach. Over the next 50 years the ecosystem services approach is set to become a mainstream way of ensuring that all the benefits and services offered by land are taken into account in decision-making and in land management.

4.2.3 Summary of key implications for policy

UK land supports a diversity of semi-natural habitats and cultural landscapes. They have great value both in their own right and for the contribution that they make to people's wellbeing and prosperity. The current system of land designations emerged and evolved over the last 60 years. It has played an important role in protecting these valued environments in that time and continues to do so.

- Recognising that designated sites cannot achieve nature or landscape conservation objectives alone, practices of nature and landscape conservation have become more integrated with other policy sectors and the wider countryside, and adapted to perform other functions. **As the impacts of climate change become more apparent, there is a case to review the designation system to, for example, identify and address gaps in the network and consider how designations should be embedded within landscape-wide strategies.** Any change in policy relating to designations would need to be based on rigorous scientific analysis of the possible future impact and for compliance with relevant EU legislation.

- Attitudes towards conservation will continue to evolve as new research improves our understanding of the complex relationships between people and land, and perceptions and preferences change over time. **Designations will continue to play an important role and will need to be kept under review in light of changing circumstances in the long-term. But they will be complemented by measures to address the quality and management of the environment beyond these special areas.** This will require landscape-scale approaches to biodiversity, including creation of habitat networks, which other agendas such as the creation of green/blue infrastructure. Novel forms of governance will be required to turn such ideas into reality across the country.

- **The somewhat fragmented sectoral approach to conservation, with biodiversity, landscape and the historic environment dealt with by separate systems, may need to be reconsidered** as the interactions between these different perspectives on the values that society attaches to land become more apparent. The ecosystem services approach, supported by the National Ecosystem Assessment, provides a valuable way of dealing with this, and governance arrangements at every level will need to deliver a coherent approach.

- **Policies across all land use sectors need to recognise that there are opportunities to enhance biodiversity in everyday surroundings as well as in special designated areas.** This means, for example, recognising the important role that gardens in urban areas can play, and protecting them and other urban green spaces from over-development. It also means seeking opportunities for habitat creation, for example in dis-used quarries.

- **Biodiversity, landscape and aesthetic value, and other cultural services provided by land are not marketed and hence in a purely market system would tend to be undersupplied.** Depending on the priority attached to them, this implies a need for intervention that is currently absent. The ecosystem services approach has made good progress in defining this wide range of values. But much more work is needed to understand and value these various services, and to consider new incentives and regulations to ensure they are provided.

4.3 Agriculture

Today, agricultural land in the UK plays diverse roles: providing food, contributing to the economy and, increasingly, contributing to wider environmental agendas[284]. This follows successive developments over the last 50 years:

- *Growth:* beginning with the 1947 Agricultural Act promoting self-sufficiency through guaranteed minimum prices and incomes, producer marketing boards and farm development schemes.

- *Consolidation:* from joining the EU in 1973, characterised by protectionism and production support under the Common Agricultural Policy (CAP) regime.

- *Adjustment:* from 1985, involving production quotas, payments per head of livestock and per hectare of crop, agri-environmental schemes, and the introduction of EU environmental directives.

- *Reform:* from the early 2000s stimulated, for example, by the CAP Agenda 2000 Reform and the 2003 reform with greater 'decoupling' of farm income support and commodity subsidies, and increased environmental regulation.

Key factors driving change have included changes in domestic and world markets, technology developments, institutional and organisational arrangements, changes in the motivation and behaviour of farmers, diseases such as BSE and Foot and Mouth, and national and EU policies. Impacts have varied in different parts of the country, reflecting important regional variations in the agricultural landscape. A review of recent trends in agriculture provides important insights for what might develop over the next 50 years.

4.3.1 Past and present trends

Agriculture's contribution to the UK economy: The contribution to GDP has declined from 5% in the 1950s to 0.8% in 2007[285] (for comparison, in 2002, agriculture's share of GDP in the EU-15 was 1.7% and in the USA 1.4%[286]). Employment in the sector has fallen from 6% to 1.8% over the same period, but still provides 531,000 full-time equivalent jobs today. A broader view to include the food industry and rural tourism increases the current share of GDP to about 8% and 12.5% respectively. In line with

284 ER: 28 (Appendix B refers)
285 Defra (2008a); ER: 28 (Appendix B refers)
286 Normile and Price (2004)

other EU and OECD Member States, agriculture's share of UK national economic output and employment has declined over time as prosperity has increased.

Agricultural land use currently occupies almost 74% of the total land area of the UK, high by European standards. The agricultural land area has declined by about 0.2% per year over the last 50 years – about 10% in total.

The total area of UK cereals has declined, although there are significant variations between crops. In the last decade, the acreage of forage maize and farm woodland has expanded considerably. Set-aside, whereby land 'surplus' to requirements is taken out of production, accounted for almost 10% of the arable area in 2007 before its discontinuation in the face of higher international prices. For livestock the picture is mixed, but in general there has been a marked fall in numbers since the 'decoupling' of farm income support. The dependency of some parts of the livestock industry, especially that located in disadvantaged upland areas, is generally high, indicating a vulnerability to policy change[287].

These changes in crop and livestock production confirm the responsiveness of farmers to a range of policy, market and technological drivers that have influenced the relative attractiveness of enterprises and have generally favoured economies of scale and specialisation[288].

Farm businesses in the UK landscape have become bigger and more specialised. The number of farms has reduced by about 50% since 1950, to about 230,000 today. During the same period, the average size of holdings in terms of area and livestock numbers has increased by about 40% and 150% respectively[289]. On average, 'commercial' farms in the UK are now about four times larger in area than the EU average[290], with the largest concentrated in southern and eastern England[291]. There has also been a recent trend towards diversification of farm businesses, with 58% of farms deriving income from non-farming sources. Small hobby and lifestyle farms[292] have increased in number, especially in peri-urban areas.

Yields per acre of crops and livestock continue to increase, but with considerable variation among crop and livestock types. From the 1950s through to the mid-1980s, reductions in farmed areas were more than offset by increased yields associated with improvements in crop and livestock genetics, nutrition and health, and land improvements such as drainage[293]. For example, average wheat yields have doubled since the 1960s[294], and average milk yields per cow doubled between 1960 and in 2005 to over 7,000 litres. Driven mainly by policy-induced incentives, it appears that technologies to enhance yields have virtually doubled the productive capacity of land over the last 50 years.

Agricultural commodity prices have been a key driver of land use and land management practices. World market prices for agricultural commodities have fallen for much of the last 70 years, notwithstanding price spikes[295]. While farmers have been responsive to

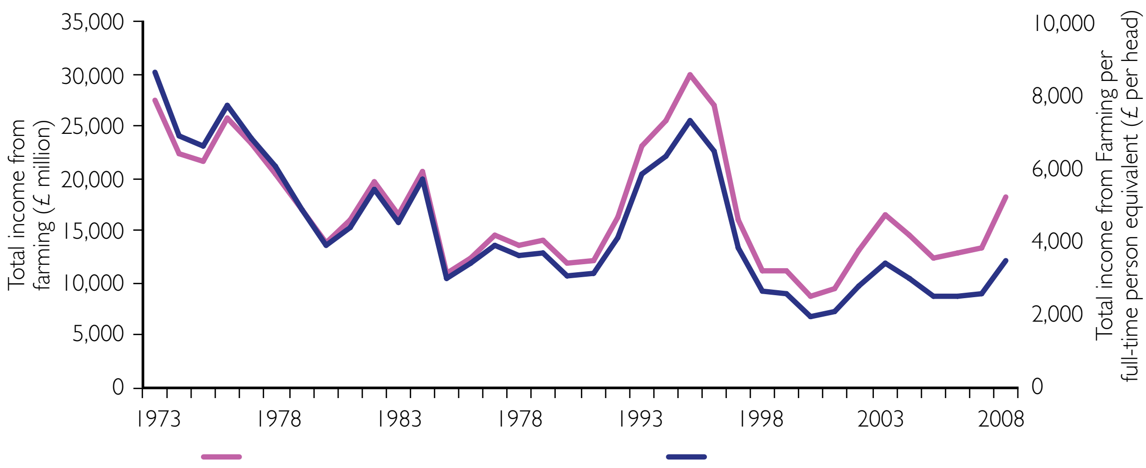
287 ER: 11 (Appendix B refers)
288 ER: 28 (Appendix B refers)
289 ER: 28 (Appendix B refers)
290 Eurostat (2009)
291 Ward (2000)
292 ER: 16 (Appendix B refers)
293 ER: 27 (Appendix B refers); Sylvester-Bradley and Wiseman (2005)
294 Austin et al. (1980); Austin (1999)
295 Piesse and Thirtle (2009)

strong prices, they have been less responsive to weak prices. This partly reflects a degree of 'asset fixity', whereby farm resources, including land, have limited alternative uses, at least in the short term[296]. This has been the experience particularly in the livestock sector, and especially in relatively remote and disadvantaged areas[297].

Agricultural commodity prices in the UK and hence the incentives to UK farmers now largely depend on three main factors: world market prices, levels of tariffs imposed on agricultural products into the EU and the relative value of the pound to US dollar and Euro exchange rates[298]. Without a major shift in policy, UK agriculture will continue to 'take' its prices from global markets, although the EU as a whole has potential to influence world market prices.

UK farm incomes, which maintain the presence of farming in the landscape, have shown volatility around a generally declining trend, largely reflecting trends in real commodity prices (Figure 4.3.1). In 2008, total income from farming (TIFF) was about 60% lower in real terms than in 1975, when commodity prices were highly protected under the Common Agricultural Policy. The prospect of higher energy prices could challenge the viability of farming systems that are dependent on large inputs of inorganic fertilisers, pesticides and farm machinery[299].

Figure 4.3.1: Total income from farming (TIFF) in the UK 1973–2008



Source: Defra (2009a)

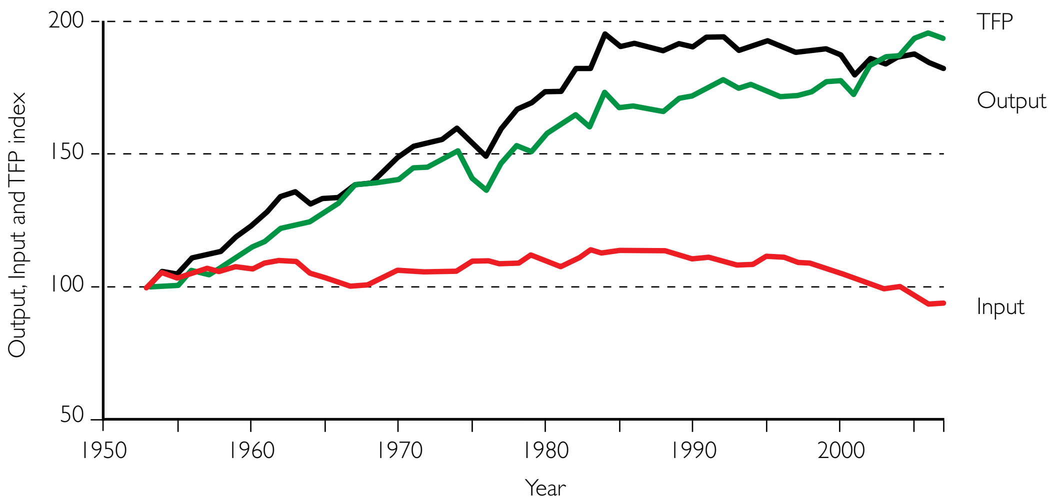
Farm incomes in the uplands have been under particular pressure in recent years. Grazing livestock farms in less favoured areas experienced a 40% fall in income to an average of £10,400 per farm between 2003 and 2008. About 25% of total receipts come from single farm payments, and compared to their lowland counterparts, upland farmers have found it difficult to diversify their resources of income, further increasing their dependency on income support[300].

The productivity of UK farms is an important determinant of the amount of land required to satisfy demand for agricultural commodities. Total factor productivity (TFP – a measure of the value-weighted volume of outputs from agriculture relative to

296 ER: 28 (Appendix B refers)
297 ER:11 (Appendix B refers)
298 Defra (2009a); USDA (2009b)
299 Sustainable Development Commission (2007)
300 Commission for Rural Communities (2010); ER:11 (Appendix B refers)

all inputs) has almost doubled since the early 1960s, mainly due to increased yields and labour savings (Figure 4.3.2). Both output and productivity increased sharply until the mid-1980s when production quotas were first introduced.

Figure 4.3.2: Levels of output index, input index and total factor productivity index for UK agriculture from 1953 to 2007 (1953=100)



(Thirtle and Holding 2003; Defra, 2008a)

International comparisons of UK agriculture suggest that UK farm productivity has lagged behind that of other EU Member States and the USA since the mid-1980s[301]. Improved productivity in farming is now more closely attuned to improved environmental performance associated with reduced waste, precision application of chemicals, and energy and water use efficiency[302]. In the event of further liberalisation of agricultural trade in the future, the comparative productivity of UK agriculture will affect whether agricultural commodities are imported or exported.

Productivity gains in labour use have been associated with major changes in the landscape. The biggest increase in productivity in UK agriculture has been in output per worker, which has increased by a factor of six since the 1950s[303]. The increased size of tractors and equipment has been associated with larger field sizes, removal of boundary features such as hedgerows, and installation of field drainage in order to extend the period when fields can be worked by heavy machines. Future trends in farm mechanisation will be a critical factor in land management, and are currently a relatively under-researched topic.

The amount of land used by agriculture in the UK reflects the proportion of the UK's total raw food requirements sourced from UK farms. This peaked at about 75% of UK requirements for indigenous foods in the mid-1970s when 'Food from Our Own Resources' was the main policy objective[304]. In 2008, UK agriculture supplied about 60% of all food consumed in the UK and about 70% of indigenous food, that is of types of food that can be grown in the UK[305]. Since the 1990s the greatest reductions in self-sufficiency have been associated with increased imports of livestock products, especially beef, pork and dairy products.

301 Defra (2008a)
302 ER: 27 (Appendix B refers)
303 Bailey et al. (2004); Thirtle and Holding (2003)
304 MAFF (1975)
305 Defra (2008a)

Government does not prescribe targets for national self-sufficiency, but seeks to achieve 'food security' by guaranteeing households access to affordable, nutritious food[306]. UK agriculture, along with the food industry as a whole, is charged with 'ensuring food security through strong UK agriculture and international trade links with EU and global partners'[307]. In this regard, UK agriculture is required to be internationally competitive.

The changing demand for food in the UK. Trends in recent years include a reduction in the consumption of milk and dairy products, and also in bread and fresh potatoes, and an increase in the consumption of fruit and vegetables. Total meat consumption has remained relatively steady, notwithstanding short-term fluctuations[308]. The demand for organic and 'welfare' foods has increased substantially, and concern about excessive food miles has promoted interest in locally procured and seasonally produced foods[309] (although demand has faltered since 2007 following the onset of the economic recession). It is unclear how these trends affect aggregate land use, but organic and animal welfare systems generally require additional land use compared with conventional agricultural production systems.

Market power has consolidated in the food retail sector in the last two decades[310] such that about 75% of food sales are now made by 'supermarkets'. This concentration has tended to favour larger farm producers[311], but has also promoted improved environmental and welfare performance in parallel with environmental auditing schemes such as LEAF[312].

Defra's Strategy for Food 2030[313] aims to enable and encourage people to eat a healthy, sustainable diet. This includes wasting less food, eating food that is in season, and buying foods that are produced sustainably. These aspects have implications for land use and management.

Agriculture and environment

It is increasingly recognised that agriculture contributes to the provision of a wide range of 'public goods' associated with managed landscapes and habitats, public access to the countryside and the regulation of water and atmospheric gases.

As referred to in Chapter 3, estimates suggest that agriculture in the UK generates a positive environmental value of about £1.74 billion per year[314] mainly associated with agriculturally-managed landscapes and habitats. Conversely, negative environmental impacts are estimated at about £2.57 billion, mainly due to soil-related greenhouse gas emissions to air (£2 billion) and the remainder linked to flooding, water pollution and soil degradation. This gives a net environmental cost of about £830 million per year. Although these estimates must be treated cautiously, they indicate the substantial positive and negative externalities that should be accounted for in the economic assessment of agricultural land use.

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306 Defra (2010)
307 Defra (2010)
308 Foresight (2007)
309 Defra (2007); NFU (2008)
310 Defra (2006); IAASTD (2009)
311 McCullough et al. (2008); World Bank (2007); IAASTD (2009)
312 Linking Environment and Farming (http://www.leafmarque.com/leafuk/)
313 Defra (2010)
314 Jacobs et al (2008), Defra (2009). At https://statistics.defra.gov.uk/esg/reports/envacc/default.asp

The relationship between farming and the environment has become the focus of European Directives such as the Habitats Directive, the Nitrates Directive and the Water Framework Directive. Under reforms of the Common Agricultural Policy, farmers are required to comply with codes of good agricultural and environmental practice as a condition of continued income support.

A comprehensive programme of Environmental Stewardship[315] rewards farmers for additional environmental protection and enhancements, including the creation of woodlands and wetlands, and improved public access. This includes a general Entry Level scheme, for which all farmers are eligible, and a Higher Level scheme, which targets specific environmental outcomes (see Box 3.2 in Chapter 3). There are currently over 58,000 agri-environment scheme agreements in England covering a total of six million hectares, accounting for 66% of 'utilisable' agricultural land[316]. The new industry-led Campaign for the Farmed Environment aims to extend participation in the Entry Level scheme and mitigate for the loss of environmental benefits formerly provided by the requirement to have set-aside. A new Upland Entry level Scheme, scheduled for 2010, uses the previous Hill Farm Compensatory Allowance to pay farmers for providing environmental and landscapes services (see Box 3.2). This reflects two realities: the current dependency of upland farms on income support and the range of valued non-market services they provide[317]. Future government support for agriculture is likely to be more targeted on environmental outcomes, seeking to achieve agricultural productivity alongside environmental protection and enhancement.

Future policy will aim simultaneously to achieve a wide range of benefits from rural and agricultural land management, such as farming, wildlife, water resource protection, flood risk management, carbon offsetting and public enjoyment of the countryside. This will require joining up various government policy arenas and non-government interests, developing schemes to 'pay for environmental services' (see Chapter 3).

Agriculture and climate change

Agriculture has an important role in the mitigation of and adaptation to climate change[318]. It can reduce its emissions by changes in farming practices. It can sequester and store carbon, as well as produce substitute energy products that have a lower carbon footprint. It must adapt practices to deal with changes in weather patterns, water availability and possible pest and disease problems that may be associated with climate change.

Agriculture currently accounts for about 7% (51Mt CO_2 equivalent) of total annual greenhouse gas emissions (GHG) in the UK[319], associated with fossil fuel usage (11% of agricultural GHG), methane from livestock (37%) and nitrous oxide from fertiliser use (52%). Release of soil carbon is currently low[320], but degradation of soils could significantly add to annual emissions; UK soils store the equivalent of 50 times the total UK annual emission of GHG. The food system as a whole, including food processing and distribution, accounts for about 18–20% of total UK GHG emissions[321], about half

315 Defra (2009b)

316 Natural England (2009)

317 ER:11 (Appendix B refers)

318 ER: 29 (Appendix B refers)

319 DECC (2009)

320 ER: 29 (Appendix B refers)

321 Garnett (2008); Cabinet Office (2008)

of which is attributable to food production, allowing for emissions associated with imported foods[322].

Although there are no specific emission targets for the agriculture and forestry sectors, and agriculture is not part of the European Emissions Trading Scheme (EU ETS, 2009), a range of possible policy interventions have been identified, focusing on improving the efficiency of fertiliser use, livestock feeding and breeding, waste management and changes in cultivation practices[323]. The complex biological processes involved in crop and livestock production make it more difficult to reduce GHG emissions compared with other sectors, especially regarding nitrous oxide and methane emissions[324]. The Government's low-carbon transition plan anticipates a relatively modest 6% reduction in total agricultural emissions on 2008 levels by 2050, supported by technical assistance and bioenergy capital grants[325]. Other measures, such as reduced consumption and production of livestock products associated with changing human diets, could, it has been suggested, achieve further reductions of 15–20% in GHG emissions from agriculture by 2050[326].

Agricultural land also offers potential to offset the emissions from other sectors through carbon absorption and storage[327]. In future, this could feature as part of emission trading schemes, linked to payments for other services such as nature and natural resource conservation (see Chapter 3).

Agriculture and energy prices

UK agriculture, although accounting for only about 2% of national energy consumption, is vulnerable to the likelihood of higher and more volatile oil prices in future. Many of the gains in agricultural productivity in the UK in the last 50 years have depended on relatively cheap and secure energy supplies. Although higher oil prices tend to be associated with higher agricultural commodity prices, potential benefits to UK farmers are offset by increased energy costs[328]. High energy costs could encourage less-intensive farming with lower yields per hectare, increasing the land area required for agriculture. Organic production, for example, uses fewer fertilisers and chemical inputs, but tends to use more mechanised power and has lower yields than conventional farming, resulting in similar overall energy efficiencies[329]. Higher energy prices will, however, induce energy-saving technologies, including on-farm energy recovery from wastes[330].

Agriculture and bioenergy crops

A review for the UK Government (the Gallagher Review[331]) concluded that there is a future for a 'sustainable' biofuels industry, but that this must 'avoid using agricultural land that would otherwise be used for food production'. Greater demand for biofuels could lead to displacement of existing agricultural production, increased land use change, loss of biodiversity, and pressure on water resources.

322 Williams et al. (2006)
323 SAC (2008); DECC (2009); Smith (2009); ER: 29 (Appendix B refers)
324 Defra (2008a); DECC (2009); Williams et al. (2006); Steinfeld et al. (2006)
325 DECC (2009)
326 Audsley et al. (2009)
327 ADAS (2009); ER: 27 (Appendix B refers); ER: 29 (Appendix B refers)
328 Sustainable Development Commission (2007)
329 Williams et al. (2006); IAASTD (2009)
330 ER: 29 (Appendix B refers)
331 Renewable Fuels Agency (2008)

There is concern globally that the additional land required for biofuel production could displace food production, and lead to higher food prices[332]. According to OECD/FAO[333] the demand for biofuels contributed 30–40% of the peaks in global agricultural commodity prices during 2007/08. However, a recent HMG publication on the agricultural price spikes of 2007/08 concluded that the impact of biofuels is often over-stated.[334]

Global biofuel demand is expected to more than double over the next 10 years, depending on oil prices, policy targets and support measures. At a global scale, FAO/OECD suggest that, while additional agricultural land is available to meet future food and biofuel demand to cope with increased world population, economic and environmental factors may limit agricultural productivity[335]. These global dimensions have important implications for trading conditions for EU and UK agriculture.

For the UK, meeting the EU 10% target for the proportion of road transport fuels to be met by renewable sources, would require the diversion of the existing oilseed rape crop of 600,000 hectares and an additional 840,000 hectares, equivalent to about 30% of the existing arable area[336], a similar proportion to that given to producing feed crops for horses at the end of the 19th century. Using a sugar beet feedstock would require about 10% of UK arable land. The Gallagher Review recommended that targets for transport fuels higher than 5% should only be adopted if biofuels can be shown to be sustainable, especially with regard to impacts on land use change[337].

Attention is likely to switch from conventional crops for biofuels, to second-generation biomass crops such as *Miscanthus* and willow[338], much of which can be grown on poorer land, within the limits of available water. Third-generation biofuels, especially algae-based biodiesel[339], are now being developed, but these also may require large-scale commitments of land and water resources[340].

There is probably sufficient land in the UK to maintain current levels of food production and go some way towards meeting EU targets for transport biofuels, but this will require improvements in productivity as well as adequate financial incentives to biofuel producers, whether driven by oil prices or policy measures (see Box 4.3.1).

4.3.2 Future prospects for agricultural land use

Future changes in the scale and intensity of agricultural land use in the UK will be influenced by the interaction of important factors relating to:

- *Demand*: for agricultural food and industrial products, including biofuels, and set in a global context with heightened concerns about food and energy security and the relationship between the UK and world agriculture[341]. There is also likely to be greater demand for non-market environmental goods and services such as

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332 Defra (2008b)
333 FAO (2009)
334 The 2007/08 Agricultural price spikes: Causes and Policy Implications
335 OECD/FAO (2009)
336 ER: 27 (Appendix B refers)
337 Renewable Fuels Agency (2008)
338 Karp et al. (2009)
339 IAASTD (2009)
340 IAASTD (2009)
341 HM Government (2006)

landscape management at the local scale, and services such as carbon sequestration at the global scale.

- *Supply*: the development and application of agricultural knowledge, science and technology that can improve agricultural productivity and its environmental performance (particularly relating to energy, climate change and biodiversity).

Among the many drivers of change, three are particularly interlinked: the future role of science and technology as it determines productivity of agricultural land use; the future demand for agricultural land and the two-way relationship between agriculture and the wider environment – notably regarding the mitigation of and adaptation to climate change.

Technology change and land use

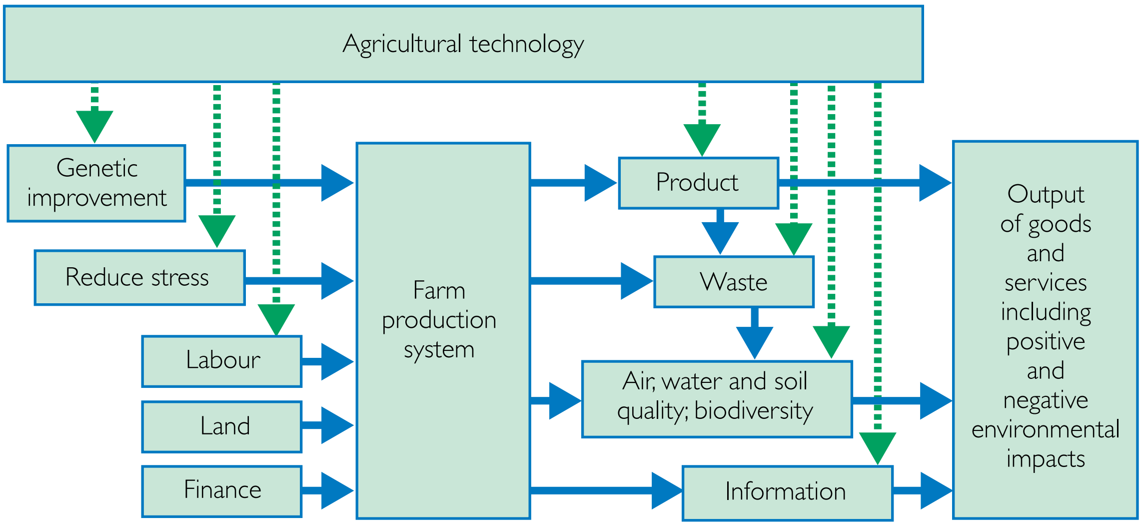
The inputs and outputs (including environmental outputs) of farm production systems are shown in Figure 4.3.3. Several aspects of technological change could yield improvements with implications for future land use – these are represented by the dotted lines in the Figure.

Examples of improvements include:

- Breeding technologies, including possible application of GM and other new technologies; adoption by farmers could potentially increase 'average farm' yields by up to 30–60% by 2050[342].
- New agricultural products associated with industrial and bioenergy crops, and niche crop and livestock products for new and emerging markets (e.g. linked to health-related or ethical foods), could bring about major changes in land use and farming practices.
- Agricultural waste – in the future this will be seen as a resource, and technology will help to realise this potential. Reduction in waste throughout the food chain could significantly reduce the demand for raw food, possibly by 10–20%.
- New information technologies, involving bio-informatics, remote sensing and automation, will further improve the performance of food production systems and the efficiency of resource use[343].

342 Sylvester-Bradley and Wiseman (2005)
343 Day et al. (2008)

Figure 4.3.3: Schematic diagram showing key inputs and outputs of farms, and where technology can affect agricultural systems and thereby land use



Source: ER: 27 (Appendix B refers)

It is likely that farming will increasingly be required to conform with prescriptions on best practices, such as cultivation methods, chemical use and possibly type of crops, especially in vulnerable or ecologically sensitive areas. A range of technologies are expected to have the potential to help agriculture to operate within environmental limits, and to cope with greater pressure on natural resources induced by climate change.

The future demand for agricultural land and the capacity to release land from agricultural production

Over the next 50 years, many of the technological innovations described above will improve land productivity, and could be pivotal in allowing more flexibility in future land use decisions[344].

A number of studies have considered possible requirements in the future for agricultural land in the UK (see Box 4.3.1) and have concluded that:

- The use of land for agriculture in the UK (and Europe) is likely to continue to decline, either due to demands for other uses or because some types of farming are no longer viable. However, much depends on commodity prices in global markets and the incentives they provide for UK farmers, including inducement for new farming technologies.
- Commodity prices might rise due to strong global demand for food and biofuels, and possible constraints on some types of intensive farming. Under such conditions, there could be strong demand for agricultural land in the UK, to produce for domestic needs or for export. In 2009 FAO and OECD[345], for example, forecast that world prices for the major UK-produced agricultural commodities will remain strong through to 2017, probably at about 25–30% higher than 2003–2006 levels.

In general, it is reasonable to predict a future where there is strong demand for agricultural products with prices that provide sufficient stimulus for UK farmers,

344 Sylvester-Bradley and Wiseman (2005)
345 OECD/FAO (2009)

especially those with comparative advantage in relatively large-scale, intensive farming systems and those specialising, individually or in groups, in niche, high value produce.

Multifunctionality and agriculture in the future

While climate change will undoubtedly be important, it is likely to be policy changes that have the greatest impact on agricultural landscapes in the UK in the next 50 years (including policies that address climate change).

In the future, it seems likely the UK's land area and land managers will be required to deliver a more diverse range of private and public goods to meet growing human needs and aspirations. This is consistent with past trends whereby the environment has increasingly become the focus of European Directives: there are currently almost six million hectares of farmland under agri-environment and related schemes in England, equivalent to about two-thirds of the eligible agricultural area. The future development of such schemes will be important, particularly beyond 2013 when the current EU Common Agricultural Policy regime comes to an end. However, it seems likely that there will be greater distinction in future between policies to protect and enhance the natural environment, and agricultural policies which enable agriculture to compete effectively in global markets, whether this means producing for domestic consumption or export.

Box 4.3.1 Some key findings of studies of the future of agriculture in the UK

Morris et al. (2005) explored '*Agricultural Futures and Implications for the Environment*'. The table below shows the possible effect of 'business as usual' and four other intervention scenarios on the change in technical efficiency, self-sufficiency and the use of lowland agricultural land in England and Wales for agriculture, in 2050 relative to 2002. Some scenarios, such as the World markets scenario, show a decline in agricultural use in the lowlands and a release of land for other purposes, mainly because improved productivity outstrips the demand for domestically produced commodities. It was also shown that a surplus of agricultural lowlands could hasten the decline of disadvantaged upland farming, possibly leading to "abandonment" where other land use opportunities are limited. There is little or no surplus land for scenarios with relatively low technical efficiency. The low intensity Local Stewardship scenario also requires relatively high agricultural use of upland areas to meet self-sufficiency targets. The production of biofuels to meet EU targets tends to lead to higher crop prices and greater land use than in other scenarios. Climate change was not considered in this analysis.

Scenario	Intervention regime	% change in technical efficiency	% change in self sufficiency	% change in land use for agriculture
Business as usual	Agricultural support as in 2002	+19	+6	-20
World Markets	Zero: market-driven free trade	+34	- 3	-34
National Enterprise	Moderate/high: protected domestic markets with limited environmental concern	+39	+26	-18
Global Sustainability	Low: market orientation with targeted sustainability compliance	+12	+ 8	-2
Local Stewardship	High: locally defined schemes reflecting local priorities	-7	+ 23	0

Note: changes relative to 2002 baseline, including cropping of conventional biofuel crops to meet EU-type transport fuel renewables targets in 2050 vary between scenarios from 4% (World Markets) to 12% (Global Sustainability).

Renwick et al. (2004) explored possible futures for agriculture at the UK and European scale, drawing on literature and expert opinion. This study predicted that agricultural land use in England and Wales to 2015 would decline by about 3% under a 'business as usual' scenario (post Agenda 2000 CAP Reform) in the face of reductions in farm income support and continued decline in real-world market commodity prices. These changes would largely maintain existing trends in land use and farming systems.

Long-term land use implications of agricultural change: These have been assessed using similar scenarios to those described above (Rounsevell et al. 2005; Ewart et al. 2005; ER:29). They allowed for changes in demand for agricultural commodities, agricultural productivity and the effects of climate change. Biofuels were shown to substitute for food production, especially if energy prices and yields of energy crop increase. At the EU level, increases in productivity were predicted to exceed growth in demand such that large areas of land would be taken out of agricultural production, with surplus land moving into urban, forestry and recreational uses. This appears consistent with past land use trends, where, even with subsidies, the area of agricultural land in Europe decreased by 13% since the 1950s.

Other EU-scale scenario studies (Meijl et al. 2006; Eickhout et al. 2007) predict that the area of arable land would decrease under liberalised world market conditions compared with continued support afforded by the CAP regime. Similarly, Verburg et al. (2006) predicted a high level of abandonment of agricultural land up to 2030, ranging from 2.5% to 13% of the agricultural area of the EU-15 in 2000, highest where agriculture is exposed to a liberalised world market and near to large urban conurbations, where there is pressure for urban growth.

These studies all point towards a decline in land use for agriculture in the UK under a 'business as usual' scenario. They concur that agricultural land for bioenergy production will be an important factor in determining this decline and its influence on prices of other crops. The scenarios also point, in general, towards an increase in productivity and efficiency of farming methods. The importance of CAP reform as a determining factor is another common theme.

4.3.3 Summary of key implications for policy

Agriculture is probably the single most dominant influence on the landscape at the national scale, currently occupying almost 74% of the UK land surface. It presents a number of critical challenges for governance because of three interrelated characteristics, namely:

- Its major role in shaping the UK landscape;
- Its dependency on government and EU policy; and
- Its strategic role, including helping to manage environmental change.

Agricultural policy and conditions in international markets for agricultural commodities will continue to be the two main drivers of agricultural land use in the UK. It seems likely that there will be greater distinction in future between policies to protect and enhance the natural environment, and policies which enable agriculture to compete effectively in global markets.

- **Increases in global population, climate change and pressure on natural resources** will require agriculture in the UK to produce more food sustainably. This will require improving the productivity of farming while reducing environmental impacts. Training, research and development, and advisory services will need to strengthen land management knowledge, skills and technologies to achieve greater sustainability.
- **It will be important to build and maintain capacity in critical agricultural assets** such as high-quality farmland and related infrastructure such as land drainage. Such

measures to improve farming practices and land use need to be integrated with other initiatives to improve sustainability throughout the food chain as a whole.

- **In future, there will be greater need to promote and reward the multiple roles of agriculture,** not only as a producer of food but also as a provider of a wide range of ecosystem services of benefit to society, such as environmental protection, especially climate change mitigation, flood risk management, biodiversity and recreation.

- **There is a need to achieve these multiple benefits through realignment of fragmented and sometimes conflicting areas of policy.** New governance systems are needed to help agriculture to reduce its negative impacts on the environment and to encourage and reward the provision of environmental services, such as managed landscapes, carbon storage and wetland habitats. Joining these initiatives up at the landscape scale will require new forms of collaborative working.

- **It is reasonable to expect strong demand in the UK over the next five decades for the various services from agricultural land.** A major issue to be faced is competition between the food and energy sectors[346]. Meeting renewable energy targets is likely to require a higher proportion of the land to be used for energy crops. While there is likely to be enough land for the UK to maintain current levels of food self-sufficiency and begin to meet EU targets on transport biofuels, this will require increases in productivity and financial incentives for producers. Further biofuel production could increase pressure on land resources and displace some food production. Incentives for farmers and other rural landowners will need to reflect a common, appropriate price for carbon and other ecosystem services.

- **The multifaceted role of agricultural management in the landscape will require greater investment in science, technology and skills** to help manage land assets into the future. This is likely to require diverse collaborations among many different public and private stakeholders.

4.4 Land for woodlands and forestry[347]

Nearly twelve per cent of land in the UK is covered by trees (see Table 4.4.1). This section explores the increasingly diverse roles that woodland and forestry are expected to play over the next 50 years. It also places these within the context of historical and present trends, and future challenges.

4.4.1 Overall patterns and trends

Governance

The Forestry Act of 1967 provides the statutory basis for forestry in the UK. This charged the Forestry Commission with 'the general duty of promoting the interests of forestry, the development of afforestation and the production and supply of timber and other forest products'. It also promoted the 'establishment and maintenance… of adequate reserves of growing trees.' Forestry has been fully devolved to Northern Ireland since 1922 and to Scottish Ministers and the National Assembly for Wales since 1999. The UK Government has retained responsibility for forestry in England and for international issues. Although forestry lies outside of the Common Agricultural Policy

346 See also Section 5.1.

347 In the following, 'forestry' is taken here to include all trees, woodlands and forests (TWF), whether subject to management or not.

(CAP), grants for farm woodland management and afforestation of agricultural land are available within the Rural Development Regulations.

In spite of the relatively narrow emphasis of the Forestry Act, today's forestry policy aspires to diverse 'ecological, economic and social functions' within the principle of 'Sustainable Forest Management' (SFM)[348]. Separate forestry strategies for England, Scotland and Wales set out the priorities and programmes for developing and implementing forestry policy over the next few decades, reflecting the different nature of each country's woodland and forests, and different priorities.

Location, extent and character

There has been a major expansion of woodland in the UK over the last century (Table 4.4.1). Woodland now covers nearly 12% of the UK land area, although this remains low compared to the EU average of 37%. Significant planting took place in the second half of the last century. More recently, the rate of planting has not been sustained, and a large proportion of woodland is now approaching harvesting age.

Table 4.4.1: Changing woodland cover in the UK

Year	England		Scotland		Wales		Northern Ireland		UK	
	Area (000 ha)	%	Area (000 ha)	%	Area (000 ha)	%	Area (000 ha)	%	Area (000 ha)	%
1924	660	5.1	435	5.6	103	5.0	13	1.0	1211	5.0
1980	948	7.3	920	11.8	241	11.6	67	4.9	2175	9.0
2008	1127	8.7	1342	17.2	285	13.7	87	6.4	2841	11.7

The expansion of forestry after the Second World War initially focused on relatively fast-growing, non-native, coniferous species, notably in upland areas in Wales, Scotland and northern England, where suitable land was available. In general, coniferous woodland, which currently makes up 60% of UK forests, has been retained and established on more acidic, infertile and poorly drained soils, which are unsuitable for other commercial species. In contrast, broadleaved woodlands are concentrated on lowland fertile brown earth soils.

In the UK, it is conventional to distinguish forestry from agriculture. These two sectors can be viewed as forms of land use along a continuum from large-scale plantations through to orchard and parkland systems, small wooded areas and isolated trees in agricultural areas. Although the area of woodland across the UK has increased over the last century, its distribution has changed. For example, the number of trees in the general agricultural landscape declined. In Great Britain, the 1998 Forestry Commission survey of small woodland and trees estimated that there were 123 million live trees outside woodland[349] in groups occupying less than 0.1 hectare, along field boundaries, within fields, and in narrow linear features such as windbreaks. The same report cited a survey from 1980 which, although not directly comparable, suggests that the number of individual trees on farms declined by about 57% between 1980 and 1998. Most of this reduction is likely to be associated with increased field size, removal of obstacles for farm mechanisation, and non-replacement.

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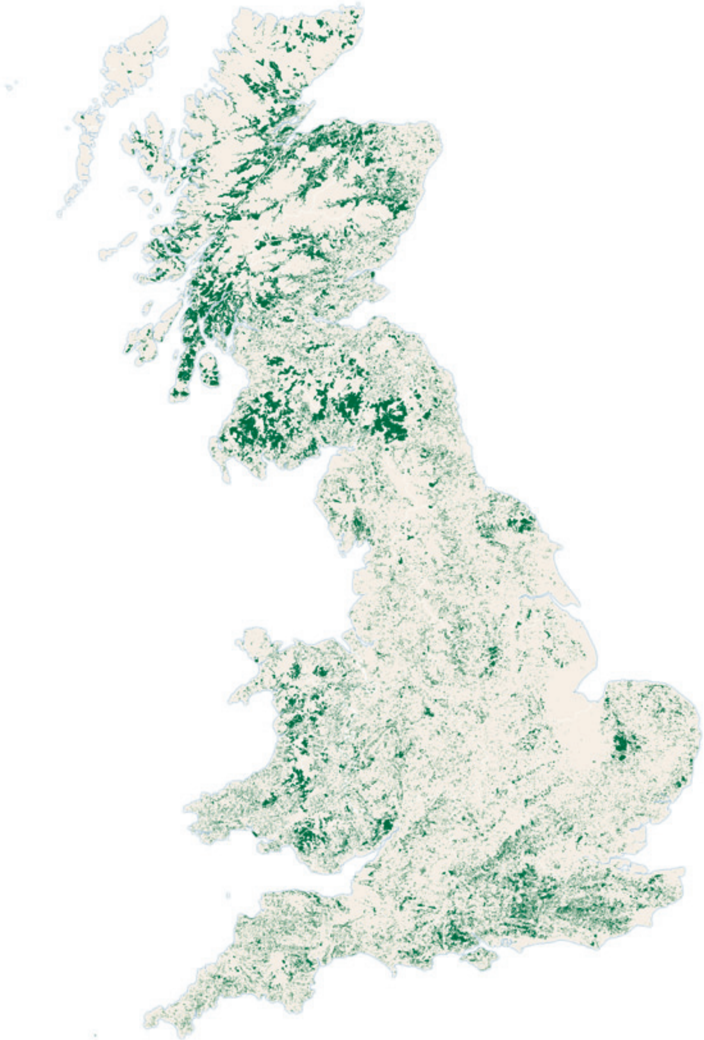
348 See Glossary in Appendix C

349 Forestry Commission (2001)

Figure 4.4.1: Distribution of woods and forests in Great Britain in 2000



Source: Forestry Commission (2003)

Most forestry and woodland planting in England in the last 20 years has involved broadleaf trees on farmland. The area of broadleaved woodland increased by 34% between 1980 and 1998, with the proportion of broadleaves to conifers increasing from 35% to 40%[350]. While the Wildlife and Countryside Act 1985 promoted woodlands composed of native tree species in order to support greater biodiversity, the main impetus to planting of broadleaves came as a result of the UK Farm Woodland Grant Schemes in 1988. These received EU recognition and were further strengthened through the CAP reforms of 1992. By contrast, expansion of conifers declined due the changes of taxation concessions under the UK Finance Act 1988.

Not only has the expansion of woodland area in England focused on broadleaves, it has also involved a switch from Forestry Commission land to private farmland.

New planting on farmland has declined in the last two years, mainly as a result of relative strengthening of the profitability of arable farming. In general, the establishment of forestry and woodland have been strongly influenced by financial incentives to land managers.

350 Forestry Commission (2003)

Spatial distribution

Woodland is unevenly distributed across Great Britain (Figure 4.4.1). Cambridgeshire, Anglesey and some Scottish Islands have less than 1% woodland cover, compared with East Galloway (nearly 36%), Surrey (nearly 24%) and south Gwynedd (nearly 20%). Woodland character also varies considerably: planted forests (mainly of Sitka spruce which comprises 49% of all coniferous woodland), are generally larger in Wales and Scotland, while in England the predominant form is small broadleaved woodlands. Major public forested areas are distributed across the UK and include the New Forest and Forest of Dean in England, Afan Forest Park in Wales and Argyll and Galloway Forest Parks in Scotland.

There is evidence[351] that the current location of forests in Wales may not generate best value. This is also likely to apply to other parts of the country, where location is largely driven by commercial criteria – i.e. growing timber, rather than providing other public benefits such as accessible outdoor recreation for urban communities.

Ownership and management

In 2008 the Forestry Commission and the Northern Ireland Forest Service owned or managed 29% of the total woodland area in the UK (18% in England and 70% in Northern Ireland). Other owners include traditional private estates, and investment and management companies[352]. Conservation charities such as the National Trust and Woodland Trust also play a significant part in woodland management (25,000 and 20,000 hectares respectively) and in the development of policy in support of Sustainable Forestry Management.

Virtually all forests and woodlands in Britain are or have been managed in some way. Only a small proportion of the woodland has a strong legacy of natural forest cover. 326,000 hectares of 'Ancient and Semi Natural Woodland'[353] have been conserved, as well as nearly 551,000 hectares of Ancient Woodland that has been continuously wooded since at least 1600 AD (1750 AD in Scotland). Restoration of 'Plantations on Ancient Woodland Sites' (so-called PAWS) has been a target in recent years. There has also been some restoration of bog from afforestation[354], but a continued pressure for woodland removal from other valued habitats, notably lowland heath. Organisations such as the Woodland Trust are committed to the preservation of ancient woodlands as well as the creation of new woodlands.

Forests on traditional private estates are typically commercially managed using tall, so-called 'High Forest Silvicultural Systems', with woodland blocks clearfelled when the tree crop reaches economic maturity. However, alternatives to clearfell, also known as Low Impact Silvicultural Systems and which include Continuous Cover Forestry, are increasingly being implemented.

The majority of woodlands on farmlands have been planted with conservation and recreational objectives in mind and the level of tree management is often minimal. Of the 3.3 million green tonnes of wood produced annually from broadleaf woodlands only 0.6 million green tonnes are harvested, suggesting an underutilised resource.

351 ER: 40 (Appendix B refers) See also Chapter 3 for detail.

352 Forestry Commission (2008)

353 Forestry Commission (2008)

354 Patterson and Anderson (2000)

Multifunctionality

It is increasingly recognised within government that forests and woodlands provide a wide range of ecosystem services. For example:

- Provisioning services
  - Timber production for construction/substitution and for bio/wood fuel
  - Non-forest products (meat, fungi etc)
- Regulating services
  - Pollution mitigation and soil protection
  - Management of surface and groundwaters including flood-risk management and water protection
  - Climate change mitigation[355]
- Cultural and social services[356]
  - Social cohesion
  - Amenity, recreation and health
  - Landscape and its historic environment
- Supporting services
  - Soil formation, nutrient cycling, water cycling, oxygen production
  - Biodiversity, including rare species (targeted management has been developed to assist their survival[357]).

It is clear that large-scale coniferous forests, especially in Scotland and Wales, have focused mainly, but not exclusively, on providing timber products and support to the rural economy. Their role in regulatory services in the context of climate change mitigation is now much more prominent. In the English case, by comparison, the role of forestry is typically more diverse, especially with respect to recreational benefits and supporting services such as nature conservation adjacent to areas of relatively high population. The Community Forest initiative is set in this context.

The value of forestry

Trees, woodland and forestry make an important contribution to the UK economy and to employment, and also deliver a wide range of social and environmental benefits.

The Gross Value Added (GVA) for forestry and primary wood processing (i.e. the difference between the value of outputs and the value of intermediate consumption), was over £2.1 billion in 2007[358], slightly more than 0.1% of GDP. In 2007, 42,000 people were employed in the forestry sector[359].

