



**Defra
Natural Resource Protection
Future Trends Study**

**Project Report
30th September 2005**

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Defra Natural Resource Protection Future Trends Study

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NRP Future Trends Study

Project Report 30 09 05

1. Purpose and Objectives

This document presents the outputs of a future trends study conducted for Defra's Natural Resource Protection (NRP) team by Fast Future. The research for the study was conducted between April and June 2005 by Mira Merme, Dr. Wendy Schultz and Rohit Talwar of Fast Future. The details of the project methodology are presented in appendix 1. A range of terms from the fields of horizon scanning and future studies are used in this report – these are explained in Appendix 2.

The study builds on the Defra Baseline Scan Horizon Scanning study. The primary objective of the NRP study was to identify and analyse trends and driving forces that may affect the natural environment from now to 2050. Further data was gathered through desk research and expert interviews (see Appendix 3 for list of interviewees) and reviewed at an NRP stakeholder conference on June 15th 2005 (see Appendix 4 for workshop outputs). This report presents the principle outputs of the study, describes the main analytical approaches used and highlights the key issues and challenges identified.

2. Executive Summary

The study has identified seven critical global trends and drivers that will have significant potential impact on and implications for NRP policy:

- **Complexity** and interdependence of issues affecting natural resource protection and the nations, regional entities and global institutions trying to address them.
- **Climate change and global warming** leading to severe weather events, water scarcity and reductions in crop yields.
- **Growth economies such as China and India** and the resulting increase in wealth and consumption, bringing pressures on resources and critical ecosystems.
- **Increasing life expectancy and urban density** creating pressure on the housing stock and potentially generating increased demand for critical resources such as water and energy.
- **Rising global energy demands** driven by economic growth and complicated by concerns over peak oil and resource scarcity.
- **Demand for and shortages of water** driven by global population growth, water starved regions and concerns over infrastructure quality.
- **Global politics and governance** with increasingly global issues, global agencies, actors and political blocks emerging with potentially differing priorities and capabilities.

These issues are described and analysed in more detail in the remainder of this report and the supporting appendices.

3. Background and Scope

The conservation, enhancement and sustainable management of the natural environment is one of Defra's Strategic Priorities, and the UK Government's Sustainable Development Strategy¹ identified protection of natural resources as one of four priority areas requiring immediate action. The policy areas that fall under this Defra Strategic Priority area are listed below. The study had a UK focus and covered trends that affected these areas:

- Biodiversity (including ecosystems and habitats)
- Water quality and supply
- The soil environment
- Air quality
- The marine environment
- Landscape
- Recreation and access to the natural environment

This study was commissioned as part of Defra's work to develop an NRP evidence base and further improve Defra's understanding of the natural environment. Further information on this work can be found on the Defra website:

<http://www.defra.gov.uk/wildlife-countryside/natres/index.htm>

4. The Defra Baseline Scan

As a start point for this exercise, the NRP programme team wanted to build on the recently completed Baseline Scan project undertaken for Defra's Horizon Scanning programme by Fast Future. This was a broad based scanning exercise drawing out the key trends and drivers from 25 well respected major trends studies conducted in the last few years. The Baseline Scan has identified over 300 relevant trends and drivers encompassing the socio-demographic, technological and scientific, economic, environmental and political (STEEP) domains.

5. Categorisation and Analysis of Trends and Drivers

Following an initial round of primary and secondary desk based scanning and initial interviews, a long list of candidate trends and drivers was produced. This list was reviewed with the NRP clients who then categorised the candidates into:

- Megatrends – Global political, economic, social, technological and environmental trends that are shaping our world and individual behaviours. These will influence the demand for and management of natural resources e.g. *Global population rising to 8.9Bn by 2050*
- Key Trends and Drivers – Trends and developments directly affecting NRP such as *Increased impacts on agriculture from global warming*

¹Securing the Future - UK Government sustainable development strategy, March 7th 2005
<http://www.sustainable-development.gov.uk/publications/uk-strategy/uk-strategy-2005.htm>

- Sub-Trends – trends and developments with potentially lower level direct impacts on the demand for and management of natural resources e.g. *Accelerating development of new organic and inorganic materials.*

From this longer list, the NRP client selected the trends and drivers to be profiled in detail. The sub-trends are listed in Appendix 5 - no further analysis of these was conducted for this study. The detailed profiles of the selected Megatrends are presented in Appendix 6 and the Key Trends and Drivers in Appendix 7. The details of the scanning sources used to identify and profile the trends are listed in Appendix 8.

Alongside the detailed profiling and analysis of individual trends, five other forms of analysis were also completed:

- Key trends were identified by participants in the June 15th NRP stakeholder conference (Appendix 4).
- A mapping of the identified Megatrends and Key Trends and Drivers by STEEP category and earliest impact timeframe (Appendix 9).
- A mapping of the relationships between the key Megatrends (Appendix 10)
- Analysis of possible Impact Pathways (Appendix 11)
- Mapping of Key Trends to NRP Key Themes (Appendix 12)

6. Overview of Analysis Models and Key Outputs

The six analysis approaches are outlined below.

6.1. Detailed Profiling of Megatrends and Key Trends and Drivers (Appendices 6 and 7)

The 'mega trends' and 'key trends and drivers' were profiled and analysed using the framework presented in Appendix 1. These profiles will also be made available online in due course.

A total of 29 mega trends were identified of which 20 have had full profiles developed. 133 Key Trends and Drivers were identified – 73 of which have been fully profiled. 29 Sub trends were identified but not profiled.

6.2. Mapping of Megatrends / Key Trends and Drivers By Impact Timeframe and STEEP Category (Appendix 9)

As part of the evaluation of each trend, an assessment was made of the earliest possible impact within one of the following timeframes:

- Now - 2006
- 2007 – 2010
- 2011 – 2015
- 2016 – 2030
- 2031 – 2050
- 2051+
- Wildcards (any time)

This assessment is based on the views of the sources consulted and of the researchers undertaking the study. Such assessments are clearly open to a high degree of subjectivity and different policy areas will and should rate the trends differently depending on the scale of impact they will have on their particular areas of responsibility.

6.3. Megatrend Relationships (Appendix 10)

The aim of this analysis framework was to explore the relationships between different mega trends and the possible implications for NRP policy. The mega trends were explored under the following seven theme headings:

- Emerging Economies
- Globalisation
- Environmental Politics
- Environmental Governance
- Public Goods
- Economic Incentives
- Global Intervention

The model below highlights inter-relationships between megatrend clusters.