355 Lawrence et al. (2009)
356 O'Brien (2003)
357 Ray and Broome (2007)
358 Forestry Commission (2009)
359 Forestry Statistics (2009)

Box 4.4.1: The value and use of woodlands in Scotland – a recent study:

- Employment due to spending from tourism and recreation attributable to woodland was estimated to be 17,900 Full Time Equivalent jobs.
- The total Gross Value Added (GVA) associated with Scottish timber is about £460 million at 2007/08 prices, or 0.5% of the total GVA for the Scottish economy.
- The GVA of visitor spending attributable to woodland visits is estimated to be £209 million at 2007/08 prices.
- 56% and 41% of Scottish adults visited Scottish woodlands in 2005/06 and 2006/07 respectively.
- In 2006/07, an estimated 64% of Scottish children made a total of 11.6 million visits to Scottish woodlands.

The main markets for timber and wood-based products are construction, pallets and packaging, furniture, fencing and outdoor-use markets. More recently, bioenergy has emerged as a potential significant market at an industrial, commercial and domestic scale. A substantial processing industry has been established, and there is significant export of wood-based products. Nevertheless, the UK is a major importer of wood-based products, being fourth (in value terms) behind the US, China and Japan.

In addition to their commercial value, forests provide a range of economic benefits associated with recreation and tourism (see Box 4.4.1 for the Scottish case). Economic analysis of forestry and woodland in England confirms the value of non-market benefits associated with use (recreation) and non-use (biodiversity). Of an estimated benefit from forests in Great Britain of £1,300 million[360], £300 million was attributed to timber, and the balance to other ecosystem services, namely biodiversity, (£400 million), recreation (£400 million), landscape (£120 million) and carbon sequestration (£80 million). The relative importance of these benefits has implications for forestry and woodland management, including the appropriate level of provision of different services and the best way of incentivising them. In particular, there is a need to identify management strategies that can achieve multiple benefits simultaneously.

There is much evidence to support the important role of forests for recreational benefit. The amenity value of forests is strongly influenced by their proximity to centres of population, and the extent to which those populations value that amenity[361].

4.4.2 Future uncertainties and drivers of change

The multifunctional nature of forestry in the UK means that it is constantly subject to diverse pressures. This section outlines what are likely to be the principal drivers of change in the future.

Climate change mitigation

It is now generally recognised that sustainably managed woodlands and forests, by adopting planting and harvesting strategies that maximise carbon sequestration and preserve soil carbon, have considerable long-term potential to contribute to the mitigation of climate change. In 2007, forests and woodlands in England removed a

360 CogentSi and PACEC (2004); Willis et al. (2003)

361 ER: 40 (Appendix B refers); Agbenyega et al. (2009)

net total of about 2.9 million tonnes of CO_2 from the atmosphere. If creation and removal continue at their 2007 rates, this will drop to 0.5 million tonnes CO_2 per year. In the absence of woodland creation, this annual abatement would fall to 140,000 tonnes.[362]

In England[363], it is estimated that an additional 10,000 hectares of new woodland per year for the next 15 years could remove up to 50Mt CO_2 by 2050[364], and the Government is intending to support private planting for this purpose. In Scotland, the aim[365] is to increase planting rates to 10,000–15,000 hectares/year by 2015 and maintain this rate both to maintain the levels of carbon sequestered annually in trees and soils and to support the wood-fuel industry. There is a need for new management and financing arrangements to achieve these higher planting rates. Such aspirations suggest major land use change. There will need to be well informed debate about how this is to be achieved in an environmentally and socially acceptable way that takes account of other land use needs.

Climate change adaptation

A recent study of five major commercial tree species considers their likely response to contrasting climate scenarios for 2050–2080[366]. It suggested that in east and west England, the area classed as 'very suitable' for growing declines for all five compared to the baseline climate. In contrast, in west and east Scotland, there is a projected increase in the area that is very suitable for nearly all the species studied. Moreover, in the south of England and in parts of east Scotland, the study suggests that it is highly likely that climate change will cause a decline in the suitability of species on many traditional site types. This is mainly due to increased drought stress, and it is likely to lead to reductions in the quality as well as quantity of timber derived from traditional species.

A major implication is that in particular areas of the country, the future climate will be unsuitable for several native species growing there at present. The composition and nature of these woodlands will inevitably change and adaptation will be required to continue to manage them sustainably. Increasing attention is being given to the use of non-native tree species which currently grow in climatic conditions predicted to occur later in this century, such as *Eucalyptus*, *Nothofagus* and Calabrian pine. These alternative species may, however, have negative effects on hydrology and water resources and present new challenges for disease and pest control. Adaptation strategies for the forestry sector will support this approach across Government[367] .

It seems likely that climate change predictions for the UK will favour more rapid tree biomass growth with potential for increased production. This increased output potential will also be shared by large-scale forested areas in the northern hemisphere, removing any comparative advantage for UK timber producers. Some research suggests that increasing concentrations of CO_2 (needed for photosynthesis) from about the current level of about 380 parts per million (ppm) to 550 ppm will increase the above-ground growth rate of young trees by about 30%[368], with lower gains shown by mature trees.

362 DECC (2009)
363 DECC (2009)
364 DECC (2009)
365 Scottish Government (2009)
366 ER: 32 (Appendix B refers); Hulme et al. (2002)
367 e.g. Kirby (2009)
368 Easterling et al. (2007)

In the boreal regions, this, combined with higher temperatures, is likely to result in a net increase in global timber supply[369].

Biosecurity and extreme abiotic events

Population dynamics of damaging agents such as bacterial microbes, insects and mammal pests[370], will change over the next few decades, due to climate change and changes in forest demographics and management. The international plant and timber trade also poses a real risk through the importation of new pests and diseases. Forestry policies and practices will need to prevent or mitigate these effects.

However, unlike many agricultural ecosystems, forest ecosystems are comparatively resilient. Unlike arable crops, however, tree stands are in the ground for decades and are therefore are more liable to pest attack and disease, although the timing of biotic and abiotic damage in the life cycle of trees can be particularly important. It has been suggested that response to events would need to be a form of reactive adaptation – as opposed to the planned, proactive adaptation. Recent experience shows the importance of planting non-single clone stands for vegetatively propagated species such as poplar and willow. Drier, hotter summers will increase the risk of fires, as well as reducing the productivity and resilience of some broadleaved species such as beech.

Future economic potential

Projections of consumption and production of forest products for Western Europe up to 2020[371] suggest a steady growth for all major types of wood product. Biologically, annual wood production has exceeded annual harvest over many years, but notwithstanding catastrophic events (e.g. mortality of an important commercial species due to a new pest or disease), it is probable that the increase in demand for conventional wood products will not be met from standing timber resources.

Softwood availability in the UK is predicted to increase over the next 15 years from 12 million cubic metres in the period 2007–2011, peaking in the period 2017–2021 at just over 14 million cubic metres[372]. However, earlier predictions[373] suggest a serious downturn in supply until the late 2040s, so the UK will increasingly need to rely on imported supplies (assuming demand increases at a similar rate to that experienced in the last decade). There are strategic reasons why this issue will need to be addressed[374].

Sawn timber can contribute to climate change mitigation by replacing materials with high embedded energy such as steel and concrete, and also through its inherent insulating properties[375]. The Forestry Commission anticipates that the Government's Code for Sustainable Homes, which sets a pathway for all new homes to be zero carbon by 2016, should strengthen the market for construction timber.

Future demand for wood for energy production in the EU is projected to be about 260 million cubic metres in 2010 from about 160 million cubic metres in 2003. In particular, if EU Member States are to meet the targets for renewable energy based on the EU Biomass Action Plan, then there will need to be an increase in harvesting intensity, an expansion of the area used for wood production, or both. Across Europe

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369 Easterling et al. (2007) p283
370 Gill and Fuller (2007); Quine et al. (2007)
371 Becker et al. (2006)
372 Hasall et al. (2006)
373 Forestry Commission (2004)
374 Lawson and Hemery (2008)
375 Burnett (2006)

there is a need to encourage the responsiveness of woodland owners to the opportunities they have for contributing to wood supply. Traditional market mechanisms may not be enough to increase supply, and new incentives may be required.

Health and wellbeing

In view of the growing evidence demonstrating the social benefits of forestry and woodlands, there is likely to be a continuation of the trend towards greater investment in community forests and woodlands with public access as environments for health and wellbeing, education and recreation. The World Health Organization regards mental ill-health as a major issue globally over next 20–30 years, and the challenge during this time is to implement what is already relatively well understood from research – that forests and woodlands provide significant restorative opportunities for an increasingly urbanised population[376]. Taken together with concerns about the disconnection of a broad range of the population from nature[377] (Nature-Deficit Disorder), these and other health matters could lead to a greater focus on forests and woodlands near to people. In urban areas, the health consequences of intense 'heat islands' could be managed by uptake of the continental and American use of 'shade trees'.

Community development and capacity

Green infrastructure including trees and woodlands will become more important for the provision of recreational networks for walking and cycling. A low-carbon economy could also encourage holidays within the UK, and there may be greater demand for forest-related tourism. The trend may continue towards greater demands from community groups for involvement in forestry and woodland management and decision-making. Forestry and woodland could also facilitate a greater focus on volunteering and community engagement in changing and improving local spaces and community life. In addition, opportunities could be taken to promote the relationship between individuals, communities, and the natural environment, strengthening behavioural change at the local and community level. The Community Forestry initiative in England is an exemplar of this approach.

New technologies

Present and future products of tree breeding could have a major impact on productivity. Within 40 years, yields of timber per hectare could increase by 25%[378] compared with areas planted 15 years ago before the benefits of tree breeding became generally available. Quality of timber will also improve. Laboratory screening using DNA-marker technology means that improved material can get released to the forest more quickly, from about 25 years today to 10 years in the future. There are further potential gains to be achieved through clonal forestry. This involves reducing diversity so that nearly all the trees are fit for end use at rotation age. However, this practice contrasts with policies to increase diversity. Currently, there is a presumption against the use of GM technology in UK forestry. However, this may change as the benefits and risk of GM are better understood for agricultural crops. It is probable that GM will be part of forest crops in 50 to 60 years from now, although it is unlikely that GM technology will make a large impact in the forestry and woodland sector[379].

376 World Health Organization (2009). *Depression.* http://www.who.int/mental_health/management/depression/definition/en/ ; Willis et al., (2003); Woodland Trust (2004). *Space for People. Targeting action for woodland access* http://www.woodlandtrust.org.uk/SiteCollectionDocuments/pdf/spaceforpeople.pdf

377 Louv (2005)

378 Lee and Matthews (2004)

379 Gartland and Oliver (2006)

4.4.3 Summary of key implications for policy

Forests and woodland can provide diverse benefits and services, such as commercial timber production, and a range of non-marketed services including biodiversity, flood protection, climate change mitigation, recreation and amenity.

- **The commercial value of forests, and the incentives provided to the new planting of forests and woodlands, are in most cases much less than the value of benefits provided,** especially with respect to landscape, biodiversity and amenity, and climate mitigation benefits.
- Forests and woodland have considerable potential to deliver multiple benefits. **More attention is required to incentivise land managers to provide non-market services,** taking better account of values from wider uses and local situations.
- **There is a need to improve the integration of service provision by realignment and strengthening of policies to promote multifunctional forests and woodlands,** especially in England. The implications of forest, woodland and tree management for flooding and water quality management needs particular emphasis.
- Forests and woodlands involve long-term investments for the most part on marginal land. Investment in forestry is not only sensitive to forestry/woodland support but also to incentives given to other land uses in less favoured areas, such as livestock production. **The longevity of forest investment requires long-term policy commitment.**
- The need for improved soil carbon management and the integration of energy issues into both agriculture and forestry means that **policies for forestry and agriculture must be better integrated, recognising how the two areas interact.** The effects of the introduction of carbon trading on harvesting practice is unknown, and likely to affect planting and harvesting strategies.
- There is evidence that the location of forests relative to centres of population is a critical determinant of value. **Community Forest and Farm Woodland initiatives should be extended and supported for this purpose, with incentives designed accordingly.**
- **New research is required to enable forest and woodland to play a full role in climate change mitigation and adaptation,** noting that climate change will have spatially distinct impacts on forest and woodland services.
- It is likely that a possible increase in demand for conventional wood products over the next 50 years will not be met from standing timber resources. **The contribution of forests and woodlands to meeting this deficit, and to the economy more generally, could be increased,** particularly through new technology. However, traditional market mechanisms may not be enough to increase supply, and new incentives are likely to be required.

4.5 Land for managing flood risk

How land is used is intimately connected with flood risk. Where we build and how we manage land can affect the likelihood of flooding and where the flooding occurs, and the number of people and nature of assets in flood-prone areas affect the possible impact that can result. In the last 20 years in the UK, flooding has become more problematic, especially in urban areas, resulting in very significant social, economic and environmental costs[380]. For this reason, the management of flood risks (defined as a combination of flood frequency and damage costs) has become a major concern for government at local and national levels[381]. This is reflected, for example, in government annual spending on flood risk management in England, which grew by 66% in real terms between 2000/01 and 2009/10[382].

4.5.1 Flooding past and present

Governance issues

The management of flood risk in the UK is an important component of public policy, with a range of publicly-funded measures to reduce both the probability and consequences of flooding. In England, Defra sets overall policy and provides funding to the Environment Agency as the principal authority with responsibility for flood risk management (although there are some differences in arrangements between England and Wales). Other organisations with responsibilities at a local level include local government, Internal Drainage Boards, Regional Flood Defence Committees, and Local Flood Resilience Fora – usually organised by local government and emergency services. In Scotland, the Scottish Executive, the Scottish Environmental Protection Agency (SEPA) and local authorities provide a similar organisational structure, as does the Department of Agriculture in Northern Ireland (DANI).

In broad terms, government policy for flood risk management adopts a risk-based approach. In England and Wales, this focuses expenditure where it will best achieve a set of outcome measures associated with economic benefits, number of households protected, protection of households in deprived areas, protection of nationally important wildlife sites and achievement of biodiversity targets[383]. The Government has agreement in principle with the Association of British Insurers (ABI) that, in return for providing measures to reduce flood risk in areas of risk greater than 1 in 75 chance of flooding per year, the industry will offer 'affordable insurance' against flooding. The ABI's members no longer guarantee to offer insurance cover against flooding for new developments built against Environment Agency advice.

Guidance from Government[384] on development and flood risk states that inappropriate development should be avoided in areas at risk of flooding, and development should be directed away from areas at highest risk. It argues that planning authorities should make the most appropriate use of land to minimise flood risk, substituting land uses so that the most vulnerable development is located in the lowest risk areas, and making the most of opportunities to reduce flood risk, such as designated flood routing and storage areas.

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380 ER: 6 (Appendix B refers)

381 Foresight (2004)

382 Environment Agency (2009a)

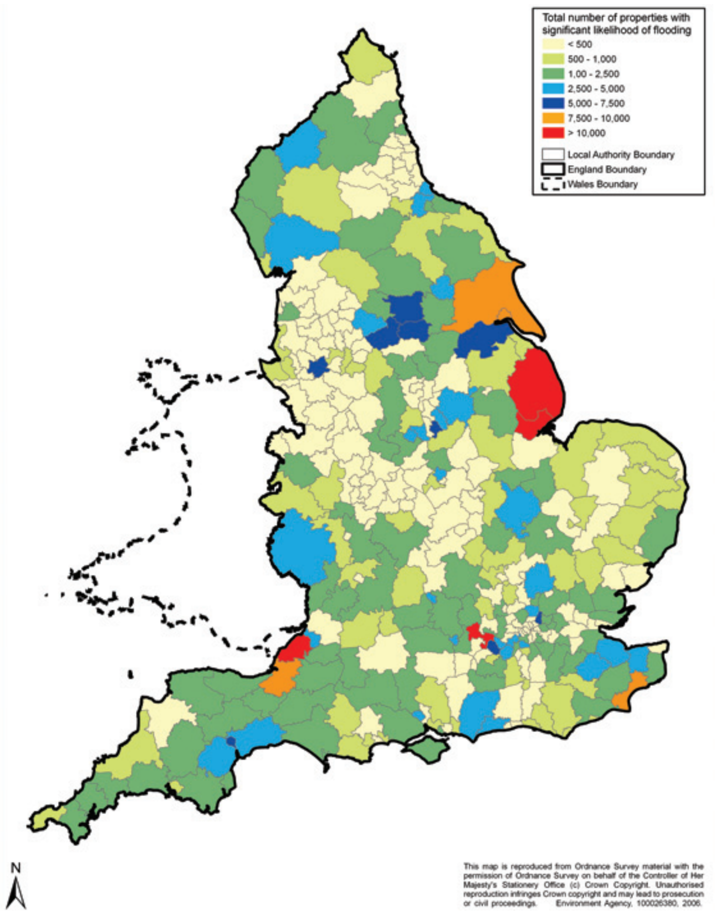
383 Environment Agency (2009a); Environment Agency (2009b)

384 Planning Policy Statement PPS25 (CLG 2008). For Wales, see Technical Advice Note 15

The management of flood risk

The National Flood Risk Assessment classifies flood risk as 'significant' (1 in 75 chance of flooding in any given year), moderate (1 in 75 to 200 chance) and low (1 in 200 chance)[385]. In England, 2.4 million properties are at risk of river and coastal flooding, of which about half a million are at significant risk. In Wales, these figures are about 220,000 and 65,000 respectively[386]. Recent flood events have shown increased incidence of surface water flooding that is not associated with river or coastal waters. In England, about 3.8 million properties are at risk of surface water flooding, of which about 1 million are also liable to river and coastal flooding. Hence in England about 5.2 million properties in total are at risk of flooding in some way[387]. About 180,000 and 45,000 properties are reported to be at risk of river and coastal flooding in Scotland and Northern Ireland respectively[388].

Figure 4.5.1: Land within floodplains by local authority boundaries



Source: Environment Agency (2009a).

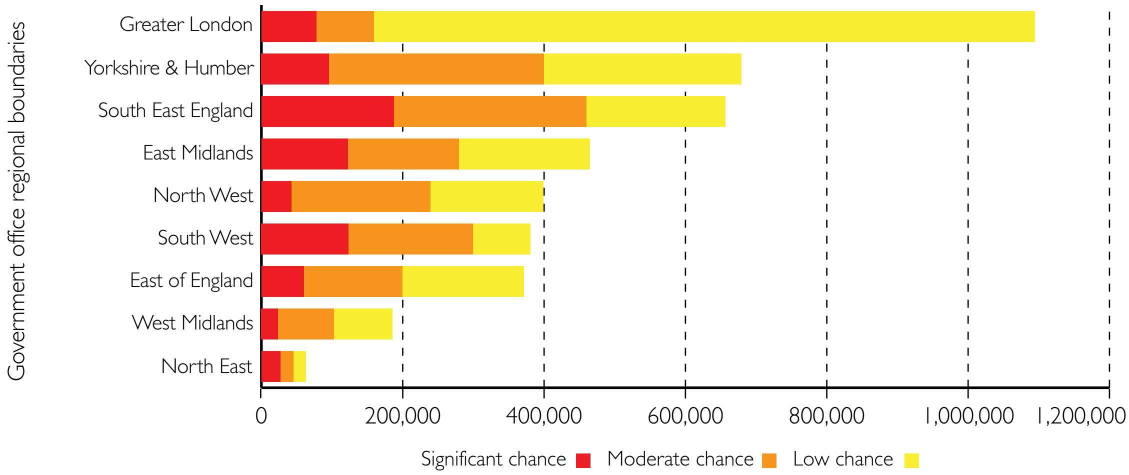
There is considerable spatial variation in exposure to flood risk. Figure 4.5.1 shows the proportion of local authority areas that lie within the 'indicative floodplain' in England; that is, they have an annual risk of flooding of 1% or greater from rivers, or 0.5% or greater from coastal flooding.

Figure 4.5.2 shows the regional distribution in England of the number of properties at risk – i.e. occupying what the Environment Agency defines as the Indicative Floodplain.

385 Environment Agency (2009c)
386 Environment Agency (2009b)
387 Environment Agency (2009a)
388 Foresight (2004); Evans et al. (2004)

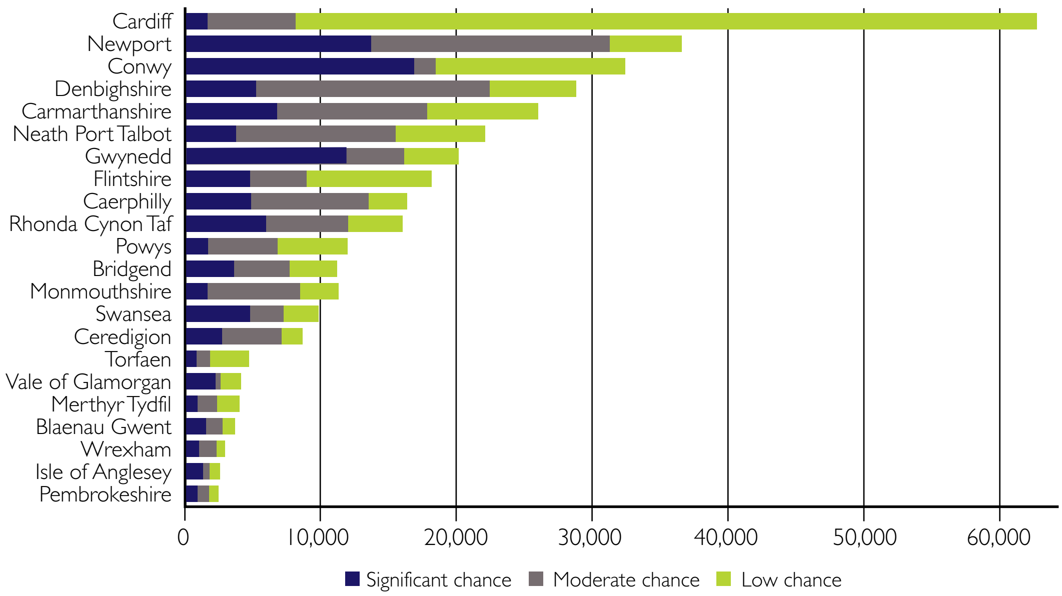
The majority of these properties are protected against significant risk, apparent for example in the case of Greater London where 84% of properties are protected by major defences, including the Thames Barrier. The South East of England is the region with the highest number of properties exposed to significant risk. These estimates do not include exposure to surface water flooding that has characterised recent flood events in urban areas[389]. In Wales the greatest numbers of properties at potential flood risk are in Cardiff but these are protected to a high degree (Figure 4.5.3). The greatest significant risk is associated with coastal flooding in Conwy, Newport and Gwynedd.

Figure 4.5.2: English regions ranked by number of people living in flood risk areas



Source: Environment Agency (2009a).

Figure 4.5.3: Local authorities in Wales ranked by the number of people living in flood risk areas



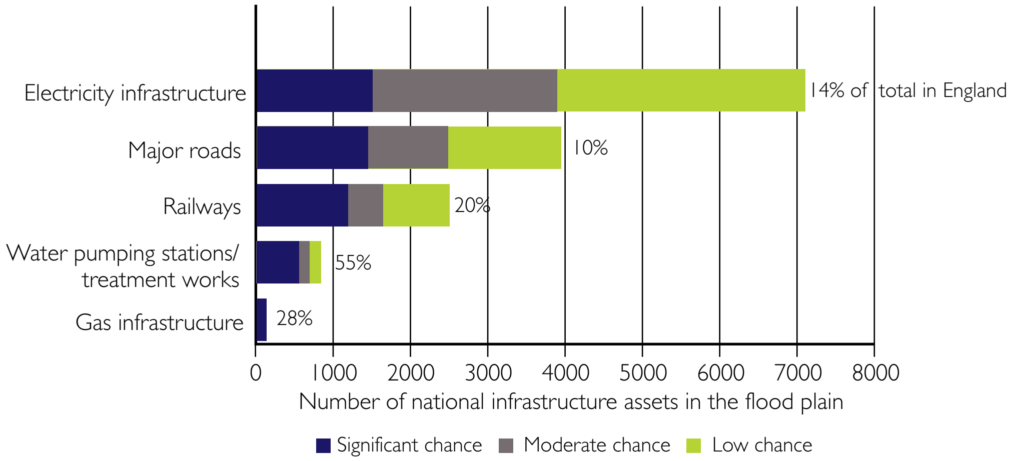
Source: Environment Agency (2009b).

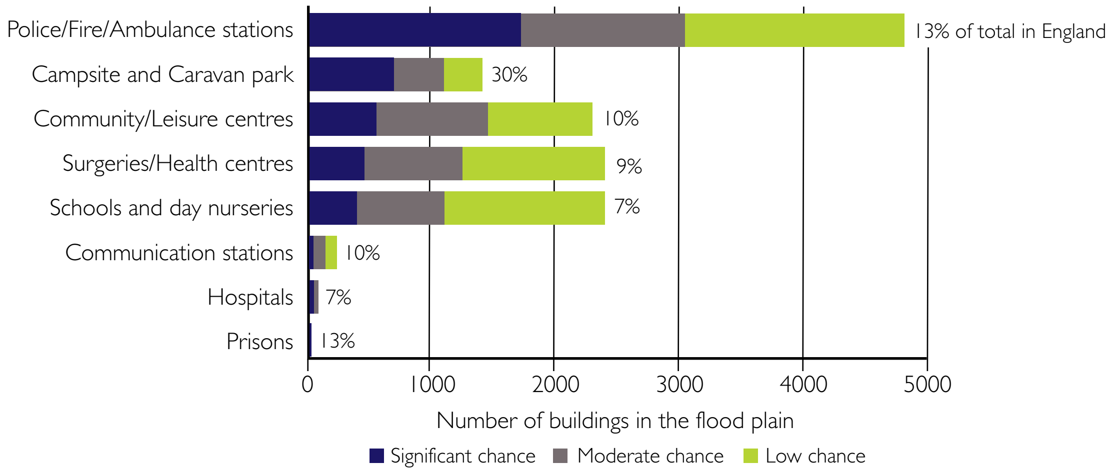
389 Pitt (2008)

Critical infrastructure

Nationally important infrastructure and public services are often located in floodplain areas and are liable to flooding as a result – as the floods of summer 2007 showed. For example, over 7% of electricity infrastructure, 10% of the railway network, 20% of gas infrastructure and nearly 50% of water pumping stations/sewage works in England are located in floodplains that have a moderate to significant risk of flooding (Figure 4.5.4). A wide range of public services is also at risk from flooding. The 2007 floods in England, for example, resulted in £660 million in damage to critical infrastructure and essential services, with water and electricity supplies, roads and schools being most affected[390].

Figure 4.5.4: National infrastructure and public services in flood risk areas in England





Source: Environment Agency (2009a).

Agricultural areas

The majority of floodplain areas are occupied by agriculturally managed land. In England, 1.02 million hectares of agricultural land are within the indicative floodplain (Table 4.5.1). Although this represents only 9% of the total agricultural area of England, it includes some of the most fertile and productive areas that have been 'reclaimed' and 'improved' for agricultural purposes over hundreds of years. A total of 57% of Grade 1 agricultural land, an important strategic asset in terms of national food security, falls within the indicative floodplain. The capital value of agricultural land at risk of flooding is

390 Chatterton et al (2010) at: http://publications.environment-agency.gov.uk/pdf/SCHO1109BRJA-e-e.pdf

probably around £15 billion in 2009 prices. The management of hydrological regimes, in the form of flood alleviation and land drainage, has been critical to maintaining the agricultural productivity of this land.

Table 4.5.1: Classification of agricultural land in indicative floodplains, England

Agricultural land classification	Typical land use	Total ('000 ha)	Indicative floodplain ('000 ha)	Proportion of total area in indicative floodplain (%)
Grade 1	Intensive arable	355	204	57
Grade 2	Intensive arable	1,849	239	13
Grade 3	Extensive arable	6,292	379	6
Grade 4	Dairy and grazing livestock	1,840	186	10
Grade 5	Grazing livestock	1,101	11	1
Total potential agricultural land		**11,437**	**1,019**	**9**
Non-agricultural land		657	31	5
Urban areas		952	72	8
Total		**13,046**	**1,122**	**9**

Source: Natural England (2002)

Economic aspects of flooding

The annual cost of flood damage in the UK has been estimated at about £1.4 billion, of which about £1 billion occurs in England[391]. Major flood events, such as those in England in 2007, can, however, cause severe disruption, economic loss and social distress[392]. The total cost to the nation of the summer 2007 flood, for example, was put at £3.2 billion, two thirds of this borne by households and businesses in the form of property damage[393]. The cost of psychological stress, based on estimates of people's willingness to pay to avoid exposure to the distress caused by flooding, was put at about £250 million, but this probably undervalues the full impact of the flood on the health of those affected.

The costs of flooding damages are highest in urban and industrial areas and lowest in agricultural areas, as demonstrated by the 2007 floods. Different standards of protection are provided accordingly[394]. A flood event in an urban area to a depth of about one metre can result in damages of about £30,000 per typical household[395]. Flooding on farmland can cost between £5,000-£10,000/ha for high value vegetable cropping, about £500-£1,200/ha for cereals, and about £50-£400/ha for grassland, depending on the time of year of the flood event[396]. Hence, priority is given to urban protection, and where appropriate to use farm land to store flood water that otherwise might cause urban flooding.

391 Foresight (2004); Environment Agency (2009a)
392 Pitt, (2008)
393 Chatterton et al, (2010)
394 Penning Rowsell et al, (2005)
395 Chatterton et al, (2010)
396 Posthumus et al, (2009)

The considerable costs of flooding to the national economy justify Government expenditure on flood risk management, currently about £1 billion per year in the UK; about 90% of this total is provided by the Environment Agency and SEPA, the rest mainly by local authorities. The current estimated replacement value of flood defences in the UK is probably in excess of £25 billion. New investments in flood risk management are subject to cost–benefit appraisal following Treasury guidelines[397]. It is estimated that every £1 spent on new and improved flood risk management assets reduces long-term damage costs by £8[398].

4.5.2 Future flood risk

The relationship between land use and flooding was explored extensively in the 2004 Foresight Future Flooding Project[399], and subsequently revised as part of the Pitt Review of the 2007 floods[400]. Catchment, coastal and 'intra-urban' flooding systems were considered for four combinations of climate and socio-economic scenarios to create alternative pictures of possible futures (in the 2050s and 2080s). The Foresight report contains illustrative maps and projections of future flood risk that show an uneven distribution of projected annual damages across England and Wales, and between different economic sectors. Subsequent to this report, the Government has committed to substantial increases to annual investments in flood risk management. Important new information on key drivers of change (e.g. relating to the future climate) has also become available. There is therefore now a case to update the Foresight projections for future flood risk.

Drawing on the Foresight Future Flooding Project and its subsequent update as part of the Pitt Review, future drivers and responses as they affect land use are set out below[401].

Climate change drivers and responses

Potential sea-level rise and storm surges generate high risks for coastal areas. Choices will need to be made between providing high levels of funding to resist rising coastal threats, realigning defences, or abandoning large tracts of land to the sea.

Increased frequency of extreme precipitation events is expected to increase risks associated with surface, fluvial and groundwater flooding, with consequences for property, livelihoods, infrastructure, agricultural production and ecosystems. The possible need to find the space through riverside towns and cities to accommodate increased flood flows of up to 40% will present challenges for engineering and urban planning. This may conflict with policy to reuse flood-prone, waterside brownfield sites. Increased intensity of rainfall may create a role for agricultural land to mitigate risk by retaining potential flood water, with possible consequences for agricultural productivity.

Although typically only between 1% and 5% of flood damage costs relate to agriculture[402], a large proportion of the most agriculturally productive land in England and Wales is dependent on flood protection and land drainage. Therefore any changes in the priority attached to specifically UK-based food production may require response options to be re-evaluated, particularly for areas of national agricultural importance.

397 HM Treasury (2003)
398 Environment Agency (2009c)
399 Foresight (2004); Evans et al. (2004)
400 Pitt (2008); Evans et al. (2008); ER: 6 (Appendix B refers)
401 Thorne et al. (2006); Evans et al. (2008); ER: 6 (Appendix B refers)
402 Evans et al. (2004); Chatterton et al. (2009)

Using the latest[403] predictions for climate change, the Environment Agency estimates that by 2035 the number of existing properties exposed to significant risk of flooding in England could rise from about 500,000 to over 800,000 in the absence of any increase in expenditure on flood protection[404]. This assumes that flood protection for any new properties is funded by developers. Annual spending on building and maintaining flood risk assets would need to increase by £20 million year-on-year through to 2035 to prevent an increase in the number of existing properties exposed to flooding; this is equivalent to a doubling of expenditure from the present £600 million per year to £1.2 billion per year in 2035 in real terms for England[405]. These estimates are consistent with those previously derived by Foresight's Future Flooding Project.

Urbanisation drivers and responses

Development of urban infrastructure can increase runoff which affects communities and assets downstream. Development on floodplains puts property and infrastructure at risk and further affects the transmission of floodplain flows.

The Pitt Review[406] shows that a number of recently constructed housing estates were flooded in 2007. Decisions on the location of houses, factories and other infrastructure are now recognised as an essential tool in managing future flood risks. The importance of protecting vital infrastructure from flooding is also widely acknowledged.

This issue is, however, not a simple one. The 2004 Foresight Future Flooding Project[407] highlighted the need to balance flood management against other economic, social and environmental needs, especially the demand for new housing. It would also be controversial to ban redevelopment of brownfield sites that lie in the floodplains served by existing well-managed flood defences affording a high standard of protection. This applies to much of London. However, there is a need to further strengthen the powers of agencies with responsibility for flood risk management to control new development in flood risk areas that is likely to be unsustainable in the longer term, especially when subjected to a comprehensive assessment of benefits, costs and uncertainties (see Chapter 3).

Future urban flood risk will be affected by changes in the way in which urban areas are managed, their characteristics, and how planning and management evolve in the context of social and climate change. Important issues are likely to include the renewal of existing urban spaces, new urban flood-resilient buildings, new types and densities of development and changes in green space. However, the current rate of replacement of the housing stock is only 0.1% per annum, suggesting that changes will need to be targeted preferentially at existing settlements.

Urban drainage systems and processes

Future flood risk could be affected by:

- Actions taken at the construction stage, such as the use of permeable surfacing in car parks and rainwater harvesting.

403 UKCP09 (2009)
404 Environment Agency (2009c)
405 Environment Agency (2009c)
406 Pitt (2008)
407 Foresight (2004); Evans et al. (2004)

- Responses from various stakeholders (i.e. individual behaviour) together with responses that relate to actions when flooding does occur (mitigation). However, even where there is control over urbanisation, 'urban creep' adds hard surfaces in an uncontrolled and unpredictable manner.

- Source controls. These include the construction of storage reservoirs to attenuate flows, sustainable urban drainage systems (SUDS – although lack of clear responsibilities have limited their uptake in England and Wales), and controls on paved areas within domestic housing.

Rural land management drivers and responses

Rural land acts both as a flood pathway (affecting surface runoff and subsurface flows) and a receptor. Agricultural practices associated with degraded or bare soils can increase the chance of flood generation, especially at the local and small catchment scale in the form of flash, muddy floods. However, the extent to which rural land management can help alleviate flooding problems during extreme events that result in wide-scale flooding remains unclear[408]. Nevertheless, rural land management can help to mitigate flood risk, both by reducing runoff, especially on hill-slopes, and by storing flood water on agricultural floodplains when required[409]. Such intervention measures for flooding can also mitigate diffuse pollution, and protect and indeed create new wildlife habitats. In future it will become more important to integrate flood risk management in rural areas with other types of benefits from land use, and to design policies which will encourage this in practice[410].

Options for managing flood risk

The Foresight Future Flooding[411] Project reviewed five main themes for responses to flood risk. The most effective and potentially cost-beneficial flood risk management responses involve some aspect of land management, namely catchment-scale (mainly rural) storage, land use management (especially reducing the exposure of urban property to flooding), and coastal defence and coastal realignment (to address probability of sea-level rise).

The 2007 flood events exposed the fragmentation of responsibility for the management and operation of flood defence and drainage systems, especially in the urban context[412]. The Pitt Review highlighted the need for a long-term, strategic and multi-agency approach to flood risk management, drawing together the wide range of interests in flood risk management and new and diverse sources of funding. New initiatives on catchment and shoreline management point the way forward.

4.5.3 Summary of key implications for policy

There is considerable experience in the UK in flood risk management. This has developed over many years, supported by a well-developed policy framework. However, given the prospects of increased pressure on land use and environmental change, there will be much greater need in future for:

- **Better understanding of the relationship between land use and flood risk management.** There will be greater need to provide research evidence to inform

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408 O'Connell et al. (2004); ER: 6 (Appendix B refers)
409 Morris et al. (2005)
410 Posthumus et al. (2008); Morris et al. (2009)
411 Foresight , 2004
412 Pitt (2008)

the relationship between land use, flood generation and the costs of flooding. The extent to which changes in land management can 'mitigate' flooding at the catchment scale for extreme rainfall events remains unclear, although it is likely that rural land can contribute to flood alleviation by retaining and storing flood waters in vulnerable catchments. In both urban and rural areas, there is need to determine cost-effective 'adaptive' measures to reduce flood damage costs, including controls on land use and development.

- **Better targeting of the appraisal of flood risk management options** and the implications for land use, exploring the suitability of a wider range of approaches and stakeholder interests than has been the case. In addition to engineered flood defences, the resilience of existing and new buildings and property to flooding will need to be improved, as well as non-structural responses such as zoning of floodplains to enhance flood tolerance.

- **More proactive floodplain zoning.** There is a possibility of future increases in the intensity of rainfall events of up to 40%. It is unlikely that upstream catchment measures such as greater storage will be able to absorb such large amounts; there will therefore be a residual problem of conveying peak flows through towns and cities. This will require much more proactive thinking and policy tools than exist at the present[413]. Flood corridors in urban areas could be designated to comprise 'two-stage' channels capable of taking extreme flows when required, but used for flood-tolerant uses at other times, such as recreation and vehicle parking. Drawing on international experience, river corridors might be zoned to regulate future development and land use in order to avoid flood damage, including, most importantly, retreat or set-back areas designated for future flood conveyance and storage, looking 50 to 100 years into the future.

- **Zoning of coastal floodplains** is particularly important given the observed and predicted rise in relative sea level. Managing retreat in both cases will require the Government to consider issues of incentives, compensation and social equity. All of this suggests a much stronger and integrated future role in development and land use planning for agencies responsible for flood risk management. It also calls for a long-term yet flexible strategy that can evolve to cope with changing needs.

- **Exploiting the considerable scope for joining flood risk management with other land use objectives and benefits.** There is significant potential for changes in management of agricultural land to reduce runoff, soil erosion and water pollution simultaneously, and to combine flood storage and restoration of floodplain ecology both in rural and urban areas (see Box 4.5.1). Substantial changes in land use, motivated by climate change policy, may have significant implications for flood risk management, which will need careful consideration. This broader, integrated approach requires new and diverse collaborations among stakeholders (such as regulators, land managers, developers, the corporate sector and the insurance industry) as well as the integration of different policy areas and funding streams. Improved targeting of agricultural Environmental Stewardship and provision of multipurpose green space in urban areas funded by development levies are examples of how this might be achieved.

- **Creating a regulatory framework** to support an integrated approach within which economic instruments can be used to create markets for land-based flood risk management services, including provisions for compensation and incentives

413 For example, PPS25 could be strengthened so that zoning is assessed on the basis of *future* flood risk; this is not clear in the present document

where appropriate[414]. Where there is new development in floodplains, the full costs of providing long-term protection should be borne by beneficiaries of the development, including consideration of the loss of benefits from alternative land use.

Box 4.5.1: Examples of flood management projects

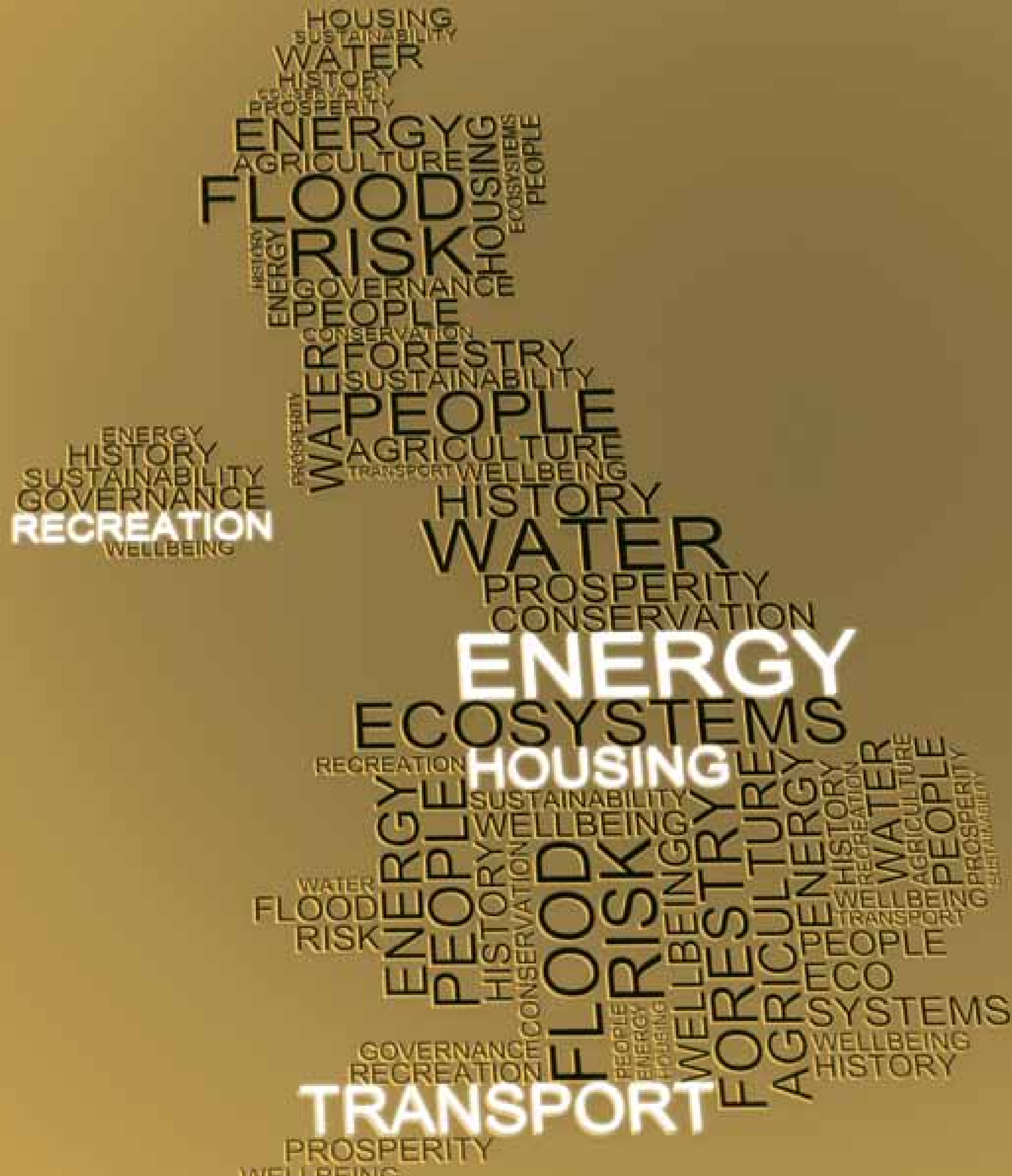
Angmering – cooperation of multiple developers and sustainable drainage

The Bramley Green development at Angmering in West Sussex, consists of a residential development of 600 units. A number of developers formed a consortium to deliver the flood management and drainage infrastructure. This included the provision of a new pond, a flood storage area, and an under-drained infiltration area within a public open space.

Templeborough, Rotherham – regeneration of former industrial areas to reduce flood risk and improve amenity and biodiversity

This is a local area initiative, developed through a partnership including the local council, Regional Development Agency and the Environment Agency. It aims to reduce flood risk to existing properties and regenerate derelict industrial sites to create a greenfield flood attenuation area alongside the river. This will increase access for the public, previously excluded from the river by heavy industry.

414 Taussik et al. (2006)


HOUSING
SUSTAINABILITY
WATER
HISTORY
CONSERVATION
PROSPERITY
ENERGY
AGRICULTURE
HOUSING
ECOSYSTEMS
PEOPLE
FLOOD
RISK
HISTORY
ENERGY
GOVERNANCE
PEOPLE
CONSERVATION
FORESTRY
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AGRICULTURE
TRANSPORT
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PROSPERITY
WELLBEING
FORESTRY

5 Major land use sectors – past and future: part II

This chapter continues the review of different aspects of land use, started in Chapter 4. Here the focus is on land for energy production, residential and commercial development, transport and leisure and recreation. As before, past and present trends are reviewed, and important future challenges and uncertainties are then assessed. Finally, the implications for policy are summarised.

The key aim is to draw out lessons from the past, and identify where changes in policy or in systems of governance might be desirable in the future.

5 Major land use sectors – past and future: part II

5.1 Energy production

5.1.1 Land use and energy – past and present

Trends in energy production

Whilst coal had powered the nation from the Industrial Revolution onwards, by 1970 the UK had become increasingly dependent on imports, with domestic production accounting for less than half the total inland primary energy consumption of 210 million tonnes of oil equivalent (mtoe)[415]. The need for additional energy supplies was met in the following decades by: the second wave of construction of nuclear power stations construction; the realisation of earlier discoveries of North Sea natural gas (these replaced the old coal-derived town gas); and the rise in oil flows, also from the North Sea. However, by 2006, oil output had fallen so that the UK had again become a net oil importer. Gas production had also started a steady decline – a trend that is forecast to continue, again raising concerns about security of supply. Since 1990, successive privatisations of the gas and electricity supply industries have opened the generating market to entry by new producers and facilities, subject to normal planning approvals for new sites.

Energy production gives rise to various environmental costs – notably carbon emissions and air pollutants which are controlled by various regulations and standards that are being gradually tightened. For example, the Large Combustion Plant Directive will result in closure of a large fraction of coal-fired power stations that have not adopted flue gas desulphurisation or other clean-up measures by 2016. The pressure to close these stations will intensify unless large-scale Carbon Capture and Storage (CCS) becomes commercially viable. With the retirement of existing nuclear power stations in the next few years, the commissioning of new low-carbon energy generating capacity, which climate change policy requires is now urgent.

New-build low- or zero-carbon electricity (nuclear and renewables) will need to become commercially viable in an increasingly competitive market[416]. A significant development has been the EU Emissions Trading System, which is intended to provide a price for carbon and hence act as an additional incentive to reduce emissions. But after a promising start, the second trading period price collapsed in 2009 to a level at which low-carbon technologies risk becoming non-viable unless fuel prices rise substantially or further incentives are provided.

Renewable electricity has been subsidised through an increasingly complex Renewables Obligation Scheme, with different technologies attracting different, but market-determined, subsidies. Non-renewable electricity has been subject to the Climate Change Levy, which the Committee on Climate Change (2009) argues should be removed from nuclear power as a low-carbon source comparable to renewables. The provisions of the EU Renewable Energy Directive will require the UK to source 15% of

415 All data from DECC UK Digest of Energy Statistics.

416 Renewables and nuclear power are almost zero-carbon in production, although building any generating facility releases greenhouse gases.

energy from renewables by 2020 – a target that requires at least 30% of electricity from renewables and might also require 10% of transport fuel to be biofuel.