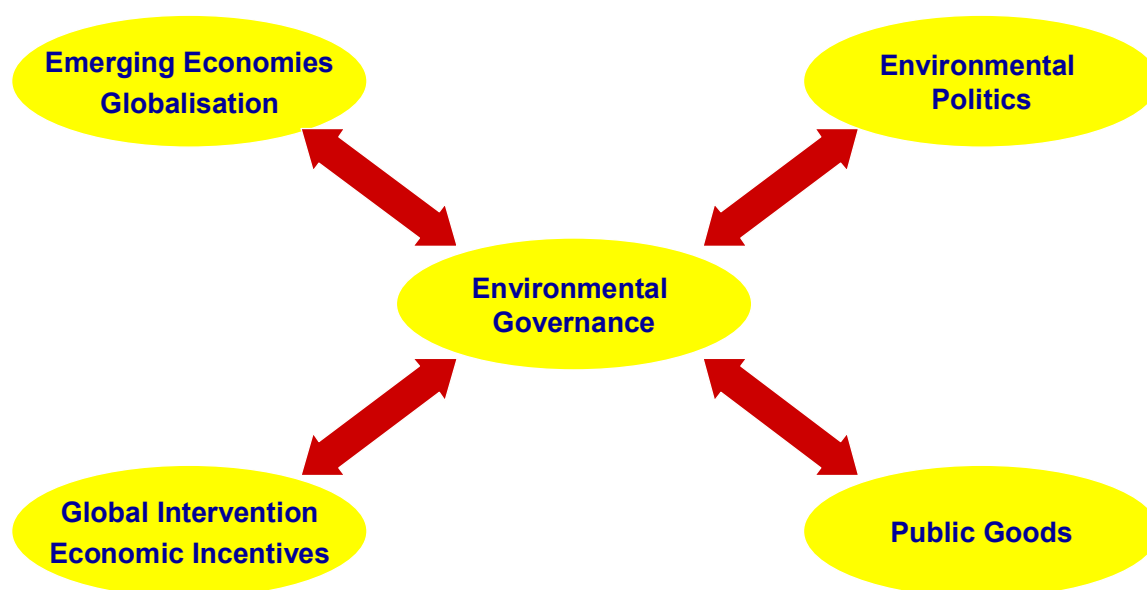


Figure 6.1 Megatrend Relationships

The combination of large populations and high growth rates of economies such as China (8-9%) and India (6-7%) are changing the footprint, intensity of demand, competition for and politicisation of natural resources. These in turn create challenges both in terms of establishing equitable approaches and standards for environmental governance and the globalisation of environmental agreements, targets, mechanisms and instruments. To aid this governance challenge, a growing number of international agencies and actors are emerging to help shape and deliver the global governance agenda. However, in parallel, citizen attitudes towards public

goods are becoming more complex with a growing dichotomy between consumer demands and resource protection goals.

Pressure is also growing globally to develop smart economic incentives that do not create negative ecosystem impacts. Finally there is a growing focus on using science to make appropriate interventions in support of global governance and to embed broader ecosystem assessments in resource protection studies and in the evaluations of new techniques and technologies.

6.4. Analysis of Impact Pathways (Appendix 11)

The aim of this analysis framework was to cluster the trends into themes with common areas of impact and explore the ‘impact pathways’ for each of them in terms of:

- Identifying the key underlying drivers of demand and resource impact
- Outlining the resultant resource impacts / pressures that could arise
- Suggesting the possible policy challenges that could arise
- Highlighting the trends and development that could act as solution enablers or impediments
- Considering local impact on natural resources and human behaviours.

From the trends identified, 15 key cluster themes emerged. The table below summarises the nature of the primary impacts of these themes on NRP:

Table 6.1. Analysis of Impact by Key Cluster Theme

Cluster Theme	Potential Natural Resource Impact			
	Increase Demand	Decrease Demand	Increase Damage	Improve Management
UK Population	X			
Global Population	X			
Climate Change			X	
Growth Economies	X			
The EU	X			X
Marine Population			X	
UK Farming		X	X	X
Public Attitudes, Values and Beliefs	X	X	X	X
Global Resource Governance		X		X
Transport	X		X	
Energy	X		X	
Use of Science		X		X
Water Demand	X		X	
Toxins and Pollutants			X	
Conflict and Disease			X	

6.5. Mapping of Mega Trends and Key Trends to NRP Key Themes (Appendix 12)

An initial analysis was performed of which areas of NRP responsibility could be affected by each of the Megatrends and Key Trends. There is obviously a level of subjectivity in any such mapping. Each of the areas involved may wish to do their own assessment.

6.6. Identification of Key Trends by Stakeholder Conference Participants

The participants at the June 15th stakeholder conference were given the mapping of trends by STEEP category and timeframe described in section 6.1 above (Appendix 9). They then brainstormed which they felt would have the greatest impact and finally voted on their top 3 by timeframe – these are listed in table 6.2. below.

Table 6.2. – Stakeholder Conference Participant Trend Selections by Time Period

Time-scale	Trend	Reason	No. of Votes
Now - 2006	More hard evidence on climate change	<ul style="list-style-type: none"> Scientific concern can drive government thinking and policy. Can climate concern drive concern on other issues – biodiversity, nitrogen etc? 	3
	Society is becoming more 'internal' and disconnected from the natural world	<ul style="list-style-type: none"> "Instant fix" and gratification seems to be demanded. Choice is worshipped (in bite size chunks) 	2
	Growth in China/India	<ul style="list-style-type: none"> Big increase in consumption and prices 	2
	Religious faith in free market	<ul style="list-style-type: none"> There cannot be a problem that cannot be solved by liberalisation (even though the markets are actually distorted) 	2
2007 - 2010	Increased social apathy	<ul style="list-style-type: none"> Lack of clear direction from government Lack of focus on <u>current</u> and future education delivery 	5
	Cap and WTO reforms will affect land ownership and use	<ul style="list-style-type: none"> Impacts on soil and water quality Interaction with Water Framework Directive requirements 	4
	Increasing ignorance of natural systems	<ul style="list-style-type: none"> Urban vs. rural population Countryside = leisure rather than resource Changing community profile within the countryside 	3
2011 - 2015	Global warming	<ul style="list-style-type: none"> Impacts on all areas - i.e. water, air, soil 	16
	Global energy demand rising	<ul style="list-style-type: none"> Unsustainable consumption 	11
	Increasing urbanisation/ density	<ul style="list-style-type: none"> The need for green space/infrastructure 	10

Time-scale	Trend	Reason	No. of Votes
		<ul style="list-style-type: none"> Quality of life Personal well being 	
2016 – 2030	Changing global politics	<ul style="list-style-type: none"> Rise in economic power of developing world and political power and environmental impacts Multinationals/trans nationals vs. government influence 	16
	Population change	<ul style="list-style-type: none"> Pressures needing to be addressed: <ol style="list-style-type: none"> Size Balance between sectors International cf. domestic Demand for resources 	4
	Changing resource economics	<ul style="list-style-type: none"> Energy supplies increase/decrease Prices up/down Government intervention e.g. taxes New technology 	1
2031 +	Water shortages (global)	<ul style="list-style-type: none"> Impact on population movements Conflict between countries 	10
	Increasing creation of green space	<ul style="list-style-type: none"> Response to addressing inactivity and mental health (obesity and diabetics) 	4

7. Key Findings

Through the various analytical approaches adopted and the June 15th workshop, some key issues emerged as having the greatest current and potential impact on NRP. The table below summarises these issues, their resource implications and the resulting policy challenges for government.

Table 7.1. Key Issues, Impact and Policy Challenges

Key Issues	Impacts	Policy Challenges
Complexity	<ul style="list-style-type: none"> Increasingly complex interactions between issues Growing interdependence between nations, regional entities (e.g. EU, ASEAN block) global institutions (e.g. UN), and private sector Many of the issues faced - or the way in which they are presented - are new Little evidence on effective solutions, and timescales for action do not allow for protracted periods of evidence collation 	<ul style="list-style-type: none"> Development of faster decision making processes and greater action orientation in key decision making forums Establishing a greater willingness to identify innovative, low cost solutions appropriate to the finances of the communities at which they are targeted Ensuring effective monitoring and accountability frameworks are in place even when acting at speed
Climate Change / Global Warming	<ul style="list-style-type: none"> Severe weather events Water scarcity Reduction in yields for many crops 	<ul style="list-style-type: none"> Increasing focus required on mitigation and adaptation Raising societal awareness of the implications and choices

Key Issues	Impacts	Policy Challenges
Economic growth and social development of China, India and the emerging economies	<ul style="list-style-type: none"> • Growing consumption and natural resource demand • Competition for scarce resources – e.g. energy, water, food, land • Severe pressure on critical ecosystems – concerns over environmental impact 	<ul style="list-style-type: none"> • Need to facilitate to the global debate about the relationship between growth, resource consumption, environmental limits and sustainability • Developing a resource protection policy that recognises competition with emerging economies
Increasing life expectancy and increasing urban density	<ul style="list-style-type: none"> • Pressure on housing stock • Increased demand for key resources such as water and energy 	<ul style="list-style-type: none"> • Balancing housing demand with environmental goals and need for green spaces • Establishing sustainable consumption and production as key societal goals
Rising global energy demands	<ul style="list-style-type: none"> • Peak oil will eventually be reached • Competition for energy will increase between nations • Energy prices may become more unstable and lead to economic problems – particularly for poorer nations 	<ul style="list-style-type: none"> • Development of clear energy policy that reflects environmental, transport and economic growth objectives • Increasing R&D and investment in alternative energy sources • Raising public awareness on the issues and options
Demand for and shortages of water	<ul style="list-style-type: none"> • Growth in global population to 8-9Bn will drive demand • Increasing number of water starved regions – potential for inter-state conflict • Concerns over quality of water and sewage infrastructure – domestically and globally 	<ul style="list-style-type: none"> • Resource allocation challenges will emerge • Greater R&D investment required in wave power and water desalination • New measures required to monitor comparative water usage across sectors and develop appropriate efficiency incentives
Global Politics and Governance	<ul style="list-style-type: none"> • Growing awareness of global nature of key issues • Emergence of new global agencies and actors • New political blocks emerging 	<ul style="list-style-type: none"> • Need to work closely with such institutions to define goals, set targets, develop programmes, allocate resources and monitor effectiveness • Decision making processes will require radical redesign to deliver solutions faster

8. Conclusions and Next Steps - Recommendations on how to use the trend data

The aim of this study was to provide an initial backdrop against which to assess the emerging NRP vision, policy and strategy and to help highlight areas for future research. The aim was not to draw definitive conclusions on which trends to address.

In this context, we make the following recommendations.

1. Defra's operating environment can increasingly be described a complex 'system of systems'. Multiple actors are involved with differing goals and priorities. To make sense of this environment and improve it's capacity for decision making under uncertainty, Defra may wish to look to the field of complexity science for tools and processes that can be adopted.
2. Many of the issues identified cut across the remit of directorates within Defra, departments across government, NGO and other agencies. Defra will to determine its stakeholder map for NRP and develop strategies for working those groups which sit outside its main spheres of influence.
3. Once Defra has determined where it wants to focus its efforts externally, the data from this trends study could provide the basis for focused bilateral or multi-lateral discussions. Such a process might start with a seminar for a broad audience to introduce the data and invite suggestions for collaborative action.
4. The trend data highlights fundamental shifts in economic and political power, societal expectations and the impact of technology on every aspect of our lives. The data can provide a valuable sense check for current policies, highlight trends and developments which may help Defra advance its goals and put the spotlight on new and emerging risks to be addressed. A systematic review of policy against these trends should help ensure the NRP strategy is sufficiently 'future-proofed'.
5. Building on the success of the June 15th vision workshop, we recommend conducting a full day exercise focusing on the trends with the aim of identifying how best to protect against or take advantage of those trends and drivers in developing the NRP policy and strategy.
6. Ensure that research programmes are not focused solely on providing evidence of the impact of these trends and drivers on natural resources. The scope of research activities should include looking for innovative examples of actions and current experiments to take advantage of positive developments and mitigate against / adapt to negative ones.
7. Develop a common language around the trends by drawing on them in all key policy outputs and demonstrating that the key issues identified in table 7.1. above have been considered in the statements of evidence produced for NRP.
8. Encouraging ongoing debate with other key stakeholders on emerging trends and developments.
9. Revisit the trend data on a periodic basis both to update it with any new data and to assess whether particular issues are becoming more or less significant to NRP and the policy process.
10. The environmental impact of the emerging nations will be a critical issue and a largely 'uncontrollable variable' for some time to come. Hence we would recommend that conducting or tapping into specific studies on resource demand and resource protection initiatives – starting with China and India and then extending this to cover other nations such as Brazil, Mexico, South Africa and

Russia. An initial scan should help determine what is already being done and help focus subsequent research activity around filling the gaps.

11. Delivering a seminar within Defra would help demonstrate how Horizon Scanning is being used to support policy work within Defra and highlight the need for cross-Defra working on a number of the issues.

The study has provided a broad base of data from which the NRP programme can draw in determining research requirements, informing policy and testing strategies and action plans. The data provided represents a snap shot in time and needs to be revisited on a regular basis to ensure it is up to date and to assess how the relative importance of critical issues may be changing.

Appendices

- Appendix 1 Trend analysis approach and framework
- Appendix 2 Glossary of Key Terms
- Appendix 3 List of Interviewees and contributors
- Appendix 4 Key Trends Output from Stakeholder Workshop – June 15th
- Appendix 5 Listing of Sub-Trends
- Appendix 6 Detailed profiles of selected Megatrends
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Appendix 1 - Trend Analysis Approach and Framework

Data Capture Framework

To capture and profile the trends, the project made use of the database that is being developed for the Defra Baseline Scan. The framework on page 16 was developed and agreed for the description of the NRP key trends and drivers.

Data Gathering Approach

At the start of the project, over 100 external stakeholders were invited to review the outputs of the baseline scan and identify additional trends that should be considered. Primary data gathering was undertaken through a combination of face-to-face interviews, telephone interviews and email submissions with a range of expert stakeholders (Appendix 2). Secondary data gathering was conducted in parallel through a combination of relevant published reports, web logs, online databases and trends newsletters.

Trend Analysis

An early draft of the table mapping the trends and drivers by STEEP category and earliest impact timeframe (Appendix 3) was then produced and circulated to the same list of over 100 stakeholders. Additional input was then received both electronically and through further interviews.