Past implications for land use

The Industrial Revolution located heavy industry near coalfields. Until the early 1990s, electricity generation was also heavily dependent on coal – two-thirds of the power generated between 1970–1990 was from coal – so power was generated near the industrial demand. The location of the coal-fired power stations also required a strong transmission system to connect them to the main demand centres, increasingly located in the South of England. In contrast, nuclear power stations could be built nearer load centres, although several were constructed in Scotland, from where they exported to England. The 'land take' implications of conventional energy production have been modest, although this could change substantially through the shift to low-carbon production. Currently, the largest power station, Drax, can produce nearly 7% of Britain's electricity, yet occupies less than 2 sq km (even with its large fuel and waste stockpiles). Refineries, coal mines, fuel storage sites and port facilities have a large local visual and social impact but together take up a modest proportion of the land. Mining, for example, accounted for only 0.9% of the land area in 2000[417].

Electricity transmission has a substantial visual impact on the landscape. Whilst gas is generally carried underground, electricity is conveyed through power lines. In 2009 there were 7,650 route km of overhead lines, with about half in the most visually intrusive 400kV supergrid category. There is little evidence of pressure to remove existing pylons, but considerable resistance to installing new ones, or even upgrading existing lines. For example, the Beauly-Denny planning inquiry prompted by a 2004 request received 18,000 objections and heard nearly 200 witnesses in the case for upgrading a key transmission line in Scotland for renewables before a decision was made in 2009[418].

5.1.2 Future drivers of change and policy options

The implications of the energy sector for land use in the future will depend on both the growth of demand and trends in the pattern of supply.

Drivers of demand

Besides population size, energy demand is driven by a wide range of factors: income per head; energy prices; the state of technology (the efficiency with which energy can be turned into services such as heat and light); regulations and standards (such as fuel efficiency standards); and, to an unknown extent, behaviour, values and social pressure (e.g. the desire to undertake voluntary carbon-offsetting – choices that cannot be explained purely in terms of private financial considerations).

Increases in income

Growth in income can create increased demand for travel (especially very energy-intensive air travel, for which the income elasticity is high), temperature control (heating and cooling), light and appliances, all of which work against energy-related reductions in CO_2 emissions.

417 ER: 24 (Appendix B refers)

418 http://www.beaulydenny.co.uk; http://www.timesonline.co.uk/tol/news/uk/scotland/article6963529.ece

Energy prices

Energy prices will be driven by world fuel prices, the CO_2 price and various taxes and levies to fund renewables. As climate change policies increasingly seek to deliver sharp reductions in emissions, the price of carbon will need to rise, encouraging replacement of fossil fuels by low-carbon alternatives[419]. It could also encourage shifts to lower energy consumption patterns – such as consumers choosing walking and cycling holidays, instead of low-cost flights and car travel. It is worth noting that in relation to income, electricity prices in 2009 were less than one-tenth their level in the inter-war period, so that even if climate change policies more than doubled the cost of electricity would still be more affordable than during that period.

Building new energy-efficient houses and industries

As about 40% of energy is consumed in buildings, a major determinant of energy demand will be the rate of replacing old with new more energy-efficient buildings, although the construction of new-builds can itself involve significant emissions of CO_2. At the UK's rate of building of less than 180,000 houses/year since 2000, it would take more than a century to replace the current UK housing stock, let alone meet the projected growth in demand[420]. Even if the rate of new-build was raised by 150% to meet that requirement, it would only add 2% per year to the building stock, and thus take many years before this strategy would reduce domestic carbon emissions materially.

The reduction in carbon emissions that could be achieved by new buildings will depend on the technologies used. One option would be to provide enough land to install ground-source heat pumps which are an efficient use of energy. Although this would involve reducing building density, the implications for overall land take would be small[421].

Upgrading existing housing stock

Most of the housing that will be in existence in 2060 has already been built, and their energy efficiency will need to be radically improved to meet climate change targets, although with little immediate impact on land use. Various government policies are directed to achieving this. New materials (for insulation and diurnal energy storage), cheaper heat pumps, more efficient electronics and motors, as well as new control technologies could all reduce energy demands, and help to improve the services that energy supplies and reduce the amount of energy needed. However, unless energy prices rise to compensate, greater energy efficiency leads to lower energy costs for any given level of energy services; for example, better insulation makes it cheaper to heat houses. Like any reduction in service prices, this would offset some of the reduction in energy demand and thus dilute the effectiveness of the efficiency improvement.

Improving efficiency – the importance of technology

The more energy consumption is reduced, the less the need to expand currently expensive low-carbon energy production to meet greenhouse gas reduction targets. As renewable energy is relatively low density, in terms of kW/sq km (see below), focusing on energy conservation may mean the land take for renewables would be lower.

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419 Stern (2006)

420 See Chapter 5.2.

421 If, hypothetically, new buildings were built at 25 buildings/ha, for every extra 1 million houses (as old houses are replaced by more spaciously located new houses or reclaimed for more urban green space), an extra 400 sq km of land would be required – only 0.16% of the UK land area.

Energy is useful insofar as it delivers valued energy services, such as heating and lighting. Technology can play an important role in improving the efficiency with which these services are provided. A wide range of possibilities include: energy-efficient lighting and motors; electronics with smart sensors; smart metering controlling time-flexible use in energy storage devices such as hot water, fridges and air-conditioning loads; and phase-change materials with temperature-responsive passive heating and cooling to improve building efficiency. Improved batteries will allow more efficient vehicles; cheap plastic photovoltaics (PV) could promote the uptake of roof-mounted panels; while high efficiency biofuels production using algae grown in water heavily enriched with CO_2 from carbon capture could return carbon to new energy.

Regulation and standards

Several important Directives and policies have already been mentioned above:

- The Large Combustion Plant Directive;
- The EU Emission Trading System;
- The Renewables Obligation Scheme;
- The Climate Change Levy; and
- The EU Renewable Energy Directive.

Together, these will tend to promote a shift from more polluting forms of energy generation towards low-carbon energy, including renewables. Continuing international negotiations and the development of national policies will reinforce these trends.

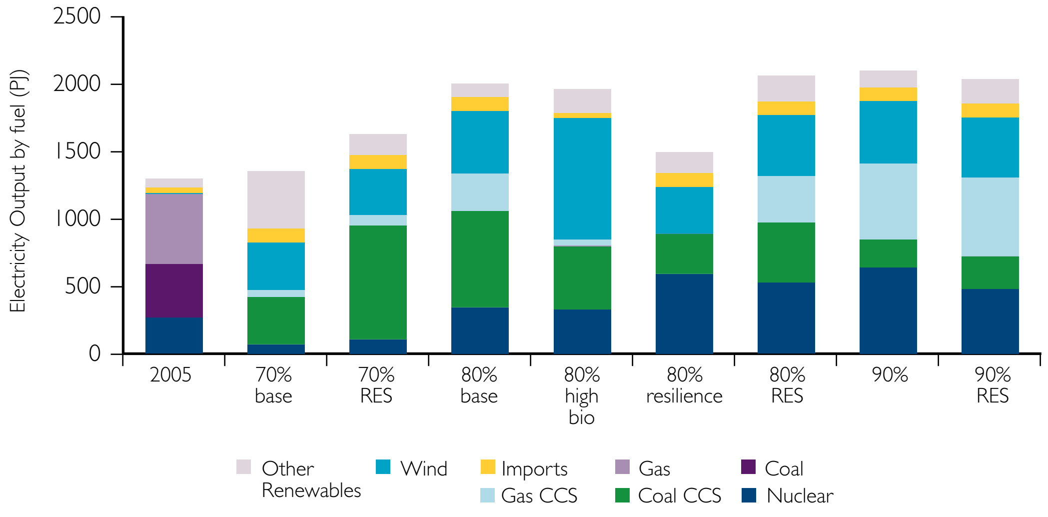
More generally, new regulations and standards could reduce issues associated with information and agency problems relating to more efficient equipment, housing and cars. However, pricing of energy, carbon and ecosystem services remains critical to ensure that such standards are financially attractive and therefore less likely to be undermined by powerful economic forces.

The shift to low carbon – a key driver of energy supply

In 2009 the Government published the *UK Low Carbon Transition Plan*[422], which sets out the policies needed to meet the first three carbon budgets – requiring emission reductions at least 34% below 1990 levels by 2020. In part, this reduction will come from lower energy use, but there is also a need to displace fossil fuels with low-carbon technologies for electricity generation. According to projections published with the Plan, overall electricity demand could be 17–65% higher in 2050 than in 2005, and the Plan gives various scenarios for the level and sources of electricity supply in 2050, as shown in Figure 5.1.1. These illustrate how the climate change targets could be met.

422 HMG (2009)

Figure 5.1.1: Variation in electricity demand and generation technologies in 2050 under MARKAL scenarios, compared to 2005 emissions



Source: Department of Energy and Climate Change chart based on MARKAL (2009)

The pattern of low-carbon energy production in the decades ahead will depend on a range of factors, including the incentives provided by government, the pattern of fuel prices, regulations and technological developments. The 2050 scenarios show varying shares of renewable and nuclear electricity. Some scenarios assume that coal generation with CCS will be making a major contribution, supplying over half of total electricity, while others assume that fossil fuel electricity comes predominantly from gas (also with CCS). CCS and nuclear plants involve minimal land take, but this is less true of on-shore wind power and energy crops.

In the period to 2020, the major driver for electricity generation investment will be the EU Renewable Energy Directive[423] which will require at least 30% of electricity to be generated from renewables, of which a large part is likely to come from wind which is the least costly and is also a mature renewables technology. However, wind is intermittent, and requires back-up or access to storage (both of which are costly). As installed wind capacity rises, so the need for adequate flexible generation increases, but plants will now run for fewer hours per year, raising the costs of supplying flexibly[424]. A switch to a mix of wind, nuclear and coal CCS and away from gas-fired generation would reduce import dependence and the influence of external disruptions.

423 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF
424 Ofgem (2009)

Scenarios for wind power

Wind is a mature renewable electricity technology and, according to HMG's 2050 scenarios, could provide from 325 petajoules (PJ) or 90 terawatt hour (Twh) (23% of a low total) to 935 PJ (260 Twh) (46% of a higher total)[425], requiring between 40 and 120 gigwatts (GW) of wind turbines. This would have substantial implications for land use in the scenarios. In particular, delays in securing planning permission for on-shore wind turbines can discourage or delay investment. On average it takes two years to secure planning permission for on-shore wind projects and only two-thirds of applications are approved[426]. Despite being one of the most favoured countries for wind power, the UK has lagged far behind Germany and Spain in developing on-shore wind power, and on current trends will require major changes in the way wind farms and transmission lines are handled through the planning process if it is to meet its EU targets at reasonable cost.

The Government has recognised this requirement, by setting up the Infrastructure Planning Commission. This body is tasked with taking decisions on major infrastructure projects, for example, related to large wind farms and power stations. This may speed up decisions related to pressing objectives such as meeting carbon budgets and the Renewable Energy Directive targets. However, while accelerating planning permission will undoubtedly help, there are still major constraints in delivering adequate transmission in time, and modifying the regulatory and market design to make the electricity system fit for high penetration of intermittent generation[427].

The middle scenarios in the *UK Low Carbon Transition Plan* envisage 125 TWh (450 PJ) generated from wind (about 22% of the total, with other renewable electricity providing about 9%), requiring 55 GW turbine capacity. However, estimates by MacKay[428] indicate that on-shore wind turbines produce on average about 2 MW/sq km, and his estimates of land take suggest that a wind farm generating, say, 2,000 MW on average would take up 1,000 sq km, although the surrounding land would still be available for, for example, agriculture. In addition, wind farm development, particularly in isolated areas that are well-endowed with wind resources, requires transmission capacity which takes land (and also has adverse visual impacts which are unpopular). If half the 2050 scenarios' wind power were on-shore, the land take would range between 1.5% and 4% of Britain's total, with the central estimate just under 2%[429].

Analysis in ER: 23[430] suggests a far more modest estimate of our on-shore potential wind capacity of 45 TWh from 8,000 2 MW turbines (16 GW), compared to our current 2,342 turbines with 3 GW total capacity[431]. The resulting 320 wind farms in the UK would occupy 900–2,000 sq km, less than 1% of the land area[432]. However, even though the area is relatively small in terms of the land area occupied, on-shore wind energy production is emotive because of its high visibility.

425 1000 PJ = 277.8 TWh

426 BWEA (2009a)

427 Ofgem (2009); CCC (2009)

428 MacKay (2009)

429 Assuming 25% load factor, using MacKay's (2009) estimates for land take.

430 Based on Enviros (2005)

431 BWEA (2009b)

432 The source estimates a land take of 900 and 2,000 sq km, (0.4–0.8% of Britain's land area).

Energy crops

Energy crops offer another option for decarbonising energy. However, depending on the type of crop and the type of land used, energy crops have significant implications for land use because of their relatively low energy density. This is perhaps on average one-quarter that of wind (0.5 MW/sq km), although this might increase in future with new or improved crops. MacKay[433] considers that algae grown in CO_2-enriched water in suitable climates might deliver as much as 3.6 MW/sq km (five times as much), or 10,000 litres (8.4 tonnes) of bio-diesel per day (provided it could be fed on at least 17 tonnes of CO_2/sqkm/day).

However, changes in land use to energy crops would need to guard against releasing carbon from the soil. The low energy density of such crops would also require either significant transport infrastructure or very dispersed energy production. Unlike wind energy, some energy crops, particularly those suited to soils currently used for grassland or crops, would displace other land uses such as food production. While there are hopes that crops such as Jatropha might be viable on marginal land unsuited to food production, once its value rises with increased biofuel demand, there is a risk that it could become more profitable than food on higher quality land. RCEP[434] calculated that to respond to the 2003 Energy White Paper[435] and deliver 16 GW of energy from biomass (8–12% of 2050 energy demand), up to 5.5 million hectares (22% of Britain's land area, or 125% of cropped area) might be needed. Howard et al (2009)[436] cite more recent estimates which take account of the more demanding current 2020 target, and other studies which calculate that around a third of the 2020 requirement could be met without significantly reducing food production. Thus the UK Biomass Strategy[437] found that to meet the 2020 EU targets, an additional 350,000 hectares of land will have to be converted to energy crops, although this excludes any land for biofuels, estimated to require a further 750,000 hectares. Their target was set when the goal was a 60% reduction of the 1990 level of greenhouse gas emissions; the Government's new target is 80%.

Overall, there is considerable uncertainty about the future economics of non-nuclear low-carbon electricity, and about its possible land take. But, as the discussion above suggests, under some scenarios it could be substantial.

Land for energy: overall land take

The potential quantity and value of land required for energy crops is difficult to estimate, and depends on both the scale of increase required and the degree to which it displaces other uses. As more and better land is switched to bio-energy, so land values will rise. By contrast, the direct land area (occupied by turbines and access roads) and the cost of wind farms is likely to be more modest.

The hypothetical location of energy sources in the future

It is useful to consider how a 'plan that adds up' for Britain in meeting low-carbon energy targets might affect land use in 2050. A hypothetical scenario for 2050 (not necessarily consistent with the *UK Low Carbon Transmission Plan*, nor the least cost) has been suggested by Mackay[438] and is outlined as follows, purely for illustrative purposes.

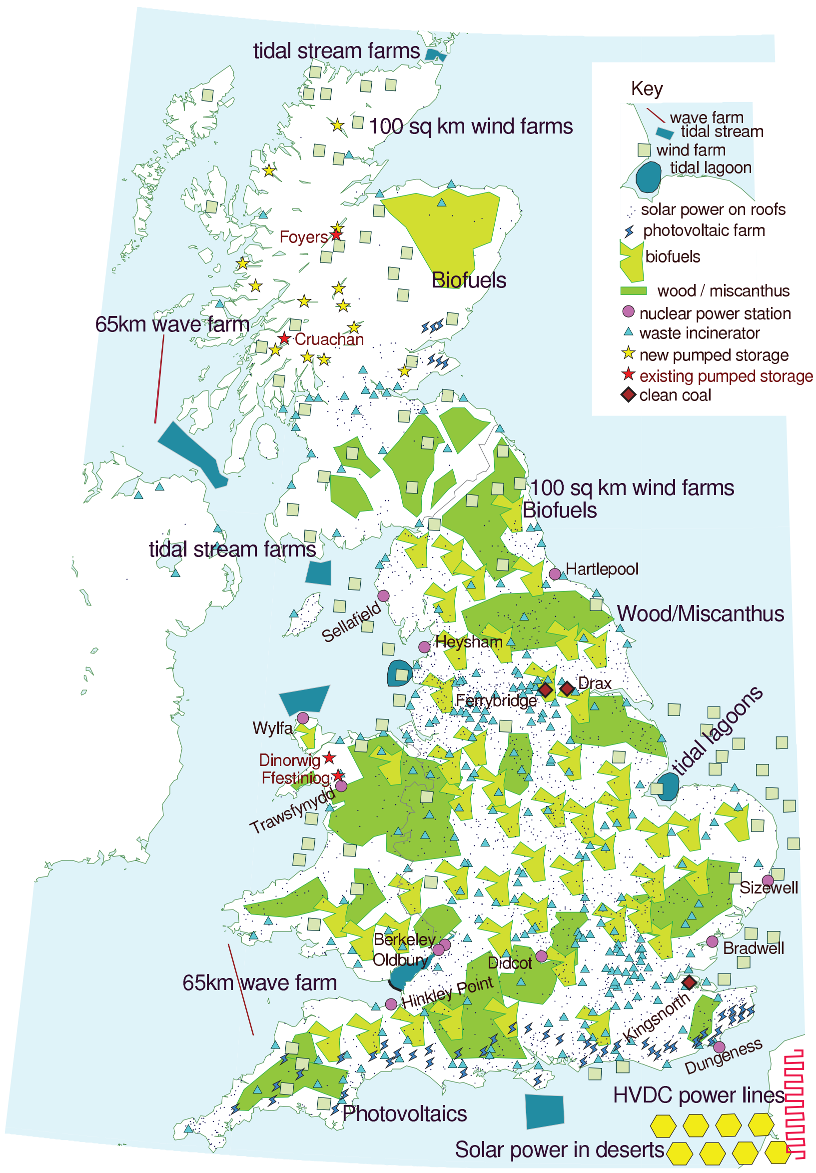
433 MacKay (2009)
434 RCEP (2004)
435 DTI (2003)
436 ER: 23 (Appendix B refers)
437 DTI, DfT and Defra (2007)
438 MacKay (2009)

It encompasses:

- 61,000 sq km for energy crops (25% of the land area, about the same as current 'rough grazing and other land' but 140% of the area currently under crops.
- 5,200 sq km (2% of the land) for on-shore wind.
- Solar photovoltaic (PV) which might become cheap enough to justify PV farms occupying 1,000 sq km of land, mainly in the South East.
- Tidal barrages, tidal stream and other marine renewables might take up a considerable area but off-shore and so with no land take (apart from the coastal zone).

Figure 5.1.2 illustrates where different energy sources might be located[439]: clearly the largest land take would be for energy crops, many of which would compete for other land uses.

Figure 5.1.2: Hypothetical location of energy sources for year 2050



Source: MacKay (2008 on-line version)

439 It should be stressed that these locations are illustrative and schematic.

Decarbonising the energy sector: some observations on the market and future policy

Recent reports[440] have raised doubts about whether the current market design is appropriate for decarbonising the electricity sector, and whether the planning system is capable of accommodating the high levels of infrastructure investment (siting wind turbines on-shore, transmission lines, gas storage and transmission facilities, and nuclear power stations) required to meet the 2020 legally-binding carbon and renewables targets. The new Infrastructure Planning Commission should contribute to resolving the planning issues. Its operation will need to be kept under review.

The other main land-use policy question is whether decisions on the supply of energy crops can be left to the market or whether they are likely to create significant adverse impacts that require anticipatory policy action. Here there would seem to be four potential issues:

- With any major land use change, there are potential impacts on carbon sequestration and greenhouse gas emissions, as well as on other ecosystem services. Policies will be needed to address these in general, and not just for energy crops.
- The second concerns the implications of the European Union Greenhouse Gas Emission Trading System (EU ETS) not delivering a satisfactorily high carbon price – additional support is needed to ensure that economically justified choices are made. The outcome of international negotiations and subsequent policy developments will condition how the scheme evolves.
- Any subsidies for energy crops will need to be coordinated with the operation of the reformed CAP to ensure that the pattern of agricultural land use will deliver best value.
- If the use (rather than the production) of energy crops and biofuel is subsidised (as at present), domestic production will not necessarily rise sufficiently to meet the higher level of demand, which will increase imports from other countries. The impact on global markets, and the ecological and economic impacts, will need to be taken into account.

Rising fuel and carbon prices would make energy crops increasingly economic, and would stimulate improvements in plant varieties. Cropping patterns in agriculture have always been sensitive to market signals and this can be expected to continue to be the case. If market signals can indicate what is socially and ecologically sound, this may be sufficient to deliver satisfactory outcomes. However, other measures may be needed if other parts of the land market are distorted, but these should avoid introducing additional market distortions – such as unduly low prices – which serve to increase energy demand and reduce energy efficiency. It is also important to avoid over-stimulation of the market for particular fuels; if the overall price of carbon is appropriate, the case for introducing fuel-specific incentives is weaker. With regard to new technology, there is a clear case for supporting research and development of new energy crops.

440 Ofgem (2009)

5.1.3 Summary of key implications for policy

Supply:

- **Targets** At past rates of growth, the UK would fall short of meeting its EU 2020 Renewable Energy Targets, and a step change will be needed in the process of granting planning approval for on-shore wind farms, transmission lines and for other renewable energy sources, if these targets are to be met at reasonable cost. While off-shore wind does not encounter the same planning obstacles, it is considerably more expensive.
- **Planning** Recent reforms to the planning process, including the Infrastructure Planning Commission (IPC), should help in the resolution of conflicts between national priorities and local sensitivities. These reforms will need to be kept under review, to assess their effectiveness, especially in light of expected increases in land required for renewable energy and transmission lines.
- **Energy crops** These have an energy density approximately one-quarter that of wind but, unlike wind, often displace other uses for the land they occupy. Using them to supply 8–12% of 2050 energy demand would account for 22–25% of the UK land area, and provide major competition with food production (although to the extent that unutilised crop residues could be used, there would be no such competition). Ensuring that all crops are correctly charged or credited with their impact on greenhouse gas emissions (and other externalities) is important to ensure the balance of rural land use delivers best value. While there is a case for R&D support for developing energy crops, the case for subsidising the production of specific fuels is weaker insofar as the overall carbon price is adequate.
- **Appropriate pricing** For energy, carbon and ecosystem services more generally, this is needed: to guide the rapid land use changes required in response to meeting biofuels and other renewables targets; in recognition of the value of ecosystem services; and to inform decisions on incentivisation of food over energy crops or forest and peatland restoration.
- **Technology** New technology may create solutions, but it may also create land take costs.

Demand:

- **Incentivising better energy efficiency of buildings** has substantial potential to contribute to balancing future supply and demand – 40% of energy is consumed in buildings. Building standards apply to new-build but this is currently adding less than 1% per year to the stock. The major effort should therefore be directed to improving the existing building stock. Ensuring the carbon price is supported or supplemented to the appropriate level is necessary to encourage efficient low-carbon production and consumption.

5.2 Residential and commercial development

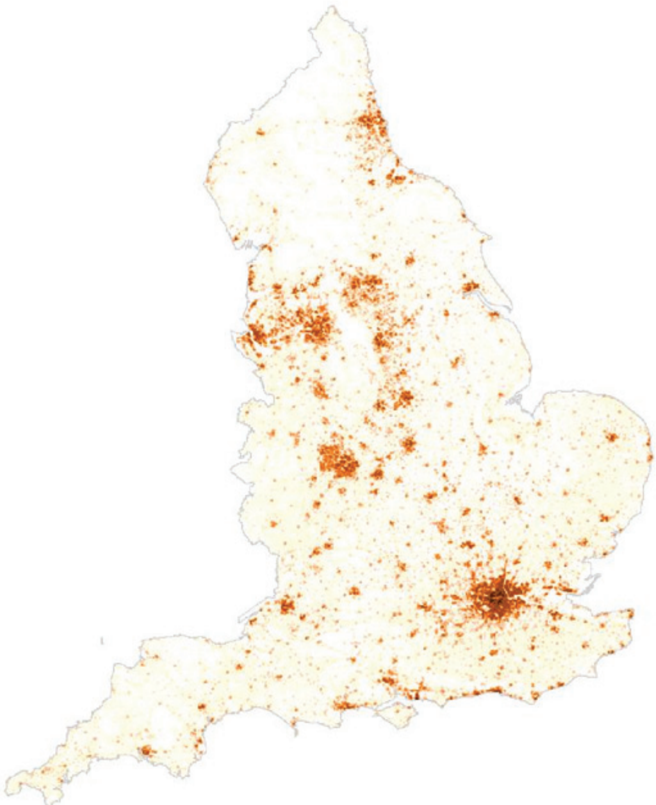
5.2.1 Past and present patterns and trends

Residential property

During the 20th century the number of UK dwellings increased from 7 million to 20 million, household size fell from 4.6 persons/household to 2.4 and owner occupation rose from 10% in 1914 to 71% in 2000[441]. With these changes came increased urbanisation. Eighty per cent of the population now live in urban areas, and one-third of the UK population lives in the 10 most populous urban areas[442].

As development has mainly been concentrated in urban areas, the overall proportion of urban land has remained broadly static. Approximately 5.4% of England's land area is in residential use: domestic buildings (i.e. the building footprint) account for 1.1% of England's land area[443], with the remaining 4.3% taken up by domestic gardens. However, the impact of urban and other developed land stretches beyond this. For example, a study focusing on the wider impact of development has demonstrated that the proportion of land in England affected by visual or audible intrusion has grown from 26% in the early 1960s to 50% in 2007[444].

Figure 5.2.1: Habitation patterns, showing an urban-rural divide



Source: ER: 20

441 ER: 15 (Appendix B refers); *Social Trends* 2000

442 ER: 17 (Appendix B refers)

443 ER: 1 (Appendix B refers)

444 CPRE (2007)

The distribution of people across England[445] is not uniform. Half the population lives in towns and cities occupying 4.5% of the total land area[446] – a figure that includes all the non-residential land at ward level. The average population density on the densest 1% of land is 70 people/hectare, and half the population of England lives at densities of 41.3 people/hectare[447]. At average occupancy rates these would translate into 30 dwellings/hectare and 17.5 dwellings/hectare respectively.

This high concentration of people is arguably linked to the policy of urban containment that dates back to the 1947 Town and County Planning Act (TCPA)[448]. As noted in Chapter 2, the TCPA was, in part, shaped by a concern to contain urban sprawl prompted in the inter-war years by the expansion of the rail, underground and road network. Policies to prevent sprawl have been largely successful. In the last decade, nearly all residential development has been concentrated in or near urban areas. Patterns of urban development demonstrate an urban-rural divide, as shown in Figure 5.2.1. Gallent argues that, the extent that household projections, and therefore plans for development, are based on past trends, projections affirm and support the urban-rural divide[449].

In England, the following major trends can be identified:

- For cities: from 1981 to 2003 a higher rate of population growth occurred in small cities; metropolitan areas and large cities witnessed a dramatic fall during the early 1980s but this has subsequently slowed down. London has been the exception, showing the highest rate of growth of any area between 1997 and 2003, although this has recently reversed.
- Nearly two-thirds of housing development has occurred in large urban areas with more than 10,000 inhabitants[450]– 80% of the population of England and Wales live in such towns.
- Over the last 20 years, more than 60% of household growth occurred in the South and only 19% in each of the North and Midlands.
- A continuing and significant trend of 'counter urbanisation', or urban to rural migration, is evident from the 1970s.

Overall, the highest rates of population growth have been recorded in small towns and rural areas, and in the South and East of the country (Figure 5.2.2). This reflects the century-long decline of manufacturing and the shift to service sector jobs that require good transport access and face-to-face contact – such as the financial and business service sector that is concentrated in the South East.

445 The most populous country in the UK

446 This is less than the amount of land in England which is designated as Green Belt: approximately 12 per cent.

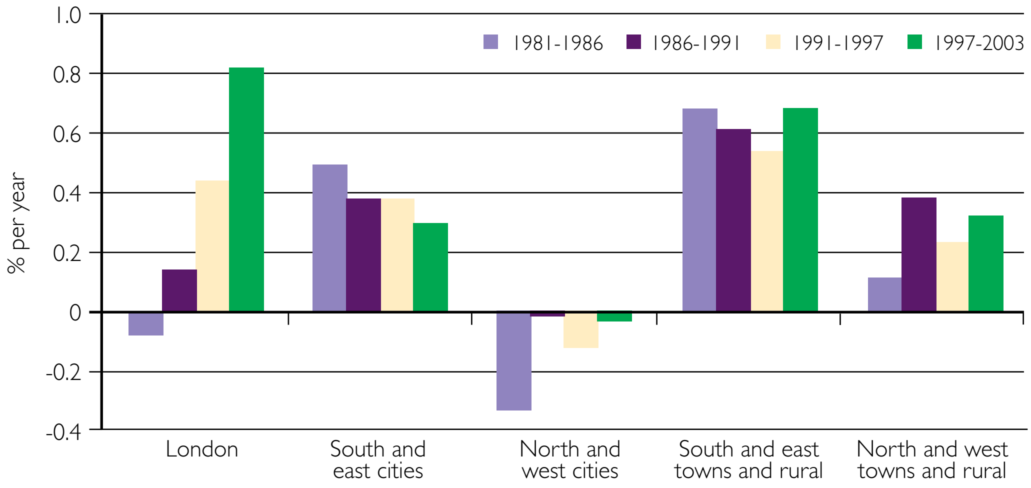
447 GLUD

448 Though the causes of urbanisation are complex (see Chapter 2).

449 ER: 21 (Appendix B refers)

450 University of Sheffield (2006)

Figure 5.2.2: Population change by city and region 1981-2003



Source: CLG (2006)

Commercial property

Data on the share of urban land occupied by commercial and industrial property are extremely difficult to locate, but a survey in 1969[451] suggested:

- 55–65% of the area of major urban areas in England and Wales was devoted to residential use;
- 10–20% was devoted to industrial and commercial use; and
- 15–25% was allocated to open space.

Data from 2007[452] show that UK commercial property was worth about £760 billion – about one-fifth of the value of commercial and residential property taken together. This figure is consistent with the earlier estimates of land take shares, and that property is generally valued at 3.34 times GDP. These values compare with a 2007 equities market value of £1,800 billion and a 2007 GDP of £1,400 billion. About 80% of commercial property is 'core' (shops, offices and industrial premises), and half of that is investment property rented to tenants (but its value per square metre is much higher than owned property so it only accounts for 20% of commercial floor area[453]).

Investment in commercial property has historically yielded higher returns than equities, and financial institutions (insurance and pension funds) have increased their share, buying during property downturns in the 1960s and early 1970s. They now own about 40% of the investment property, concentrated in high-value property in a small number of key markets.

Housing supply and prices

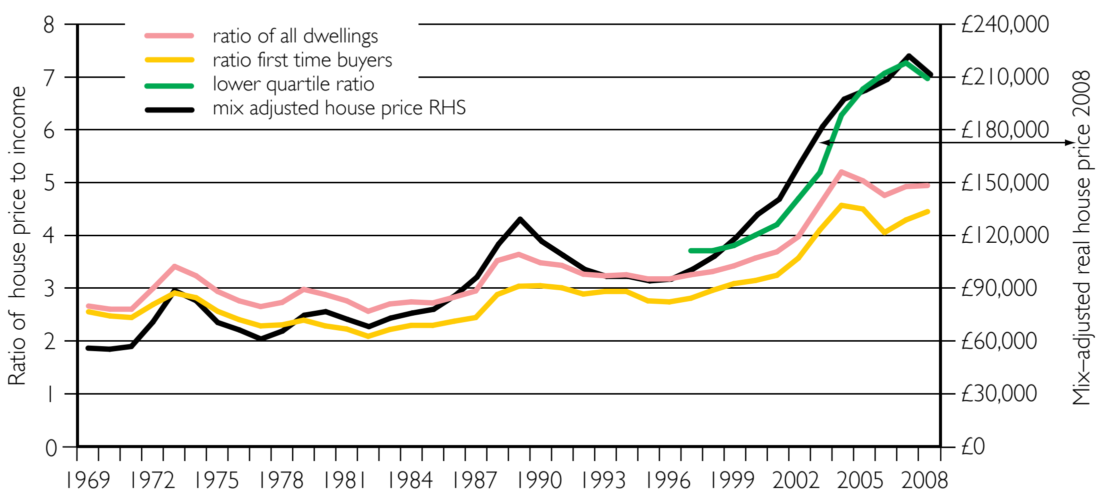
House prices have been rising steadily for several decades (measured in real terms deflated by the Retail Price Index (RPI), and also relative to incomes) (Figure 5.2.3). From 1969–2008, prices rose at an average real rate of 3.5%. However, first-time buyers in 2008 were paying 4.5 times their income to buy a house, compared with

451 ER: 17 (Appendix B refers); DoE (1978)
452 ER: 17 (Appendix B refers)
453 ER: 17 (Appendix B refers)

roughly 2.5 in 1969–89. Those with an income at the lower quartile who bought a house at the lower quartile price, would have paid seven times their income (even more in 2007 before the collapse in house prices). Real house prices have risen faster in the UK than in any other continental country[454]. Germany, for example (with a comparable population density and GDP per capita), has experienced no real house price inflation over the past 40 years, and has had lower house prices per sq m of floor space.[455]

The cost to social welfare is arguably high. Figure 5.2.4 tracks the cost of a plot of land (at a building density of 40/hectare) in terms of the number of months' pre-tax income that a worker would need to buy the plot (as development land) over more than a century. Before 1958 it would take about six months of before-tax income for a worker to earn the money to buy a plot of land. Now it requires 30-36 months, despite the increase in real wages over the past century (real income per week has risen by a factor of 5.1). House prices in rural areas are even higher on average than in urban areas, although rural incomes are lower, creating serious problems for the sustainability of rural economies, as highlighted by the Taylor report[456].

Figure 5.2.3: Real house prices and house price to income ratio, 1969-2008

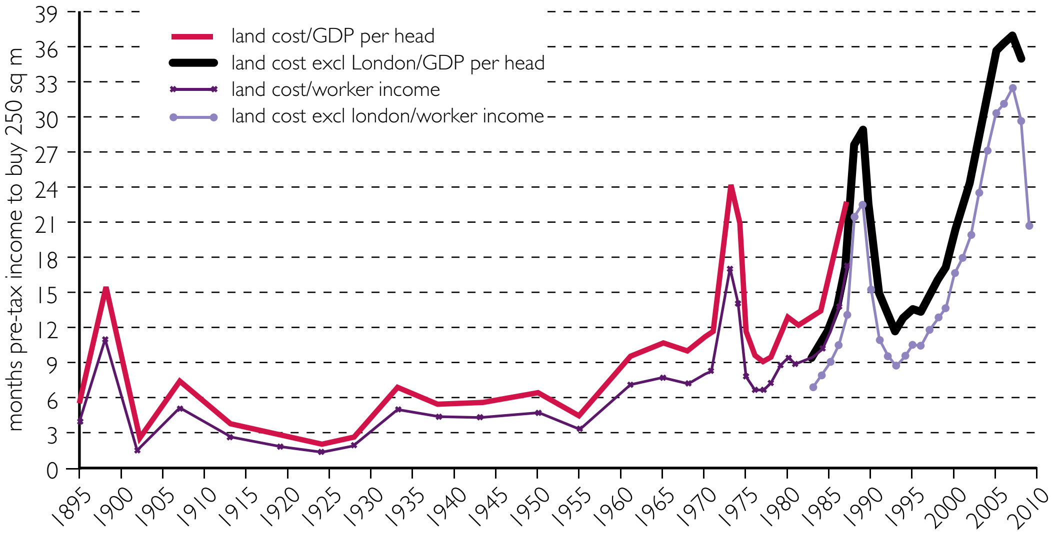


Source: CLG (2009)

BCIS data show that the general cost of building has been fairly stable (when deflated by the RPI), rising at just 0.8% a year over the past 30 years.[457] By contrast, the real cost of building land, which showed no trend before 1955, grew at nearly 6% per year in real terms between 1983 and 2008 (or at 4.9% per year until after the collapse of land prices in 2009).

454 Barker (2006a; 2006b)
455 Barker (2006b)
456 Taylor (2008)
457 See http://www.bcis.co.uk/online

Figure 5.2.4: The real cost of a plot of land in terms of months' pre-tax income, England 1892-2009



Source: Vallis and Cheshire; Craft and Mills (1993); DCLG; ONS[458]

An indication of why land costs have risen so rapidly is given by examining the ratio of the value of land with planning permission to that of agricultural land. For England and Wales (excluding London) the ratio has risen by a factor of five since 1983 and by far more since the early post-war period. As noted in Chapter 3, obtaining permission to change use from agriculture to development can increase the price of land 600 to 700-fold. This suggests that it is specifically land with planning permission that has become scarcer, relative to demand (driven by population and income growth and a fall in nominal mortgage interest rates)[459].

A similar conclusion can be reached by comparing house prices and building costs. In the South East of England, semi-detached property prices have exceeded building costs by over £158,000 averaged over 2003–2008, while in the East Midlands the excess was only £52,000[460]. Recent research has demonstrated that not only does the tightness of planning controls raise the average level of house and land prices substantially above the level it would otherwise occupy, but also it increases price volatility – perhaps by around a quarter[461]. Volatility in turn increases the risks of financial problems – the recent financial crash was precipitated by a collapse of the collateral of sub-prime mortgages.

Whilst this evidence strongly suggests that the planning system has a major influence on the availability of land for development and housing supply, demand drivers and other factors such as the actions of developers are also important. Housebuilders acquiring planning permission for land and then 'banking' it for future development is another factor. Statistics for 2006 show that the 10 major housebuilders had, on

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458 Vallis (1972); Cheshire and Sheppard (2004); data for worker income has been compiled from Crafts and Mills (1994) updated with average weekly earnings from ONS; data from 1963 to 1988 from DOE *Housing and Construction Statistics* and relate to England and Wales; from 1983 onwards from the Valuation Office Agency *Property Market Report* (Various). House price series came from ODPM Historical House prices from 1930.

459 Valuation Office Agency

460 Drawing on http://www.voa.gov.uk/publications/property_market_report/index.htm, BCIS data, and housing statistics of CLG, taken from the Regulated Mortgage Survey. Prices are at £2008 values.

461 Hilber and Vermeulen (2009). Their starting point is 1974, a year of above trend land prices, so their estimates of the impact of planning restrictions understate the full effect relative to a more relaxed regime.

average, planning permission and plots for an extra 2.7 years of construction, while under the 2004 Planning and Compulsory Purchase Act, permission expires after three years[462]. Provision of infrastructure is also important. Residential development often needs to occur alongside either a programme of new infrastructure or measures that ensure that existing infrastructure can adequately cope with increased demand[463]. Public attitudes are also influential in dictating the amount of land released for development, and hence the tightness of planning controls.

But underlying demand and cost drivers cannot alone account for the fact that land prices have risen so rapidly. There is clear evidence that the supply of development land has not kept pace with rising demand in key regions, towns and cities. This has resulted in property prices rising progressively, with the increase over time predominantly accounted for by higher land prices.

If full values were to be ascribed to all aspects of land use and land use change, as advocated in Chapter 3, the differential between prices of developed land and undeveloped land at the margins of settlements would essentially reflect the net external costs imposed by development, including the loss of environmental benefits. The price of land and property in more favourable locations would be higher than property in less favoured locations. As incomes have increased over time, so has the value attached to ecosystem services – and hence the net external costs of development are likely to have grown. However, on the basis of current valuations, these issues are of a different scale. Comparing market and non-market values, as given in Chapter 3, helps illustrate this. Whilst the current non-market benefits of extensive agricultural land at the urban fringe have been valued at £3,150 per annum, per hectare, the price differential between undeveloped land and land allocated for development, in one study is from £6,000 to almost £5,000,000 per hectare[464].

This suggests that incorporating the non-market value of undeveloped land and other possible environment and social costs, such as increased flood risk at present values, would not lead to internalised[465] values offsetting the huge price differential. On this analysis, a more flexible development system would over the long-term reach equilibrium between different values as land prices fall, and improvements in our understanding and ability to value non-marketed goods and services improves. However, existing difficulties in assigning monetary value to some ecosystem services mean that this approach to allocating land use may, at times, struggle to accurately reflect the full range of values and therefore the full impact of land use change. This could result in unintended social and environmental consequences, particularly if an equilibrium has been reached because land or resources have become so scarce as to tip the balance sharply, forcing the land use community to react to rather than manage change.

The issue is further complicated by the need to weigh the net benefits (social, economic and environmental) created by a change in use now, for example developing land which is currently in agricultural use, against the potential long-term effects. This is even more important for changes which are virtually irreversible. Anticipating the 'future' value of land in alternative uses is not an exact science. However, more systematic consideration for example, of the capacity of land in particular locations or landscapes to:

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462 Royal Town Planning Institute (2007)

463 Callcutt Review (2007)

464 See Chapter 3

465 "Internalised" means in this context reflecting all costs in the value of land.

- support a narrower or broader range of uses (its versatility);
- provide a narrower or wider range of services (its functionality);
- be used for a high-value single use; and
- futures analysis (such as in this report) suggests that the value of those services and uses is more or less likely to rise in the future

is likely to lead to more informed and more sustainable decisions. It could be described as a means of 'costing' irreversability. This does not mean that the needs of future generations outweigh those of people today (or vice versa). By considering issues related to land capability, functionality, versatility, alongside questions of irreversibility and present and future social, economic and environmental value, land use change is more likely to create outcomes which benefit both present and future generations.

5.2.2 Changing patterns and projections for the future

Drivers

Housing demand is primarily driven by income, the availability of credit, and affordability. A trend towards smaller family units, with more single households and increased life expectancy (growing at four hours per day), also raises the demand for houses per head of population.

The importance of income to house prices

Cheshire[466] compares two scenarios for the period 1996–2016 for meeting the projected increase in household numbers of 4.4 million, based on the then recently announced planning policy of providing at least 60% of new housing on brownfield land (i.e. within existing urban areas). The first assumed no growth in real incomes and resulted in a 4.4% total increase in house prices, while the second assumed that real incomes grew by 25% over the period (consistent with at the trend rate between 1986 and 1993) and resulted in an increase of 132%. He concludes that in a world in which the supply of land is restricted, the real driver of house prices seems to be income, not household numbers, and this stems from the income-elasticity of demand for space.

The implications of rising incomes on planning for development are profound. If there is no change in mortgage availability, even if the supply of land for development were to be increased to match the increase in household formation, this would leave prices rising broadly in line with earnings, and would do nothing to reverse the substantial deterioration in affordability.

Changing demand for housing

There are several different projections for future household formation. The most recent figures project total household numbers in England rising from 21.5 million in 2006 to 27.8 million in 2031, a rise of 6.3 million or 29% from 2006. This equates to 252,000 households per year[467]. This alone would imply a building rate of 265,000-270,000 per year taking account of vacancy rates and second homes[468]. The South East

466 Cheshire (2008)

467 CLG (2009)

468 ER: 20 (Appendix B refers); Bramley (2008)

region is projected to have a 39,000 increase in households per year, whilst the figure for the North East is 8,000 per year[469].

Box 5.2.1: How CLG's household projections are made

The government department Communities and Local Government (CLG) produces household projections to 2031 by applying projected household formation rates to the population projections published by the Office for National Statistics. They are based on demographic trends but not possible future government policies, changing economic circumstances, incomes, prices, or other factors. The projected growth in the population is used as the main driver of increase in households, accounting for almost three-quarters of the increase in England between 2006 and 2031. If there were no change in the population level or age structure, the number of households would be projected to grow by 36,000 per annum from 2006 to 2031 due to changes in marital status and household formation.

However, as Box 5.2.1 explains, the projections do not take changes in price and income trends into account, nor policies such as increasing housing densities. They make no allowance for suppressed demand for household formation. Evidence shows that 35% of people in their late 20s were living in the family home because they could not afford to move out. There are an estimated 1.2 million 'suppressed households' of this type[470]. If the supply of development land were to be increased more rapidly than these demand projections, and if that land were to be made use of, then land prices would be expected to fall, housing affordability would improve, and suppressed demand could be reduced. If this deficit were to be removed by 2020, then potentially an extra 120,000 households would be added to the annual total, making 390,000/year. However, actual housing 'starts' from 2006–2008 were only 167,000. This translates into a two-year backlog of approximately 200,000 houses. To meet this by 2020 would require a further 20,000 dwellings per year, making 410,000 per year. A significant increase in building rates would be required.

The amount of land that may be needed for housing

Assuming densities remain roughly constant (40 dwellings per hectare on brownfield land and 20 to 30 on greenfield), the land take per dwelling might be about 0.0325 hectares, which includes land for access roads, private garden space, car parking, incidental open spaces and children's play areas. It does not include major distributor roads, primary schools, open spaces 'serving a wider area', or significant 'landscape buffer strips'[471]. The annual land take on this basis for the CLG target of 240,000 houses per year would then be 7,800 hectares, but to reach 410,000 would be 13,325 hectares, or 133 sq km.

By 2060, the number of homes might have increased to 31 million and the additional land take for the homes themselves, plus gardens and directly associated uses, would be 2,925 sq km[472]. This amounts to 2.2% of the total land area in the UK. It could be argued that overall land take for development, including the infrastructure and economic development needed for a bigger population, could increase by 41%,

469 CLG (2009)

470 NHPAU (2009) http://communities.gov.uk/nhpau. Note that Planning Policy Statement 3 (2006, para 33) requires Local Planning Authorities and Regional Planning Bodies to take account of 'Local and sub-regional evidence of need and demand, set out in Strategic Housing Market Assessments' and so can take account of suppressed demand in formulating their Regional Spatial Strategies.

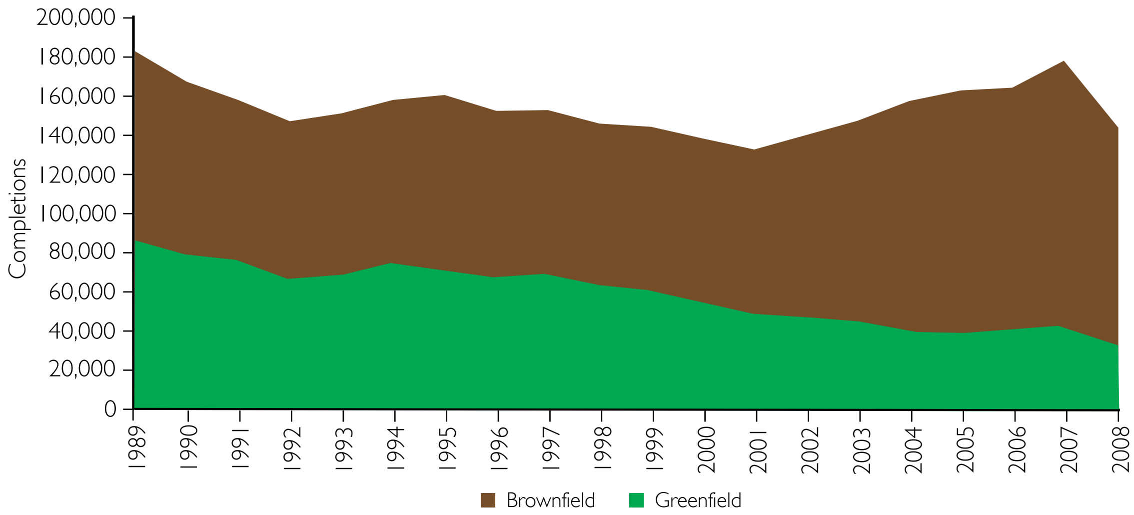
471 ER: 20 (Appendix B refers)

472 ER: 20 (Appendix B refers)

matching the growth in the number of homes from 22 million to 31 million. This would mean that 15,930 sq km of England's total land area would then be 'developed', roughly 12% of the total.

Government policy is that previously developed land is the most suitable location for future development, and development on greenfield land is broadly undesirable. This is reflected in government targets to build at least 60% of new dwellings on "brownfield" sites. The proportion of homes actually built on brownfield land rose from 50% in 1991 to 80% by 2008[473].

Figure 5.2.5: Building on greenfield and brownfield sites



Sources: CLG Land-use Change Statistics; CLG house building statistics

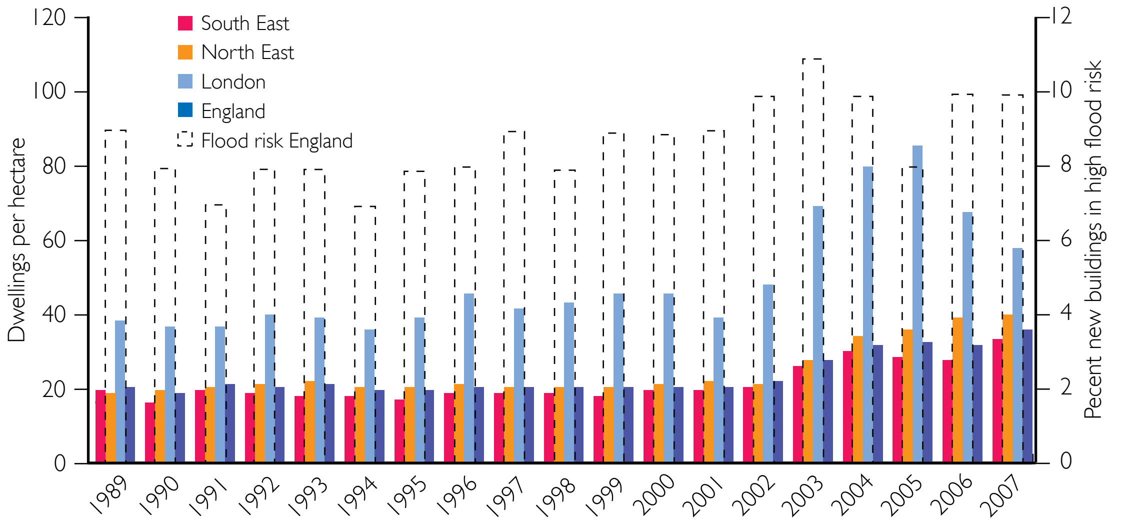
It is clear that Government is currently exceeding the targets and that policies of encouraging local authorities and developers to make the most of disused land, empty properties, and identify new potential brownfield sites have been successful. However, there is a question over the long-term feasibility of concentrating growth in existing urban boundaries.

There are currently estimated to be 62,000 hectares of brownfield land that may be available for development, of which 50,000 hectares are within or near urban areas[474]. If 60% of the projected house build of 240,000 per year were on brownfield sites at the high density of 40/hectare, the annual requirement would be 3,600 hectares/year, compared to 2,700 hectares in 2006 and the peak of 3,280 hectares in 1990.[475] It would require all urban brownfield sites to be used to meet the 60% target for the planned three million extra homes by 2020, not including the backlog of suppressed demand. The challenge will be to locate suitable brownfield sites in areas of housing demand. On the other hand, industrial land in residential areas is currently priced lower than residential land, and arguably reduces the amenity of neighbouring residential property. It has been argued that relocating industry over time to less valuable sites could release considerable extra land in areas of high residential demand. Even in London there are more than 2,500 hectares of industrial land at the moment, excluding warehousing and other low value commercial land[476].

473 *CLG* (Ongoing)
474 ER: 17 (Appendix B refers)
475 CLG (Ongoing)
476 Leunig and Swaffield (2008)

Development on floodplains has shown a slight increase in recent years (see Figure 5.2.6), but due to growing densities the amount of land used has remained broadly constant. Again, development on floodplains results from the interplay of many influences, including price signals, but there is potential for conflict with policies that seek to discourage building on floodplains (see also Section 4.5 on managing flood risk).

Figure 5.2.6: Density of new buildings in England and associated flood risk



Source: CLG (ongoing)

The possibility of building outside existing footprints

This will be a significant issue for policy-makers. Whilst this report cannot make recommendations, present and past experience could provide a useful guide.

Not all new development has been confined to existing brownfield sites or existing urban areas. Areas of greenfield development have occurred between West Yorkshire and the West Midlands, within the Mersey Belt and in the North East, areas of below average demand pressure. Interestingly, between 1998 and 2003 greenfield development has occurred near (but not necessarily abutting) many urban areas, with the exception of London and Birmingham[477]. This is almost certainly linked to the existence of Green Belts around London and Birmingham and other towns. Significant greenfield development has also occurred at key growth points and also in former coalfield belts.

Of greenfield development, the evidence suggests that the predominant form is not expansion at the urban fringe. Using a classification that identifies a narrow band of land adjacent to the build up area as 'fringe' and a wider zone as 'peri-urban', roughly one-quarter of all land brought forward for development between 2000 and 2006 fell into these zones. These areas accounted for only 31% of all greenfield land conversions. Sixteen per cent of greenfield development occurred in villages or deep rural areas[478].

477 University of Sheffield (2006)
478 ER: 1 (Appendix B refers)

Spatial distribution and counter-urbanisation

The spatial distribution of growth is also likely to change significantly. There is a great deal of variation across regions within England, as Figure 5.2.2 demonstrates, and also the countries of the UK.

Small city growth over recent years has been driven by economic dispersion. But more spectacular, perhaps, has been the continued flow of residential migrants to smaller towns and residential areas. These patterns, if they continue to hold, point to increasing population dispersion throughout England – continuing the established pattern of counter-urbanisation. The South and East will, however, continue to grow. In the North of England, a greater shift away from towns and cities towards small towns and rural areas may generate different patterns of development demand, running counter to policies designed to address weakening housing markets in some cities.

People, space and changing densities in the future

Concentrating development in urban areas and on brownfield sites, as well as the shift towards flats and away from detached and semi-detached houses, has had consequences for the amount of space per person: the average density of new housing has increased from less than 25 dwellings per hectare up until 2002 to over 40 in 2007 (Figure 5.2.6).

As overall densities increase, houses are becoming smaller. To some extent this can be explained by falling household sizes, which imply that average living space has risen from 38 sq m per person in 1991 to 44 sq m in 2001[479]. Only 7% of households in the UK now contain four or more people, compared with twice that share 30 years ago, and 35% of the projected household increase to 2016 will be single person households[480]. Another related trend is that house ownership increases with age. 81% of over 65s are owner-occupiers[481], and are less likely to move out of their existing homes, meaning that the demand for small new houses will not necessarily match the increase in single occupancy. This matters, because new houses in the UK are now amongst the smallest in Europe. More widely, average new house sizes in Australia and the US are nearly three times as large as in the UK.

Whilst preferences for modes of living are diverse, there is strong evidence that, at present, people generally dislike living at high density if they can afford not to[482]. A recent study found that around half of all residents living in new dwellings in London and the South East were dissatisfied with the amount of space in their home, and a separate study found that there is a distinct mis-match between what homebuyers want in terms of size and what the market is producing[483]. This may, in part, be due to the commercial attractiveness of building smaller homes and apartments to cater for the expanding buy-to-let market in the early 2000s. Most people's preferences are for detached or semi-detached homes, rather than flats or terraces[484]. As people grow wealthier, they tend to demand more space, both within and around the home (at constant house prices). It may be that high density can be made sufficiently attractive that enough people would choose these rather than lower-density living, even if both options were priced at levels that reflected their full social and environmental cost.

479 ER: 14 (Appendix B refers); OPDM (2003)

480 ER: 14 (Appendix B refers)

481 ER: 17 (Appendix B refers)

482 ER: 14; (Appendix B refers) CABE (2005a, 2005b); Dis: 2 (Appendix B refers); Howley (2008); Song and Knaap (2004)

483 ER: 14 (Appendix B refers); HATC (2006)

484 Dis: 2 (Appendix B refers)

Japan's Urban Renaissance programme is an example of measures to make high-density living more attractive (and an example of taking account of the non-market value of green spaces).

Case study: Urban regeneration in Japan

Poor regulatory controls during the period of urban expansion have given many Japanese cities an unattractive physical appearance and left them without the common spaces and green spaces that are important in attracting residents and investors. However, recently, the focus of Japan's urban policy has significantly broadened.

Under the Urban Renaissance programme, housing is designed to benefit current and future generations. High-density residential developments occur alongside greenspace provision and commercial facilities. Public consultation, environmental considerations and technological developments are all important features of the programme. Many of these new urban projects are carried out with the intention of promoting regeneration and international investment in cities.

Through including provision of public amenities, alongside high-density development, Japan's urban policy is designed to increase the wellbeing of urban residents and promote growth and regeneration of its cities.

Policies that keep densities on an upward trajectory could mean living at 'super-densities' in inner urban areas, which, based on evidence of present preferences, is likely to be unpopular. The argument that higher-density living promotes lower transport demand gains some support from evidence that commuting distances steadily increase as urban sizes decrease[485]. Commuting is only a small part of total travel, but total distance travelled per person decreases as population density increases, falling from about 175 miles/person/week at densities of less than 1/hectare (100/sq km) to about 133 miles/person/week at a density of 5–15/hectare and 110 miles/person/week at densities of 30–50/hectare[486].

However, this correlation does not imply causation, and it does not immediately follow that building new houses at higher densities will automatically lead to a reduction in transport and energy demand. Evidence from the New Towns programme, and especially Milton Keynes, suggests that there is a long initial phase of commuting before people relocate[487]. Allowing for portfolio careers and other transport demands, compact cities seem just as likely to lead to higher travel demands as less dense cities[488]. Also, open rather than compact cities are more efficient for energy generation, particularly if space is to be allowed for emerging forms of energy production such as ground-source heat pumps[489]. Nevertheless, there is considerable evidence from international research studies that higher densities are linked to a reduction in journey length, and to a lesser extent increased use of non-car modes, after controlling for the effects of socio-economic characteristics and attitudes[490]. In general, there are disagreements about the wider effects of higher-density settlements and whether density is of primary importance when analysing the social and environmental impacts of settlements[491].

485 ER: 1 (Appendix B refers)

486 Commission for Integrated Transport (2009); TRL (2004); CABE (2005b)

487 ER: 21 (Appendix B refers)

488 Jarvis and Pratt (2006), see also Section 5.3.

489 ER: 21 (Appendix B refers)

490 e.g. see http://www.plan4sustainabletravel.org/further_reading

491 Gordon and Richardson (1997); Burton (2000); Neuman (2005)

Significant future uncertainties in drivers of change

The number and nature of household formation Projections of household growth are built on assumptions as to how and why households form. In recent years (2001 to 2006) the formation rate has been lower than expected. The migration component of demographic change is particularly uncertain. Household projections are based on past trends and therefore do not consider the possibility that population levels could remain constant or even decline. Household formation also depends on the cost of housing – there is an estimated 1.2 million potential new households that might form if house prices were lower.[492] Demographics alone are insufficient to project demand.

Economic influences There is a clear link between housing production and the state of the national and global economy. Financial crises have been shown to have a devastating effect on the housebuilding industry. As well as affecting overall output (because of the impact on both development finance and credit for home buying), such crises can change the distribution of development, with housebuilders focusing their efforts on bringing forward the most profitable sites nationally and regionally, and turning away from those with significant physical or local planning constraints.

The future location of jobs will also affect future development patterns There is an argument that the overarching trend of counter-urbanisation of people is being supported by a counter-urbanisation of jobs[493]. This could require diverting development to edge-of-city locations and controlled small-town and rural growth. The dispersal or counter-urbanisation of homes and jobs will be mutually-reinforcing and strongly felt in all regions, although continued intensification of residential development in the major cities will help to secure the future of existing service centres.

Changes in consumer behaviour Across society as a whole, aggregate attitudes and behaviours may change, for example, towards borrowing, owning a home and forming households. This is in turn affected by expectations about future house price increases – in a future in which there is a significant reduction in house prices, then attitudes to home ownership would be likely to change considerably, and renting would become more attractive.

Changing policy The future distribution of residential development will be affected by the outcomes of a number of policy initiatives and debates, including those on: place shaping; the nature and viability of sustainable communities; the growth area and growth points programme[494]; the development and delivery of 'eco-towns'; the future of urban containment policy and policies to incentivise housing delivery; as well as any incentives (including changes in local finance) for local authorities to increase the rate of land release for development.

Resource constraints and future environmental risk Resource constraints in the South East region (for example, deficits in water supply) may act in tandem with the demographic trends and support movement northwards. This might lead to redistribution of population and industry to the northern regions in the 21st century. Such trends would work against the existing 'economic geography' paradigm that sees people moving southwards to experience 'agglomeration benefits'. A recent report by the Environment Agency[495] summarises the constraints and risks that the country now faces. There is a clear imperative to 'build in the right place'. As the climate changes and

492 See the section on Changing demand for housing.
493 Breheny (1999)
494 See: http://www.homesandcommunities.co.uk/growth_points
495 Environment Agency (2009)

risks such as flooding become more acute, the challenge for government will be to reduce risk and make development decisions based on the realistic use of resources – particularly in relation to flooding and water resources. The economic costs of constraining economic activity in the most vigorous sectors and regions of the country will need to be weighed against the distributional benefits of a fairer regional allocation of talent, skills and living standards.

Cities There is a tendency to decentralise away from big cities and the evidence shows that building houses in declining areas, if anything, can lead to labour lock-in for lengthy periods as housing is so durable. Whilst a combination of economic, demographic and environmental drivers could result in larger numbers of people living away from the South East, evidence suggests that growth beyond London will be strongest in towns and rural locations. Therefore, environmental risk and economic restructuring in the South East will not guarantee the renaissance of northern cities.

5.2.3 Summary of key implications for policy

Delivering residential and commercial development represent major challenges for policy-makers, not least because of the need to accommodate future population increases whilst balancing the conflicting public aspirations for lower-density housing whilst protecting the countryside, the natural environment and access to greenspace. Also, certain market and institutional failures conspire to exacerbate pressures in areas such as the South East of England.

- The housing and commercial property markets are distorted by a number of factors, of which the system of development control is particularly significant. Aspects of the planning system seek to contain urban sprawl, drive regeneration and to protect environmentally and culturally valued land. The balance struck must reflect the full value or strategic importance (including non-marketed services) of land in alternative uses.
- There is evidence that, at present, the net social welfare cost of restricting land supply is particularly high at the "urban fringe",[496] compared to existing evidence of the net environmental benefits. Given the scale of pent-up demand for development land there is a strong case for some relaxation of restraint policies based on careful strategic and site analysis.
- Another option includes relocating industry over time to less valuable sites. This could release considerable extra land in areas of high residential demand. Even in London there are more than 2,500 hectares of industrial land at the moment, excluding warehousing and other low-value commercial land.[497]
- The strategic policy options for meeting development needs in the South East of England and other high demand areas – including whether to make additional land available for development – will need to factor in the full impacts for the land system at an early stage in policy development, including on the range of ecosystems.
- The allocation of housing and development land needs to pay appropriate attention to the costs imposed, for example, relating to issues such as flood risk, or the real cost of water supply.

496 See Chapter 3

497 See also Chapter 7 which sets out further options including buildings at higher densities and maximising the use of existing capacity in other regions and counties of the UK.

- Making development land prices more reflective of the value in alternative uses and the cost imposed by development would reduce the intense and unsustainable upward pressure on land and property prices, leading to a situation more like that in Germany, where house prices have been flat in real terms. This would lower the cost of employment, increase worker and social mobility, and make housing much more affordable for a wider range of people. Government could consider a range of mechanisms, including, for example, replacing S106 agreements by a fully assessed Community Infrastructure Levy[498] (CIL) that attempts to measure the costs of any development imposed on a town, including the value of any loss of amenity. At present the CIL is to be set according to simple formulae, but these are unlikely to include the full range of costs incurred, and the overlap with S106 appears an unsatisfactory way of making charges site-specific. While it may be difficult to make accurate valuation assessments, such changes are likely to represent an improvement on the current system. They would need to be accompanied by the creation of an independent regulatory authority that would provide methods and data for such assessments, and would adjudicate on their reasonableness. Measures such as restoring the Business Rate to local control, reforming local taxation so that towns and cities benefit rather than being disadvantaged by the influx of new residents, and facilitating green swaps to enhance access to green space as land is released for building[499] would encourage development where needed.

5.3 Land for transport infrastructure

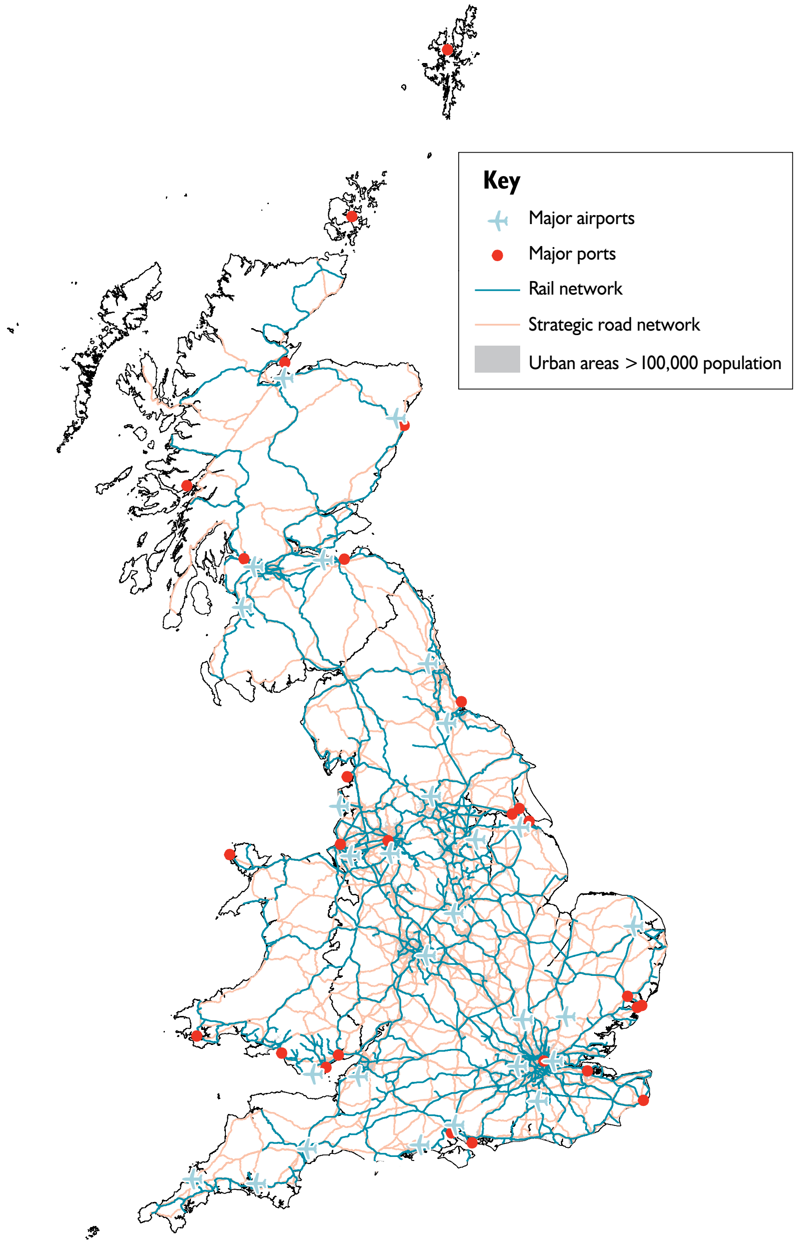
Transport-related infrastructure is essential for the efficient and healthy functioning of society, business and the economy. Not only does it enable diverse public services to operate, but it also contributes to wellbeing, for example, by allowing people to meet with each other and to access the countryside. According to the 2005 Generalised Land Use Database (GLUD) statistics, 2.4% of land in England is roads, paths and railways, whilst other developed uses, predominately transport-related, account for a further 1.4%. Thus, transport-related infrastructure represents almost two-fifths of the total developed land in England; this is unsurprising, given its pivotal role in society (see Chapter 2).

The information included in this chapter relates to England and where possible to Great Britain primarily because statistics for land use (GLUD) by the Department for Communities and Local Government refer only to England and the transport statistics by the Department for Transport refer only to Great Britain.

498 See Section 5.3

499 See chapter 7 (Case study: Cambridge Futures)

Figure 5.3.1: Main transport infrastructure of Great Britain



Source: Eddington (2006)

The transport network of Great Britain is well connected but suffers from creeping congestion (Fig. 5.3.1). It is estimated[500] that within Great Britain £17.5 billion per year is lost, in terms of time and resources, due to congestion. Without an increase in road investment and/or other ways of managing this congestion, losses could increase by an additional £22 billion per annum by 2025[501]. By the period 2020 to 2030, there is also likely to be substantial overcrowding on the rail network, particularly on the West Coast mainline and East Coast mainline. Congestion is also an issue for air traffic, currently causing delays to 3% of all UK flights[502].

500 British Chambers of Commerce (2007). The analysis covers time lost by lorry drivers and employees in business travel, as well as fuel and capital costs. The figures for 2008 are higher.

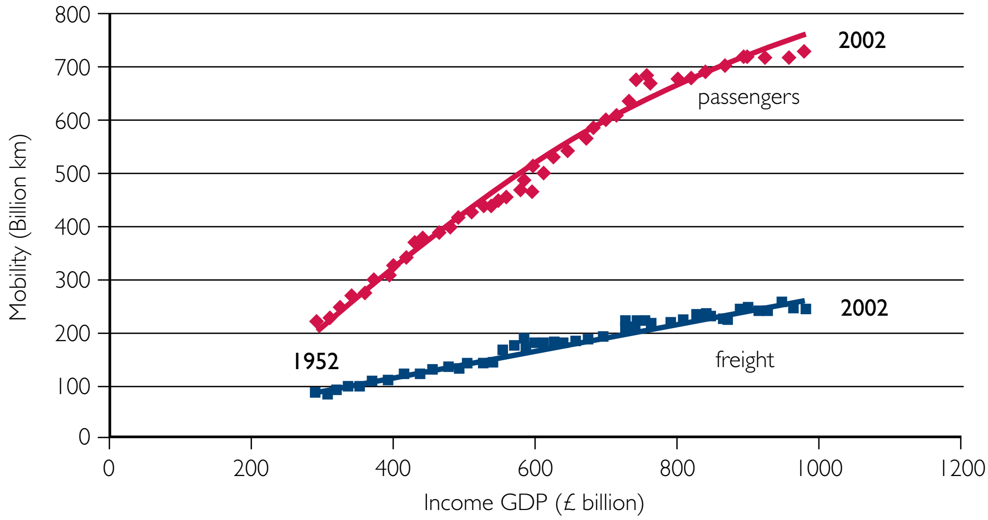
501 Eddington (2006)

502 CST (2009)

5.3.1 Past and present trends

In Great Britain, both passenger and freight mobility has increased closely in line with the growth of Gross Domestic Product (Figure 5.3.2), a relationship that holds true in all countries[503]. But in recent years road travel has grown more slowly than GDP. This has led some to conclude that the link between mobility and income has been broken, and that income growth can be maintained without increased mobility[504]. However, the growth of *total* mobility continues apace with GDP growth. Figure 5.3.3 illustrates changes in all forms of mobility since 1990, including international traffic with origins or destinations in Great Britain, as well as the changes in road travel and GDP. While growth in road mobility is levelling off, total mobility has grown at the same rate as GDP.

Figure 5.3.2: Relationship between national passenger and freight mobility and income (GDP) in Great Britain for 50 years up to 2002

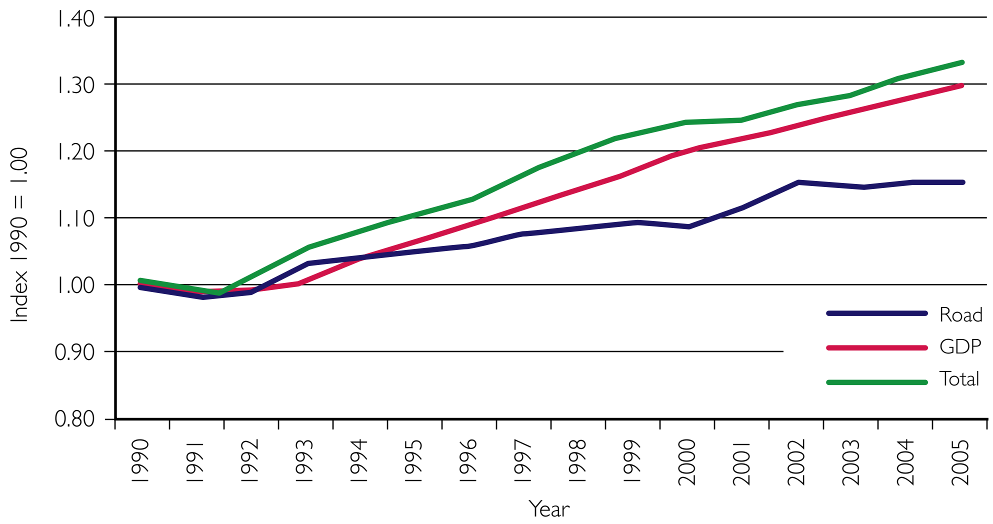


Source: Echenique (2007)

503 Schafer et al. (2009)

504 See DfT (2007). Some authors have used national statistics to demonstrate that GDP is growing at faster rate than passenger and freight mobility. However, the absence, of international travel by air and sea in the comparative statistics means that it is not total mobility that is shown. The international component of travel from and to Great Britain should be included in the overall mobility statistics. Today, passengers are likely to substitute a leisure journey to the beach to, say, Cornwall for Mallorca. Equally, a retailer is more likely to bring a garment from China rather than the north of Britain. Thus there is no evidence that the link between GDP and total mobility growth has been broken.

Figure 5.3.3: Change of total mobility (including international travel), GDP and road travel for 15 years up to 2005.



Source: ICAO (various years) and DfT (2008)

As a percentage of total mobility, road traffic has a ceiling and can actually decline in developed countries, as has occurred in the US[505]. The observed continuing increase in mobility in developed countries is due to increased use of high-speed transport (high-speed rail and cheap air travel for business and leisure). However, even if road use declines in Great Britain as a share of total mobility, the absolute number of 'vehicle-km' is still forecast to continue to grow in the future[506].

Components of mobility

Income growth has been assumed to be the primary driver of personal and freight mobility. However, it is highly probable that growth in mobility and income reinforce each other. For example, by travelling further, people and firms can increase their income. And with higher incomes, faster and more comfortable transport can be used.

Over the last three decades the numbers of trips per person per year in Britain has been roughly stable at about 1,000 trips, regardless of changes in average income[507]. However, during the same period, the average distance of the trips increased by 45%[508]. For freight, there has been a relatively constant 20 tonnes 'lifted' per person per year, independent of income change, but an increase in average freight distance transported by 70%[509]. Thus the main reason for the growth in passenger and freight mobility is this increase in average trip distance which is highly correlated with rises in income.

Why do people travel further as they become wealthier? One explanation is that by travelling further, people and businesses can find lower cost and/or better-quality goods and services. By travelling further, a person can potentially obtain a better or cheaper dwelling, reach a better-paid job, shop at higher-quality and/or more inexpensive shops, and enjoy better and lower-cost holidays. In other words, travel is a 'derived demand' – people do not demand travel for itself, but as a means of obtaining goods and

505 Schafer et al. (2009)
506 Eddington (2006); Echenique et al. (2009)
507 Echenique (2007)
508 Echenique (2007)
509 Echenique (2007)

services. Producers can also obtain lower-cost inputs by searching over a wider area, and can produce accordingly, increasing efficiency and hence income. In addition, increased income allows people and firms to acquire more efficient transport systems, which in turn increase mobility.

The power of this relationship is geometric. The market area increases with the square of the distance travelled: thus, more suppliers are encountered and competition is stimulated between them, which, in turn, acts to reduce prices and encourage more firms to enter the market. Also, enhanced transport mobility increases the size of the market and reduces the market power of providers, whether they are landowners, shopkeepers or any other supplier. This increased competition results in reduced market imperfections. Further, larger market areas encourage increased demand and production from suppliers, which, in turn, creates economies of scale and lower costs. Increasing mobility improves efficiency and has the potential to enable more people to prosper. These benefits need to be balanced against related negative externalities such as air pollution, noise and those affecting the natural environment. Any reduction of mobility could have serious implications for both prosperity and wellbeing. However, a recent report by the Cabinet Office's Strategy Unit also highlights how catering for long distance travel could accelerate the negative impacts of transport and create car dependency whilst reducing the viability of short walking trips and decreasing the diversity of goods and services available in local areas[510].

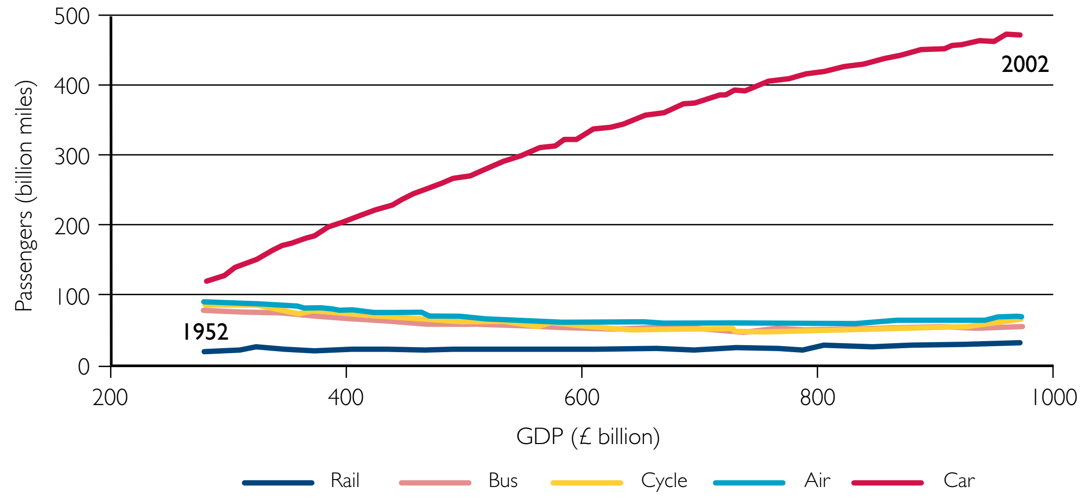
Modal shift in transport

With improvements in technology over the past five decades, people and freight have shifted towards increasingly faster transport modes – from pedestrian through rail and road vehicles to high-speed trains and air. The increase in passenger mobility within Great Britain is mainly due to the five-fold increase in car use over a period of 50 years to 2002 (See Fig 5.3.4), while the increase in freight mobility is due primarily to the increase in road vehicles and in sea transport (see Figure 5.3.5).

The focus of recent transport policy has been directed at improving public transport, especially rail. Rail transport was the predominant mode of transport for nearly a century prior to 1952, but now accounts for only 7% of passenger-km travel and 8.5% of freight[511]. Recent investments in improving the capacity and speed of travel by rail have arrested the decline in rail use and have increased its patronage by 27% in the last six years, but with high capital and operational costs, requiring large subsidies[512]. This change has had a substantial impact on rail use, but has not made very much difference to road traffic, which accounts for over 90% of all national passenger traffic[513].

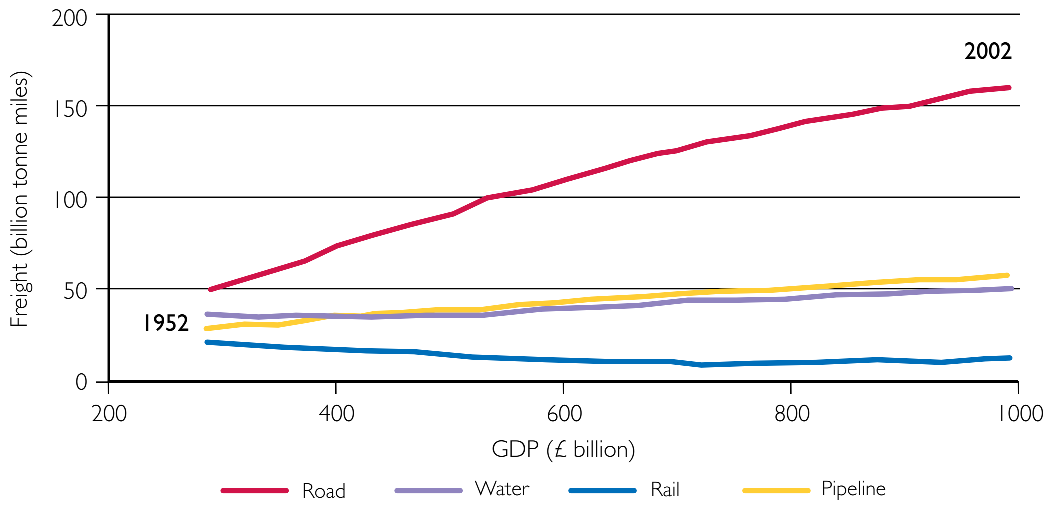
510 COSU (2009)
511 DfT (2008)
512 Office of Rail Regulation (2009)
513 DfT (2008)

Figure 5.3.4: Growth of national passenger traffic by mode and GDP growth for 50-year period to 2002



Source: DfT (2008)

Figure 5.3.5: Growth of national freight traffic by mode and GDP growth for 50-year period to 2002



Source: DfT (2008)

Technological improvements for freight such as containerisation have made maritime transport extremely efficient, encouraging international trade which has implications for land use through the expansion of ports and logistic facilities[514]. Similarly, air traffic increased sixfold from1970 to 2002, to nearly 200 million passengers per annum. By 2020, the numbers are forecast to at least double again[515]. Since 1993, air travel, including the international portion of trips starting or ending in Britain, constitutes the main driver of mobility growth alongside high-speed rail (see Figure 5.3.3), but while the immediate cost of the first is paid by the users, the second is heavily subsidised.

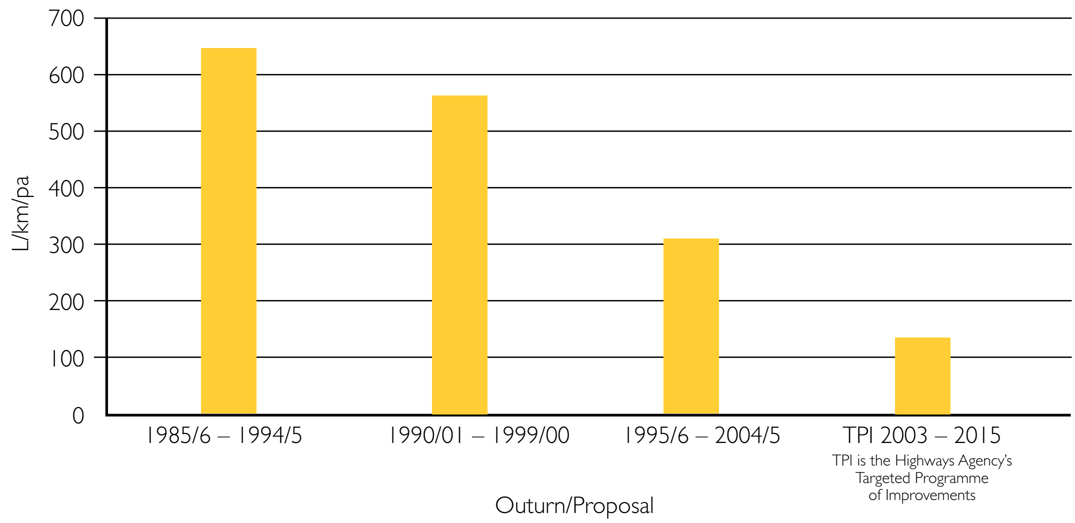
514 ER: 22 (Appendix B refers)
515 DfT (2003)

Road expansion

Road transport has allowed people and businesses greater choice of location, and more space at lower cost and in preferred environments, thereby promoting prosperity and wellbeing. But conversely, by encouraging the use of road vehicles, increases in accidents, the use of non-renewable energy and levels of CO_2 emissions and other pollutants result. They are also negative impacts for the natural environment, increased noise and severance, i.e. making the pedestrian connection difficult between neighbourhoods.

Arguments against road and airport expansion assert that investment in transport capacity will increase travel, with adverse environmental and social impacts. Over the last 25 years the annual increase in road capacity has fallen by 80%[516] (see Figure 5.3.6), while highway traffic has risen by 50% over the same period, making the English road network the most congested in the EU. However, in recent years, there have also been several government actions to alleviate congestion, including promoting increased and integrated bus usage, which as well as providing environmental and social benefits can help reduce congestion through modal shift[517].

Figure 5.3.6: Actual road expansion in lane km per year since 1985



Source: Banks et al. (2007)

Social issues

There are welfare consequences associated with subsidies to rail users and high taxes on car users. Annual road and fuel tax payments apply to a growing proportion of the population as car travel has become important for all income groups. Low-income earners now use cars in much the same way as other earners[518]. Car use by women has also increased substantially and is now approaching the level of car use by men[519]. Rail, on the other hand, is particularly used by high earners[520] and is heavily subsidised. There are also social consequences associated with congestion. Evidence suggests that people who live on streets with heavier traffic interact less with their neighbours, compared to those living in areas of lighter traffic.[521]

516 Banks et al. (2007)
517 COSU (2009)
518 Lucas and Jones (2009)
519 Lucas and Jones (2009)
520 Banks et al. (2007)
521 COSU (2009)

Environmental issues

Increased mobility can affect the environment adversely through, for example, noise and visual intrusion and severance. However, some of these impacts could be partially mitigated by better design of infrastructure including sound barriers, tunnelling and other devices. It is commonly thought that roads make less efficient use of land than rail.[522] In fact, most use of land by roads is for local access to dwellings and other buildings and cannot be replaced by rail. Strategic roads, which do potentially compete with rail, use less than 0.2% of the land in Great Britain and carry far more passenger and freight traffic than rail.

CO_2 emissions from transport accounts for a quarter of the total emissions in the UK[523]. The introduction of stricter European regulation has already reduced harmful emissions by between 50% to 90% from cars and goods vehicles[524]. Implementation of European regulations are also expected to reduce nitrogen oxide and particulate material to half the 2005 level, and non-methane volatile hydrocarbon by a third, as the older and dirtier vehicles are replaced by 2015[525]. CO_2 emissions from transport are expected to decline from 2010 onwards as improvements in engine technology outstrip the increase in vehicle travel[526].

5.3.2 The future of transport

The central role of the country's transport infrastructure in promoting economic growth and wellbeing is expected to continue. It is therefore vital that transport policy is integrated into the heart of any future strategy for land use.

Public transport

The use of private road vehicles is likely to continue rising[527] if public transport continues to lose ground to private vehicles, and trends in decentralisation of jobs and housing from central areas are maintained[528]. With dispersed origins and destinations now predominant in modern cities, it will become increasingly difficult for fixed-track public transport to run an economic service to satisfy a thin demand at any time of the day and at any given location. However, there are schemes that offer some scope for increases in public transport by assisting with supplying transport links to dispersed origins and destinations. Travel cards can encourage intermodal transport use – the introduction of the travel card during the 1980s in London led to an estimated 16% increase in bus trips[529]. The use of shared taxis in continental Europe that use software to match individuals' journeys has proved a cost-effective alternative to buses in remote areas[530]. Solutions for serving people in dispersed locations with public transport will need to draw on a wide range of policy solutions, beyond focusing on fixed-track public transport schemes.

Increasing urban density

Decisions about future development and settlement patterns have important consequences for mobility and emissions. However, the scale of the effects and the extent to which CO_2 emissions are changed is the subject of debate.

522 Banks et al. (2007)
523 Eddington (2006)
524 Stern (2006)
525 Banks et al. (2007)
526 DTI (2006)
527 Eddington (2006), Echenique et al. (2009)
528 Breheny (1996)
529 COSU (2009)
530 CfIT (2008)

The debate on the relationship between density and energy use for travel stems from the work of Newman and Kenworthy[531], which is influential in policy terms. They examined fuel use in relation to density of development, concluding that with increased density, there is a reduction of fuel usage. However, the relationship between fuel usage and fuel prices was not taken into account by Newman and Kenworthy. When the costs of motoring is included in such analyses (particularly the effect of low fuel prices), density plays a much less significant role in energy consumption patterns [532]. In addition, some argue[533] that an increase in density leads to a reduction in mobility and therefore in CO_2 emissions. A recent study[534] also shows that car drivers across Great Britain average 3,600 miles travelled per annum, living at an average density of 2.5 people per hectare. However, those in London, living at densities of 46 people per hectare, travel by car on average half as far.

However there are two important further considerations which need to be factored into future policies. Firstly, the combined effect of policies. Studies in the United States have shown that policies of increasing density of development alone, and increasing density alongside other policies, such as the supply of public transport and the location of jobs and housing, reduced household vehicle miles travelled by 5% and 12% respectively[535]. In addition, a recent study on the *The Future of Urban Transport* by the Department for Transport illustrates how people's travel patterns are not only influenced by the transport network, but for example, the ease of switching between different modes of transport[536].

Secondly, evidence is emerging that policies which seek to reduce the need for travel by increasing the density of development may not lead to significantly lower energy consumption or lower CO_2 emissions – and may even increase it[537]. This is because increased congestion is often associated with high densities, and congestion affects the speed of travel. If the speed of travel is reduced to very low speeds, for example from 30 miles per hour to 10 miles per hour, energy consumption and therefore CO_2 emissions increase substantially[538]. An average trip in London takes 43 minutes, and half that time outside of London[539].

In summary, it will be important for future transport policies to connect to changing policies in other land use sectors, especially to development and climate change strategies.

Linking development and transport policy

Development controls can lead to houses being built in areas that do not reflect the availability of employment opportunities or infrastructure. Transport demand and congestion risk being exacerbated as a result, though regional allocations are increasingly taking this into account. For example, the Planning Act 2008[540] contains provisions enabling regulations to be made to establish a Community Infrastructure

531 Newman and Kenworthy (1989)

532 Gordon (1997)

533 Banister et al. (1997)

534 CfIT (2009)

535 Transportation Research Board (2009)

536 DfT (2009)

537 Ewing and Cervero (2001): Echenique et al. 2009. For a review of the literature on the impact of the built environment on travel demand see Halcrow Group (2009).

538 Barth and Boriboonsomsin (2009). Transport for London speed survey data from 1968 to 2006 shows a continued deterioration of speeds. Inner London, with higher densities, has averages speeds of around 11 miles per hour.

539 Independent Transport Commission (2004)

540 At http://www.opsi.gov.uk/acts/acts2008/ukpga_20080029_en_16

Levy (CIL) in England and Wales. Local authorities in England and Wales will be empowered, but not required, to charge a levy on most types of new development in their area to finance any infrastructure that the development necessitates[541].

Pricing

Policies to restrain transport demand by pricing (congestion charging) have proved effective in cities such as London, which has public transport alternatives to private vehicles[542]. There is evidence that rationing road use in cities by pricing is economically and environmentally sound, but there could be a reduction of economic activity in those areas, because of an increase access costs.[543] Pricing may accelerate the rate of decentralisation of economic activities to fringe locations (Edge Cities), thereby increasing the demand for land. However, there is evidence from London that the introduction of the congestion charge in 2005 had a 'broadly neutral impact on the central London economy'[544].

Technology

Improvements in technology can reduce vehicles' dependency on non-renewable energy by progressive improvements in fuel efficiency and the introduction of hybrid and electrical motors, thereby greatly reducing emissions[545]. Improvements in information technology applied to vehicles and transport systems in general will increase the effective capacity of networks and reduce accidents. However, congestion will still be a serious problem for the foreseeable future. For this reason, the Eddington Review[546] recommended that investment in the expansion of transport capacity should be focused on urban areas, interurban pinch points and access to international gateways. Such investments were shown to have a high benefit-cost ratio.

Other technologies such as telecommunications may substitute some journeys, but there is no conclusive evidence that they reduce total travel[547]. Indeed, it is possible that the increase in telecommunications will increase the demand for travel as more interaction stimulates more transactions and trade.

5.3.3 Summary of key implications for policy

The country's transport infrastructure has a pivotal role in enabling economic growth and promoting prosperity and wellbeing. However, it also needs to meet the challenges of rising congestion, especially in the road network, in a sustainable way that takes account of the social costs. The introduction of more energy-efficient road vehicles with lower CO_2 emissions and improved design of transport infrastructure are vital for the future. Specific spatial challenges will concern the relationship between development and the provision of new transport infrastructure. Transport policies need to be integrated into any future strategy for land use.

- Policies that seek to reduce the need of travel in the future by increasing the density of development are unlikely to be as effective by themselves and may actually exacerbate congestion and environmental damage.

541 CLG (2008)
542 TfL (2009)
543 Quddus et al, (2007)
544 TfL (2006)
545 King, 2007
546 Eddington (2006)
547 There is some evidence of a small fall of less than 1% in vehicle travel with telecommuting. See Choo et al. (2005).

- There is evidence that rationing road use in cities by pricing it is economically and environmentally sound, but there could be a reduction of economic activity in those areas, because of an increase in access costs.
- It is essential that the full costs of congestion and the need for new transport infrastructure are taken fully into account in decisions about the location of development, which should seek to take advantage of existing links.
- Congestion will still be a serious problem for the foreseeable future. There is substantial evidence from the Eddington Review that an increase in transport capacity to reduce inter- and intra-urban congestion is highly beneficial and should be considered alongside other policy measures to manage demand and improve transport technology. This form of development will have only a very small land take.

5.4 Land for recreation

Leisure activities, including all forms of tourism and recreation, are a fundamental part of modern lifestyles and can play a vital role in promoting health and wellbeing. They are also an important component of the economy. Some require dedicated areas of land such as shopping malls, hotels, children's play areas, sports fields and golf courses. Others, for example, walking and climbing, rely on the land itself, and are often managed through other primary land uses such as agriculture and forestry. Recreation is in this sense often part of multifunctional land use, especially in rural areas. In this section, how land impacts on leisure and recreation and trends in recreational activities are examined, and key future challenges are identified.

5.4.1 Recreation: past and present

The main leisure activities of the population in England are diverse (Table 5.4.1). Particularly striking is the wide range of activities, which in turn have diverse implications for land use. They range from those that entail a direct involvement with the land surface such as gardening or walking to others that take place within people's homes.

Table 5.4.1: Free time activities (of adults in England) 2005-06

Selected activities	% participating
Home based	
Watching TV	82
Time with family/friends	75
Listening to music	69
Reading	63
Gardening	49
Internet/emailing	42
DIY	36
Playing computer games	18
Arts and crafts	18
Away from home	
Shopping	62

Selected activities	% participating
Eating out	59
Days out	57
Sport/exercise	49
Going to cinema	42
Going to theatre/concerts	36
Going to pubs/clubs	43
Visiting Museums	37

Source: Social Trends (2008)

Direct involvement with land for leisure

Gardens provide many people's main opportunity for direct involvement with the land surface. Estimates suggest that between 49% (Table 5.4.1) and 67%[548] of the population in England view gardening as a leisure activity. The 15 million gardens in the UK cover some 800,000 hectares and occupy up to 25% of total urban land[549]. Natural England recently reported[550] in a survey that half of those questioned remembered having their first contact with nature in a garden.