A final list of (i) Mega Trends and (ii) Key Trends and Drivers was then produced, from which the NRP client selected the trends and drivers to be profiled in detail. The sub-trends are listed in Appendix 4. No further analysis of these was conducted for this study. Alongside the detailed profiling and analysis of individual trends, three other forms of analysis were also completed:

- A mapping of the relationships between the key Megatrends (Appendix 5)
- Analysis of Impact Pathways (Appendix 6)
- Mapping of Key Trends to NRP Key Themes (Appendix 7)

Part of the project remit was to develop and experiment with alternative models and frameworks for analysing the trend data. As part of this experimentation, two additional approaches were evaluated:

- *Mapping to Ecosystem Services* - The aim was to explore the possibility of mapping the trends against the ecosystem services model produced by the Millennium Ecosystem Assessment programme². After initial analysis and subsequent discussion with the NRP client, it was agreed that the ecosystem services model was a valuable tool but would need to be explored in more detail by NRP and better understood before such an analysis would add value.
- *Analysis against a generic 'NRP management model'* – the aim here was to identify the trends and drivers that would have the greatest impact at different stages of the NRP management process from visioning through to 'on the ground' operational resource protection activities. After initial analysis and discussion, it was agreed that the management model was still at an early stage

² United Nations Millennium Ecosystem Assessment <http://www.millenniumassessment.org/en/index.aspx>

of development and that this form of analysis should be revisited once the model was in place.

Stakeholder Workshop – June 15th 2005

The aim of this workshop was to bring together a diverse range of stakeholder to discuss and agree the key components of an NRP vision. The first exercise in the workshop was focused on identifying key trends and their implications for NRP.

Participants were allocated to one of six tables, each comprising a diverse range of 5-8 stakeholders. The tables were each allocated a time period to consider and asked to identify the five key trends that would have the greatest impact on Natural Resource Protection in that time period and to outline the reasons for selecting those trends. To aid their selection of trends, the participants were issued with the Mapping by Impact Timeframe and STEEP Category of Megatrends / Key Trends and Drivers as presented here in Appendix 3. The time periods considered were:

- Now - 2006
- 2007 – 2010
- 2011 – 2015 (2 tables)
- 2016 – 2030
- 2031+

The key trends outputs from each table were posted for all participants to review individually. The participants were then asked to vote for the three trends across all of the time periods that would have the greatest impact on Natural Resource Protection. These outputs are presented in Appendix 8.

NRP Trends Study – Data Capture Framework

Title e.g. <i>Global population rising to 8.9Bn by 2050. (2031- 2050)</i>	
Earliest Possible Impact e.g. <i>Now-2006, 2007-2010, 2011-2015, 2016-2030, 2031-2050, 2051+, wildcard (any time)</i>	
DESCRIPTIVE DATA:	
Description	Brief description of trend or emerging issue of change, including concise explanation of technical terms; inflection points / key dates where available; and diversity of expert views, where applicable.
Potential Impact(s):	Brief description of strongest general impacts
NRP Impacts:	Examples of specific potential impacts within the NRP policy domain
NRP Category:	Megatrend – Global trends that are shaping our world and individual behaviours. These will influence the demand for and management of natural resources e.g. <i>Global population rising to 8.9Bn by 2050</i> Key Trends and Drivers – Trends and developments directly affecting the NRP policy domain such as <i>Increased impacts on agriculture from global warming</i> Sub-Trends – trends and developments with potentially lower level direct impacts on the demand for and management of natural resources e.g. <i>Accelerating development of new organic and inorganic materials.</i>
Shape of trend & approximate position:	Linear growth, S-curve, step change, etc and estimated current position in that change process, where applicable
NRP Area Impacts	Menu selection from the following list: <ul style="list-style-type: none"> • Air quality • Biodiversity • Flood risk • Landscapes • Marine environment • Soils • Water quality • Water supply and demand
Impact areas:	Keywords: e.g. demography, population growth, food security, water availability, environment, resource demand, waste
‘STEEP’ category:	Indicates from what sector the change originates. The categories and subcategories used in the database are: Social (demographics, values, lifestyles, culture); Technology/Science (basic research, technology, health, other); Economic (production, labour, trade); Environment (biosphere, geosphere, hydrosphere, atmosphere); and Politics (governance, policies, laws & regulations).
Source(s) citing this	Citation of scanning projects / sources which identified this trend or development
Citation date:	Publication date of the first source citing this trend
Original research source and date:	Where the scanning project(s) obtained their data, if known, and the complete bibliographic citation with publication date.
Credibility of cited source(s):	From three broad classes: fringe; popularist; expert

Appendix 2 – Glossary of Key Horizon Scanning Terms

Horizon Scanning	<i>The Centre of Excellence defines Horizon Scanning as:</i> “The systematic examination of potential threats, opportunities and likely future developments including but not restricted to those at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues as well as persistent problems or trends.”
Scan Hit	An annotated description of a significant change; ideally, a significant change that is objectively new even to experts, which confirms or is confirmed by additional scan hits, and that has been identified in time for social dialogue, impact assessment, and policy formation. Items of significant change may be trends, developments, drivers, emerging issues, wild cards, or megatrends (see below).
Trend	A pattern of change over time in some variable of interest. Having trend data for some variable implies multiple instances of that variable. For example, one revolution in Africa is an event; two or three revolutions would call for comparative case studies; fifteen revolutions in Africa countries within five years would be a trend. One of the most obvious, and largest, trends is the increase in world population. A potentially even larger trend, but much less obvious -- or even agreed upon -- would be the gradual warming of the Earth’s atmosphere. Another is the continuing decline in the cost of microchips and the consequent reduction in the price of computers.
Driver	A cluster of related trends which reinforce each other to form a significant ‘metatrend’. A good example is globalisation: a cluster of related trends in production, infrastructure development and integration, labour mobility, capital mobility, global IT developments, etc., all of which reinforce each other’s growth through a complex system of interrelationships allowing feedback and feed forward (almost synonymous with a "megatrend", see below).
Emerging issue / Seed of change / Weak signal	Futurists use a variety of terms to describe a new signal. However, all mean essentially the same thing: the sources of change – the first case; the original idea or invention; the watershed event; the social outliers expressing a new value or mode of behaviour. Such signs of change exist presently in only a few scattered instances, which might increase into enough data points to constitute a trend.
Development	A change demonstrating or confirming the emergence and increased certainty of a previously identified emerging issue of change, e.g., increased Antarctic ice shelf calving as evidence of global warming.
Wild cards	Low probability, high impact changes – like the twin towers bombing on 9/11, or the invention of table-top fusion. These are usually considered as events rather than gradually unfolding changes.
Megatrend	<i>Commonly used to indicate a widespread (i.e. occurring in more than one country) trend of major impact, composed of subtrends that in themselves are capable of major impacts. For example, global climate change will have a major impact, on all the countries of the world, and can be disaggregated into global atmospheric warming, sea-level rise, decrease in stratospheric ozone, etc.</i>

Appendix 3 – Interviewees and Contributors

Mr Walter Blum - Centre for European Nuclear Research
Dr Mark Everard - Environment Agency UK
Dr Clive Hambler - Department of Biology Oxford University
Dr John Hopkins - English Nature
David Marks - Marks Barfield Architectural Practice
Mr Robert Martin - World Business Council for Sustainable Development
Dr Laurence Mee - School of Earth, Ocean and Environmental Science,
University of Plymouth
Mr Colin Palmer - Wind Prospect
Mr Marcus Sangster – Forestry Commission
Mr Malcolm Shepherd - Wessex Grain
Mr Achim Steiner - International Union for Conservation of Nature
Professor Andy Stirling - University of Sussex
Mr Simon Wardell - Global Insight
Mr Matthew Ware - National Farmers Union
Dr Gil Yaron - GYA Associates

Appendix 4

Outputs from NRP Visioning Workshop – June 15th 2005

Table Discussion 1: Identifying key trends and their implications for NRP

Approach

Participants were allocated to one of six tables, each comprising a diverse range of 5-8 stakeholders. The tables were each allocated a time period to consider and asked to identify the five key trends that would have the greatest impact on Natural Resource Protection and to outline the reasons for selecting those trends. To aid their selection of trends, the participants were issued with the Mapping By Impact Timeframe and STEEP Category of Megatrends / Key Trends and Drivers as presented here in Appendix 9.