Allotments offer a similar opportunity for 'hands-on' involvement with a piece of land and are currently growing in popularity. An estimated 300,000 occupied allotments in the UK take up an estimated 12,000 hectares of land[551], and waiting lists in England have grown from an estimated 13,000 in 1996 to over 76,000 in 2009[552]. City farms and community gardens offer similar opportunities, although on a much smaller scale. Volunteering for conservation and other environmental management tasks provides another means by which people can become actively involved with particular places, in both rural and urban areas.

Sport, recreation and other leisure activities

Leisure in England is dominated by activities that are based in people's homes. In Table 5.4.1 watching television scored highest (82% of adults in England) followed by spending time with family and friends, and listening to music and reading. Outside the home, shopping (62%) and eating were followed by cultural activities such as attending live performances or visiting museums and galleries. Only 21% of those surveyed had taken part in sports and active recreation for at least 30 minutes on three or more occasions per week in the four weeks prior to the survey. Excluding walking, the most popular activities were swimming, followed by snooker, billiards or pool for men, and by gym or fitness activities for women. Another survey[553] shows recreational walking is top of the list of active sport/recreation activities, with more than 8 million adults over 16 having taken a walk of at least 30 minutes in the four weeks leading up to the survey.

Local authorities are the bodies primarily responsible for the supply of recreation facilities. There has been considerable concern over the last decade about the loss of

548 Gross et al. (2007)
549 Loram (2007). The study was based on a survey of five urban areas and excluding non-urban land such as farmland within the administrative boundary.
550 Natural England (2008)
551 Pretty (2007)
552 Campbell (2009)
553 Sport England (2007)

sports pitches and playing fields to development. In response, Planning Policy Guidance 17[554] makes clear that existing open spaces, and sports and recreational buildings and land, should not be built on unless an assessment has been undertaken which has clearly shown them to be surplus to requirements. It also makes clear that parks, recreation grounds, playing fields and allotments must not be regarded as 'brownfield' land and emphasises that 'local authorities should rigorously ensure that communities' needs for open space, playing fields and sports and recreational facilities are met'. There is an additional legal requirement that Sport England has to be consulted on any proposals involving development of playing fields on greater than 0.2 hectares in size (this represents half a football field and is a more stringent requirement than the previous limit of 0.4 hectares). Planning applications affecting playing fields are monitored, originally by the Playing Fields Monitoring Group and then by its successor body, which includes several government departments and agencies and other interested organisations.

In 2006, according to official statistics collected through the monitoring process[555], the number of applications affecting playing fields ranged from 625 in 1999/2000 to 1413 in 2003/2004. Between 13% and 27% of applications had yet to be decided but of those that had been, only between 4% and 6% were deemed to be detrimental to playing fields leading to a non-sporting development or one of little sporting benefit. The proportion of cases approved for development where Sport England objected but CLG did not support the objection was very small, at between 2% and 5% per year. In 2006 the Government announced net gains of approximately 60 to 70 new playing fields in 2003/2004 and 2004/2005.

Informal access and recreation

The great majority of the population use land by actively gaining access to it for recreation, or more passively by simple enjoyment of their everyday surroundings. Table 5.4.2 shows the percentages of the adult population in England who visit the countryside and parks and green spaces, and the frequency with which they visit, drawing on surveys carried out since 2000. The surveys are not identical but the results can be interpreted sufficiently to allow rough comparisons over time.

Table 5.4.2: Frequency of visits to the countryside and urban green spaces in England

Frequency of visit by adults	Visits to the countryside %		Visits to green spaces %	
	2001[1]	2007[2]	2002[3]	2007[4]
At least once a week	16	30	46	54
At least once a month	23	30	21	23
Occasional	41	31	20	18
Never	20	9	13	5

Sources:
1. National Statistics and Department of Environment Food and Rural Affairs (2002)
2. British Market Research Bureau (2007)
3. Dunnett et al. (2002)

554 Communities and Local Government (2002)
555 DCMS (2006)

4. British Market Research Bureau (2007)

These figures give some sense of the scale on which society actively uses land and landscapes for enjoyment. These studies, and the England Leisure Visits Survey[556], show that some 3–4 billion visits are made either to parks and green spaces or to the countryside each year, which averages to 60 to 70 visits per year for each adult member of the population.

In terms of trends[557], the data in Table 5.4.2 suggest that there has been an increase in visits to the *countryside* between 2001-2007. Comparable figures for visits to *parks and greenspaces* in 2002 and 2007 also suggest an increase, albeit smaller, in people's use of these areas in this period[558]. This apparent increase in people's visits to the countryside (and to parks and green spaces) appears to contradict widely reported declines[559] in the numbers of leisure visits (of all types and to all destinations including towns and cities) since a recent peak in 1998. The England Leisure Visits Survey (ELVIS), which surveyed all such leisure visits from a home base in 2005, suggested that between 2002/03 and 2005 visits to the countryside and coast in England seem to have dropped by some 15%, compared with a 20% decline in all leisure visits. The pattern appears similar elsewhere in Great Britain. So, the figures in Table 5.4.2 suggest an increase in levels of visit in the five years to 2007, while ELVIS showed a decline up to 2005. Part of this apparent divergence may be due to methodological differences in the surveys. Other reasons may be lifestyle changes with increasing proportions of leisure time being spent at home. It is also possible that the 2007 survey reveals the first early signs of changing patterns of behaviour in response to economic pressures and environmental concerns. It may possibly be anticipating the much-reported but as yet unsubstantiated increase in domestic tourism and leisure reactivity arising from the economic crisis of 2008/09.

Informal access to the countryside for recreation is both extensive and diverse. In England for example:

- Country parks created under the Countryside Act 1968 cover nearly 39,000 hectares of land[560].
- There are an estimated 188,500 km of public rights of way, of which 78% are footpaths[561]; 13 National Trails in England total 3,787 km.
- 1,720 enclosed water bodies are more than one hectare in size, and there are about 15,000 km of major rivers, 43,000 km of minor river and 2,300 km of canals, which together make up 4,300 km of navigable waterway.
- About 865,000 hectares of land are open country (as in the Countryside and Rights of Way Act 2000) or registered common land.
- There are 490,000 hectares of publicly accessible woodland in England.
- Some form of access exists to some 70% of the coastline of England.

556 Natural England (2006a)
557 See ER: 12 details and sources (Appendix B refers).
558 Note that the data set uses different time periods.
559 Natural England (2006a); Curry (2009)
560 Urban Parks Forum and the Garden History Society (undated)
561 These and the subsequent figures are all from Natural England (2008).

Tourism

Tourism is generally defined in terms of spending at least 24 hours away from home either for any purpose or, in a more targeted sense, for leisure purposes, excluding business and educational motivations. There is an overlap between tourism and recreational activities which makes separation of the two sectors somewhat imprecise.

There has been some expansion of the combined tourism and recreation sector, evident in increasing proportions of household expenditures devoted to related activities: up from 9–10% in 1971 to 12% in 2006[562]. A more notable change has been the shift since the 1970s from longer-stay tourism to short-break tourism, paralleled by a shift from overnight holiday breaks to day visits. Between 1995 and 2002, the number of short stays (between one and three days) rose from 53 million to 64.5 million per year, whereas the number of longer stays (four nights or more) fell from 40.5 million to 37 million[563]. Second home ownership, changes in disposable income and in the amount and flexibility of leisure time have been associated with this shift.

The land use impacts of tourism activities depend largely on net international tourism flows. Both inbound and outbound tourism have expanded more or less constantly over recent decades but in 1971 outbound tourism, overtook inbound. The gap has grown since, so that by 2006 UK residents made 69.5 million visits abroad, two thirds of these being for holidays[564]. This is a threefold increase since the early 1980s. Inbound tourism has also expanded rapidly, but at a lower rate, and has been largely static since 1997. The total number of inbound visits was 32.7 million in 2006, less than half the outbound number. A continuation of this trend in inbound numbers could create further demands on land use for related infrastructure to support increasing numbers of international visitors. Although the growth of international tourism has been substantial, domestic tourism continues to be dominant, accounting for approximately four-fifths of all tourism within the UK. Aggregate domestic tourism has been relatively static in the past 10 years[565].

There have been important changes in preferences for tourism: since the mid-1980s, heritage and cultural activities, eco-tourism and eco-recreation, adventure activities, theme parks and mega shopping malls have all expanded[566]. The extent of these changes is illustrated by heritage-related activities; since the mid-1970s, more than 1,000 new museums have been opened, and the National Trust has seen its membership grow from 270,000 in 1971 to 3.5 million in 2008[567].

Inbound tourism is strongly polarised, with London accounting for some 45% of all international visitors, followed by Edinburgh, Manchester, Birmingham and Glasgow. The distribution of domestic tourism is more complex, and is the outcome of relative shifts in the importance of urban, rural and coastal destinations, and of long-stay and short-stay holidays. Since the 1970s, the fall in the numbers of long-stay holidays has had particular impact on traditional holiday regions such as the South West, Southern England, East Anglia, and Yorkshire and Humberside.

562 ER: 24 (Appendix B refers)
563 ER: 24 (Appendix B refers)
564 Travel Trends (2008)
565 Travel Trends (2008)
566 Shaw (2007)
567 Visit Britain (2008)

Table 5.4.3: Destination types and trips by 'staying tourists' and 'day visitor recreationists'

Destination type	UK 'Staying Tourists 2007' (trips)	'Day Visit Recreation' in Great Britain 2002-03 (visits)
Seaside	25.5 million	267 million
Large city/town	47.7 million	3.7 billion
Small town	29.8 million	
Countryside/village	23.4 million	1.3 billion

Note that, for day visits, seaside and coast (undeveloped areas) are combined and there is no category 'small town'.
Source: UKTS (2007); TNS Travel and Tourism (2005)

Tourism and recreation have distinctive daily, weekly and seasonal rhythms which have particular consequences where space is shared with other land uses. The timing of different uses may be complementary, such as the replacement of commuters in city centres by recreational users at weekends. Elsewhere they may generate conflicts, for example, when tourism and recreational visits coincide with peaks in farming activities, or when summer holiday visitors compete with commuters for limited transport capacity.

The contribution of recreation and tourism to the UK economy

This is illustrated by the following:

- The recreation and tourism or 'visitor' economy has been estimated to contribute £52 billion or 3.7% of the UK economy (2007 figures). Taking account of the wider indirect impacts, the sector is estimated to contribute £114 billion or 8.7% of UK GDP[568].
- Employment related to the visitor economy is estimated at 1.36 million jobs based on direct economic contribution and 2.65 million (8.4% of the total) based on both direct and indirect economic contribution[569].
- Visit Scotland estimates that tourism was worth £4.2 billion in revenue to the Scottish economy in 2006 and tourism contributed 4% of Scotland's Gross Value Added in 2002[570]. It accounts for about 14% of jobs in remote areas[571].
- The Countryside Agency (2002) estimated that rural tourism in the English countryside is worth nearly £14 billion a year and supports 380,000 jobs[572].

The contribution is especially important in rural and coastal areas, where these activities often make a disproportionate contribution to local economies and to quality of life for residents[573]. This was clearly demonstrated by the severe economic impact of the foot and mouth disease outbreak in 2001 when access was restricted. For example,

568 Deloitte MCS Ltd (2008)
569 Deloitte MCS Ltd (2008)
570 Visit Scotland (2007)
571 Scottish Executive (2007)
572 GFA/RACE AND GKN (2004)
573 Deloitte MCS Ltd (2008)

in England it has been estimated that tourism and supporting industries lost revenues of between £4.5 billion and £5.4 billion[574].

Tourism and recreation are heavily dependent on public goods in providing the basic resource that draws people to visit places. This is especially true of rural recreation where primary land uses such as agriculture and forestry create the landscapes, habitats for wildlife and historic environments that are the main attractions for visitors. The same is also true of urban areas where the built environment, historical heritage and landscape setting provide the primary motivation for visits. Tourism and recreation are therefore effectively free-riding on other land uses. Landowners and managers often do not have the means to gain income from this use of the land resource.

Contribution to health and wellbeing[575]

The interaction of the built and natural environments with lifestyle and physical activity can have profound effects on both health and wellbeing[576]. For example:

- There is a rapidly expanding literature on the importance of proximity to and exposure to green environments (urban and rural), and growing evidence of the benefits to both physical and mental health[577].
- The natural environment itself plays a significant part in facilitating physical activity, and evidence consistently shows that accessible and safe urban green spaces have a positive influence on levels of physical activity.
- Children who have easy access to safe green spaces (parks, playgrounds) are more likely to be physically active, and this has a positive effect on health, particularly for those from low-income families[578].
- One analysis of a European cross-sectional survey suggests that the likelihood of being physically active is three times greater, and the prevalence of obesity 40% less, in neighbourhoods with high levels of green space as opposed to those with low levels[579].

It is not just a question of the importance of the natural environment for formal recreation, but of benefits from participation in exercise and other activities both in nearby green space[580] and in the wider countryside[581]. A review by Greenspace Scotland suggests that physical activity is particularly influenced by factors such as:

- distance of residence from green space;
- ease of access in terms of routes and entry points;
- size of green space in relation to levels of population use;
- connectivity to residential and commercial areas;
- the range of amenities for formal and informal activities;

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574 National Audit Office (2002)
575 This section draws substantially on ER: 12 and ER: 30 and the references therein (Appendix B refers).
576 Foresight Obesities Report (2007); Foresight Mental Capital and Wellbeing Report (2008)
577 OPENspace (2008); Mitchell and Popham (2008); Pretty et al. (2005); Bird (2007)
578 Mitchell and Popham (2008); Croucher et al. (2007)
579 Ellaway et al. (2005)
580 RSPB (2004)
581 Pretty et al. (2005); Pretty (2007)

- perceived safety and maintenance.

The benefits of exposure to green environments relate not only to physical health but also to mental health[582]. Physical activity in itself can reduce feelings of depression and anxiety, and promote physiological and psychological wellbeing. Research for Natural England[583] also identifies how the wider rural landscape provides the range of cultural services identified in the Millennium Ecosystem Assessment (MEA), offering people inspiration, aesthetic value, and a contribution to sense of place. It also identified a range of benefits gained by viewing landscapes which may have previously been underestimated, especially mental aspects such as calm, stress relief and spiritual feelings, as well as social dimensions such as strengthening personal relationships.

Mental benefits are also linked to the social benefits that can arise from exposure to and involvement with land and landscape. The building of social capital in communities can be aided by interaction with their landscapes, which also contributes to social learning and development of community identity[584]. It has been shown that individuals who have some nearby vegetation or live closer to green environments seem be more effective in managing major life events, in coping with poverty, and in performing cognitive tasks. This applies to adults and children, especially those living in difficult social or economic circumstances[585]. There is also some evidence that green environments promote social cohesion within and between different groups in places such as parks and gardens[586].

The social benefits of involvement with land and landscape can arise at many levels; from that of the individual, such as the idea of 'a sense of self in place' to that of the population as a whole, often explored through ideas of landscape and national identity.

5.4.2 The future: drivers of change

Participation in all forms of tourism and recreation is influenced by a variety of factors or drivers of change. This section examines drivers that are considered to be important, and considers how these could develop in the future to influence land use.

Socio-demographic shifts and consumer lifestyles

Socio-economic groups show significantly different participation in both tourism and informal recreation, and also in behaviour. Those in the A, B and C1 groups tend to take above the average number of overseas holidays and make more trips for leisure and to the countryside within the UK. Those in groups C1, C2, D and E tend to take annual holidays in the UK, but are less likely to take trips to the countryside. Activities are also strongly differentiated by age, stage in the family life cycle and lifestyle groups[587].

There are two significant demographic trends in the UK: an ageing population and the creation of more single-person households. Significant growth in tourism and recreation, with consequential implications for land use, is likely to occur as the post-war or baby-boomer generation ages. Baby-boomers are expected to live longer and have greater propensity to travel, to be more active and to embrace healthier activities. This is likely to lead to further marked increases in rural and urban visits, particularly for

582 Pretty et al. (2005); Bird (2007)
583 Research Box (2009)
584 Pretty (2003); Pretty and Smith (2004)
585 OPENSpace (2008)
586 Roe (2003)
587 Euro Direct (2002)

activities such as walking, cultural events and visiting heritage attractions. Other interests likely to benefit from this demographic shift include wildlife tourism and visits to national parks. How long this booming market will last, and whether subsequent generations will have the same tastes, is unclear. At the other end of the age spectrum, more younger people are establishing single-person households and forming partnerships later in life. These form a significant segment of an important youth market.

Changing attitudes to health; the Olympics

Growing awareness about the importance of physical exercise for health could lead to increased demand for active recreation in the future[588], although this is likely to be socially selective[589]. The Government is committed to maximising sporting success, spurred by the 2012 Olympics and Paralympics. This will mean that rates of participation in physical activity may be stimulated and sustained for some years, leading to greater demand for more and/or better facilities.

Disposable income and free time

Tourism and recreation depends on disposable time, defined as time away from paid and unpaid work and various responsibilities. As in recent years, future growth in disposable time is expected to continue to be unevenly distributed by gender, age, ethnicity and social class – increasing the availability and flexibility of disposable time for some, while constraining it for others. Disposable income will also be important. The long post-war growth in disposable incomes has been brought to a recent halt by the current recession. When growth resumes, a change in the relationship between consumption and savings, and the availability of credit, may lead to reduced growth in expenditure on tourism and recreation in the short to medium term.

Technological changes

Three significant sets of technological innovations will continue to shape tourism and recreation: the growth of home-based entertainment; use of the internet by individuals to acquire information on tourism and recreation opportunities and make direct bookings; and use of technology to enhance individual mobility, including the use of GPS navigation systems, off-road vehicles, and high-powered boats. All of these developments have already had an impact on rural land use, intensifying conflicts between users of shared spaces.

For the future, recent innovations that have blended different technologies, such as the internet, mobile phones and cameras, are potent agents of change. The journey to work may increasingly become an opportunity for recreation, breaking down traditional distinctions between work and leisure for technologically-aware consumers who are able to use a variety of electronic entertainment devices and internet connections en route. IT is also likely to contribute to a trend towards more individualisation and personalisation so that supply of tourism and recreation opportunities will need to become more responsive to user needs. In terms of land use, this may lead to more spatially dispersed patterns of activity compared to the spatial concentration which is typical of mass tourism. Similarly, in terms of recreation, individuals may be less tied to particular sites, especially as more individualised activities replace collective ones such as organised team sports.

In the longer term, technological changes – driven by a highly innovative games industry – may lead to virtual activity replacing some physically mobile tourism and recreation,

588 Henley Centre (2005)
589 Natural England (2006a)

with the UK potentially becoming a nation of 'couch recreationists'. Whilst face-to-face contact remains essential to the sociability that for some, is central to the travel experience, younger generations are increasingly socialising through social network sites and may adapt more easily to virtual activity.

Climate change

Climate change will have major implications for tourism and recreation activities and therefore land use. Climate is an important determinant of destinations for tourists. While rising summer temperatures may make the Mediterranean less attractive for UK tourists, this does not automatically translate into increased domestic tourism. An increase in temperatures, more rain in winter, and more unstable weather patterns, may all have an impact on where and when people travel and therefore on land use as well.

There could be several possibly contradictory pressures on land use for recreation activities. Hotter, drier summers could mean a need to enhance water supplies to maintain private and public green spaces, while increased winter rain and more unstable weather could create new demands for all-weather facilities, whether for tourism, sporting events or recreational shopping.

Climate change may also have direct impacts on the basic resources for some outdoor recreation through its effects on other elements of environmental systems. Rises in sea level may threaten existing coastal destinations, especially highly sensitive ecosystems such as the Norfolk Broads. Flooding may threaten lowland ecosystems and tourist sites, and vegetation change may alter the attractiveness of landscapes for better or worse.

Uncertainty and risk

Tourism and, to a much lesser extent, recreation, are highly susceptible to perceptions of uncertainty and risk. The global economic recession that commenced in 2008 is already influencing these activities through perceptions of risks associated with incomes and savings. The result is a decrease in planned trips, reduced consumer expenditure on recreation, and more emphasis on cheaper alternatives. Past experience shows that events such as the terrorist events of September 11, 2001 and the July 2007 bombings in London, as well as the outbreak of foot and mouth disease in the UK in 2001, all had significant effects on inbound tourism and, in the case of foot and mouth, on domestic rural tourism and day visits.

Future change in patterns of recreation

Rural recreation

Rural recreation has been important for many people over the last 50 years, encouraged by the mobility brought by the car and, for urban dwellers, a taste for escape from the urban environment. These trends have brought benefits to rural economies, on a scale that was only fully recognised after the effects of the foot and mouth crisis in 2001. The relative wealth, in both time and money, of many of the 'baby-boomer' generation should ensure that in the short and medium term there will be continued high levels of visits to rural areas. Possible promotion of the benefits of rural recreation to socio-economic groups who do not currently participate much could also serve to increase the numbers of visits, aiding the rural economy in many places.

Equally, these trends have potential to exacerbate possible conflicts with primary rural land uses and perhaps with rural communities, including traffic congestion. There could also be overuse of sensitive resources, and increases in physical erosion as already experienced in places such as the Peak District and the Lake District National Parks.

If levels of attachment to the countryside are sustained, the likelihood of increased pressure on these areas to accommodate new land uses such as renewable energy schemes, and new housing in and around towns and villages, could lead to growing tensions. In the longer term, such changes may make parts of the countryside less attractive to day visitors and tourists, and even reduce numbers in some areas.

The rise of home-based sedentary recreation

However, several drivers could conspire to reduce the frequency of countryside recreation drastically in the medium to longer term. Technological drivers could reinforce current trends towards home-based recreation. It has been suggested that the reported 15% decline in visits to coast and countryside between 1998 and 2005[590], while possibly due to differences in survey methodologies, could also be a sign that a range of home-based leisure activities (widescreen television, digital satellite and DVD, CD players, computers and the internet) have created a huge increase in leisure choices. Rising proportions of leisure time are spent at home in a sedentary way[591]. Predictions suggest that these counter-attractions will grow and the current younger generations will not share the enthusiasm of their parents and grandparents for getting away to the country. Thus the growth seen in people visiting the countryside in England since 2001 (Table 5.4.2) may not be sustained.

Carbon credit allowances

Potentially, the introduction of measures to restrict car use in an attempt to mitigate climate change will be even more significant in the longer term. Personal or family carbon credit allowances, for example, could significantly reduce car travel for leisure purposes and reduce rural recreation. The balance of users enjoying the countryside regularly would therefore shift in favour of those living in rural towns and villages. This could have significant impacts on rural communities who rely on the visitor economy and could hasten the demise of the more remote rural settlements. The loss of opportunities for real escape from urban pressures to find tranquillity and solitude would be highly significant for some people, and the benefits for health and mental wellbeing would be much reduced, if not completely lost.

Green spaces

The importance of green space in and near towns and cities is likely to increase for a variety of reasons. Climate change will mean that parks, gardens and other green areas will have a crucial role to play in helping urban areas to adapt to higher temperatures by mitigating the urban heat island effect and providing cooler places for urban dwellers. Outdoor living at home and in local neighbourhoods is likely to become more popular, making gardens and green spaces essential amenities. Campaigns to increase physical activity are likely to raise demand for use of these spaces while reduced opportunities to travel further afield to the countryside could mean increase their value.

However, there is likely to be competition for land to accommodate green spaces in the fringes around towns and cities, which are also likely to be the target for the development of housing and employment opportunities. Such changes have already, to a degree, been anticipated by the 'green infrastructure agenda', which has linked the development of networks of green spaces to the development of new housing under the 'Sustainable Communities Initiative'. If the countryside becomes less accessible, the need to provide recreation opportunities that maintain a sense of escape, tranquillity and a chance to enjoy nature near to urban centres will become much greater. This will

590 Natural England (2006a)
591 Curry (2009)

pose planning challenges in finding the right mix of development and green space, in achieving appropriate styles of design, and in securing proper long-term management so that the quality of experience is maintained.

5.4.3 Summary of key implications for policy

It is increasingly recognised by Government that recreational activities can play a vital role in promoting health and wellbeing. They are also an important component of the national economy – the visitor economy alone contributes over £50 billion per year. Tourism and recreation will continue to be seen as a fundamental consumer activity and, in spite of short-term declines, may increase in importance in the future.

- **Future pressures on land use from tourism will stem particularly from inbound visitors.** It has been estimated that there could be a doubling of international tourism by 2020, which will have an impact on the UK's share of inbound visitors. This would have implications for land use in terms of provision of accommodation, facilities, infrastructure and transport, as well as management issues.

- **Looking ahead, population growth and increased participation rates in recreation, could lead to demand for more facilities for sports and active recreation.** The promotion of the physical activity and health agenda, as well as the hosting of several major international sporting events in the UK, are likely to be influential. However, the continuation of policies of urban containment and densification could lead to increased competition with other forms of development in urban areas, leading to the loss of gardens and green spaces, and the possible displacement of highly valued recreational facilities to the edge of towns and cities.

- **Rural recreation has been important** for many people over the last 50 years, encouraged by the mobility brought by the car and opportunities to escape from the urban environment. It has brought benefits to rural economies, on a scale that was only fully recognised after the effects of the foot and mouth crisis in 2001. **Some drivers of change may serve to increase the number of visits,** aiding the rural economy in many places. **However, others,** especially technological drivers and the introduction of measures to restrict car use to mitigate climate change, could become very significant and **could drastically reduce levels of countryside recreation in the medium to longer term.**

- **Many forms of countryside recreation are a by-product of other rural activities, such as forestry and farming. As such, they are not fully marketed (or not marketed at all);** the benefits and associated public goods are not properly taken into account in commercial decisions, constituting a clear market failure. There is therefore a case for greater attention to be placed on the value of recreational activities in planning or in incentivising rural land use, including provision for multiple use.

- **There needs to be greater clarity on the value of such non-marketed benefits and public goods, although this is not straightforward.** For example, accessibility to recreational resources, and thus to proximity to centres of population, is important. However, people who live far away, who may never visit but who nevertheless have the option to do so, may also value the potential of such opportunities.

- **The importance of green space in and near towns and cities is likely to grow if population densities increase.** There is likely to be competition for land to accommodate green spaces in the fringes around towns and cities, which are also likely to be the main target for the development of housing and employment opportunities. If visits to the countryside are much reduced, the need to provide recreation opportunities that maintain a sense of escape, tranquillity and a chance to enjoy nature near to urban centres will become much greater. Such changes have already, to a degree, been anticipated by the green infrastructure agenda, but there are major challenges: in finding the right mix of development and green space, in achieving appropriate design of green spaces, and in securing proper long-term management so that the quality of experience is maintained.


HOUSING
SUSTAINABILITY
WATER
HISTORY
PROSPERITY
ENERGY
AGRICULTURE
HOUSING
ECOSYSTEMS
PEOPLE
FLOOD
RISK
ENERGY
GOVERNANCE
PEOPLE
CONSERVATION
FORESTRY
SUSTAINABILITY
WATER
PEOPLE
AGRICULTURE
TRANSPORT
WELLBEING
ENERGY
HISTORY
SUSTAINABILITY
GOVERNANCE
RECREATION
WELLBEING
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WATER
FLOOD
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GOVERNANCE
RECREATION
PEOPLE
ENERGY
HOUSING
TRANSPORT
PROSPERITY
WELLBEING
FORESTRY

6 A geographical perspective

Two major themes which run through this report concern the range of products and services that we are increasingly expecting land to provide, and the diverse future challenges (e.g. from demographic shifts and climate change) that will need to be addressed.

This chapter illustrates how particular tensions could develop in a specific region of the UK – the Greater South East of England. It demonstrates the need for a more integrated and strategic approach to land use – but one which takes account of local conditions.

6 A geographical perspective

6.1 Introduction

The UK land system can be viewed as having three overarching components or subsystems: (i) the physical fabric of the land with its physical and natural characteristics and history of settlement and land use; (ii) a complex pattern of overlapping uses of land for economic, social and environmental purposes, and (iii) multi-level institutional structures which govern land uses. In the future, there will be changes in the demands for the services that land provides, not only in terms of quantity and quality but also their geographical location. These changes will be driven by the influential factors (drivers) identified in Chapter 1, and will reflect the broad range of services derived from the land and the relationships between land assets, flows of benefits and the implications for human welfare.

The impact of the drivers of land use change across the UK has created distinctive geographical areas where demands for land services are already converging or may do so in the future[592]. Such convergence has led to 'pressure points' around the UK, which are not static but subject to ebbs and flows in demand. By contrast, beyond these pressure points are areas of land which may be underutilised.

The review of the evidence in Chapters 4 and 5 has also highlighted the substantial variety of demands which are being placed on the land system, and which can be expected to intensify in the next five decades. When considered together, these demands are already leading to conflicts as well as opportunities across all levels of governance and across spatial scales for decision-making. The latter include river catchment boundaries, administrative boundaries, functional economic areas, ecosystems and areas of different landscape character.

In this chapter the spatial distinctiveness of different land uses is illustrated through two maps of the Greater South East of England showing projected change caused by population growth, climate change, and also infrastructure and economic development under certain scenarios. The maps (Figures 6.1 and 6.3) illustrate conflicting demands on land use and how these may intensify in the future.

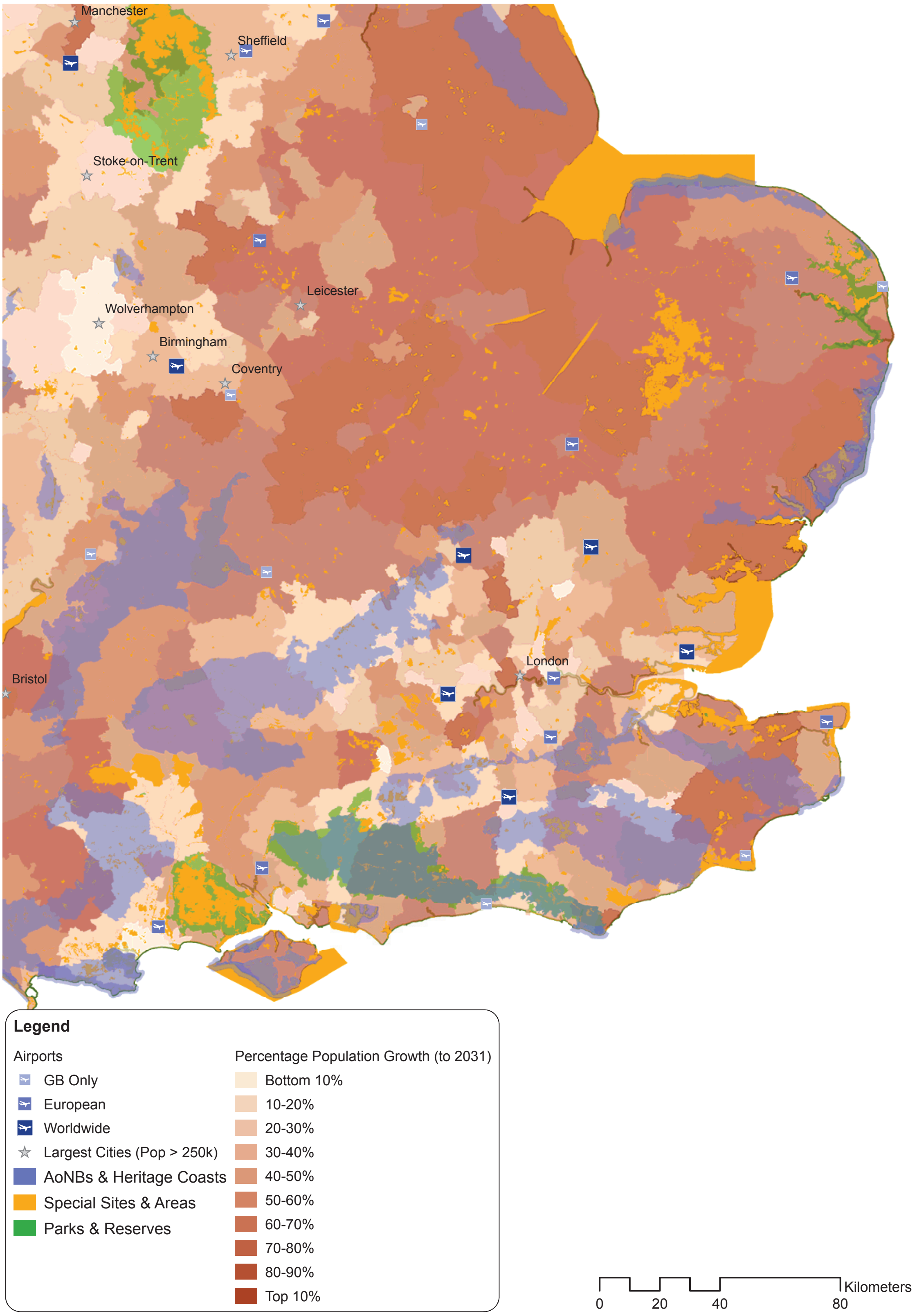
The maps are necessarily selective – they are not meant to cover all the different types of land use, or to suggest that the 'overlays' produced are more important than other possible combinations. However, they demonstrate the convergence of a range of issues, certain policy commitments and possible changes in the future, and highlight the spatial impact. They are examples of a multifunctional perspective of land use change over different geographical areas, and show the combination of the spatial perspective, a possible long-term outlook, and consideration of land services as a series of flows. The maps do not reflect a detailed analysis of land use data and future projections. Rather, they are intended to:

- Be illustrations that introduce the concept of multiple-layered land systems;
- Prompt further thought about the interconnectedness of the drivers of land use change and current and future uses of land; and

592 Chapter 2

- Promote understanding of how drivers of change in land use have the potential to converge and create opportunities and/or challenges for the future in different places in both the long and short term.

Figure 6.1: Map 1



6.2 The Greater South East of England

6.2.1 Context

The Greater South East of England is one of the UK's wealthiest areas and the most geographically varied. It has complex governance arrangements that encompass the three administrative regions of London, the South East and the East of England. It is characterised by a dominant city, London, a large number of provincial cities and large towns, which border neighbouring regions, and which are affected economically by the capital. Within the area, there is significant intra-regional competition for influence, resources and investment and it has long been the recipient of high levels of inward migration and international investment. These factors have combined to create high demand for urban development through the need for land for additional housing and to support new infrastructure. These demands create pressure for land release and on existing policy designations such as landscape protection areas and greenfield sites on the edge of built-up settlements.

Much of the development demand within the region is influenced by improved connectivity – the infrastructure of telecommunications (which closely follows population densities) and sustained growth in travel. This has led to the national concentration of information-intensive economic activities within the Greater South East. The major implication for transport is the growing need for rapid intercity travel, delivered by high-speed trains. There are repeated calls for new high-speed lines as a result. While cities outside the Greater South East may benefit from such links, the direct impacts on land use are likely to be in this region – as is occurring with new commuter services to central London on the Channel Tunnel link.

Extended travel patterns are also the outcome of the fact that intra-regional housing choice is not fundamentally driven by employment opportunity. Family ties and local knowledge tend to bind households to local communities over generations. Moreover, the transaction costs of relocation and potentially higher housing costs of moving to more economically successful locations mitigate against a highly mobile workforce. Consequently the average journey to work has lengthened in both distance and time[593]. Without major national policy changes, current housing projections and continuing preference for locations in the Greater South East are unlikely to be affected by a possible northern industrial renaissance based on the supply of new and renewable energy resources and environmental services. These industries might expand their land requirements but they are not major employers.

6.2.2 Population and household growth

Although all regions of the UK are expected to see growth in the number of households[594], it is likely that the greatest pressure will be felt in Southern and Eastern England[595]. Map 1 indicates one scenario of projected population growth (as a proportion of existing populations) in the Greater South East, the East Midlands and the East of England over the next 20 years. The lighter shaded areas include Greater London and the areas to the south and west of London which are already highly populated and where past housing growth has been concentrated. The darker areas

593 Section 5.3

594 Section 5.2

595 Section 5.2

indicate where future percentage population growth[596] is likely to be concentrated, using evidence from the Office of Population Census trend projections.

Current areas of growth are concentrated around London, and the area to the south including Surrey, Sussex, Hampshire, to the west including Berkshire and Buckinghamshire, and to the east to Essex and Bedfordshire. These areas of the country have been under considerable pressure to release land for development due to increased economic activity generating greater wealth and attracting more people. Projections from the Office of National Statistics suggest that, if long-term economic growth rates continue, there will be an increase in employment from 2001–2031 of approximately 12 million jobs. The SOLUTIONS project demonstrates the importance of linking employment growth to development.

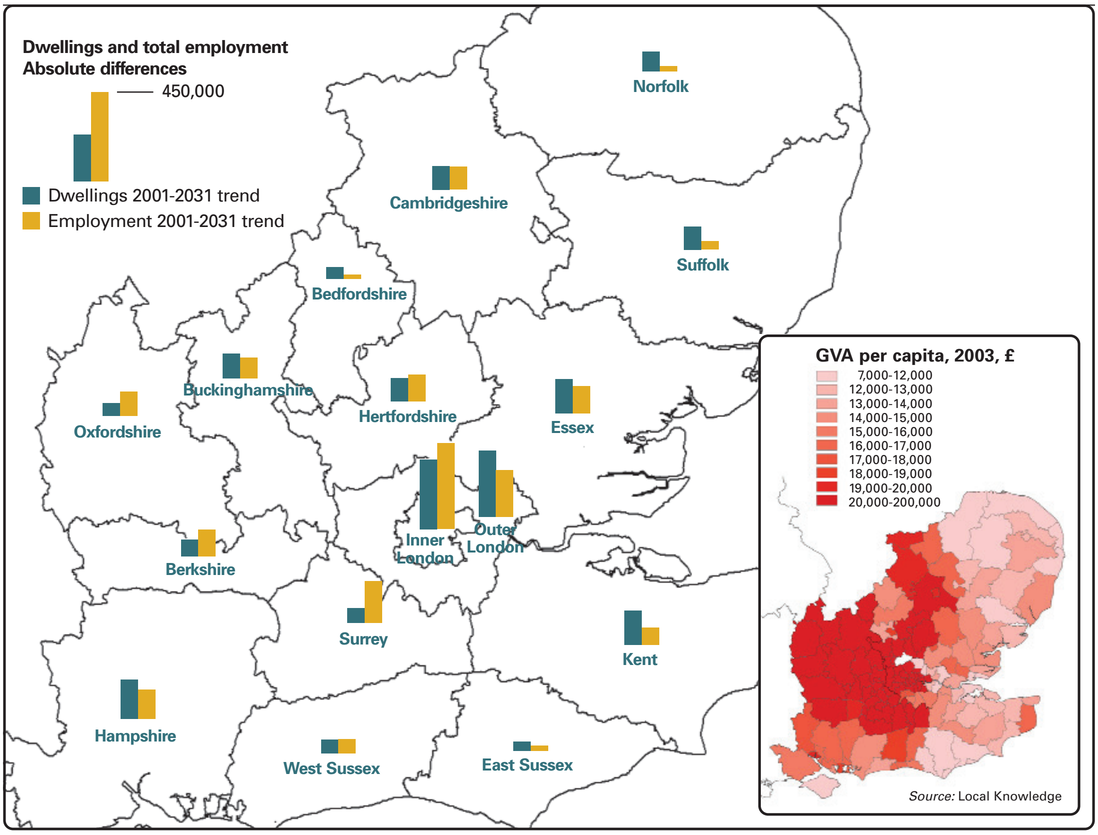
The SOLUTIONS Project[597] produced a number of in-depth case studies, carried out in partnership with local authorities and other stakeholders, for systematically testing the effectiveness of alternative design and development strategies for year 2031, in structuring and restructuring outer urban areas. Amongst the many findings, it forecasted possible future growth in development in relation to growth in total employment in the 'Wider South East'[598]. It assumed that current policies directing development to 'brownfield land' will continue to be prioritised. Interestingly, the research shows that proposed development is not necessarily where jobs are being created (see Figure 6.2). The absolute growth in jobs in Western counties such as Surrey, Oxfordshire and Berkshire far exceeds the absolute growth in dwellings. Conversely, in Outer London and the Easter counties, such as Kent and Essex the reverse is happening: absolute growth in employment is much lower than absolute growth in dwellings. This misallocation increases travel distances with adverse impacts in congestion and CO2 emissions. When mapped onto Gross Value Added (GVA) per capita, there is a close correlation between high income earners and lower levels of development and vice versa. By taking an integrated look and by mapping the findings spatially, such patterns can be more easily identified and potential future mismatches reduced.

596 It is recognised that absolute population growth is also an important parameter for some areas. A more comprehensive analysis would need to consider that also.

597 See www.suburbansolutions.ac.uk

598 The "Wider South East" is the area that includes Greater London, East Anglia and the South East of England.

Figure 6.2: Trends in dwellings and employment



New areas of projected population growth are much further afield from London and comprise Kent, Wiltshire, Suffolk, Norfolk, Cambridgeshire, Lincolnshire, Leicestershire and Nottinghamshire. Recognising that development in these areas will have to increase substantially, the Government has designated two regions for growth: London–Stansted–Cambridge–Peterborough, and Milton Keynes and South Midlands. The government scenarios supporting the 'Growth Area' designation shows population changes arising from internal migration from North to South being matched with migration out of London, placing added demands on housing and associated infrastructure and services in the rest of the South East.

6.2.3 Infrastructure provision

The South East accommodates major sites of strategic infrastructure such as airports and seaports. The demand for air travel is greatest in London and the South East, and many of the counties in Map 1 have major airports. There were about 120 million journeys through airports in the South East, more than half of a national total of around 200 million in 2003.

The Department for Transport estimates that in the South East the unconstrained demand for air travel will be 300 million passengers per annum by 2030 (60% of the UK-wide total), although this does not take account of any voluntary or mandatory measures to reduce air travel in response to its contribution to carbon emissions. This suggests increasing pressure on airport capacity, both at the current international airport sites and at provincial airports. In this scenario, further airport development would be required, with implications for major transport corridors, the road network and the public transport system. Continued international trade could also put major pressure on the Greater South East ports and access routes as they seek to meet the demands of the region's growing population of consumers. Northern ports could remain under-utilised.

The distribution of population growth, and the potential extension of existing transport hubs, may influence the pattern and location of economic activity[599]. Historically, these factors have contributed to the development of logistic and distribution services and to office development in towns outside or at the edge of major metropolitan areas. Recent evidence points to the continuation of the importance of the historical North–South divide for future patterns of economic growth, with a Greater South East (encompassing London, the East and parts of the South West and South Midlands) as the driving force of the UK knowledge economy. Within this region a more dispersed pattern of 'hot spots' composed of centres, clusters, nodes and districts of production can be identified, but these are highly connected through global economic linkages. At the sub-regional level, many manufacturing businesses blur with a range of knowledge economy-related services (e.g. digital media and the creative sector) creating diffuse concentrations of small and medium-sized enterprises. Typically, these are found in science and office parks, reclaimed inner-city brownfield sites and renovated industrial buildings. All these factors in turn would put further pressure on the Greater South East and the East of England for economic-related land use.

New retail parks have also developed over recent decades, moving away from historical concepts of the retail hierarchy, generating the move to out-of-town sites on city and town peripheries, and creating 'mega malls' and shopping centres of size and stature that encourage inter-regional, and even international visitors. City and town centres are responding as part of broader leisure and tourism strategies, and the development of city-based creative and cultural industries. These developments are taking place within the structural shift to internet shopping – and the now accepted understanding of a desire for 'clicks and bricks' as part of the shopping experience. Future pressures on land use can be expected to remain relatively contained within cities and towns, with competing economic uses for individual brownfield sites causing them to return to the land market. New developments in response to pressures may be located in the centre, in inner and outer estates, or in the peri-urban periphery around the transport network at the edge of centres.

It is in the geography of financial and business services (and associated knowledge services) that uneven geographies have principally materialised in recent decades. A regional geography exists within these industries, with London dominating the UK, and major cities (such as Cardiff, Edinburgh, Leeds and Manchester) acting as regional capitals in those services where they can overcome the shadow of London. More broadly, and reflecting the blurring of manufacturing and services within the knowledge economy, the Greater South East is likely to continue to act as a hinterland to, and be partially fed by, the global city demands of London.

6.2.4 Environmental impacts – water supply

The environmental impacts of these likely patterns of demand could be far-reaching. The area of England that is most likely to see the impact of climate change on farming and agriculture coincides with those areas expecting population and economic growth. Water resources in the South East are already over-abstracted, leading to low or intermittent flow, or over-licensed[600]. Climate change is likely to exacerbate this problem, with drier summers in the South East and warmer temperatures increasing

599 Section 5.3
600 Section 4.1

evaporation and thus cancelling out the benefits of expected increased winter rainfall. In addition, the dense population and legacy of heavy extractive industry has contaminated available water resources so that they have a high financial and energy cost associated with their use, making it increasingly more costly to meet EU standards. Demand for groundwater and surface water extraction already exceeds supply in this region. Agricultural demand for water alone currently accounts for almost 70% of total abstraction in the summer peak irrigation periods in some parts.

6.2.5 Landscape designations

A number of environmental policy designations have been created to protect the UK landscape over the last 80 years. These include, for example, the identification of greenbelts to prevent the coalescence of settlements, and the designation of valued landscapes such as National Parks or Areas of Outstanding Natural Beauty (AONBs)[601]. These designations have a variety of different objectives, although the majority are intended to protect the land from inappropriate development or damaging changes in land use. The Greater South East region is extraordinarily rich in biodiversity. There are over 35 internationally important wildlife sites and over 680 Sites of Special Scientific Interest (SSSIs), supporting a wide range of habitats including coastal mudflats, ancient woodlands, river valleys, heaths and calcareous grasslands. The region has over a third of England's ancient woodland, 40% of the UK's lowland heathland, a quarter of the UK's flower-rich chalk grassland, and over 30% of the UK's species most in need of urgent conservation action.

When mapped against the existing designated areas intended to protect landscapes from development, the projected population growth areas are adjacent to or encompass several types of designated areas, such as AONBs and SSSIs. Pressure to provide new housing and infrastructure in these areas to meet projected population growth may place strain on these protection policies. Conversely, environmental issues associated with these designations could lead to constraints on development with consequences for land and property prices.

6.2.6 Population increases, agriculture and recreation

The convergence of drivers of change will also have significant implications for agriculture in this part of the country. For example, there is substantial overlap between population growth areas and Grades 1 and 2 agricultural land (see Figure 6.1 and 6.3). This high quality agricultural land will also be particularly affected by climate change, further compounding the problem.

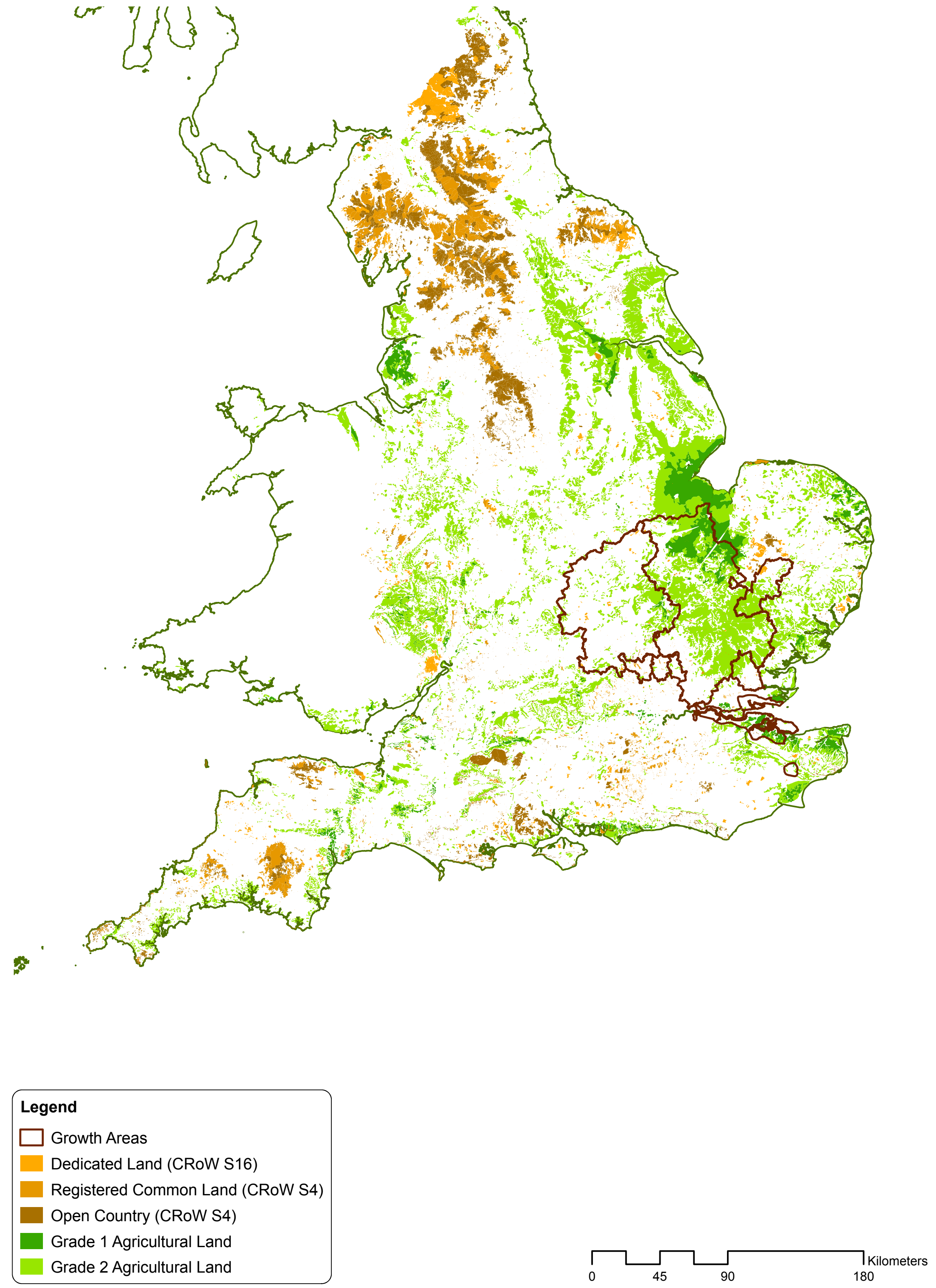
In addition to housing and other essential services, as the population grows over the next 20 years, more space for outdoor recreation will be needed. A significant proportion will also seek access to the surrounding countryside[602], although opportunities will be very limited in this area in comparison to other parts of the country, as illustrated by Figure 6.3. Agreed rights of access, are concentrated in areas mainly in the north of England, the South West and around Breckland in the east of England. Rights of way, which would give access to farmland, are also less dense compared to other areas. This lack of access could make it difficult for a larger population to benefit from outdoor recreation and its effects on health and wellbeing. Although new green infrastructure is planned for these growth areas, there is again potential conflict with maintaining the best and most versatile agricultural land (Grades

601 See Chapter 2 and Section 4.2

602 Section 5.4

1 and 2). While the planning system has attempted to protect Grades 1 and 2 agricultural land since 1947, the spatial convergence of these drivers of change, suggest that there is a case for Government to consider relevant sectors together, when assessing the need, or otherwise, for policy changes.

Figure 6.3: Map 2



6.3 Conclusions

The services provided by land in the UK are crucial both to the economy and to the wellbeing of its citizens. However, the spatial variability of these services will be key to managing the multiple demands on land now and in the future. Recognising and managing the interdependencies of these services and ensuring their efficient and sustainable access will be essential.

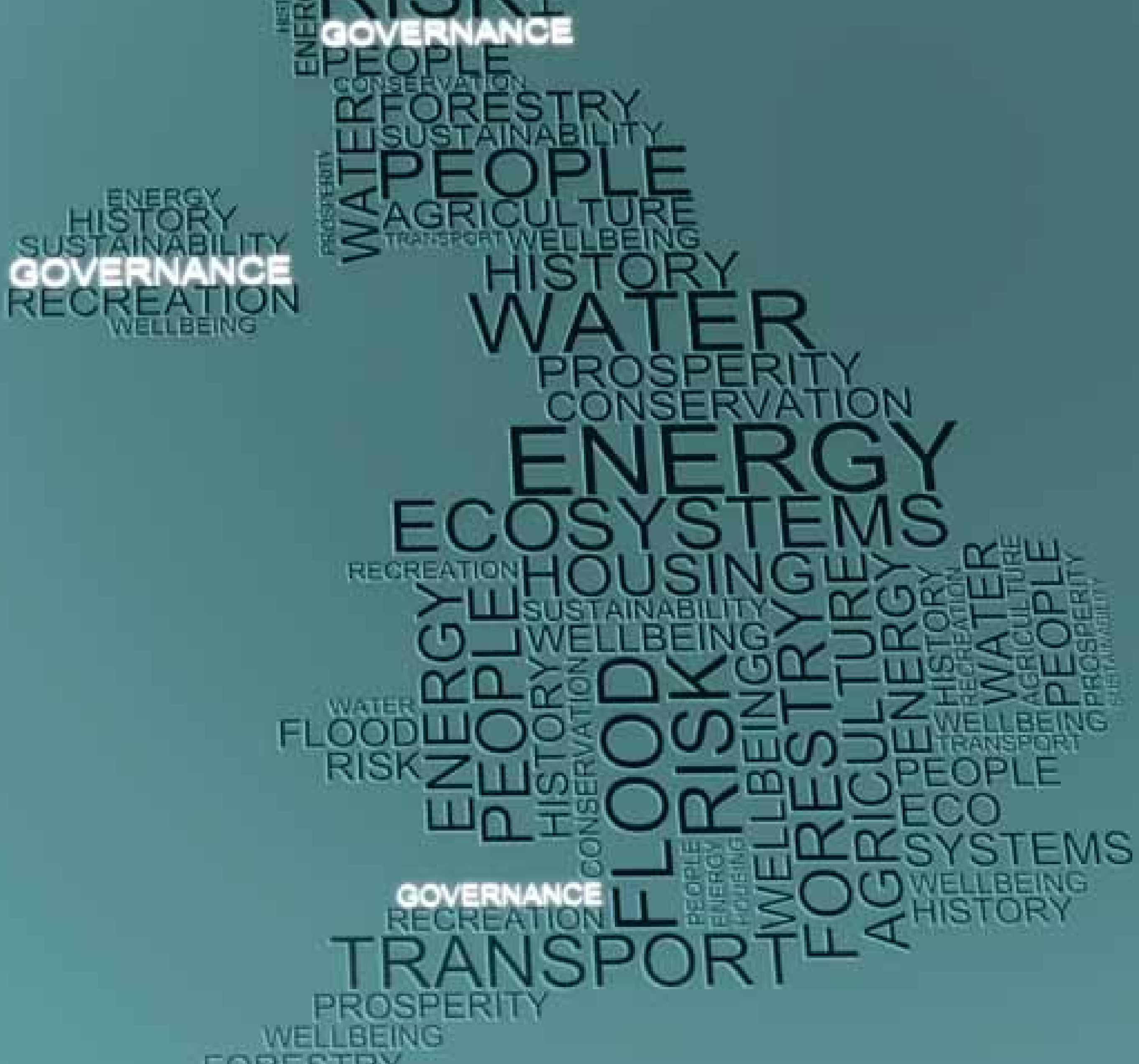
Use of these services is connected through a series of natural and man-made 'trends and flows' that enable day-to-day activities to take place across the UK. These include, for example, preparing for the impact of climate change to agricultural land and farming, building homes to accommodate increases in population growth and household formation, ensuring mobility and the movement of goods, services and people, protecting the best landscapes from unsustainable development, and ensuring economic growth for long-term prosperity. In the future, these flows influenced by drivers of land use change will need to evolve to adapt, cease to exist or be replaced by new flows. It is therefore crucial that the spatial dimension is taken into account when multiple implications for land use decisions are being assessed.

The specific example of land use change in the Greater South East of England shows how demographic change and diverse factors such as climate change, water availability, limited access to green space, and the need for efficient use of high quality agricultural land can place multiple, and sometimes conflicting, demands on land use in particular locations. The example also demonstrates the important link between environmental change and the range of services provided by land, including the extent to which people and communities might become vulnerable and/or disadvantaged. Ensuring future positive flows will require changes to land management systems that encompass integrated strategies, and which draw upon technology and governance mechanisms, to achieve solutions that are sensitive to the needs of different places.

This focus here on the Greater South East is not to imply that the tensions within the land system are simply regional issues. This is a region which embraces a large proportion of the national population[603] and economic activity in a fraction of its land area. The challenges of land system management in this region are national issues and can only be addressed by setting them in the context of the supply and demand for land within the whole national territory.

Hitherto, spatial integrated assessment has been patchy and has not covered the multitude of land uses or policy commitments materialising from national, or local, authorities and agencies. The spatial element, which encompasses the uniqueness of places and the flows and changes that occur within them, should assume much more importance.

603 Section 5.2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PROSPERITY
WELLBEING
FORESTRY

7 Achieving sustainable land use

This chapter draws together future challenges outlined in previous chapters and develops the case for a more integrated, coherent and consistent approach to the management of the land system.

It argues that there is a substantial opportunity to build upon and improve existing systems of governance: to guide land use and management change to be more sustainable, and to create greater value for people now and in the future. The chapter concludes by outlining key principles and considerations pertinent to future land use policy development.

7 Achieving sustainable land use

This chapter draws together evidence and analysis from the preceding chapters to determine the implications for the land system and the governance of future land use change across the UK. In particular, it takes an overarching perspective, looking across: key drivers of change[604]; the challenges implicit in valuing land (both qualitative and quantitative) and in allocating its use[605]; key sectoral issues, particularly those involving cross sectoral interactions[606]; the convergence of competing demands in particular areas (notably the South East of England[607]), and the wider opportunities across the UK.

In doing so, this chapter makes the case for revisiting the policies and mechanisms that guide land use change and land management – to meet the major challenges of the 21st century, to ensure the sustainable use of land, and to realise greater value from land. The case advances the argument that a much more strategic approach is required which:

- spans the urban and rural domains;
- recognises the unique challenges and opportunities in different sectors, regions and countries of the UK;
- minimises unintended consequences across sectors, across geographical areas and over time;[608] and
- promotes harmony in the land system through achieving greater integration, coherence and consistency.

7.1 A summary of important drivers of change in the land system

This report demonstrates that over the previous decades, demands on the land system have intensified in response to changing levels of prosperity, aspirations and the expectations of a growing UK population. Land policies have progressively changed in response to these shifts. Three legislative reviews of the land use planning system have occurred since 2001 in an attempt to manage the provision of housing, help deliver necessary infrastructure and modernisation programmes, meet climate change commitments, and ensure continued economic growth. However, over the next 50 years, current pressures on the supply of goods and services from land are expected to intensify in every sector, with profound implications for land use. Major drivers of change include:

- **Climate change** – The impact of climate change and strategies to help the UK to reduce GHG emissions and adapt to changing temperatures and rainfall patterns will drive changes in land use and alter the physical characteristics of the land system. They will also affect the nature of rural landscapes and economies, and urban form.
- **Economic growth and changing global economic conditions** – Despite uncertainty about future rates of growth, incomes and the demand for the goods and services which land provides are expected to rise.

604 Chapter 1
605 Chapters 2 and 3
606 Chapter 4 and 5
607 Chapter 6
608 For example, those set out in Section 1.4

- **Demographic change** – Projections for the future UK population are uncertain, but an increase of approximately 9 million people is projected by 2031, driving demand for land for development, natural resources and ecosystem services.

- **Societal preferences, attitudes and motivations** – The desire to protect and enhance the environment, and changing preferences for home ownership, car usage, shopping patterns and other social trends, will generate new patterns of land use. A challenge for policy-makers will be to reflect these changing desires, particularly when they are in conflict.

- **The policy and regulatory environment** – As policies evolve in response to climate change and other drivers, they will shape rural and urban land use. For example, more emphasis might be placed on the use of agricultural land for conservation or energy production, as opposed to food.

- **New technology** – This will affect land use, for example through changing patterns of work and transport, and also agricultural productivity.

The analysis of the foregoing chapters has shown that these drivers of change will interact with each other and with the system of land use governance in complex ways to create a range of specific future challenges for policy-makers, the private sector (including land owners and managers), providers of public services and the general public. These challenges are discussed from three complementary perspectives:

- First, three particularly important **cross-sectoral challenges** are summarised (Section 7.2). Each one involves a number of different sectors of land use that will interact to create specific problems. They are considered to merit special attention, since analysis within this Project has shown that there is a danger that if they are not addressed adequately, and in an integrated way, the long-term implications could be profound. They concern increasing pressures in the South East of England; the implications of climate change for land use; and the future delivery of a range of public goods and services such as clean water and provision of green space.

- **Systemic and governance challenges** are discussed in Section 7.3. These relate to aspects of the current governance system which, if not addressed, could inhibit meeting future challenges, and in addressing tensions – between land use sectors, between different parts of the country, and between different levels of governance.

- **Interactions between individual land use sectors** are dealt with in Section 7.4. Drawing on chapters 4 and 5, individual land use sectors are considered to identify cross-sectoral issues that need to be addressed with the benefit of insights into the spatial and long-term implications.

7.2 Cross-sectoral challenges

7.2.1 Rising demand for land and resources in and around the South East of England

Specific drivers of change will combine to create particularly strong pressures on goods and services derived from land in some parts of the UK. In particular, the South East of England is an acute example where there is a high risk of future shortages in the housing and commercial sectors, increasing stress in the water supply, problems affecting water quality, and rising congestion; all of which have the potential to reduce the quality of life for many people.

Decisions taken to manage this cross-sectoral challenge will have knock-on effects for the rest of the UK. For example, decisions will need to be made on the desirable balance to be struck between accommodating increasing population growth in the South East, and encouraging population shifts to other parts of the country. This could involve choices between policies which ensure that those who live and work in the South East bear (as far as possible) the full costs involved – which relate to housing, congestion, pollution, water resources and the natural environment – and policies which do not pass on external costs and which subsidise market costs (e.g. by extensive provision of 'affordable housing'). An alternative approach would be to alleviate pressure on the South East by actively providing incentives to expand demand in other regions, for example through regional economic and industrial policies. Detailed and careful appraisal of costs and benefits of these alternatives would be required.

Meeting rising demand for housing in the South East will also inevitably lead to choices between increasing the density of urban areas and making more land available for development. If there is acceptance that there are limits to the densities at which people are prepared to live[609], decisions will be needed on:

- Whether to release more land for development;
- The types of land to release;
- Where land should be released; and, if appropriate,
- Managing any possible implications for the Green Belt around Greater London.

There would also be important decisions to be taken on pricing policies relating to the provision of water supply, housing, transport and public services.

7.2.2 The implications of climate change for land use

Land will have a pivotal role in both mitigation of and adaptation to climate change. For adaptation, there will be important choices to be made on:

- Settlement patterns[610] and infrastructure;
- Conservation policy as biodiversity and habitats change;
- Flood risk management measures and coastal defences;
- The threat to high grade agricultural land from rising sea levels, but also opportunities presented by previously unviable land becoming productive.

Mitigation will involve choices about the use of land, including:

- Low-carbon energy production, particularly incentives for delivery of onshore wind farms, energy crops and other renewable energy sources that encourage the transition to low-carbon energy, while taking account of the implications for other services delivered by the land system;

609 Although alternative future scenarios could see changing accommodation preferences. See Appendix E
610 http://www.tyndall.ac.uk/

- Strategic use of forests and woodland for carbon sequestration;
- Reduced emissions from the agricultural sector;
- The limitation of actions which release carbon from natural sinks.

Because of the pervasive and substantial nature of the climate change challenge together with the many choices to be made (as outlined above), there is a strong case for the development of a coherent climate change adaptation and mitigation strategy specifically relating to UK land use. This strategy will need to ensure that:

- Complex interactions between climate change and all the sectors of land use considered in this report, are fully taken into account when developing the wide range of policies affecting land use – so that land use and land management does not undermine emission reduction targets;
- Incentives that will affect commercial land use (e.g. relating to renewable energy, natural carbon sinks such as forests and woodlands, and agricultural practices) are appropriately aligned with the needs of climate change strategies.

7.2.3 Delivery of public goods and services

In a land system increasingly influenced by global and domestic market pressures, it will be critical to ensure that vital public goods and services from privately owned land (such as the provision of clean water, flood risk management and supporting biodiversity) are actively encouraged and delivered.

> Public goods and services describe those in which the benefit received by any one party does not diminish the availability of the benefits to others, and where access to the good cannot be restricted. The term is therefore not synonymous with ecosystem services, but there is some overlap between the two terms.

Actively promoting and providing incentives for the 'multifunctional' use of land is one way of realising a greater range of benefits from a given parcel of land or landscape (see Box 7.1). Multifunctionality is therefore inherently an efficient response to meeting future challenges, which require balancing competing demands on space. However, to be effective, it can require a combination of institutional and regulatory mechanisms (e.g. relating to planning decisions), and also economic measures (e.g. financial incentives).

Some policy choices relating to multifunctional use of land include:

- Working across administrative boundaries by adopting an area or catchment-based approach to land use policy. This could help provide public goods and services more effectively. For example, an area or catchment-based approach could address issues relating to the fragmentation of habitats. Such an approach would have implications for governance, such as: the creation of appropriate institutions for land management, and encouragement of stewardship covenants and partnerships. Such mechanisms could enable different features of individual tracts of land to be considered together in decision making by local communities and stakeholders.
- The nature and extent of incentives. Promoting multifunctional land use may not be appropriate when land is valued for a single use. Policies would also need to provide incentives for appropriate and realistic combinations of uses.

- How to incentivise land owners and managers within and across sectors, recognising their varying motivations[611]. For example, rural land managers are a diverse group which include: agribusinesses, family farms, equine enterprises, voluntary bodies and water companies. The Relu Programme found that "the fourth-generation family farm producing basic commodities" is not typical[612].
- How best to take account of the physical characteristics and potential "values" imbued in land at given locations and at different scales[613].

Box 7.1: Multifunctional land use

There are two interrelated definitions of 'multifunctional land use'. The first is:

- **An area of land in one use that *simultaneously generates* flows of several different benefits and services.**

For example, public spaces in urban areas combine a variety of roles, creating opportunities for recreation, creating an urban sense of place, and providing for circulation of those living, working, shopping or simply moving about in the city.

Rural examples include land which is farmed, but which also provides a wide range of services and benefits in terms of ecosystem services. For example:

- provisioning services, by producing food and fibre;
- regulating services, such as the regulation of hydrological cycles;
- cultural services, such as the provision of landscape and aesthetic benefits; and
- supporting services through the formation of soil and habitats.

Those responsible for the main use of an area of land need to be encouraged to recognise, maintain or enhance the full range of services and benefits that can be generated. This approach requires:

- collaborative action by adjacent landowners or managers to generate greater benefits;
- appropriate governance arrangements;
- incentives or regulations which encourage delivery of services and benefits.

For example, the managers of urban commercial properties could be encouraged to view their responsibilities as a contribution to a range of urban services and benefits. Similarly, managers of woodlands and forests could be encouraged to support services relating to public amenity.

A second potential definition of 'multifunctional land use' is:

- **An area of land previously dedicated to a single use that *is developed* to generate additional complementary uses.**

In urban areas multiple uses can often be accommodated by partitioning of space previously devoted to a single use, or by using vertical segregation, such as underground parking below residential or commercial developments, or under railway stations. Different uses of the same building at different times of day or different times of week or even a year is another example.

In rural areas partitioning forests for recreational use, including construction of visitor centres and holiday accommodation, is one example of multiple use.

611 Dis: 3 (Appendix B refers)
612 Securing Integrated Land Management ((2009, for the Relu Programme),
613 See Chapter 3

7.3 Systemic challenges

There are a number of particular obstacles in the present land system that need to be addressed in order to help meet the three cross-sectoral challenges discussed above. These are systemic challenges and are primarily concerned with the governance of land. It is vitally important that the governance system, which regulates the allocation, use *and* management of land, should be coherent and consistent. However, the current system of governance has a number of problematic characteristics:

- It involves decisions taken at different spatial scales that do not always reflect the scale at which impacts are felt, or the physical boundaries of natural systems. For example, effective water resource management requires action across the whole catchment.
- It combines market mechanisms and regulation in ways which can be in conflict, with misaligned incentives generating severe pressures in some sectors such as housing.
- It delivers outcomes which are sometimes hard to justify given the evidence on the range of potential values of the land in different uses. Land policies that are legacies of historical priorities may not reflect the value of the land in a different use that corresponds to new and future aspirations and priorities.
- It is fragmented, with different governance arrangements for different sectors, and it lacks overarching objectives to guide all land use change across the urban and rural domains.
- It faces growing pressures as population and demands for goods and services from land increase, and as the prospect of climate change requires the implementation of both adaptation and mitigation strategies.

Some options for addressing these 'systemic issues' include taking greater account of how land is valued, managing the 'disconnect' between institutions and private ownership of land, providing incentives for the provision of public goods and services, aligning incentives and policy objectives, and managing conflicts between different parts of the governance system overseeing land use change. These are covered in the section below.

7.3.1 The need to improve understanding of how land is valued, and how value is reflected in decisions

Much debate is focused on how land and the services it provides should be valued. Currently, decisions are generally based on relatively narrow or inconsistent definitions of value, often focusing on those benefits that are most easily quantified in economic terms. Thus, those services that are less easy to quantify (such as the cultural value of landscapes, or the capacity of land to regulate water quality) may not always be given sufficient weight in land use decisions. Equally, the real costs of the wider impacts of changes in land use may not be adequately accounted for. Furthermore, decisions may be taken which do not reflect the value of the potential range of benefits that a given parcel of land or landscape can provide simultaneously. This can lead to land use decisions that fail to reflect the greatest net value. A view on value will need to be taken, implicitly or explicitly, even if it cannot be quantified. There is therefore a case to adopt a new approach to valuing land use: as set out in Chapter 3, the appropriate concept of value is a broad one, encompassing the full range of ecosystem services, whether or not they are marketed.

Thus, more work is needed first to improve our understanding of the economic, social and environmental value of land use, spatially and over time, and secondly, to collect the sophisticated data necessary to assess value. There is already a large and growing body of evidence relating to valuation. This research needs to benefit from the scrutiny of different academic disciplines and be embedded at early stages in policy-making cycles.

7.3.2 The disconnect between institutional arrangements and private ownership

Institutional arrangements designed to deliver public policy on land use can sit uncomfortably alongside private ownership of land and property rights. Governments create land use regulation and devise policies, whereas it is the private sector that mostly owns, invests and develops land[614]. A balance needs to be struck between protecting the interests of existing landowners, local priorities and the wider public interest, and between short-term priorities and possible future demands for land-related goods and services.

Some local decisions relating to development are heavily controlled. They are guided by planning policy, which requires that important factors such as effects on biodiversity are duly considered. However, it can be unclear how priorities should be judged, whether the cumulative effect of decisions is recognised, and whether the effect of a given change in a particular location may be strategically important or not. In certain sectors (such as agriculture) land owners and managers are not governed directly by the planning system, but their incremental decisions making will have wider social and ecological consequences.

Private incentives, in local land markets and planning institutions, are not always aligned with the declared objectives of land use policy, which makes conflict and delay in the governance system endemic. The fiscal system, particularly the local tax system, can contribute to this misalignment of incentives. For example, new urban developments typically impose significant costs on the local community, including increased service usage, impacts on transport capacity and degradation of local amenities. However, the fiscal system's response to these higher costs is slow; central government revenue streams take time to adjust to changes at local level, and the central operation of business rates means that local authorities cannot raise local taxation to meet upfront costs without an undue burden on existing residents.

7.3.3 Incentives for the provision of public goods and services

There is an inherent tension in the roles of farmers and other rural landowners, who are generally motivated by commercial interests[615], but who are also *de facto* stewards of the land. As such, they are responsible for ensuring that it provides a range of public goods and ecosystem services. Some argue[616] that property rights over land could be adjusted or redefined to ensure greater provision of ecosystem services. However, market instruments (e.g. subsidies, taxes and charges) would potentially encourage the provision of ecosystem services at low cost – although in some cases a mix of regulations, charges and payments may be more effective. Where increasing the supply of public goods and ecosystem services is costly (such as improving water quality, or providing access to walkers), credible and durable funding streams will be needed if landowners are to provide the services (although these funds could take the form of

614 See ER: 15 (Appendix B refers); ER: 16 (Appendix B refers); ER: 17 (Appendix B refers)

615 Though it is recognised that this is not always the case (see DIS:3) (Appendix B refers)

616 ER: 25 (Appendix B refers)

lower taxes if certain standards are maintained). Completely unacceptable practices, such as those which cause irreparable damage to the natural environment, cannot usefully be regulated by market instruments, and there will be a continuing need for tight regulation. Incentives would differ depending on the type of outcome being sought and the capacity of the land in a given location.

Other approaches can help support market mechanisms in delivery of public goods. For example, partnerships between landowners, farmers and conservation bodies can also be encouraged. The Sustainable Catchment Management Programme has delivered impressive results in delivering water quality, biodiversity and landscape improvements in a local setting[617]. It also demonstrated how local land management in groups, rather than just individually, can deliver shared benefits. For these initiatives to succeed, obstacles such as competing interests, established property rights and the need to work across boundaries would need to be addressed.

Mechanisms for the management of land for public goods and services would need to be tailored to individual areas or landscapes. Also, the institutional arrangements – particularly the balance between national, regional and locally determined mechanisms – would need to be designed accordingly. Where the source of services which land provides is distant from the end consumer, as for example in flood risk management, their provision cannot be left solely to local communities.

7.3.4 Aligning incentives and policy objectives

In some areas of the UK the misalignment of incentives and policy objectives is leading to very high differentials in prices for land in different uses (e.g. housing and agriculture)[618]. Granting planning permission for development can convey substantial windfall capital gains on the owners of the land, which could encourage 'gaming' the system, and may not be in the wider national interest.

A more harmonious system would ensure that property rights, prices and incentives are properly aligned with strategic policy objectives. Also, where market prices convey important information about the general public's preferences and pent-up demand for land, as they do with housing, there is a strong argument that this information should inform land use policy at a strategic level.

Continued attention needs to be given to the interaction between the planning system and market signals. Future choices need to be made on whether development should be:

- Channelled through the planning system, to land where the cost of delivering services that people need (such as transport links, water supplies, and urban services such as schools and hospitals) is lowest and the cost to the natural environment and landscapes is lowest; or
- Shifted to a more market-guided system of land release which reflects people's preferences for living and working.

The analysis in Chapter 3 suggests that the ability to capture land values and public perceptions and attitudes will strongly determine the choice of mechanism. Taking greater account of market prices in deciding the best location for additional development, for example, would help ensure that housing allocations become more

617 DIS:5 (Appendix B refers)
618 See Chapter 3 and also Section 4.1.1

responsive to economic factors. Other values may be best captured and represented though planning and regulatory measures. The capacity of the land system overall to respond to changing circumstances is another important factor, for example in relation to "environmental tipping points". In a governance system which combines both mechanisms, strategic oversight is needed to identify when and how to intervene to reduce the unintended consequences created by the interaction of each.

7.3.5 Conflicts between different parts of the land use governance system

The structures in place to deliver infrastructure development and land use changes within or adjacent to urban areas have also proved to be problematic. In recent decades, urban land has been managed by a range of public and quasi-public authorities, and through delivery vehicles with competing objectives, at arm's length from central government. In these circumstances it can be hard to balance strategic national or regional objectives against local interests. Major infrastructure projects provide a good example where local and national priorities have often been in conflict, and for which the Government has recently put in place new machinery – the Infrastructure Planning Commission – to take decisions on nationally significant infrastructure projects and to articulate priorities for such projects in national planning statements.

Importantly, the structures in place to deliver land use change which do not relate to built uses are subject to different governance arrangements, often at the EU or international level. Responsibilities for energy, transport, agriculture and environmental policy, and the potential implications for land use involved, are split between different government departments and involve different institutional arrangements[619]. All have an impact on land use or land management. Mechanisms for ensuring that a coherent and consistent approach to policy-making is taken across these different sectors are needed, and should cover both urban and rural areas. In some cases it may be sufficient to ensure that private incentives are properly aligned with wider public policy objectives, in which case decisions can be devolved to the landowner or government department directly involved. In other cases, notably for irreversible decisions that have significant impacts over wide areas affecting many people, or which cast a long shadow into the future, a more systematic and coordinated approach will be required.

7.4 Interactions between sectors

In addition to the particularly important cross-sectoral challenges (Section 7.2) and the systemic issues identified in Section 7.3, this report has also analysed a number of future challenges within specific land use sectors, but that also strongly interact with other sectors. The following illustrates some of those that are considered important.

7.4.1 Water resources

Water resources are under most stress in the South East of England over the summer period.[620] Climate change will mean hotter and drier summers, and will alter precipitation patterns that affect river flows and groundwater recharge. UK Climate Impacts Programme (UKCIP 09) scenarios show that on average winters will be wetter and summers drier, and that the greatest temperature increases will be in the South and South East of England. Climate change will also combine with a variety of land use changes to affect flow and recharge rates: for example, the development of built

619 See the 'Governance Framework' diagram in the "Systems Maps Catalogue" accessible at http://www.foresight.gov.uk
620 See section 4.1 in chapter 4 and chapter 6.

infrastructure and its associated drainage, and possible changes in agricultural practices. Together, these will affect the availability and quality of groundwater on which the majority of the population in London and the surrounding area rely.

Sustaining a greater population will therefore require some combination of increasing supply, which could be expensive (desalination, water transfers via pipelines, new reservoirs), and managing demand (e.g. pricing, metering). Since water is a marketed good, pricing has an important role in determining demand, alongside other measures that seek to educate and influence behaviours. Over the long term, this could help more accurately set the value of water resources.

Land's capacity to regulate both water supply and quality, and how this is affected by land use change, will need to be given greater recognition and accorded greater value: the Water Framework Directive targets for water bodies already go beyond simple chemical measures. The degradation of groundwater quality as a result of urban land uses and agricultural practices will need to be addressed. More generally, as Section 4.1 argues, a more integrated approach is needed to manage water quality and supply issues, with coherent strategies, involving *inter alia* integrated catchment management and appropriate and environmentally-sensitive pricing. These steps would allow the implications of potential land use and land management changes to be factored more systematically into decision-making, nationally and locally.

7.4.2 Conservation

The system of land designations currently plays an important role in conservation of land for protection of biodiversity and to maintain the integrity of beautiful and culturally significant landscapes – which in turn plays a central role in the leisure and tourism sectors. Adaptation to climate change will require innovative policies that help to connect habitats to guard against species extinctions[621]. Greater attention will need to be given to ensuring that land's value, now and for future generations, is recognised as integral to wellbeing and quality of life. Designations will need to be kept under review in the light of changing climatic and environmental conditions. And the system will need to be complemented by measures to maintain the quality and careful management of land both within and outside the designated areas.

7.4.3 Agriculture

To maintain a strong domestic capacity in food production for the future, high-grade agricultural land (currently categorised as 'best and most versatile') would need to be identified as strategically important. This may require protection against irreversible sea encroachment and development. Therefore, the current approach to protection of high-grade agricultural land and competition with other uses could usefully be reviewed.

The design of suitable incentives and reward systems for managers of rural land needs to reflect the wide range of ecosystem services which land can provide if managed appropriately. As well as providing, for example, food and energy, rural landowners and managers will increasingly need to play a role in maintaining the quality of the natural environment and managing land for carbon sequestration, flood risk management, conservation and recreation – as well as reducing water pollution, soil erosion and GHG emissions.

621 See Section 4.2

The current provision of many ecosystem services is not adequately rewarded and many harmful practices such as nitrate pollution are not penalised. Consequently, the management of land may result in damage to ecosystems so that important functions such as carbon regulation are hindered. Output-based support measures have already been replaced by more targeted schemes designed to encourage the stewardship and management of land for ecological and environmental goals. Such developments are welcome, but much more needs to be done, especially in encouraging the provision of ecosystem services not directly connected to farming practices, and in defining the duties on property owners.

7.4.4 Woodlands

More comprehensive measures to provide incentives for the use of forestry and woodlands to supply a range of ecosystem services in addition to timber supply will be needed[622]. Carbon sequestration is especially important, given the stringent targets set by climate change policy. New planting and felling at an appropriate age can increase carbon sequestration potential. Other services are also important. For example, the species of tree and the size of forested areas also affect the capacity to provide habitats and opportunities for recreation.

The present approach to sustainable forest management recognises the need to encourage provision of these services, but it needs to be developed further to ensure that the different incentives for forestry and alternative agricultural uses properly reflect their relative social values. Institutional arrangements need to reflect this. As Section 4.4 points out, forests provide opportunities for recreation, and greater proximity to well-populated areas increases the social value that they provide. As urban expansion continues and the demand for recreation and tourism expands in the decades ahead, access to forests and the maintenance of urban green spaces will become even more important. Much greater attention will need to be given to recreational potential in planning or encouraging this use of land.

7.4.5 Flood risk management

Land use clearly has a potentially large role to help manage flood risk in the future[623]. With continuing urbanisation and climate change, the risk of flooding across the UK will rise. More research is needed to understand the relationship between land uses (such as agriculture, woodlands and urban design) and flooding, so that appraisal of options for flood risk management can be improved. There is scope for integrating analysis of flood risk and management costs more fully into appraisal of different land use options, and thus for managing land in ways which keep these risks and costs to a minimum. Regulatory and economic instruments are needed to provide appropriate incentives and compensation where appropriate. In particular, the full cost of long-term flood protection and increasing risk, need to be taken into account when considering whether to site new developments on floodplains.

7.4.6 Energy

The energy sector has potentially major implications for land use, as Section 5.1 indicates. For example, on the supply side, any significant increase in renewable energy supplied from energy crops (which have a very low energy density), could add substantially to the demand for land, sometimes in direct competition with food

622 See Section 4.4
623 See Section 4.5

production. While some energy crops displace food production, wind power does not and allows the surrounding land to retain its agricultural use. Nevertheless, onshore wind turbines require adequate space, so the land required and the resulting visual impact can be extensive. Under some scenarios for 2050, the on-shore land area taken for wind farms in Britain would range from 1% to 4%. It is important that all land uses are correctly charged or credited with their impact on GHG emissions in order to ensure that land is allocated and managed effectively, realising the best value for society. This is certainly true for agricultural land, where it is reasonable to expect strong demand for competing services, including food and energy, in the decades ahead.

7.4.7 Residential and commercial development

The increasing pressure on land for residential and commercial development poses a major challenge for policy[624]. Aspirations for more living space need to be reconciled with strong public support for protection of the countryside and the natural environment[625]. Existing policies are leading to higher density living, which appears to conflict with evidence of existing public preferences to live in larger houses. There is also evidence that planning controls are leading to a mismatch between the location of housing development and employment opportunities, with adverse consequences for transport demand, managing congestion and energy use. To provide more living space without increasing congestion and pollution would require more development land being released in locations where people will live and work in the future. Housing itself occupies only 1.1% of England's land area, or 5.4% if gardens are included. The land area (including all buildings, green space, roads etc.) accounted for by towns with more than 10,000 people (over three-quarters of the total population) is approximately 6.5% of the total land area[626]. Contrary to popular perception, only a relatively small area of the land in England is built on.

The rapid rise in the real price of development land over the past three decades indicates that supply of development land has not kept pace with demand. Moreover, there is evidence that price differentials with some classes of agricultural and other undeveloped land is large, and is higher than it would be without planning controls[627]. This raises extremely difficult policy questions about releasing land for development at the urban fringe. Releasing extra land could be justified if the price of development land exceeds the price of nearby undeveloped land by more than the net external costs of development. However, a large proportion of the population support the idea of preserving Green Belts.[628] But there is also some evidence that when offered choices between development strategies (as in the Cambridge Futures project – see Box 7.2 below), many are content with 'green swaps', trading certain areas of Green Belt for green space. What is critical for future policy development in this area, is to weigh the full range of values – ecological, social and economic – including values which are more difficult to quantify.

7.4.8 Transport

Assessing the implications of different options for using land to manage transport flows, and the potential consequences for congestion, pollution and climate change, is an essential component of a full assessment of social benefit. The mismatch noted earlier

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624 See Section 5.2

625 Section 4.1

626 Chapter 2 and Section 5.2

627 See Chapter 3

628 ER: 18 (Appendix B refers)

between the location of housing development and the availability of jobs[629] suggests that transport needs to be integrated fully into future land use strategies. It is also important that the full implications of policies designed to reduce the need for travel by increasing housing density are considered, including congestion, pollution and the costs for individual householders in terms of reduced space and higher prices. Transport policies, such as congestion charging in urban areas, may also have land use implications.

7.4.9 Recreation

The impact of changing land use on tourism and recreation will continue to be important. The visitor economy alone contributes over £50 billion per year to the UK economy and leisure activities are increasingly being recognised as vital in promoting health and wellbeing. Provision of accommodation, facilities, infrastructure and transport will be required to meet the needs of the UK share of an estimated doubling of international tourism by 2020. Pressures on land for recreation are also set to grow, with an increasing population and higher recreation participation rates. This growth in demand for land for recreation is likely to compete with other land uses, particularly in urban areas, which may displace highly valued, inner city recreation land, such as sports fields, to the edges of towns and cities.

Many forms of countryside recreation are by-products of other rural land uses (e.g. forestry), and the benefits that arise from this dual usage should be taken into full account in valuation. Countryside recreation makes a significant contribution to rural economies. However, some drivers, for example the effect of technology in encouraging home based leisure activities and measures to reduce to restrict car use, could reduce outdoor recreational activity in the longer term – with adverse consequences for rural economies.

7.4.10 Summary of interactions

The above examples illustrate just some of the many interactions between different land uses. The Project's 'influence diagram' demonstrates the connectivity and complexity of these interactions in more detail.[630] The key message from the preceding examples and the influence diagram is the need for land use governance, in its broadest sense, to take account of the many linkages between sectors in order to meet challenges over the next 50 years, and to take advantage of future opportunities. Developing and building on this conclusion is the subject of the next section.

7.5 Options for policy-makers – towards a more coherent framework for sustainable land use

If our use and management of land is to meet the multiple challenges of the future discussed in Sections 7.2–7.4, while optimising value and wellbeing for all, a strategic and coherent national response will be essential. This would require collective involvement of the wider land use community: government, devolved administrations, agencies, civil society, the research community, businesses, landowners and land managers.

A more strategic and coherent approach to managing land use change across the urban and rural domains could, in principle, take various forms, ranging from a centrally managed system of land allocation and regulation to a decentralised, market-based system involving common ground rules for decision-making for individual sectors and spatial levels. It is not within the scope of this report to identify precisely where within

629 Reference Echenique diagram

630 See "Systems Maps Catalogue" accessible at http://www.foresight.gov.uk/

this continuum the appropriate solution lies, but rather to set out the principal requirements for a well-functioning system. These requirements include the following:

- Decisions concerning land use change should take account of the full value of land in alternative uses (marketed and non-marketed), including possible uses in the future.
- Value should be assessed on a consistent basis by decision-makers at different spatial levels and in different sectors to help make more sustainable choices.
- Private incentives should be aligned as far as possible with wider objectives and values to minimise tensions in the system and deliver better outcomes.
- A combination of regulatory, institutional and economic mechanisms should be used to enable best value to be delivered most efficiently and at least cost.

Without greater strategic oversight to capture value and promote harmony in the land system, there is a risk that incremental decision-making on individual project and sectoral choices will continue to create unintended consequences and unsustainable outcomes. Making improvements to the land use system in line with these requirements is therefore essential to provide coherence, certainty and direction for the governance arrangements at different levels of decision-making (national, regional and local), whatever the balance between regulation and market mechanisms.

The guiding principle for a more coherent strategic approach would be to combine a more sophisticated understanding of how land creates value for society with a governance approach which more proactively encourages the achievement of better value and delivery of a wide range of services from land in a sustainable way. This strategic approach should set out the implications for the methodologies employed in particular decision contexts (e.g. local, regional) to ensure a consistent and coherent governance system.

A strategic approach would help identify and manage:

- Land-related problems in urban and rural areas that are addressed inadequately and, if left unresolved, are likely to get worse or dramatically reduce wellbeing (e.g. decreases in the quality of water supply or increases in flood risk).
- Vulnerabilities or systemic weaknesses on which external influences and forces could cause a spiralling of unintended and adverse consequences (e.g. environmental tipping points).
- Geographical pressure points where a combination of influences are creating specific pressures (as for example in the South East of England).
- Policy dilemmas where targets and commitments could lead to unintended consequences or produce conflicting outcomes.
- Drivers which produce uncertain outcomes over which we have little or no control (e.g. climate change effects already in train).

There is therefore a case for government to develop an overarching framework for managing land use change, that recognises the fundamental and cross-cutting importance of land across many different sectors, and which, by taking a long-term perspective, considers new circumstances (notably relating to climate change, changes in population levels and economic growth) that will emerge over the next 50 years. By building upon existing systems of governance, this approach would encompass all changes in land use and management, including both the built and natural environments, and the unique characteristics of, and the strategic opportunities in, the regions and countries of the UK. It would acknowledge the contribution of existing systems over past decades, but would equally recognise the need for change to meet the new challenges and demands of the 21st century.

7.6 The role of a strategic land use framework

The appropriate framework for land use decisions will depend in part on the respective weight given to regulatory and market mechanisms. At a minimum, a framework covering the UK and its constituent countries could simply lay down a common approach to decision-making and the methodology to be used. Currently, this varies greatly across sectors and decision levels. For example, it might set out:

- The institutional arrangements for taking decisions in a more coherent and integrated way – including the roles of sectoral bodies and different tiers of government.
- How value is to be assessed on a consistent basis and taken into account by decision-makers.
- UK-wide objectives for land use and how they are to be implemented.
- How funding streams, taxes and subsidies should be deployed to bring private incentives into line with wider objectives.
- The rights of local people and organisations to participate in deliberations by decision-making bodies.

This framework would in effect set out the ground rules within which the existing governance system operates, potentially leaving decisions to either the market or to lower-tier decision-making bodies and sectoral authorities where appropriate.

Decisions which might be more appropriately taken centrally or in higher tiers of government might include land designations and planning for major infrastructure, as at present, but also potentially zoning and regulation for particular types of land use. In practice, the existing system has elements of both central and devolved decision-making, but the key innovation would be to embody the requirements set out in Section 7.5.

7.6.1 Objectives for land use

The adoption of a coherent set of strategic, UK-wide objectives and goals for the future of land use, which articulate a vision for how land is allocated and managed, could create a greater impetus to recognise land as a national asset. Such objectives would need to recognise the autonomy of the devolved administrations, and the varied governance arrangements and land use policies. For example, a National Land Use Strategy for Scotland is currently being developed. A cascade of plans, strategies and guidelines at national, regional and local scales created under clearly articulated UK-wide objectives would create greater certainty for landowners and managers. However, defining clear objectives for land use also requires sensitivity to the substantial variation in land across the UK. All land is different; it possesses multiple values, both ecologically and economically, and helps create a sense of place and identity particular to a specific location.

Importantly, defining land objectives for the UK as a whole would not entail the imposition of standardised or uniform solutions. Rather, it would allow the particular values of land in different locations to inform decisions on how best to make the most of any comparative advantage. This would generate robust policies and choices about how different types and locations of land can be used optimally. The approach would require a more comprehensive evidence base to inform choices; currently evidence is either absent or patchy across the country. Even where it is available there may be uncertainty as to how it should be taken into account by decision-makers.

7.6.2 Levels of decision-making

Inherent in such an overarching framework is the need to articulate the preferred level of decision-making for certain types of land use change. If the impacts of particular decisions are primarily local, then they are arguably best taken locally, but if they are widespread or have future repercussions that fall outside the jurisdiction of the decision-maker, then some means of coordination is needed to align the decision-maker's interests with the wider public good. For example, the UK's major infrastructure needs, such as airports, ports, major road and rail projects, energy and water, cut across the boundaries of established administrative regions and localities. Such projects are difficult to plan and assess on a local, or even regional, basis. Housing demand and the related transport demands have impacts which also fall across different jurisdictional boundaries. Similarly, it could be difficult to form a national picture of the benefits and flow of ecosystem services spatially and over time at the local level[631].

7.6.3 Improving the evaluation of land values and their use

Inherent in this framework is the need to draw upon a deeper understanding of the value of land and how benefits flow. For example, it would not be sufficient to value ecosystem services by developing a set of standardised values for particular types of land, although that may be better than assuming a zero value or none at all, as so often the case at present.

7.6.4 From local to national

A clear understanding of the locational aspect of land assets is needed. The geographical pattern of landscapes, resources, capability, ecosystems and the arrangement of human activities constitute unique places that are the outcomes of both unintentional and purposeful action. This sense of place helps create communities and social cohesion, but also influences perceptions and attitudinal responses, manifested through markets and other mechanisms, which condition further spatial changes to the land. Incremental local land use changes can cumulatively become a matter of national importance. Interests of the wider community or segments of the nation are often under-represented in local decisions, and consequently given insufficient weight. There is an opportunity to improve the system in a way that allows a better understanding of what different geographies and landscapes offer, not just locally but also nationally.