The key trends outputs from each table were posted for all participants to review individually. The participants were then asked to vote for the three trends across all of the time periods that would have the greatest impact on Natural Resource Protection. These outputs are presented below. Note – 2 separate tables were asked to consider the time period from 2011 – 2015.

Table / Timescale	Trend	Reason	No. of Votes
1 Now - 2006	1. More hard evidence on climate change	<ul style="list-style-type: none"> • Scientific concern can drive government thinking and policy. • Can climate concern drive concern on other issues – biodiversity, nitrogen etc? 	3
	2. Increased transport	<ul style="list-style-type: none"> • Big increase in CO2 emissions 	0
	3. Society is becoming more 'internal' and disconnected from the natural world	<ul style="list-style-type: none"> • "Instant fix" and gratification seems to be demanded. • Choice is worshipped (in bite size chunks) 	2
	4. Faith in technology	<ul style="list-style-type: none"> • Unwillingness to accept a link between consumption and impact 	0
	5. Growth in China/India	<ul style="list-style-type: none"> • Big increase in consumption and prices 	2
	6. Religious faith in free market	<ul style="list-style-type: none"> • There cannot be a problem that cannot be solved by liberalisation (even though the markets are actually distorted) 	2
2 2007 - 2010	1. Increased social apathy	<ul style="list-style-type: none"> • Lack of clear direction from government • Lack of focus on <u>current</u> and future education delivery 	5

Table / Timescale	Trend	Reason	No. of Votes
	2. Increasing ignorance of natural systems	<ul style="list-style-type: none"> • Urban vs. rural population • Countryside = leisure rather than resource • Changing community profile within the countryside 	3
	3. Increasing imbalance between availability and use of water	<ul style="list-style-type: none"> • Existing regional imbalance • Complex relationships between national government, local government and private business 	1
	4. Reduction in current energy sources	<ul style="list-style-type: none"> • Security of supply • Economic development within China and India • Climate change 	2
3 2007 - 2010	1. Population and household growth in southern England	<ul style="list-style-type: none"> • Will increase pressure on the environment in the south • May reduce development pressure in other regions? 	1
	2. Pressure for increased proportion of our energy needs from renewables	<ul style="list-style-type: none"> • Competition for coastal resources • Conflicts over land use changes 	0
	3. More adaptive to implications of climate change in land use planning	<ul style="list-style-type: none"> • Less building on flood plains • Changed building standards 	0
	4. Cap and WTO reforms will affect land ownership and use	<ul style="list-style-type: none"> • Impacts on soil and water quality • Interaction with Water Framework Directive requirements 	4
	5. Greater awareness of environment/health interactions	<ul style="list-style-type: none"> • Increased knowledge about impact of air pollution on health • Increased awareness of importance of diet and food quality 	0
4 2011 - 2015	1. Global warming	<ul style="list-style-type: none"> • Impacts on all areas - i.e. water, air, soil 	16
	2. Water crisis set to worsen	<ul style="list-style-type: none"> • Impact on public 	0
	4. Global energy demand rising	<ul style="list-style-type: none"> • Unsustainable consumption 	11
	5. Natural resource consumption (and exploiting problems)	<ul style="list-style-type: none"> • Exploitation 	3

Table / Timescale	Trend	Reason	No. of Votes
5 2011 – 2015	1. Increasing urbanisation/density	<ul style="list-style-type: none"> • The need for green space/infrastructure <ul style="list-style-type: none"> ○ quality of life ○ personal well being 	10
	2. Climate change	<ul style="list-style-type: none"> • Impact on resource consumption • Good trigger for debate as public awareness is high 	1
	3. Shift in global economy	<ul style="list-style-type: none"> • Increased tourism from China/ India (NRP more important for tourism) • Loss of manufacturing here 	0
	4. Increased importance of water	<ul style="list-style-type: none"> • Water consumption unsustainable 	0
	5. Social values (media impact)	<ul style="list-style-type: none"> • Money vs. health vs. environment • Lifestyle choices 	3
6 2016 – 2030	1. Population change	<ul style="list-style-type: none"> • Pressures needing to be addressed: <ul style="list-style-type: none"> • Size • Balance between sectors • International cf. domestic • Demand for resources 	4
	2. Changing resource economics	<ul style="list-style-type: none"> • Energy supplies increase/decrease • Prices up/down • Government intervention e.g. taxes • New technology 	1
	3. Changes in attitudes	<ul style="list-style-type: none"> • Predictions become reality (e.g. oil supplies swindle) • Spiritual vs. Material attitudes • Better evidence/awareness/technologies 	0
	4. Changing environmental quality	<ul style="list-style-type: none"> • Degradation/improvement of habitat • New/ unforeseen impacts • Policy impacts 	0
	5. Changing global politics	<ul style="list-style-type: none"> • Rise in economic power of developing world and political power and environmental impacts 	16

Table / Timescale	Trend	Reason	No. of Votes
		<ul style="list-style-type: none"> • Multinationals/trans nationals vs. government influence 	
7 2031 +	1. Increasing creation of green space	<ul style="list-style-type: none"> • Response to addressing inactivity and mental health (obesity and diabetics) 	4
	2. Stabilised or decreased consumption in UK e.g. recycling	<ul style="list-style-type: none"> • Increased public awareness of Natural Resource issues • (May affect certain aspects of environment positively?) 	0
	3. Global population rising to 8.9 bn by 2050	<ul style="list-style-type: none"> • Resource impact on UK • Economic impact on UK • Global markets/supply of food/water 	0
	4. Water shortages (global)	<ul style="list-style-type: none"> • Impact on population movements • Conflict between countries 	10
	5. Outbreak of virulent diseases	<ul style="list-style-type: none"> • Scale of impact due to ease of travel (even now – impact of Aids on entire economics of countries) 	0

Appendix 5 – Sub-Trends

No.	Title	Earliest Impact
151	Increase in consumer desire to buy environment-friendly products	now to 2006
155	Increased demand for organically farmed produce	now to 2006
158	Increasing focus on agricultural issues after new EU members gain accession	now to 2006
161	Increasing incidence of asthma	now to 2006
162	Increasing amount of computer hardware in the wastestream (now to 2006).	now to 2006
166	Growing counter-urbanisation	now to 2006
193	Evolution of micro-scale and nano-scale technology -- "nanotechnology" -- will fuel economic growth	2011 - 2015
195	Increasingly better educated consumers in foreign markets, especially in developing countries	2011 - 2015
223	Accelerating development of new organic and inorganic materials	2011 - 2015
245	Decreasing biodiversity	now to 2006
297	20% of world's freshwater fish species have become extinct, threatened, or endangered	now to 2006
299	By 2025, over 75% of the world's population will live within 200 kilometers of a coast	2016 - 2030
340	Bacteria may be 'built' by scientists for specific purposes, such as energy generation and cleaning up pollution	now to 2006
467	Power will shift from states to non-governmental actors including inter-governmental and non-governmental organisations, transnational corporations, and terrorists	now to 2006
531	Accelerating wind and solar power industries, the fastest-growing energy sources in the world	2016 - 2030
559	Sovereignty and environmental security may increasingly be in conflict.	2007 - 2010
562	Rapid growth of global standards and mechanisms to judge them (e.g., the International Organization for Standardization)	2007 - 2010
4035	Growing recognition of the value of countryside and coastal recreation for both physical and mental health, leading to more diverse 'users', with respective diverse requirements	2011 - 2015
4037	Step-change in scientific ability to model key systems, for example UK	2011 - 2015

Appendix 5 – Sub-Trends

No.	Title	Earliest Impact
	land use, nitrogen and phosphorus pathways, etc	
5025	'Smart dust' comes out of the lab	2007 - 2010
9161	Increased soil erosion in the UK due to wetter winters and increased rainfall events	now to 2006
9203	World fishery production growing by 2%; it has septupled since 1950.	now to 2006
9204	Continued growth in aquaculture: 50% of fish harvest by 2020.	2016 - 2030
9206	Nuclear generating capacity growing slowly at only 2% per year.	2011 - 2015
9207	China and India plan to add 34,000 megawatts of nuclear generating capacity by 2020.	2016 - 2030
9231	Growing community ownership of forests.	2031 - 2050
9232	Forests managed under stewardship certification increasing worldwide.	now to 2006
9233	Increase in premature deaths due to air pollution through 2020.	2007 - 2010
9234	Rapid growth in socially responsible investing.	2007 - 2010

Appendix 6 - NRP Future Trends Study Fully Annotated Megatrends

REF No.	Title of Trends Annotated	Timing
1	Global population rising to 8.9Bn by 2050. (2031- 2050)	2031 - 2050
23	Expanding EU (2007-2010).	2007 - 2010
24	Increasing numbers of global institutions (2011-2015).	2011 - 2015
118	Rising global energy demand (2016-2030).	2016 - 2030
128	Increasing potential for global environmental management (2007-2010).	2007 - 2010
141	Rising Chinese economic strength (now to 2006).	now to 2006
169	New patterns of consumption in non-Western countries (now to 2006).	now to 2006
177	Uncertain impact of accession of Eastern European states on EU Common Agricultural Policy (CAP) (now to 2006).	now to 2006
194	Increased global economic growth (2016-2030).	2016 - 2030
445	Little progress in developing independent supranational enforcement mechanisms to enforce international law (now-2010).	2011 - 2015
584	Energy prices become more unstable to 2015.	2011 - 2015
1000	Combined BRIC economies of China, India, Russia and Brazil exceed G6 economies by 2039. (2031 - 2050)	2031 - 2050
4036	Increasing dichotomy between environmental concerns and consumer aspirations.	2011 - 2015
4043	Food demand will increase with rising world population, and increased consumption of livestock products (2011 - 2015)	2011 - 2015
9103	Increasing recognition that economic value of managing ecosystems sustainably can be higher than conversion value (2011 to 2015).	2011 - 2015
9109	Increasing pressure for elimination of subsidies which have negative ecosystem impacts (2007 - 2010).	2007 - 2010
9110	Increase in trading schemes using economic instruments to change market behaviour towards the environment (2007 - 2010).	2007 - 2010
9120	Oil price forecast by Goldman Sachs to rise to \$105 per barrel within a few years (2007 - 2010)	2007 - 2010
9121	Increase in global food demand (2016 - 2030)	2016 - 2030
9141	Increasing conflict between EU environmental protection goals and USA, China and other trading partners using WTO regulations to attempt to overturn EU legislation (2007 to 2010)	2007 - 2010
9149	Improvement in global governance expectations and standards (2016 to 2030)	2016 - 2030

Global population rising to 8.9Bn by 2050. (2031- 2050)

Description: Earth's population reached 6 billion in 2000 and according to the UN's medium variant projection, is projected to reach approximately 7.9 billion by 2025 and to be near stable at around 8.9 billion in 2050. Declining fertility rates have significantly reduced annual growth rates, which peaked at 2.04% in 1965-79 and declined to 1.35% between 1995 and 2000.

The population of England will grow from 49 to 52.7 million by 2021; it will peak in 2023 at about 61 million before then declining (National Statistics).

Potential Impact(s): - Population pressures could force migrations to less populated areas;

- In-migration to the UK could in turn pressure small towns and create environmental quality issues;
- Possible internal migration from cities back to the countryside;
- Environmental causes of conflicts are expected to become more significant as environmental deterioration increases the number of “environmental refugees,” which could in turn increase the number and scale of conflicts related to migration;
- Loss of land available for food production, increased food insecurity and increased water utilisation.

NRP Impacts: - Potential severe negative impacts on NRP;

- Degradation of local environments;
- Stress on water systems and aquifers;
- Increased non-point-source and point-source pollution;
- Potentially decreased biodiversity.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: demography, population growth, food security, water availability, environment, resource demand, waste

STEEP category: Social: demographics

Source(s) citing this:

Britain in 2020 (Forethought, Labour Party)

BT Exact Technology Timeline

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Future Health Care Trends (Strategy Unit, DOH)

Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts (CIA)
Millennium Institute: Publications
Strategic Futures Thinking (Strategic Foresight / DERA)
The Catalog of Tomorrow (TechTV, Que Publications)
The Future and How to Think About it (PIU / Strategy Unit)
Tomorrow's Markets: Global trends and their implications for business (WBCSD)
Vital Signs 2004 (Worldwatch Institute)

Citation date: 2002

Original research source and date: UN, quoted in McRae, The World in 2020 (1996); none specifically cited in the BT Exact Technology Timeline (2002). UN Population Division Report May 2002. Global Trends 2015, p. 8.

Most recent figures from Tomorrow's Markets, quoting UN Population Division (UNPD), World Population Prospects: The 2000 Revision. 2000, New York: UNPD.

UK figures from Govt Actuaries Dept in DOH Future Health Care Trends and Britain in 2020.

Credibility of sources: Expert

Expanding EU (2007-2010).

Description: The EU enlarged to 25 countries in 2004 and is planned to rise to 27 members in 2007. This could grow to 35 to 40 members by 2030 - potentially strengthening policy coordination and creating a single market as well as a genuine European foreign, security, and defence policy, but decision-making may slow in a welter of diverse interests.

Potential Impact(s): - Increasing complexity coordinating UK policies with EU legal strictures, economic policies, and foreign and security agreements as well as health/environment issues;

- Increased trans-border labour flows;

- Increasing potential for protests, civic actions, and conflict related to EU - UK tensions;

- Potential for entry of criminal groups from enlargement countries.

NRP Impacts: - Enlargement could considerably increase the magnitude of the environmental problems facing the European Union;

- New Member States will have to shoulder huge costs in complying with EU environmental policy requirements (estimates of about €200 billion);

- Major and very urgent clean-up operations – from industrial and military soil and water pollution, to unsafe nuclear reactors and radioactive wastes – will add their burden upon the European economy over the next few years;

- Greater influence of EU on UK government policy;

- Less autonomy;

- EU progressive environmental agenda might be helpful to UK

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality

Impact areas: EU expansion; single market law; security and defence policy; crime;

STEEP category: Politics: governance

Source(s) citing this:

Future Health Care Trends (Strategy Unit, DOH)

Strategic Trends (MOD)

The Future and How to Think About it (PIU / Strategy Unit)

Citation date: 2003

Original research source and date: None listed in "The Future and How..." or 'Strategic Trends' or DOH FHCT.