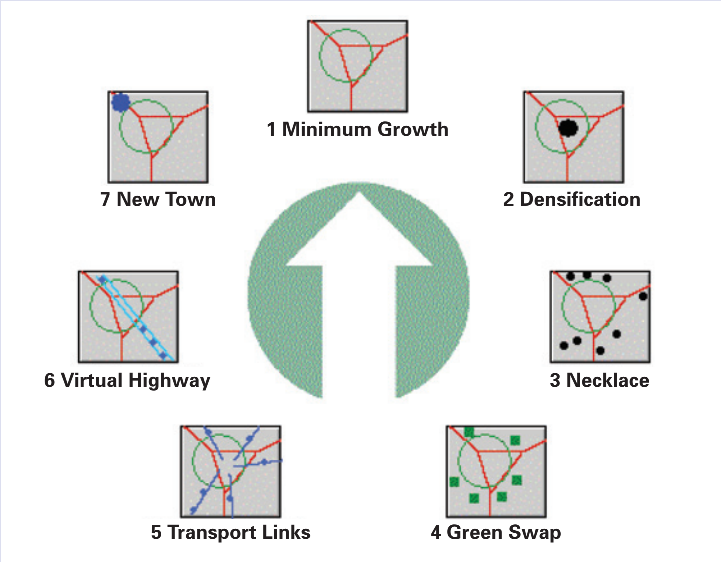
To achieve outcomes from land use change that are acceptable to local people as well as consistent national objectives requires greater emphasis on mechanisms which can reconcile conflicting interests. Achieving consensus is not always possible, but the Cambridge Futures exercise carried out a decade ago provides a successful example of

631 http://uknea.unep-wcmc.org/

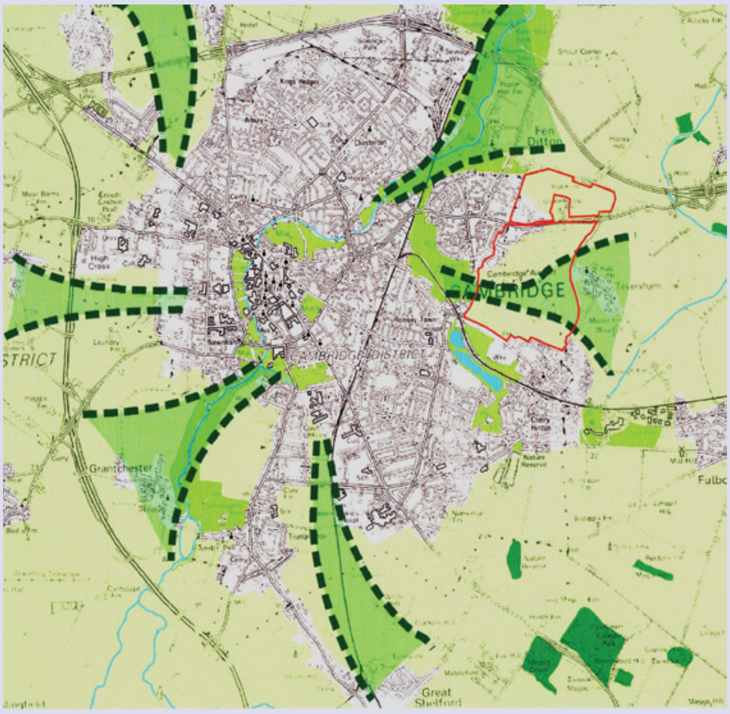
how this can be done (see Box 7.2). This initiative combined rigorous analysis with public participation to create a consensus for the future of the Cambridge sub-region, which led to the implementation of a new plan for development.

Box 7.2: Cambridge Futures

Cambridge Futures is a unique partnership of business, local government and the academic world, which published objective research on a range of proposals for the development of the city in 1999.



Cambridge Futures analysed seven scenarios for the future of Cambridge – as illustrated in the above diagram. The final analysis appraised each option in terms of its economic, social, transport and environmental impacts. The results were presented at public exhibitions accompanied by an animated video which illustrated the physical consequences of each option. The visitors expressed their preferences for the options.



Contrary to expectations, the public rejected the options of minimum growth and necklace of development. Instead, they supported options that encouraged growth of the city, especially the 'transport links' option – development associated with high quality public transport, and 'green swaps' – extensions into the less scenic areas of the green belt in exchange for public open space. The public understood the impact on prosperity, housing affordability and quality of life of the different options. This helped to create a consensus for the future of the Cambridge sub-region, which has resulted in a new plan being implemented.

The new public spaces created by the 'green swap' option have been introduced through a set of 'green wedges' to bring the natural landscape into the heart of the city, as illustrated in the above figure. For further information see http://www.cambridgefutures.org/.

Outcomes created by the systems of governance would need to be reviewed periodically and, where necessary, revised as circumstances change. Building in a rigorous evaluation process would be essential. A summary of the principal elements of such a 'framework' are shown in Box 7.3. A more comprehensive list of the possible key elements, together with their rationale and options, appears at the end of this chapter (Table 7.1).

Box 7.3: Possible key elements of a strategic framework for land use

- Establishing and cascading land use objectives.
- Ensuring clarity on what decisions should be taken at national, regional and local levels, so that there is a better balance between delivering national and strategic objectives while respecting regional and local circumstances and local views.
- Ensuring decision-making is evidence-based. The aim should be to promote decisions in different sectors that are based on a consistent approach and take better account of the full range of services and values which land could provide. It also implies the need for guidance on valuation and other aspects of methodology to be widely available.
- Facilitating the collection and dissemination of improved data and information flows on land use. Such data provide part of the evidence-base on land and place to help identify and measure the multiple values of land needed for decision-making at all levels.
- Ensuring appropriate incentives to deliver more sustainable decisions on land use – particularly for landowners and land managers.
- Promoting decisions and policies that are robust in the face of changing circumstances and future uncertainties – for example when the costs of delaying action might outweigh immediate savings.
- Providing periodic evaluation of outcomes against national and local objectives, coupled with adjustments to incentives and governance.
- When developing new policies and interventions, it will be important to evaluate their robustness against future uncertainties. The scenarios developed by this Project (see Appendix E) should be used for this purpose.

7.7 Implementation: administrative issues

The primary challenge to incorporating a broader understanding of the value of land and the wider long-term impact of land use change into policy lies in working with existing governmental mechanisms at varied spatial scales. An important issue for government will therefore concern the extent to which existing governance systems (including providing incentives) should be refined (to a greater or lesser extent), as opposed to working within the status quo.

Certain existing governance arrangements could work against a more integrated approach. Examples include:

- *Administrative areas:* The UK has tended to use administrative areas as the spatial frameworks to formulate and deliver land use policies and initiatives. However, the boundaries of administrative areas such as regions and local authorities do not necessarily relate to the functional and economic flows across the land.
- *Some specific policies focus on networks,* such as the transport system, that stretch across various governmental and geographical boundaries. These may not be compatible with strategies and plans for the growth of towns and cities that are clustered in specific places. Movement of people and goods, and flows of services, are increasingly difficult to manage through investment decisions and strategies that are often bounded within a local or regional planning framework. There is also a tendency to focus on the land surface and various land uses rather what land can offer ecologically or otherwise.
- *The forces that drive change in and over the land interact* in complex ways, and sector-specific policy responses (in housing, or transport, or agriculture, for example) may be ineffective in addressing broader challenges.

7.7.1 Institutional oversight

An important political issue is whether there should be central oversight of all aspects of land use policy and implementation, or whether to adopt a more decentralised approach which ensures that individual departmental policies are better connected. Central oversight (either in the UK or in individual countries of the UK) could be conducted by an existing government department or by a new body set up for the purpose. Much will depend on the range of responsibilities it is required to take on.

7.7.2 The role of taxes and subsidies

Achieving sustainability and delivering better value from land is likely to involve a range of policy instruments including taxes and subsidies that relate directly to the specific problems. These could be used to foster partnerships between businesses and farmers, encouraging land management regimes to deliver multiple benefits, and allocating land use more strategically. However, there will be a need to provide incentives and 'mainstream' choices and decisions which are intended to generate better value in a sustainable manner, while retaining sufficient overall control to ensure that principal objectives (such as avoidance of urban sprawl and adequate provision of accessible green spaces) are met.

7.8 Conclusion

This chapter has reviewed important cross-sectoral challenges, systemic obstacles to change and sector-specific challenges. It has considered the risks of 'business as usual' and has argued the case for a more strategic approach to land use governance which embodies coherent and consistent goals and processes. Here the aim has not been to identify specific changes that must be made but rather to set out the desirable characteristics of a new approach based on a sophisticated and long-term perspective on land. However, evaluating how to implement the findings in detail will be a significant task requiring consultation and review, framed against prevailing political priorities and approaches. The next steps to take this forward form the subject of the final chapter.

Table 7.1: Possible elements of an integrated framework for sustainable land use

Desirable aspects of the governance system for land use	Rationale	Additional consideration. Does the system:
A. Includes a statement of UK-wide objectives and ambitions for land use and land management to inform decisions.	To enable future policy and decisions across the system to reflect wider social objectives.	• Clarify whether the objectives and principles are aspirational or mandatory requirements. • Recognise the unique characteristics, challenges and opportunities of the different countries and regions of the UK. • Actively involve representatives of actors in the system, including policy-makers, the research community, agencies and NGOs, landowners and business. • Potentially vest the responsibility for oversight of land use policy in a central body to encourage consistency, coherence and the use of analysis and evidence.
B. Sets out a clear framework for taking land use policy decisions and allocating land via plans or other mechanisms which take explicit account of the *full potential value* of land in alternative uses, including all the benefits and costs involved, based on good evidence and analysis.	To encourage policy decisions on land use and management which deliver the highest possible value to the country in a sustainable way, considering the whole range of possible ecosystem services.	• Establish a clear methodology for decision-making. • Establish the principle that decisions should aim to achieve the highest value use. • Provide clear guidance on how value is to be assessed, including those land services which are difficult or impossible to quantify.
C. Ensures that strategic national, regional and local objectives are taken fully into account in individual local planning decisions, striking a balance between protecting the interests of existing landowners, meeting local priorities and the wider public interest.	The current framework gives planning authorities wide discretion on individual decisions, and frequently allows 'material considerations' to override some policy objectives.	• Establish clearly articulated land use objectives at national, regional and local level. • Reform the basis on which local planning decisions are taken to ensure that a full range of relevant strategic priorities is taken into account and given due weight to ensure that decisions deliver best value.

Desirable aspects of the governance system for land use	Rationale	Additional consideration. Does the system:
D. Encourages decisions to be taken at the appropriate level and spatial scale.	Local decisions which only affect that area should be taken locally. Decisions which affect people more widely across different areas, or in the country as a whole, need to reflect these more strategic considerations while taking account of local preferences.	• Encourage decisions to be taken at the lowest level consistent with ensuring that high-level strategic objectives are met. • Recognise the variability in the spatial extent and nature of the impact of change in different parts of the land system (e.g. at the scale of water catchment areas, or housing market areas). • Have mechanisms in place to review the institutional structure for decision-making on issues which, taken together, are of regional or national significance. • Articulate which decisions need to be taken at higher levels, because decisions at local level are unlikely to give sufficient weight to strategic objectives, and those which can be influenced sufficiently by provision of suitable incentives at local level.
E. Requires a consistent approach to decision-making across sectors and at different levels of governance, which covers both urban and rural land use and management.	Sectoral decisions affecting land use are largely uncoordinated, spread across different government departments, agencies and local institutions, and use different methodologies and criteria for decision-making. This approach does not ensure that alternative land uses are examined simultaneously to ensure positive and sustainable outcomes. It can also lead to unintended consequences.	• Require all bodies concerned with decisions affecting land use to adopt a common methodology, including factors to be taken into account and assessment of value. • Assess where coordination across institutional boundaries is needed. • Ensure that land use aspects of economic development, energy, transport, housing, conservation, water, flood management and agricultural policy are handled consistently. For example, greater coordination of ground water and surface water management, and linking this to the economic development of a region.

Desirable aspects of the governance system for land use	Rationale	Additional consideration. Does the system:
F. Ensures that private incentives are aligned as far as possible with land use and management policy objectives.	To ensure the delivery of public goods and services and the protection of land and the natural environment, in situations where land use decisions are primarily a reflection of commercial considerations, and to keep tensions in the system to a minimum where market signals and regulations are in conflict.	• Adjust taxes, subsidies, compensation regimes and other instruments (e.g. emissions permit trading) to bring financial benefits to levels consistent with policy objectives for ecosystem services. • Ensure that a consistent carbon price is set for landowners and managers. • Recognise that a different range of incentives can be applied in different locations in accordance with their unique land use requirements, challenges and opportunities. • Ensure that land allocation policies and price differentials reflect the difference in the value of non-market benefits in different uses.
G. Takes full account of public attitudes and preferences in making strategic decisions about land allocation and use.	Currently, decisions on the allocation of land for development give greater weight to trend-based projections, which make less reliance on formal allowance for either economic indicators of the value of land, such as prices, or other evidence on public attitudes and values.	• Ensure that the significance of high and low market prices for land is properly reflected in assessments of the value of land in delivering marketed services such as housing and commercial activity. • Require that opinion surveys and deliberative methods are used regularly and are given due weight and status, and in the context of particular decisions, establish public attitudes on different land uses and their impacts. • Identify land to which the public attaches highest cultural, environmental, amenity or development value.

Desirable aspects of the governance system for land use	Rationale	Additional consideration. Does the system:
H. Ensures that the system of property rights and incentives is well designed to enable satisfactory provision of specified ecosystem services and public goods from the land, to minimise harmful activities, and to encourage multifunctional land use where appropriate.	Currently, property rights over rural land entail no duty to deliver environmental services, and land use and management is generally based on commercial criteria risks. This takes little or no account of the impact of decisions on whole ecosystems and the consequences for the services they provide (affecting the wider population). As a consequence these services can be undersupplied or undervalued.	• Encourage key participants in the system to form concordants, establish covenants or adopt other innovative methods to deliver key ecosystem services at the appropriate spatial scale. • Ensure that all the external costs and benefits of particular land uses, such as GHG emissions, amenity value and water pollution, are reflected explicitly in either charges or funding streams.
I. Ensures that the fiscal system, including funding streams and both central and local taxation, is consistent with the incentives required to deliver the objectives of land use policy.		• Ensure that the local government finance system, including the national non-domestic rate, does not unintentionally discriminate against development. • Include measures such as the Community Infrastructure Levy, which reflects all the costs (financial, social and environmental, as far as possible) that development imposes on communities. • Reward communities for accommodating necessary developments that meet strategic long-term objectives.

Desirable aspects of the governance system for land use	Rationale	Additional consideration. Does the system:
J. Ensures that the prices of marketed and potentially marketed services from land, including those subject to economic regulation, properly reflect their scarcity and the need for appropriate investment decisions.	Land use in some areas of the country, such as the South East of England, is subject to severe pressure, resulting in environmental degradation and demand for resources threatening to exceed supply. The incentive to live and work in such high demand areas should reflect the full costs involved if the balance of demand between different parts of the country is to reflect better the resources available.	• Require that water scarcity in high/growing demand areas is fully reflected in regulated prices, and in higher investment. • Encourage communities in such areas to charge for scarce resources such as road space.
K. Encourages active participation by local communities in decisions about strategic land use change.	There is good evidence that decisions about land use can benefit from community involvement in decisions. This involves providing information and analysis of different options and allowing people to express their preferences in an informed way.	• Require local and regional planning bodies to conduct formal consultations with local people about land use change. These consultations should be informed by rigorous analysis of alternative scenarios. • Make use of new and innovative methods and technologies (e.g. high quality visualisation) for demonstrating the positive and negative impacts of land use change.
L. Sets out clearly how land services are to be valued for use in decision-making, including those whose value is difficult or impossible to quantify.	Valuation of land in alternative uses is key to making good decisions, but assessing value is not straightforward. Provision of information and guidance on this is necessary to help decision-makers and ensure consistency.	• Set out the full range of services and impacts to be assessed and, where possible, valued. • Provide guidance on best practice methodologies in each case, and the methodology for comparing values where financial valuation is not possible.

Desirable aspects of the governance system for land use	Rationale	Additional consideration. Does the system:
M. Encourages greater access to information for local decision-makers on the value of land in different uses, and the potential benefit of changes.	Local decision-makers require the best possible information about the value of land in different uses, and the results of relevant research studies – and thus the potential benefits available from existing or alternative land uses.	• Coordinate provision and dissemination of data on land uses and their impacts. • Bring together and publish the best available evidence on land values in different uses and locations, including all external impacts as well as marketed services.
N. Supports the further development of knowledge, science and technology needed to enhance the sustainable use and management of land.	Increased pressure on land (and related ecosystem services), with the adoption of multipurpose land use requires new technologies and management approaches.	• Review the existing capacity in land resource management systems in the context of the 'living with environmental change'. • Assess the need for more educational programmes, research and development of new technologies to address future challenges. • Make strategic investments to enhance the research capability in land-based sciences and achieve integration across rural and urban sectors.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8 Conclusions – next steps

This chapter identifies what needs to be done to take forward the findings of this Foresight Project. Two classes of actions are suggested. The first relates to those issues that have been identified as particularly important, and which merit early consideration. The second relates to taking a more strategic and systemic look at how the existing systems for managing land use change can be improved to meet the new challenges of the 21st century.

8 Conclusions – next steps

This report has highlighted the vital importance of land to the prosperity, health and wellbeing of the nation. Land is a versatile national asset: delivering food, wealth, energy, living and working environments, transport, and cultural, natural and semi-natural landscapes. It needs to be used to deliver best value to society in a sustainable way.

However, the report has also discussed the breadth of challenges faced in managing land, not only today but over the next 50 years. Demographic change, shifting energy supplies, climate change adaptation and mitigation, and changing public values and expectations create the pressures on land to deliver a growing range of services.

In a Foresight project with such a broad scope as this, it is not feasible to consider every issue in the same level of detail and complexity as the responsible government departments. Indeed, it would not be credible to claim to do that. Instead, the added value has come from taking a broad and strategic view across the many sectors that relate to land use, to identify the most pressing challenges that need to be addressed, and to take a fresh look at how these disparate – and often conflicting – interests could be better addressed. This chapter now considers what needs to be done to act on these insights.

8.1 A key choice for Government

Land use governance in its broad sense has evolved over the past 50 years in response to changing demands and expectations. Formal governance structures, how land is valued, and how its sustainable use and management are incentivised, have all adapted to changing circumstances. Existing patterns of land use and approaches to managing change have arguably been successful at balancing demands. However, as competition for space and the demand for resources intensify in the future, the processes in place for managing land use change will need to be come more sophisticated and more coherent across all aspects of the land system.

Without an integrated approach to managing land use change, balancing the increasing number of objectives across different levels of government and across sectors, such as housing, transport and agriculture, will become more difficult and risks creating unintended outcomes. And without incorporating better understanding of land use change impacts, spatially and over time, into wider policies and strategies, there is a substantial risk that measures to address future challenges – such as those relating to climate change mitigation – would be undermined.

This report argues for the need to take stock, and to assess where changes to the processes and mechanisms that guide land use change would be useful. However, identifying actions and implementing new systems of governance that can relieve pressures on land, as well as generate extra benefits from our available land resources sustainably, is a substantial task.

At the highest level, the choice is straightforward. Chapter 7 argues that some incremental benefits could be realised by a piecemeal approach, for example, by addressing the key sectoral challenges that were identified in Chapters 4 and 5. However, more sustainable and better outcomes would be obtained by developing a more strategic approach to managing land use change which tackles the root causes of problems in the system. Such an approach should combine a sophisticated understanding of how land creates value for society with a governance system that more proactively incentivises the delivery of a wider range of sustainable and valued land services. It could also embody objectives or goals for land use and land management which reflect the unique opportunities for change in the different countries and regions of the UK. Having clear objectives and ambitions for the operation of the future land system would promote greater consistency and coherence in decision-making across all sectors for urban and rural land. Such goals would need to set out how these opportunities are to be realised, for example, by identifying mechanisms that could be used to implement change.

These mechanisms need to be framed by political decisions – for example, relating to: the balance between national, regional and local powers; the various future challenges; and the relative roles of regulation, incentives and markets. They will also, to some extent, be determined by existing legislative commitments related to land, such as international and EU-level directives and treaties. Wider issues of resource availability would also be a central concern, as would achieving a balance of economic development, social progress and environmental protection. Critically, there is a need to appreciate spatial variation in the demand and supply of land resources of given qualities, and in the comparative advantage that land (and other natural resources such as water) confers on particular regions and communities. Such 'critical geographies' mean that, although there are common land use and management challenges they can vary considerably within and between regions and countries of the UK. Meeting housing demand in the densely populated South East of England, optimising the use of existing infrastructure and housing capacity in other cities, and supporting rural livelihoods in relatively remote upland areas, are examples.

Developing and implementing an integrated and strategic cross-government approach, which incorporates regional and sectoral interests, presents significant challenges. It will require detailed consideration by policy-makers and involvement of interested parties.

8.2 Next steps

As in previous Foresight projects, the launch of this report is only one step of a continuing process. Detailed consideration of the findings will be needed, and it is suggested that responsible government departments should take the lead – separately and in concert. In some cases, it may be appropriate to integrate this within existing and planned policy review exercises.

Tables 8.1 and 8.2 identify two sets of possible actions that could be undertaken over the next 6 to 12 months. The first set relates to specific sector challenges where there is a case for early review. They are not intended to be exhaustive. Further details concerning these challenges can be found in Chapters 4, 5 and 7.

The second set of possible actions (Table 8.2) is directed at strengthening land use governance so that it is more integrated and strategic. As such, the actions focus on addressing the systemic problems with the land system – with the aim of unlocking greater and more sustainable value from land, and easing conflicts across sectors.

Foresight and its experts will liaise with relevant government departments and devolved administrations in considering the report's findings in the first half of 2010, with a view to developing a detailed way forward later in the year. Clearly, consultation with key stakeholders would be crucial to this process.

Table 8.1: Suggested sectoral actions

Possible actions to address important sectoral challenges
Water resources: There is a case to consider options for a more integrated strategy for quality and supply – involving catchment area management, water pricing and demand management, particularly in areas of stress – and to ensure that the implications for water resources are factored more systematically into decision-making on land use and land management at both national and local level. Consideration of options to reverse long-term degradation of aquifers due to ingress of nitrates and other pollutants.
Flood-risk management: Consideration of how to integrate the analysis of flood risk and management costs more fully into the appraisal of different land use options. Consideration of options for new regulatory and economic instruments to provide appropriate incentives to enable flood risk to be better managed. For example, how the full cost of long-term flood protection and increasing risk might be better taken into account when considering new developments in flood-risk areas.
Energy and carbon: A broad assessment of the contribution of land use and management policies, and land use change, to meeting EU2020 Renewable Energy Targets. Consideration of the extent to which pricing of carbon in the energy sector and competing land uses (including agriculture and forestry) can guide necessary land use change.
Residential and commercial development: Consideration of strategic policy options for meeting development needs in the South East of England and other high demand areas – including whether to make additional land available for development options will need to factor in the wider impact on the land system at an early stage, including: the range of ecosystem services, public preferences, the appropriate mechanisms for delivering, and the present and future value of land in alternative uses.
Rural and urban land: Consideration of options for improving incentives and reward systems for managers of land, to reflect the wider range of ecosystem services they will need to manage.

Possible actions to address important sectoral challenges *(continued)*
Conservation: Review the operation of designations, with a view to assessing how they might become better connected to enable species to more easily adapt to climate change. Consider the effectiveness of measures designed to ensure the quality and management of land, both within and outside the designated areas.
Forestry: Consider how best to promote and encourage the strategic use and positioning of forestry and woodlands to increase the range of benefits they provide in addition to timber.
Recreation: Consider how to improve links between research on both landscape value and the integrity of landscapes. The value of recreation and tourism for rural communities and the UK economy needs particular attention.
Transport: Consider how to ensure that transport needs are integrated fully into future land use strategies, and that new mechanisms for assessing decisions on major infrastructure projects encompass the full range of potential land system impacts.

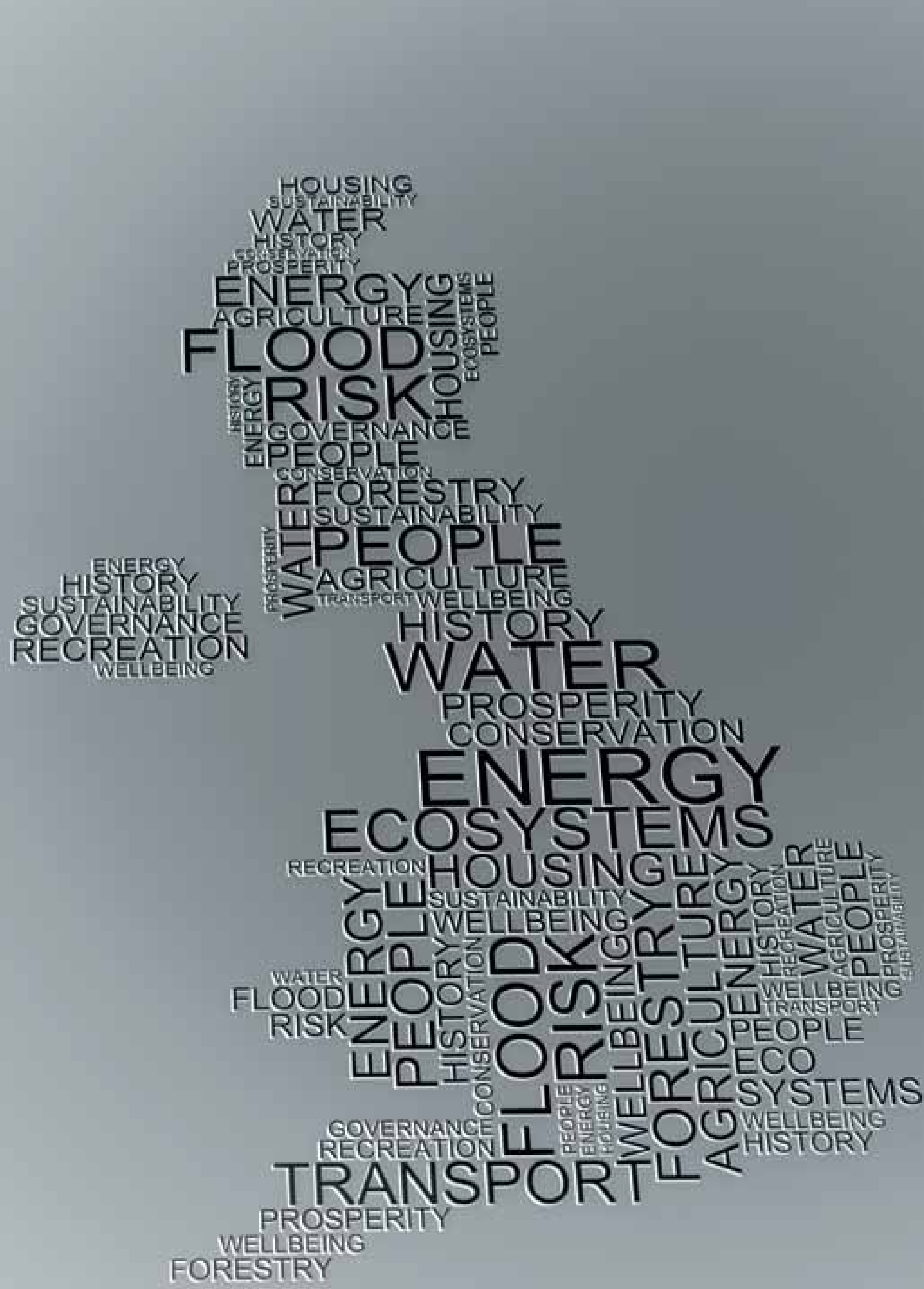
Table 8.2: Actions to address systemic issues – towards a strategic framework for land use

Possible actions to address systemic issues
It is suggested that officials in responsible government departments and devolved administrations should take the lead in considering the potential implications of this report, particularly those that are cross-cutting in nature. Part of this process would be to assess how a more integrated approach to managing land use change can be developed.
Consideration of: • Whether there should be overarching objectives and goals for UK land – spanning the urban and rural domain and sectoral interests – to guide future policies that affect how land is used or managed. • Which type of land use change decisions are needed at national, regional and local levels, so that there is a balance between delivering national and strategic objectives whilst respecting regional and local circumstances and the views of people. • How to apply research on the value of land, ecosystems and the value created by changing land use early in the policy-making cycle, so that policies take better account of the full range of services and values that land can provide. • The effectiveness of current incentives for landowners and managers to deliver public goods and services, and whether they can be aligned more closely with wider goals for land use. • The circumstances where the option value of land is high (perhaps due to its versatility) and where there is potential for different uses in the future. • When anticipated future needs should take priority over immediate concerns – for example, when the costs of delayed action might outweigh immediate savings. • New possibilities for land-related research needed to support an evidence-based approach to land use decision-making; and how existing sources of data can be better utilised. • The impact of future uncertainties on possible new governance structures. The scenarios developed by the Project (see Appendix E) could be used for this purpose.

8.3 Concluding remarks

When a Foresight project is started, it is not known where the scientific and other evidence will lead. This report has provided a vision of both future challenges and opportunities for the land system. It has also demonstrated the central and pervasive importance of land for all communities within the UK. Perhaps most encouragingly, has been the realisation of the considerable potential to unlock additional value from the land – particularly since the most powerful key to realising this would seem to lie not with spending, but rather through a vision for new systems of governance, in the broadest sense.

Moreover, whilst some incremental benefits from the land system could be realised by an approach involving individual parts of Government, significantly greater benefits in the environmental, social, environmental and economic outcomes from land could be achieved through a more strategic and integrated approach to land use allocation and management. This report aims to provide the evidence to help catalyse such a change.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Appendices and references

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Appendix B: Evidence reviews and other project documents

The views expressed in these papers are the views of the authors and do not represent the views of the Government Office for Science, nor the policy of the UK Government.

Evidence Reviews (ER)	Ref No.*
Land use change in Britain	ER:1
The present and future use of 'land' below ground	ER:2
The future of soils and land use in the UK: Soil systems for the provision of land-based ecosystem services	ER:3
UK land use and soil carbon sequestration	ER:4
The relationship between land use and surface water resources in the UK	ER:5
Land use, water management and future flood risk	ER:6
The relationship between land use and groundwater resources and quality	ER:7
Land use and biodiversity relationships	ER:8
Land use and the state of the natural environment	ER:9
Land use and the coastal zone	ER:10
The future of the uplands	ER:11
Society's attitudes to and preferences for land and landscape	ER:12
Perceptions about land use	ER:13
Space per person in the UK: A review of densities, trends, experiences and optimum levels	ER:14
Land ownership in the United Kingdom: Trends, preferences and future challenges	ER:15
Rural land ownership in the United Kingdom: Changing patterns and future possibilities for land use	ER:16
Urban land and property ownership patterns in the UK: Trends and forces for change	ER:17
Conservation designations – Are they fit for purpose in the 21st century?	ER:18
Managing land use change	ER:19
The future of housing and homes	ER:20
Social and economic drivers of land use change in the British space economy	ER:21
The present and future land requirements of logistical activities	ER:22
The impact of sustainable energy production on land use in Britain through to 2050	ER:23

* These reference numbers are used throughout the report to refer to the various reviews and papers

Future play: tourism, recreation and land use	ER:24
Property rights, land use and the rural environment: A case for reform	ER:25
Agricultural land use in the era of climate change: The challenge of finding 'Fit for Purpose' data	ER:26
Agricultural technology and land use futures: The UK case	ER:27
Agriculture and land use: Demand for, and supply of, agricultural commodities, characteristics of the farming and food industries, and implications for land use in the UK	ER:28
Land use and climate change in the UK	ER:29
Land use planning and health and well being	ER:30
Future UK land use policy and the risk of infectious disease in humans, livestock and wild animals	ER:31
The state of the natural environment: land use and forestry	ER:32
Digging the backyard: Mining and quarrying in the UK and their impact on future land use	ER:33
Political economy of local and regional development in the UK	ER:35
International perspectives on future land use	ER:38
International perspectives on future land use: country case studies	ER:39
Bringing the real world into economic analyses of land use value: Incorporating spatial complexity	ER:40
Land Use Futures Project reference material	ER:41
Discussion Papers (Dis)	
The following reports and papers contain interesting perspectives, views and opinions but are not formal Evidence Reviews. They do not represent the views of the Government or of Foresight.	
A perspective on sustainable land use	Dis:1
Urban land market and policy failures	Dis:2
Findings from the Rural Economy and Land Use (RELU) projects contributing to the Land Use Futures Project	Dis:3
Horizon scan of emerging issues for the Land Use Futures project	Dis:4
Defra Land Use project: Demonstrator case studies workstream	Dis:5
Land Use Futures environmental valuation paper	Dis:6
Report of the Scoping workshop, 28 February 2008	Dis:7
Report of the Scoping workshop, 12 March 2008	Dis:8
Annex on Change drivers: from scoping workshop report, 12 March 2008	Dis:9
Report of the workshop on framing the SYSTEMS Work, 30 October 2008	Dis:10
Report of the first systems workshop, 1 December 2008	Dis:11
Report of the systems workshops, 20 January and 4 February 2009	Dis:12

Report of the workshop on valuing land, November 2008	Dis:14
Telling stories: Report of the scenarios workshop 18 February 2009	Dis:15
Report of the discussions from the Foresight Land Use Futures Project and the North East Regional Strategy workshop, June 2009	Dis:16
Report of the multifunctionality of land workshop report, July 2009	Dis:17
Report of the workshop on governance of the UK land system, July 2009	Dis:18
Report of the workshop on land valuation and decision making, July 2009	Dis:19

Note: Some reference numbers were originally reserved for reports that were subsequently not commissioned.

All of the Evidence Reviews and Discussion Papers can be downloaded through the Foresight website (http:/www.foresight.gov.uk)

Appendix C: Glossary of terms and acronyms

Because of the broad scope of this project and the many disciplines that have contributed to it, it has been essential to establish an agreed set of definitions that underpin the analysis.

Affordable housing: Housing provided to specified eligible households whose needs are not met by the market. Includes social, rented and intermediate housing.

Afforestation: Planting of forests on land that has historically not contained forests.

Big Box Retailers: Retail stores that occupy a large physical space, offer a variety of products and focus on large sales volumes, resulting in very competitive pricing.

Brownfield sites: Land that is, or was, occupied by permanent structures (excluding agricultural or forestry buildings) and associated fixed surface infrastructure.

Built environment: All the developed settings in which people live and work, from villages to large cities, and including housing, health and educational and other government buildings, shops, work and leisure places, transport and energy infrastructure, and the spaces between them.

Carbon sequestration: The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen and store the carbon.

Community Forests: Areas of land transformed into wooded landscapes by a partnership of local authorities, national agencies, and voluntary and community organisations – to provide employment, recreation and wildlife habitats.

Cultural services: The non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g. knowledge systems, social relations, and aesthetic values.

Demographic shift: A shift in the distribution of a population – for example relating to age, gender, or ethnicity.

Designations: The various areas of land protected for conservation of habitats and biodiversity, or special cultural significance and beauty.

Diffuse pollution: Pollution arising from land use activities (both urban and rural) that is dispersed across a catchment, or sub-catchment, and does not arise as a process effluent, municipal sewage effluent, or an effluent discharge from farm buildings.

Ecosystem services: The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

Environmental limit: The point or range of conditions beyond which the benefits derived from a natural resource system are judged unacceptable or insufficient.

Environmental stewardship: An agri-environment scheme that provides funding to farmers and other land managers who deliver effective environmental management on their land.

Externality: Costs or benefits that impact society, but are not included in the market price of a good or service.

Green Belt Policy: A planning policy which aims to prevent urban sprawl by keeping land permanently open.

Green/blue infrastructure: A network of multifunctional green spaces, riverine or coastal environments in urban areas or wider countryside.

The Green Book (HMT): The central point for access to guidance on the economic assessment of spending and investment, including the preparation of business cases for the public sector.

Green corridors: Green spaces in urban areas that provide scope for movement and access such as habitat connectivity.

Greenfield sites: Land which has never previously been developed.

Green spaces: Parks and other urban spaces characterised by extensive vegetation which make the built environment more enjoyable for people and more resilient to external stress.

Groundwater: Water that percolates through the subsoil into aquifers.

Heat islands: Urban and suburban areas that are significantly warmer than their surroundings.

Intermodal terminals: Locations for the transfer of freight from one transport mode to another e.g. between road and rail.

Land cover: The physical coverage of land, usually expressed in terms of vegetation cover or lack of it. Related to, but not synonymous with, land use.

Land management: The process of managing the use and development of land based on different types of activity taking place within each category of land use.

Landscape: An area of land that contains a mosaic of ecosystems, including human-dominated ecosystems. The term cultural landscape is often used when referring to landscapes containing significant human populations or in which there has been significant human influence on the land.

Land system: The land system embodies the relationship between human activities on land, socio-economic conditions, the natural environment and also the systems of governance that manage these interactions.

Land use: What land is used for, based on broad categories of functional land cover such as urban and industrial use and the different types of agriculture and forestry.

The Millennium Ecosystem Assessment: A research programme launched by the UN in 2001, focusing on ecosystem changes over the course of decades, and projecting those changes into the future.

Multifunctional land: An area of land that delivers a variety of goods and services.

Perfect Storm: The hypothesis that growing populations and climate change will generate problems of accessibility to water, energy and food by 2030.

Peri-urban: The areas where urban and rural land meet and where the environment is at its most vulnerable. Used widely in describing developments in the developing world but also used to describe the interface between urban and rural land. Also known as the urban fringe.

Public goods and services: Goods and services in which the benefit received by any one party does not diminish the availability of the benefits to others, and where access to the good cannot be restricted.

Quality of life: The term used to evaluate the general wellbeing of individuals and societies.

Resilience: The capacity of the human and natural systems to deal with surprises and changes including climate change, severe weather events, or terrorism. An increasing policy priority for the UK and other countries.

Scenario: A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about key driving forces (e.g. rate of technology change, prices) and relationships. Scenarios are not predictions, and may sometimes be based on a 'narrative storyline'.

Section 106 agreement (S106): Relating to the Town and Country Planning Act 1990, S106s allow a local planning authority to enter into a legally binding agreement or planning obligation with a landowner in association with granting planning permission. They are a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. S106s are generally used to support provision of services and infrastructures e.g. highways, recreational, education and health facilities, and affordable housing.

Semi-natural habitats: Semi-natural habitats are globally considered (though a common definition doesn't exist) as any habitat where human-induced changes can be detected, or that is human-managed but which still seems a natural habitat in terms of species diversity and species interrelation complexity.

Urban fringe: See Peri-urban.

Urbanisation: An increase in the proportion of the population living in urban areas.

Valuation: The process of expressing a value for a particular good or service in a certain context (e.g. of decision-making), usually in terms of something that can be counted, often money, but also through methods and measures from other disciplines (sociology, ecology, and so on). See also Value.

Value: The contribution of an action or object to user-specified goals, objectives, or conditions.

Water stress: Where there are tensions between water quality, supply and demand.

Wellbeing: A context- and situation-dependent state, comprising basic material for a good life, freedom and choice, health and bodily wellbeing, good social relations, security, peace of mind, and spiritual experience.

Acronyms

AONB	Area of Outstanding Natural Beauty
BAP	Biodivesity Action Plan
CAP	Common Agricultural Policy
CCS	Carbon Capture and Storage
CEH	Centre for Ecology and Hydrology
CLG	Department for Communities and Local Government
CS	Countryside Stewardship
DCMS	Department for Culture, Media and Sport
DEFRA	Department for the Environment, Food and Rural Affairs
DTLR	Department for Transport, Local Government and the Regions
EA	Environment Agency
ELS	Entry Level Scheme
ESA	Environmentally Sensitive Area
EVRI	Environmental Valuation Reference Inventory
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GES	Good Ecological Status
GLUD	Generalised Land Use database
GVA	Gross Value Added
HLS	Higher Level Scheme
LAA	Local Area Agreement
LSP	Local Strategic Partnership
LUCS	Land Use Change Statistics
LWEC	Living with Environmental Change programme
MA	Millennium Ecosystems Assessment
NE	Natural England

OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
PPG	Planning Policy Guidance
PSA	Public Sector Agreement
RELU	Rural Economy and Land Use programme
RPI	Retail Price Index
SCS	Sustainable Community Strategy
SSSI	Site of Special Scientific Interest
TIFF	Total Income From Farming
UKCIP	United Kingdom Climate Impacts Programme
WGS	Woodland Grant Scheme
WWF	World Wildlife Fund

Appendix D: List of important research, futures projects, and government initiatives drawn upon during the Project

The analysis in this report has taken account of a large number of past and present government and non-government initiatives, reviews, research programmes and strategies, as well as a number that are currently underway. The following list is not intended to be exhaustive but provides a flavour of the range of material the analysis has drawn upon.

A vision for the Countryside 2026, CPRE

Barker Review of Housing Supply: Delivering Stability: Securing our future housing needs, 2004

Barker Review of Land Use Planning, 2006

Building Britain's Future, 2009

Countryside Quality Counts project

Countryside Survey project

Climate Change and River Flows in 2050s

DECC 2050 scenarios

Demonstrator Case Studies – Natural England for DEFRA and Foresight Land Use projects

The Eddington Transport Study, 2006

England Catchment Sensitive Farming Delivery Initiative

Environment Agency Catchment abstraction management strategies

Environment Agency Catchment Flood Management Plans

Environment Agency River basin development plans

Environment Agency Scenarios to 2030

Environment Agency Shoreline Management Plans

Environmental Outlook to 2030, OECD 2008

Environmental Stewardship Initiatives

EPSRC Sustainable Urban Environment (SUE) research

The European Landscape Convention, 2008

Foresight Flood & Coastal Defence Report, 2004

Foresight Global Food and Farming Futures, (ongoing)

The Gallagher Review, 2009

The Global Land Project, The Macaulay Institute

Green Infrastructure Guidance, Natural England

Greener Homes for the future? An environmental analysis of the Government's house-building plans, House of Commons Environmental Audit Committee, 2008

Homes for the future: more affordable, more sustainable, CLG 2007

International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD)

An Introductory Guide to Valuing Ecosystem services, DEFRA 2007

Landscape Institute Green infrastructure Position statement, 2009

Land Use and the Natural Environment, Environment Agency

Living With Environmental Change Programme (LWEC)

Living Spaces – A vision for the future of planning, RSPB

Multi-Agency Geographic Information for the Countryside (MAGIC)

Making land use Sustainable. Forum for the Future

Making space for water

The UK National Ecosystem Assessment, DEFRA (on-going)

The Natural Capital Initiative (NCI)

England's natural environment in 2060, Natural England 2009

New Industry, New Jobs – Building Britain's Future 2009, BIS

The Northern Way initiative

Policy Commission on the Future of Farming and Food 2002

PRELUDE Land use scenarios for Europe, European Environment Agency 2006

Peri-Urban Land Use Relationships (PLUREL), University of Manchester (ongoing)

Quality of Life Capital Approach, Countryside Agency English

Heritage, English Nature, Environment Agency

Realising Britain's Potential: Future Strategic Challenges for Britain, Strategy Unit 2009

RegIS Project, Cranfield University

ReVISIONS – Sustainable City Regions, University of Cambridge 2008

Rural Economy and Land Use Programme (RELU)

The Scottish Rural Land Use Study

Spatial Economics Research Centre (SERC) Programme

SPIRE Project, Defra

The Review of Sub-national economic development and regeneration review, HMT 2006

Sustainable Catchment Management Programme (SCaMP)

Sustainability Research Institute Research Programme, Leeds University

The Taylor Review, Affordable Housing Drive to Create Rural Renaissance, 2008

Total Land Management, RELU 2009

Towards a Strong Urban Renaissance – report from The Urban Task Force 2005

Tracking Change in the character of the English Landscape project

Transforming Places: changing lives, a framework for regeneration, CLG

UK Climate Impact Programme 2009

UK Futures: Society & Economy 2030, DIUS 2009

UK Low Carbon Transition Plan, DECC 2009

UN Millennium Ecosystem Assessment

A Vision for the Natural Environment, Natural England

A Vision to 2060, Natural England (in progress)

What is Land For? The Food, Fuel and Climate Change debate, Michael Winter and Matthew Lobley 2009 for RELU

World class places, The Government's strategy for improving quality of place, CLG

Appendix E: Scenarios

1 Introduction

1.1 About the scenarios

The Project commissioned a contractor to develop, in association with leading experts and stakeholders, three 'Land Use Futures scenarios'. These explore different ways in which the pressures and forces acting on UK land use might play out over the next fifty years. In doing so, they offer insights into different policy choices and challenges that the UK might face in the future.

The scenarios are designed to stimulate thought, not to predict what will happen in the future. In some instances, they highlight difficult policy dilemmas that government and other actors may need to consider in the future. In others, they play-out courses of action that may lead to some positive and some less positive outcomes. Throughout, there is scope for readers to interpret the stories as possible backdrops against which they may have to make decisions or policy recommendations in the future.

Using scenarios can help policy makers explore what might happen if current uncertainties resolve in particular ways and rehearse the possible choices and issues they might face in the different futures. The scenarios are based on discussion, opinions and ideas – they are not quantitative models.

2 Developing the scenarios

2.1 Identifying the drivers of change

The scenarios were developed[632] by considering how drivers of change that are shaping the future of UK land use might interact with each other. The drivers were identified from a number of sources: including drivers workshops, the systems analysis work, existing scenarios[633] and the Project's evidence reviews.

There were two drivers workshops. The first involved 60 individuals with an interest in land use – academics, policy makers, local government staff, land owners and others from the private sector – who identified key trends and drivers affecting land's capacity to deliver economic, social and environmental benefits in the future. The brainstorm identified nine broad themes and their associated uncertainties (for further details see the 2009 workshop report available on the Foresight website). The second drivers workshop was conducted by the project review team and built on the findings from the early stage of the research phase of the project.

The early development of the systems diagrams carried out by the consultancy, shiftN, provided a useful source of information about drivers and, in particular, about how they interact.

The final source of information about drivers was the Project's evidence review process and, in particular, the interim review workshops where authors of the reviews highlighted the drivers shaping the future of their area of interest.

632 The scenarios were prepared by Waverley Management Consultants for Foresight.

633 Including Natural England's Scenarios 2009: The Natural Environment in 2060.

2.2 Identifying the critical uncertainties

Three critical uncertainties for UK land use over the next 50 years emerged from the drivers and uncertainties workshops, focus group discussions and our review of the systems analysis:

- The rate of climate change, and the degree of adaption to environmental change;
- The degree of societal resistance to change, including at the global scale; and
- The concentration of people and economic activity within the UK.

The rate of climate change, and the degree of adaptation to environmental change

Climate change is changing the natural environment, and there are also consequences for the built environment. However, the rate of change, its consequence for ecosystem services and the capacity of the "land system" to adapt to these changes are unclear. Maintaining land as a multi-purpose resource with adaptive capacity may require new infrastructure and governance systems to manage or adapt to change.

The critical uncertainty is whether the extent of adaptation to environmental change will be high or low.

The degree of societal resistance to change

Attitudes about land and landscape are deeply embedded in society; so, too, are attitudes about ownership and the value of land. The institutions and governance arrangements tend to reflect these values and attitudes. It is not clear how attitudes may change over the next 50 years. As UK society evolves, people live longer, living patterns change, and new technologies and new research influence how people interact and think: perceptions of what land and landscapes are for may change dramatically; or society may resist changes to land use and seek to protect historical landscapes and traditional values.

The critical uncertainty is whether societal and institutional resistance to change will be high or low.