Credibility of sources: Expert

Increasing numbers of global institutions (2011-2015).

Description: Development and expansion of global institutions such as the World Trade Organization and the International Monetary Fund, with the potential for a global environmental body arising out of various international environmental agreements.

The World Trade Organisation could expand to cover international investment and competition policy; nations may use WTO machinery to set international standards; IMF may be given a greater role in supervising financial services.

Potential Impact(s): - National government increasingly bypassed as local communities with international interests interact directly with global players;
- Increasing numbers of rural links directly to international environmental or sustainable development institutions;
- Possible emergence of a global environmental regulatory regime in the long term.

NRP Impacts: Increasingly co-ordinated global institutions offer greater potential for:
- Monitoring meteorological data and early warning of extreme weather events;
- co-ordinated action to reduce emission of ozone depleting substances;
- Conserving high-seas fisheries;
- Developing vaccines or medicines against major infectious diseases,
- Surveillance of infectious disease outbreaks; and
- Controlling greenhouse gas emissions to reduce global warming, carrying out the intent of the 1997 Kyoto Protocol on Climate Change.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: NGOs; GROs; WTO; IMF; global governance

STEEP category: Politics: governance

Source(s) citing this:

Britain in 2020 (Forethought, Labour Party)

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts (CIA)

Scenarios Europe 2010: Five Possible Futures for Europe (EU/FSU)

Strategic Futures Thinking (Strategic Foresight / DERA)

The Future and How to Think About it (PIU / Strategy Unit)

Citation date: 2000

Original research source and date: None listed in "The Future and How...". or GT 2015

Credibility of sources: Expert

Rising global energy demand (2016-2030).

Description: The World Energy Council forecasts worldwide energy consumption to be 50% greater than 1993 by 2030. Across three economic growth and technological improvement scenarios (IEA 2000), projected energy consumption will increase between 1.5-2.3 times between 2000 and 2050. The projected energy consumption varies by region, with particularly high rates of growth in the large emerging economies such as China and India. This level of growth may require \$16 trillion in new investment by 2030.

Potential Impact(s): - Global competition for energy resources, resulting in higher costs;

- Increasing technological innovation of fossil fuel extraction and efficiency of use;
- Increased cost-based incentive to switch to renewables;
- Increased production of greenhouse gases and pollution;
- More nuclear power plants built.

NRP Impacts: - Continued increase in air pollution;

- Continued exacerbation of global warming;
- Threat of environmentally catastrophic accidents due to oil spills and nuclear contamination remains.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Soils
- Water quality
- Water supply and demand

Impact areas: energy; energy consumption; power demand; fossil fuels; renewables; nuclear power

STEEP category: Economic: production

Source(s) citing this:

2003 State of the Future (The Millennium Project)

Britain in 2020 (Forethought, Labour Party)

BT Exact Technology Timeline

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts (CIA)

Scenarios Europe 2010: Five Possible Futures for Europe (EU/FSU)

Strategic Trends (MOD)

Tomorrow's Markets: Global trends and their implications for business (WBCSD)

Vital Signs 2004 (Worldwatch Institute)

Citation date: 2001

Original research source and date: MOD directed study by Prof Laughton Queen

Mary College, Oxford

World Energy Council

In Tomorrow's Markets, Nakecenovic, N., Grubler, A. and A. McDonald. Global Energy Perspectives. Cambridge: Cambridge University Press, 1998.

http://www.iiasa.ac.at/cgi-bin/ecs/book_dyn/bookcnt.py

2004 State of the Future, p. 4.

Credibility of sources: Expert

Increasing potential for global environmental management (2007-2010).

Description: The potential for global environmental management is being facilitated by a number of developments: a near complete list categorising between 1.5-1.8 million known species could be available on the web by 2010; growth of scientific environmentalism; effective management of the organic environment; more effective prediction of natural disasters; development of carbon dioxide fixation technologies for environment protection; artificial precipitation induction and control; and emergence of global environmental management corporations.

Potential Impact(s): - Increased, and increasingly effective, international collaboration on environmental issues;

- More effective counter-pollution strategies;
- Earlier warning of large systemic changes;
- Potential for region-scale environmental disasters after mistakes in precipitation induction and other prospective technologies for environmental systems control.

NRP Impacts: - More focus on, and potential for protection of, natural resources;
- Ability to pressure governments with poor environmental management track records;
- Potential also for environmental mismanagement on a global scale, with distant decision-makers evading accountability for locally disastrous errors.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: environmental management; known species; scientific environmentalism; carbon dioxide fixation; artificial precipitation; global environmental management

STEEP category: Environment: biosphere

Source(s) citing this:

BT Exact Technology Timeline

Citation date: 2002

Original research source and date: None specifically cited.

Credibility of sources: Expert

New patterns of consumption in non-Western countries (now to 2006).

Description: Increasing aspirations and demand for Western lifestyle are changing global demand for food resources, as well as producing related problems (e.g., obesity or environmental impacts of packaging).

Potential Impact(s): - Increasing environmental stress, particularly upon globally shared resources (e.g., fish stocks);
- Landfill and waste disposal problems go global;
- Potential increase in conservation values as a backlash emerges in the West de-emphasising consumption.

NRP Impacts: - Increased pressure on natural resources in the UK and internationally;
- Competition for natural resources could increase demand on organic sector;
- Environmentally friendly emerging economy technological innovations could reduce impact on natural resources worldwide.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: lifestyles; consumption; emerging economies; waste

STEEP category: Social: lifestyles

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Citation date: 2004

Original research source and date: None listed.

Credibility of sources: Expert

Uncertain impact of accession of Eastern European states on EU Common Agricultural Policy (CAP) (now to 2006).

Description: Distribution of productive and extractive activities will change within the EU; the degree to which subsidies are decoupled from agricultural production will also change.

Potential Impact(s): - Potential changes in who produces what and where, in agriculture, with subsequent impacts on population, migration, and local and rural economies and social life;

- Changed patterns of UK food and energy security;
- Potential for significant costs to the current Member States created by applying the CAP in its current form to the Central and Eastern European accession states because of existing price gaps between the Central and Eastern European countries and the CAP prices;
- Uncertain market for surplus EU agricultural production stimulated by the introduction of CAP prices: The World Trade Organization prevents the sale of such subsidized exports to third markets; thus, the enlarged EU would have no market for the surplus goods.

NRP Impacts: - Increased pressure to decide whether to import or produce certain agricultural products, and to identify potential impacts on the environmental footprint in the UK and in the producing country;

- Potential for permanent loss of farm land to other activities with resulting erosion of "traditional" countryside as well as environmental and biodiversity impacts.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: EU; European Union; Common Agricultural Policy; CAP: subsidies; agricultural production

STEEP category: Politics: governance

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Citation date: 2004

Original research source and date: None listed.

Credibility of sources: Expert

Increased global economic growth (2016-2030).