The concentration of people and economic activity within the UK

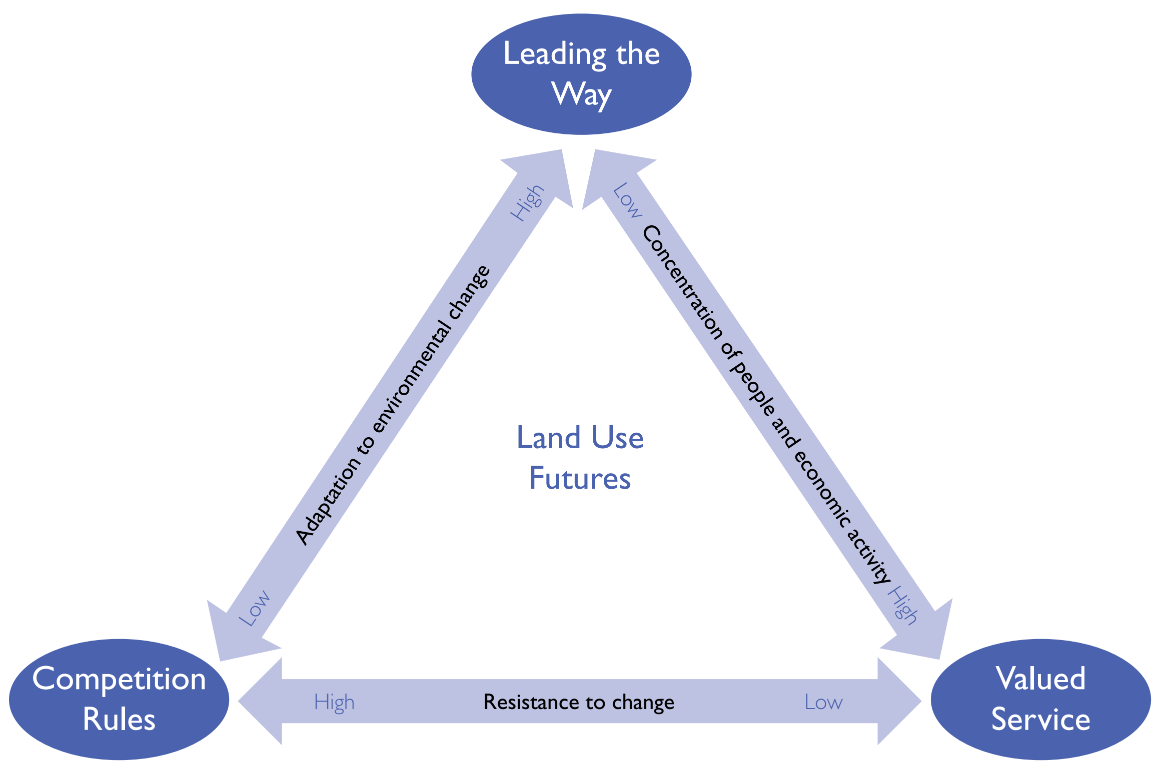
The degree of population growth, and how the population will be distributed throughout the UK, is uncertain. The distribution will be partially linked to the degree to which the economic geography of the country changes: which industries will drive the economy, where they will be located, and extent of regional disparities. Uncertainties will, to a large degree, be driven by global economic and environmental conditions, but also by social shifts within the UK. Depending on the scenario, settlement patterns may agglomerate further or become more dispersed, with consequences for the balance of urban and rural interests.

The critical uncertainty is the degree of demographic and economic change and whether spatial concentration of people and economic activity will be high or low.

3 The scenario framework

The scenario framework combines the three critical dimensions of uncertainty described in Section 2.2 (Figure E.1) and provides the basis for three scenarios:

Figure E.1: The scenario framework



- **Leading the Way** describes a scenario in which the degree of adaptation to environmental change (and the institutional response) is high, and the population and economic activity is dispersed (low concentration).
- **Valued Service** describes a scenario in which resistance to societal and institutional change is low and the concentration of the population and economic activity is high.
- **Competition Rules** describes a scenario in which the degree of adaptation to environmental change is low and societal and institutional resistance to change is high.

In **Leading the Way**, nations collaborate closely to tackle the challenge of climate change and the UK government takes a hands-on approach to driving through the changes required to ensure the UK makes the transition to a low carbon economy. Despite the scale of the challenge and the strength of government intervention, the British public is pleased to see positive action to tackle climate change and to address the needs of future generations as well as present ones. Changes in UK land use reflect the needs of the age: the amount of productive arable land has fallen by around one third, but productivity has doubled; the average farm size in the UK has increased; forest cover has expanded; and renewable energy production is high. The UK's track record of investing in environmental research and technology developments has made it a world leader in biotechnology and environmental engineering. Land based and land related industries now account for a large proportion of UK GDP and the strength of the sector means that more people live in or close to the productive rural centres of the UK. London and the South East of England is under significant water stress. A new 1800 acre reservoir built to the west of the city has improved the short term situation, but continuing population growth means that this may be a short lived solution. Accordingly, the government is considering plans to disperse citizens to three new towns in Dumfries and Galloway, Northumberland and Powys – now engines of innovation and growth at the centre of the UK's land based industries.

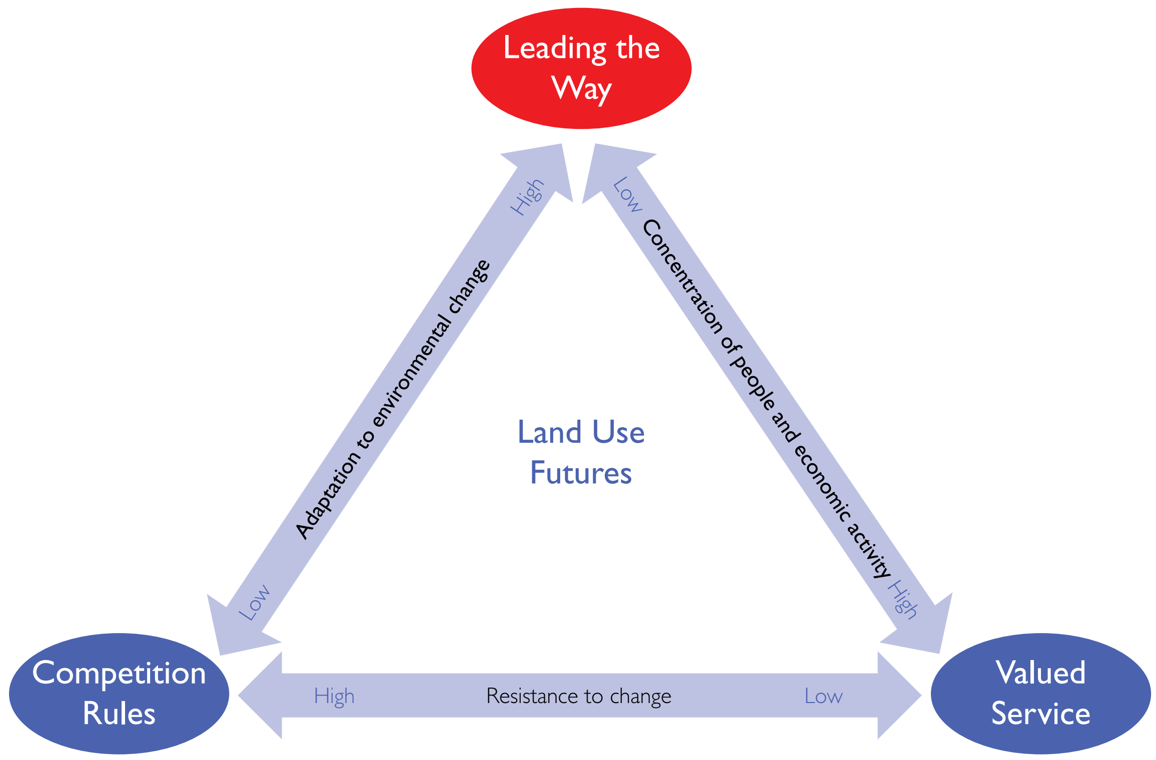
In **Valued Service**, western societies have recognised the imperative to ensure economic growth is achieved within environmental limits. While there is still work to be done to ensure that growth can be sustained across all nations, innovative business models that minimize resource use and still deliver growth are feasible, practical and successful. Consumer attitudes have changed significantly; people now take a longer term view and strive to be more sustainable in their daily lives. These haven't been easy changes to make; however, better and more visible information about the impact of lifestyles on the environment has helped consumers understand the need to be more responsible. The ecosystem services approach has been placed at the heart of land use policy. The planning system has been reformed to facilitate the collaborative decision making that is needed to make the ecosystem services approach work. Planning regions have local autonomy – with guidance set by central Government – to develop their own plan based systems and legally binding plans. Government guidance is focused on remodelling UK landscapes around greenways that connect urban areas with the surrounding countryside, green wedges that provide access to green spaces and shape urban growth, and sustainable urban drainage systems that integrate with wider river basins. The aim is to bring the benefits of the countryside into the cities. The next phase of development is to secure wellbeing for residents in rural areas, in market towns and villages.

In **Competition Rules**, governments around the world have struggled to agree a co-ordinated approach to tackling the challenges of population growth and environmental insecurity. The challenge of securing food and energy supplies remains, particularly in the developing economies. The Common Agricultural Policy has been removed in order to completely stop subsidised production, and opportunities to create more favourable conditions for long term investment in agriculture in Asia and Africa are sought. The UK's agricultural sector has struggled to thrive in the post CAP era and short term economic survival has to take precedence. Insufficient investment in and protection of the natural environment has resulted in a sharp decline in biodiversity. Co-ordination of land use policy in the UK is limited, and London's prosperity is under threat. Having attracted businesses and residents it has failed to improve or guarantee access to critical resources such as water. A growing number of foreign governments are interested in investing in the UK's land base in order to establish large scale agricultural experimental stations to test new crop and production technologies.

4 The scenarios

4.1 Leading the Way

Figure E.2: Leading the Way



Combating climate change takes a serious turn in 2014 when new research demonstrates unequivocally that the even the worst-case climate change scenarios envisaged in 2011 had been too optimistic.

Leaders of the G-20 nations gather in Lucerne for an emergency session to confirm their commitment to a coordinated global and regional response to climate change. Over the first two days, they agree a five point plan to (1) create a global carbon market for emissions trading; (2) develop and deploy technology and energy efficiency solutions; (3) transfer low-carbon technologies to developing countries; (4) tackle deforestation; and (5) develop global and regional adaptation policies.

The big achievement at Lucerne is the agreement to create a global carbon market for emissions trading based on the model that has been operating in the EU since 2005.

The United Kingdom begins work on the five point plan immediately. The first step is to introduce carbon rationing; the second is to draw up a transition strategy to move the UK towards a low carbon society.

The land use element of the transition strategy has four key priorities:

- **agricultural production:** minimising greenhouse gas emissions, and optimising productivity;
- **low carbon energy production:** determining the best approach and sites for nuclear, renewable, biomass and waste energy production;
- **carbon storage:** determining the best sites and systems to use; and

- **settlement planning:** managing population movement, urban planning and coastal zone retreat.

The strategy makes provision for three new bodies to assist with implementation: the Agricultural Production Authority (APA), the Energy and Technology Deployment Authority (ETDA), and the Sustainable Strategic Planning Authority (SSPA).

APA works with the agricultural sector to increase food production, and sanctions the release of over 1 million hectares of arable land for forestry and bio-energy production. It reviews the development of new technology to help inform production of food crops.

By 2025, bio-energy crops planted on released land and former set aside (now supported by the Common Agricultural Policy's Bio-energy Fund) cover 900,000 hectares. This, combined with improvements in yield and crop management, means that a growing proportion of the UK's electricity in 2027 comes from bio-energy and biomass.

The continued expansion of the UK's onshore and (particularly) offshore wind and wave farms are now generating a much larger proportion of the UK's electricity. The Energy and Technology Deployment Authority, however, has some concerns about the environmental impact of on-shore wind farms' and establishes a moratorium on on-shore wind power to allow scientists to explore the issue further.

By 2025, greenhouse gas emissions have peaked, but leaders are not complacent and recognise the need to keep up the effort to ensure that the downward turn continues. The industrialised nations' focus on their own transition plans means that progress on tackling poverty and hunger in developing nations is going more slowly than intended; lack of investment in new industries for clean fuels and sustainable technologies means there has been insufficient uptake of new technologies in these countries. Combined with socio-political conditions, the situation for some is bleak.

Now that emissions have peaked, it is increasingly hard to hold the line and avoid the global coalition tasked with tackling climate change from breaking up. The G-20 leaders set to work to keep the pace up. The launch of the Global Emissions Trading Scheme in 2027 is a positive boost. Some governments are interested in a global personal carbon credits scheme.

Carbon rationing in the UK has led to significant shifts in lifestyle as everyone tries to stay within budget. In the cities, rationing has increased the number of people walking, cycling or using public light rail and low energy bus transportation – which in turn raises demand for better local infrastructure and services.

By 2030, global electrification of transport is finally close to implementation and car manufacturers have doubled production of electric vehicles (EVs).

Elsewhere in the UK, work is continuing on improving productivity of the land on all fronts. The Agricultural Productivity bill introduces legislation requiring farms to increase average yields per hectare – which causes many farms to scale up, and increase investment in technology and improved practice. The average farm size in the UK increases from 57 hectares to 500 hectares; farms in the east and south east of England increase to 5,000 hectares.

By 2035, London is suffering high water stress and the Strategic Spatial Planning Authority begins construction of a 750 hectare reservoir on the site of a former airport. Flying is now a severely reduced activity and after considering whether to build another airport on the Isle of Dogs, the SSPA decides that London will not suffer from the loss of the airport.

The quiet success of the first half of the 21st century is the UK's econeering industry, built on the historic strengths in the biotechnology, agriceutical and regenerative medicine sectors and on its innovative engineering solutions for wind and wave power. By the mid 2040s, econeering is one of the leading sectors in the UK. Biotechnology is core to the success of the global industry, providing solutions to many challenges, such as new diseases, yield and viability in arid or less fertile soils.

2045 is the year that electric cars finally become mainstream. One of the big incentives for consumers is the low carbon cost of driving one (and indeed buying one, since governments offered a zero carbon incentive) meaning that consumers with a renewable energy mix can fuel up for little or no credits. The uptake is strong, despite the significant decline in the culture of the car.

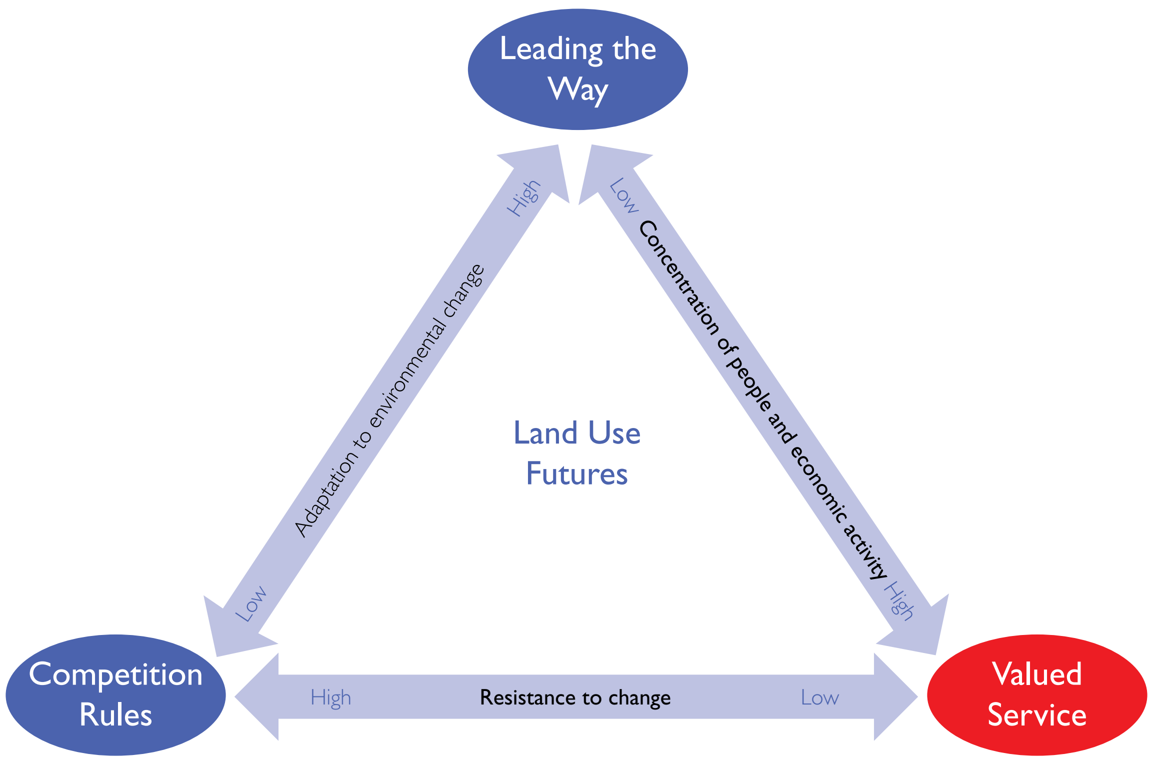
The UK's distribution network and its physical infrastructure have migrated towards the ports and rejuvenated inland waterways. UK ports are global assets owned and managed by global distribution consortia that keep international trade afloat.

Water and wider environmental stress begin to constrain London's ability to grow and makes it a less pleasant place to live than it once was. The government revisits plans to build three new towns in Dumfries and Galloway, Northumberland and Powys – once 'rural' areas, these are now engines of innovation and economic growth that are creating new wealth and delivering new jobs. The planned developments will bring a new scale of development to the green industrial landscape that, it is hoped, will accelerate green growth even further.

Anyone comparing Google Earth images from 2060 and 2010 could be forgiven for thinking initially that land use in the UK hasn't changed much. Zoom in a little, however, and the changes start to become more visible. The landscape is mottled with wind turbines; the patches in the patchwork are bigger; there are more forests and fewer animals; the buildings in cities cast longer shadows in the evening sun; there are fewer vehicles moving along the roads; there is greater physical development around the ports and waterways; and more housing in the brownfield spaces where distribution warehouses used to be.

4.2 Valued Service

Figure E.3: Valued Service



It is clear by 2015 that the long period of stability that has characterised food production and pricing is coming to an end. Erratic energy and commodity prices, combined with prolonged worldwide recession, are leading to countries drawing up plans for much greater levels of local and regional food production.

The UK Government proposes an increased use of agricultural technology and genetically modified crops to support future UK food production. The British public is initially reluctant and high profile campaigns result in plans being delayed.

The campaign is symptomatic of a wider failure in the research community to raise awareness of the benefits as well as the risks of new technologies and ideas, but also of citizens to take responsibility for the long-term impact of their lifestyles, attitudes and choices. These phenomena are not restricted to the UK, but are prevalent throughout developed nations.

By 2020, the focus on economic recovery in the developed nations and rasing living standards in developing countries, means that interim emissions targets are missed. The world's governments are forced to react to energy and climate change issues and as a result, emissions continue to rise.

Some nations have pulled back from their emissions reduction programme and expand oil production. Maple Oil increases oil sands mining in Alberta. Arc-oil finalises plans to drill below the Arctic ice cap. For other nations and their citizens – including the UK – these decisions to put emissions reduction programmes on the back burner are a major concern.

By the start of the 2030s the global population has grown significantly and climate change impacts are being experienced. Over half the world's population is regularly experiencing food and water shortages and one in five people's lives and livelihoods are affected. By 2035, millions in arid and semi-arid tropics in the Asian and African megadeltas and across Latin America are affected by famine and disease.

This is partly due to a failure to anticipate and plan to secure resources, but also because institutions and infrastructure are unable to cope with the scale of the challenge, and to respond with sufficient speed. Global aid and environmental organisations begin a concerted campaign to make consumers aware of a direct link between rising consumption, climate change and the failure of the world's marginal ecosystems. As more information emerges about the virtual water costs of food production and the environmental costs of bio-fuels, consumers begin to realise the scale of unintended consequences. This is a wakeup call to redouble efforts to tackle environmental degradation and manage growth within environmental limits.

The UK Government's initial response is to define land as a national resource from which environmental and societal benefits must be managed through an ecosystem services approach. One key element of the approach is the recognition that, as human populations continue to grow and impose increased demands on ecosystems, the services they provide cannot be regarded as free, invulnerable or infinitely available. Another key element is that ecosystems are a public good, and responsibility of society as a whole.

The UK opens discussions within the EU to see how land management based around ecosystem services might work. The UK proposes to trial its approach in collaboration with the EU, using its CAP subsidies to fund its ecosystems services policy. The agreement to proceed is ratified in 2037.

Institutional and governance systems in the late 2040s are unsuitable for facilitating the collaborative decision making between different stakeholders and between different spatial scales, that the government needs if the ecosystems services approach is to work. Drawing on experience in the devolved administrations, Westminster establishes five planning regions in England – the North, the Midlands, the East, the South and London – and gives each local autonomy to develop their own plan based systems.

The Land Rights (Private and Public) Bill, enacted in 2042, distinguishes between the private rights of land owners to profit from their land and society's rights to public benefits from the services produced by it. The Act establishes that land owners have a responsibility locally, globally and temporally to maintain the services provided by the land and landscape and that any change of use is only allowable if it maintains the benefits across all three levels. The Act also introduces ecosystem service rates, a location based annual levy on residents which is used to part-finance good practice and maintenance of land by landowners.

In a parallel move, the Government introduces its Green Grid White Paper, setting out plans to create a grid of visually, ecologically and hydrologically connected spaces and corridors across the country which will conserve areas of strongest landscape character and biodiversity and create new spaces where land management can be strengthened.

The Green Grid is designed to blur the distinctions between town and country to deliver the multiple benefits of land in both urban and rural areas. At the Grid's heart are plans to reshape the landscape around greenways that connect urban areas with the surrounding countryside.

Tweve suburban areas – four in London, three in Birmingham, two in Manchester, two in Glasgow and one in Cambridge – are designated as Ecosystem City Exemplars (ECEs) and are developed as phase 1 of the project – a substantial housing development jointly managed by City Exemplar Development Companies and Community Land Trusts set up to own and manage land and other assets in perpetuity for the benefit of the community.

By 2047, the housing programme increases the stock of housing by 10%. The Development Companies increase the amount of land used for residential development by re-zoning (and, where necessary, compulsorily purchasing) significant areas of industrial land around the new green corridors.

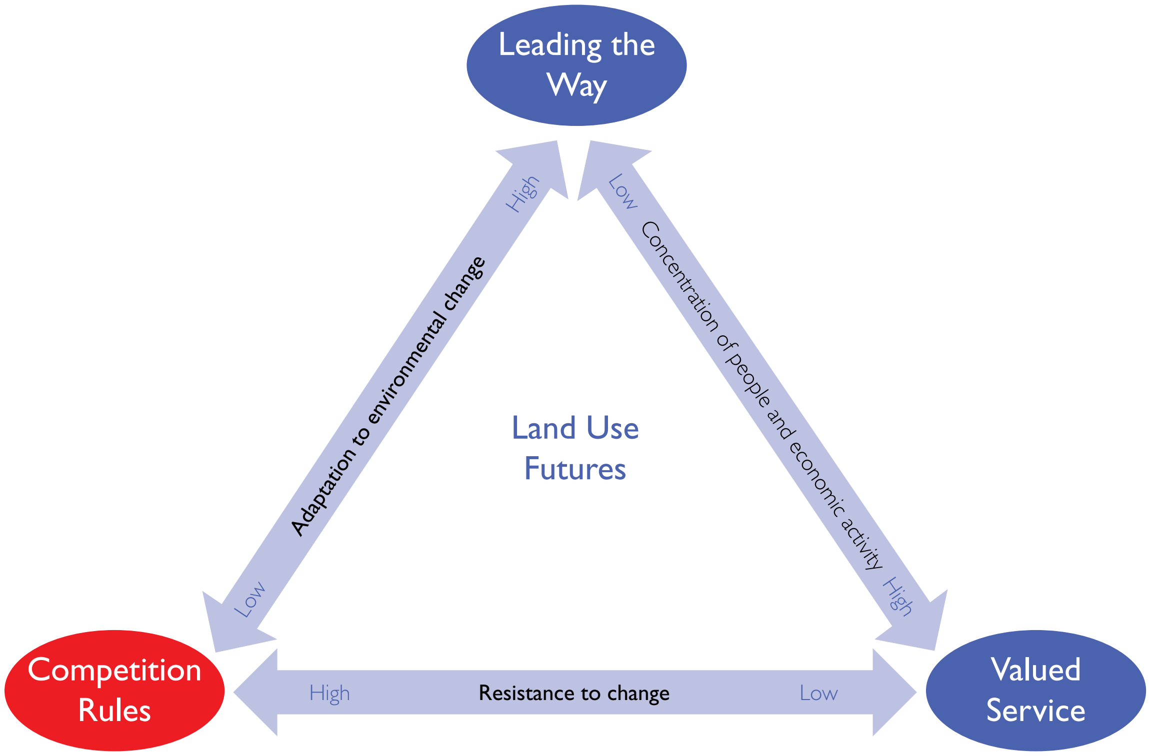
Newbuilds are designed and constructed to maximise the services from the land around them. One consequence of this smart design is that, within the housing market, a significant price differential opens up between new and old properties (which have a very high carbon footprint and are costly to retrofit).

Home ownership falls as UK society continues its transition towards stewardship. People are more interested in leasing or sharing goods and less interested in consumption that threatens sustainability of supply. The UK makes a significant cultural shift away from meeting present desires and towards protecting the needs of future generations.

Across the UK, the greening process brings the benefits of the countryside into the cities. The shape and colour of the cities is changing. London in 2060 has developed some commons as well as its industrial sites; other areas have been opened up to provide access to rural land. Development is spreading out; greenbelts have been replaced with green wedges and the number of houses in the peri-urban fringe has increased significantly. The centres of cities are changing as green corridors move in and and densities approach Parisien levels. People move easily between cities and countryside and old fashioned notions that urban and rural areas are separate are disappearing.

4.3 Competition Rules

Figure E.4: Competition Rules



As the Common Agriculture Policy (CAP) reaches its 50th birthday, its future direction is widely debated. The prevailing view of political and economic commentators outside the EU is that market forces should be allowed to operate freely and that the link between subsidy and production in Europe should be broken entirely.

Globally, a combination of extreme weather, high energy prices and speculation in the food markets leads to a shortage of crops in 2018. A subsequent spike in food commodity prices leads many more people into poverty. Large numbers of the world's small-scale farmers – particularly in central Asia and Africa – continue to be constrained by lack of access to markets, lack of investment in irrigation systems and infrastructure and by costly fertilizers and seed.

In 2019, the World Environment Security Council (WESC) meets in Dubai to discuss how to reform the global food market infrastructure in order to boost production and maximize stability of supply. The Council immediately introduces price regulation to buffer the tight markets of food commodities and sets up a global micro-finance fund to boost small-scale farmer productivity in high-risk economies.

Progress on delivering these reforms is slower than expected. The Dubai Treaty makes an immediate and positive impact on short term food prices and on small scale agricultural production, but talks on the detail of institutional reform are frustratingly slow. In particular, attempts to reach agreement on the conclusion of CAP and the transition to a sustainable food production system are protracted.

India hosts a Summit in 2022 for leaders of China, Japan, the United Arab Emirates and the developing nations to explore how they might all work together to improve agricultural productivity if the reforms fail to happen. The main topic of discussion is how to restart the Farmland Partnership Programme, a large scale purchase, leasing or concession of farmland between different countries.

Europe and North America are concerned by the implications of the summit for world trade and agree to push through the final reforms. The CAP is removed in 2023.

The shift from a subsidy dependent industry to a market responsive one is both culturally and economically difficult for UK farmers. Many experience significant capital losses and reduced incomes in the early years following CAP removal.

The agricultural sector's response is to seek economies of scale. Five years after the CAP is removed, the average farm size increases from 60 hectares to 85 hectares, with the largest farms in the east and south east of England averaging 560 hectares. Nevertheless, farms struggle to control costs and increase profitability. Inputs such as fertilisers, labour and machinery fall, sheep and beef production declines and diversification into fruit and vegetables increases. Many farms in the more remote parts of the UK fail.

Renewable energy production has increased, mainly on the sea bed and the wind platforms around Scotland's coast. Land from failed farms in the uplands in Scotland, Wales and the South West is bought up by wind farm development consortia.

The agriculture sector gradually becomes more market oriented, but the struggle for survival means there is little focus managing the land sustainably. The decline in owner occupation and the increase in corporate farms signals a cultural move towards land as a capital asset to be exploited. The failure to recognise the value of ecosystem services means that public aspirations to steward the land for future generations are not translated into action.

As a consequence, the 2031 Index of Global Biodiversity, published by the Global Environment Security Council shows that the UK has fallen down the world rankings. The Council reminds the UK that "…it remains incumbent on all nation states to focus…more on the policies needed to meet national and international obligations [on biodiversity]."

The Biodiversity Index is not the only aspect of Britain's performance that the Security Council is concerned about and it asks the European Commissioner for Environmental Security to meet Ministers to discuss their mitigation plans. The Commissioner suggests that avoiding environmental decline can only be achieved if the UK makes a cultural transition to a coordinated spatial approach to land use planning.

After much debate, the move to a new approach is agreed, but requires substantial reform. The Cross-Governmental Regional Planning Forum is introduced by the governments and devolved administrations of England, Scotland, Wales and Northern Ireland. Its purpose is to share information, approaches and best practice between its members. Its first major task is to drive through reforms to its spatial and land use planning processes. In England, each of the regions is given local autonomy – within strategic guidance set by Westminster – but the market is the chosen mechanism through which land use change is primarily delivered. Within a market based approach, local Authorities designate areas of land for special protection, and the Planning Forum is tasked with monitoring the landscape scale impacts.

However, by the late 2030s, over 90% of the UK population is now living in towns and cities – and these are feeling more crowded. Property prices and the demand for space make it commonplace for three or even four generations to live together. The UK's growing population is partially housed through a programme designed to bring empty buildings back into use.

Resource constraints and continuing environmental risk in southern England make it a less popular location to live. This, combined with attractive relocation packages and new infrastructure in the regions, means that some businesses relocate in the north of England and Scotland. Half of the 1.6 million new homes built in the UK between 2030 and 2047 are located outside of the South East region.

The northern migration is an unintended consequence of the planning reforms – instead of collaborating to slow environmental decline, regions use their powers to compete vigorously for people and businesses. Competition has created a new energy and dynamism.

Coastal areas are under threat from rising sea levels and many seaside towns are now contemplating a complete re-housing programme that will see them create a 200 metre wide rising plaza between the beach and a new 'front'. Recent projections have suggested that anyone still living around the coast in 2100 is likely to be a resident of one long strip. Property speculators in coastal areas have been damaged by a disconnect between the value of land and the price of houses. Over the last few years, developers have built up expensive land banks, secured planning permission and built houses – but are now finding that the properties aren't selling.

The effects of the agricultural reforms of 30 years ago have now stabilised. Farm sizes remain static and although the industry has regained some market share following CAP reform, it is limited. Farming has kept going through a strong culture of cost control and but there has been limited long term investment in technology. Crop yields in the south are falling as temperatures rise. Overseas investors are looking closely at hundred of thousands of hectares of UK land as an investment opportunity. Current rumours suggest an overseas government is interested in establishing several large agricultural experimental stations in the UK to test new crop and production technologies. After generations of fighting for their livelihoods, many of farmers are hoping the rumours are true.

London, however, has continued to pursue and create economic value from knowledge – but its prosperity is now under threat from a national planning regime that has attracted businesses and residents to other parts of the UK, but has failed to improve or guarantee local basic resources. London feels increasingly anxious about relying on its geographical neighbours for its resources and has therefore welcomed the interest of foreign governments in the UK's land base. It is particularly interested in their proposals to invest in the city's water and infrastructure issues as part of any purchase deal on UK land.

Appendix F: Definitions of land use – urban and rural

Understanding patterns of land use requires a sophisticated understanding of the nature and distribution of urban and rural land, and associated land uses. At first sight this might appear a simple matter. Indeed, until 2004 there was a relatively straightforward two-fold classification of urban and rural administrative areas across England[634]. However, recognising the limitations of this distinction, a new set of definitions were established in 2004, and these have been widely adopted in the analysis of urban and rural areas and of land use change[635]. Changes in land classification have also occurred in the devolved administrations; for example, Scotland introduced six and eight-fold urban–rural classifications in 2003.

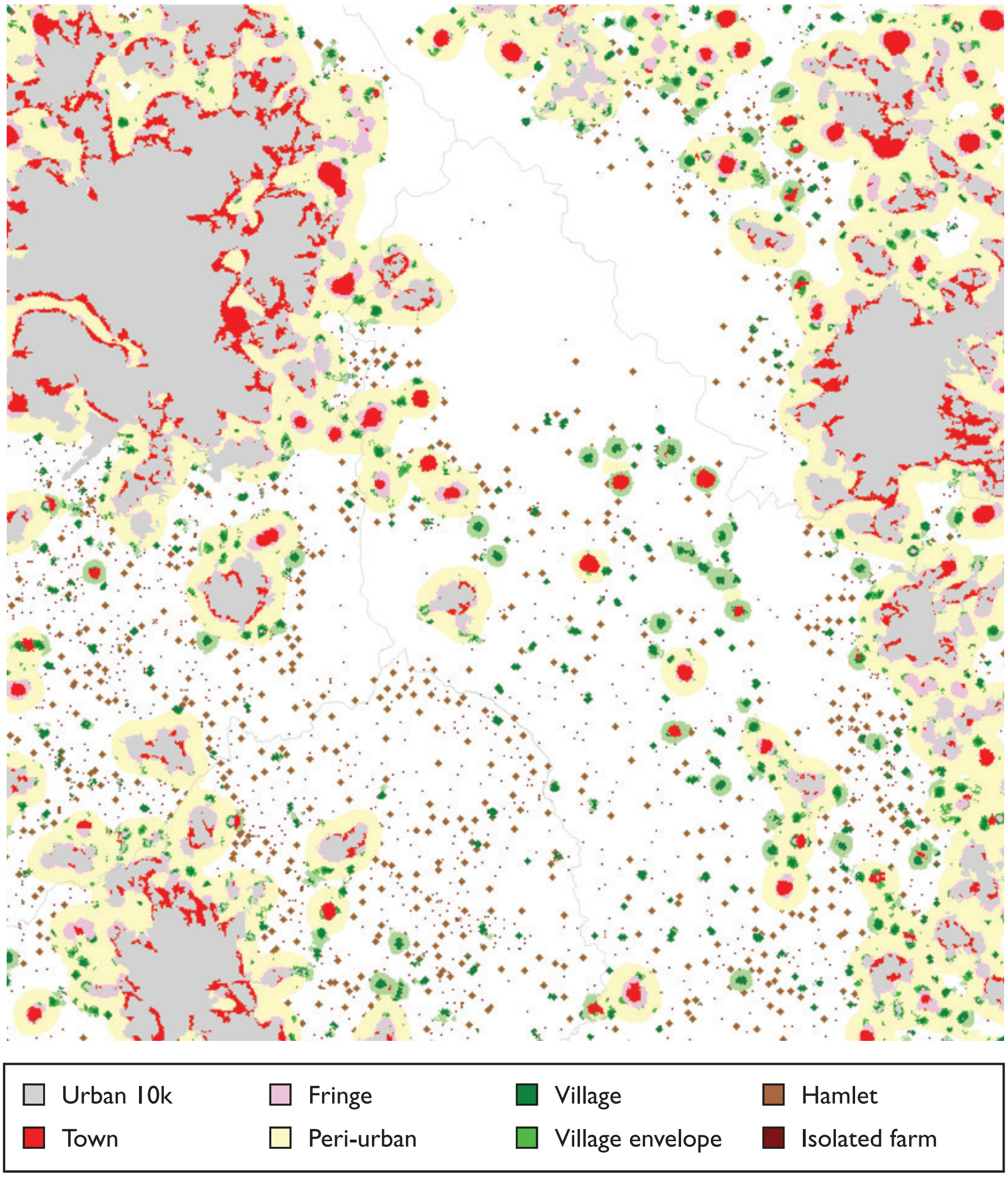
The new classification system in England takes account of several factors that determine the levels of 'rurality' or 'urbanity', namely the morphology, or physical form of settlements, the density of development, and their geographical context. Using Ordnance Survey (OS) and census data, 'areas of urban land' are constructed by combining individual parcels or cells of land whose use is traditionally described as 'urban' that are located within a critical distance of each other: where an area of urban land has an associated population of 10,000 or more it is classified as urban. All other settlements fall into the rural domain. Information on the density of settlements at different distances from the core of individual cells are broadly used to allocate rural settlements to seven types: rural town, urban fringe, village, peri-urban, village envelope, hamlet and scattered dwelling/isolated farms. Figure F.1 shows the distribution of these settlement types in an area around the Peak District.

The geographical context of these settlement types is classified in terms of the density of settlement at a much larger scale, allowing measures of sparsity of settlement and accessibility to be calculated. By using these additional measures, all of the cells in rural areas, outside the main urban areas with populations of over 10,000, are divided into one of six types as shown in Figure F.2. The cell data are then used to classify census output areas (see Figure F.3).

634 Based on the then Department of Transport, Local Government and Regions (DTLR's) adoption of urban area boundaries and their census-based populations, combined with the then Countryside Agency's administrative area classification of urban and rural local authority districts and wards.

635 Bibby and Shepherd (2004)

Figure F.1: Settlement types for the area around the Peak District, with Manchester in the northwest and Sheffield to the east



Source: Peter Bibby and Paul Brindley, University of Sheffield

Figure F.2: Settlement types in England

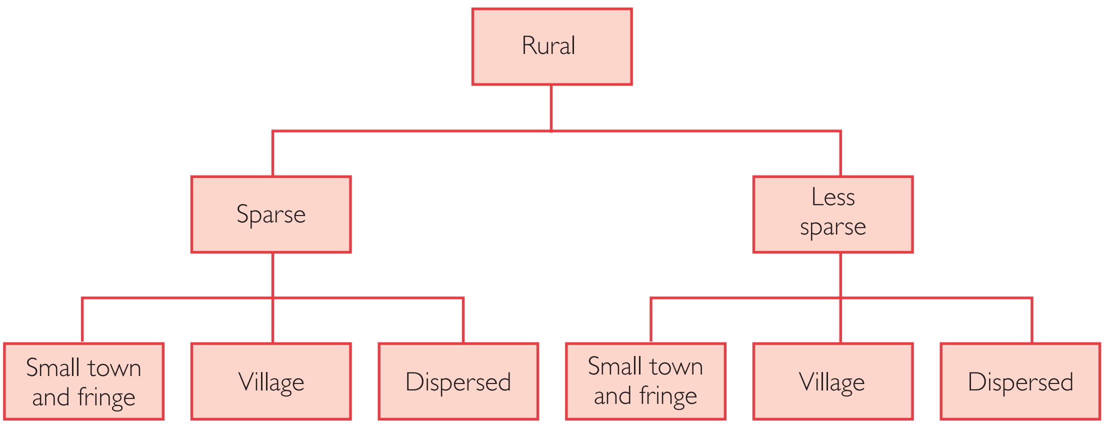
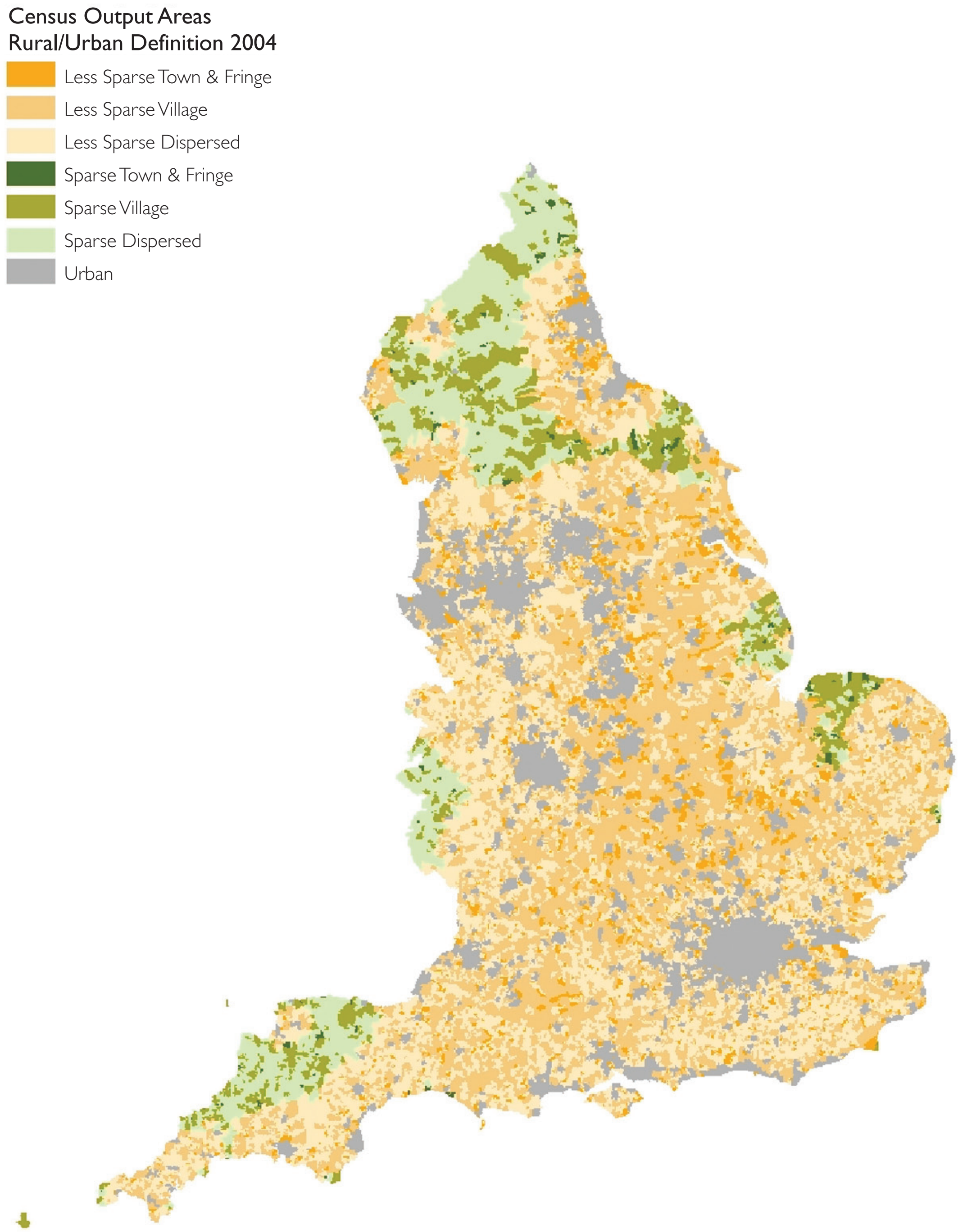


Figure F.3: Urban–rural settlements in England mapped by Census Output Areas

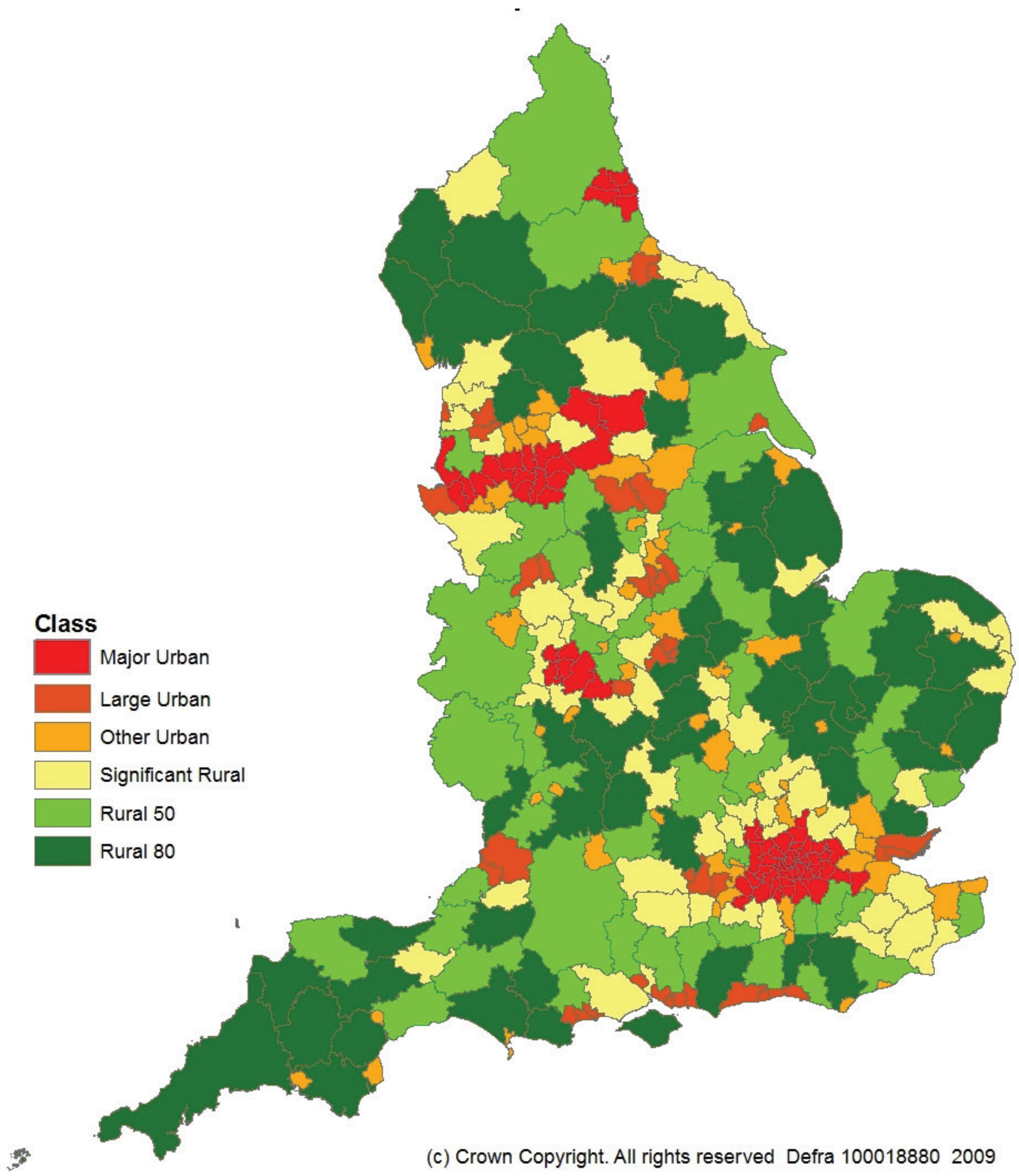


However, reporting and analysing data that are not available at a more disaggregated level requires a higher resolution of local authority district. Defra has developed a classification for this purpose based on the settlement geography described above linked with population data in England. This defines a set of 'major' and 'large' urban areas distinguished by population size; a set of districts that have the majority of their populations living in rural settlements; and a set of mixed urban and mixed rural districts which are differentiated according to whether they have a 'significant' amount of rural population. In analysing the nature of populations both absolute numbers and percentages are used. The categories are:

- **Major Urban**: 76 districts which have either 100,000 people *or* 50% of their population in urban areas with a population of more than 750,000.
- **Large Urban**: 45 districts which have either 50,000 people *or* 50% of their population in one of 17 urban areas with a population between 250,000 and 750,000.
- **Other Urban**: 55 districts which have fewer than 37,000 people *or* less than 26% of their population in rural settlements and larger market towns.
- **Significant Rural**: 53 districts which have either 37,000 people *or* more than 26% of their population in rural settlements and larger market towns.
- **Rural-50**: 52 districts which have at least 50% but less than 80% of their population in rural settlements and larger market towns.
- **Rural-80**: 73 districts which have at least 80% of their population in rural settlements and larger market towns.

This brief description of how land is classified in England makes clear that the historical concept of a straightforward urban–rural divide is now an oversimplification and thinking about land use purely in urban and rural terms is, in general, unhelpful. The picture is much more complex, with different levels of 'urban-ness' and different types of 'rural-ness' often occurring in close association with each other. Indeed, truly remote rural areas are quite rare, certainly in England, where they occur predominantly in the southwest, the north and the east of the country. This complexity must be central to any analysis of the changing nature of the land use, and perceptions about increasing urbanisation.

Figure F.4: Local authority districts classified into urban and rural types



Source: Defra.

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