Description: Even pessimistic forecasts suggest 3% growth per year up to 2030, in excess of population growth, producing increased wealth per person worldwide. Nonetheless, the gap between per capita income in rich and developing countries will increase to \$32,000 in 2020 from \$20,000 in 2000.

Potential Impact(s): - Potential for broadening customer base for UK products, as well as the visitor industry;

- Increase in world trade, with necessity for increased monitoring of imports vis-a-vis environmental impacts (e.g., alien species);
- More pressure on global environment generally, as more people adopt Western consumer lifestyle;
- More conflicts, protests, and terrorist acts arising driven by inequities in global wealth.

NRP Impacts: - Accelerating resource exploitation and degradation with rising need for raw materials to fuel increased production;

- Increased air and water pollution as growing energy demand drives greater fossil fuel use for both transport and electricity generation;
- Decreased water supply and quality as demand rises due to production needs and lifestyle changes;
- Higher consumption patterns require ever more strict environmental protection policies, legislation, monitoring, and enforcement;
- More funds available to address and ameliorate environmental problems.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: economic growth; global economy; income gap; inequity

STEEP category: Economic: production

Source(s) citing this:

Britain in 2020 (Forethought, Labour Party)

Strategic Futures Thinking (Strategic Foresight / DERA)

Tomorrow's Markets: Global trends and their implications for business (WBCSD)

Citation date: 2001

Original research source and date: 2020 Scenarios, The Drivers (Chatham House), 2001;

Exploring the Environment for Healthcare: The Madingley Scenarios (NHS Confederation, Institute of Health Service Management, International Hospital

Federation);
Future Strategic Context for Defence (MOD), 2001
Credibility of sources: Expert

Little progress in developing independent supranational enforcement mechanisms to enforce international law (now-2010).

Description: The next 5 years will see little progress in the development of independent supranational enforcement mechanisms to force states to obey international law (now-2010). International law will remain subject to interpretation, with the most powerful Western states providing the will and means to enforce international law on behalf of the 'international community'. Other states (particularly the least developed ones) and non-state actors may refuse to comply and increasingly contest claims that the West equates to the 'international community'. International law will become increasingly permissive about when outside force can be used to intervene in a nation's domestic affairs, if there are strong humanitarian grounds for that intervention.

Enforcement by states for transboundary environmental breaches involves a determination by an international body, such as the ICJ in The Hague.

- e.g. the Montreal Protocol trade restrictions can be imposed on imports to and exports from non-parties to the Protocol, and a fund has been created to assist countries in complying with their obligations under the Protocol, thereby encouraging participation.
- The UNFCCC Kyoto Protocol provides a number of "flexibility mechanisms" (including cooperative implementation, emissions trading, and technology transfer) to assist parties to meet their commitments.
- The United Nations Convention on the Law of the Sea provides the International Sea Bed Authority with the power to supervise implementation of parts of the convention but the convention is frequently breached.

Potential Impact(s): - Increasingly uncertain context for some international business activities;

- Increased vulnerability of businesses and activities of developing countries in international economy;
- Increased damage to global commons.

NRP Impacts: - Increasing pressure on all natural resources - few governments will be willing to take drastic measures on their own for fear of loss of competitive edge in a context where compliance of all is not assured;

- The ICJ, the principal judicial organ of the United Nations, rules on questions of international law, including - potentially - issues of international environmental law.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: international agreements; multilateral agreements; international adjudication; environmental law; maritime law; trade agreements

STEEP category: Politics: governance

Source(s) citing this:

International Environmental Law

Citation date: 2005

Original research source and date: World Bank International Law

Credibility of sources: Expert

Energy prices become more unstable to 2015. (2011-2015)

Description: Increasing instability of energy prices through 2015, with periodic price rises alternating with collapses (2010-2030). Sustained global economic growth, along with population increases, will drive a nearly 50 percent increase in the demand for energy over the next 15 years. Total oil demand will increase from roughly 75 million barrels per day in 2000 to more than 100 million barrels in 2015, an increase almost as large as OPEC's current production. Natural gas usage will increase more rapidly than that of any other energy source-by more than 100 percent-mainly stemming from the tripling of gas consumption in Asia. This accelerating demand occurring in the context of declining reserves in some oil-exporting countries will increase market uncertainty regarding oil supplies, contributing to erratic price conditions. Political instability in many producing countries will exacerbate these price instabilities.

Potential Impact(s): - China, and to a lesser extent India, will see especially dramatic increases in energy consumption;
- By 2015, only one-tenth of Persian Gulf oil will be directed to Western markets: three-quarters will go to Asia;
- Increased uncertainty in financial markets;
- Lack of consumer confidence;
- Increased incentives for move to alternative energy sources and renewables.
Increases in cost of carbon fossil fuel based product from oil to plastic and fertilisers.
An intermediate phase of increased costs of water, sewage infrastructure, energy, food, as new sources of energy are put in place

NRP Impacts: - Increased pollution where Asian energy demand is met by fossil fuels;
- Increased likelihood / number of severe oil spills in Pacific Rim due to increased oil transport traffic to that region;
- Potential for accelerated shift to renewables and alternative energy sources if they present a more stable, strategically secure source of energy.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: energy; oil prices; natural gas prices; oil futures; gas futures; LNG; 'peak oil'

STEEP category: Economic: production

Source(s) citing this:

Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts (CIA)

Oil prices surge to new records- BBC.Com Report

Citation date: 2000

Original research source and date: Global Trends 2015, p. 30.

Credibility of sources: Expert

Combined BRIC economies of China, India, Russia and Brazil exceed G6 economies by 2039. (2031-2050)

Description: 1000. Combined economies of China, India, Russia and Brazil larger than G6 economies by 2039 (2030-2050).

China plans to raise its GDP from one trillion (US) to four trillion in the next twenty years. China's economy is forecast to overtake the UK in economic size in 2005, Germany by 2008 and be larger than that of the US by 2041. China's per capita income reaches \$30,000 by 2050.

India's economy is forecast to grow faster than 5% over the next 30 years and be larger than Japan's by 2032. Per capita income is expected to rise 35 times by 2054. Economic growth is anticipated to have an impact across all segments of Indian society. The majority of wealth is currently trapped in the 'business class' segment - representing 2-3% of the population - which is expected to continue growing. However, economic development is also anticipated to lead to further growth of the middle class (15-17%) and the resulting shrinkage of the 'bullock class' (80%).

India's level of urbanization is expected to rise from 28 per cent in 2001 to 36 per cent by 2026.

By 2034, Russia's economy in US dollars could overtake Germany, France, Italy and the UK. By 2050, Russia's GDP per capita is comparable to the G6 and the labour force will have shrunk dramatically, with working age population declining to near the same as the other G6 nations.

By 2050, Brazil's GDP growth rate could average 3.6%, and the Brazilian economy could overtake Italy by 2025, France by 2031 and Germany by 2036.

Potential Impact(s): - By 2050 the annual increase in US dollar spending by the BRIC countries would overtake the G6 nations.

The annual increase in US dollar spending by Brazil, Russia, India and China combined could be 4 times that of the G6 nations

- China's currency could double in value by 2014

The net effect is likely to be a dramatic rise in consumption and demand for critical resources - food, energy, water and building materials. Demand for travel, cars, computers, domestic furniture, communications and internet access are also expected to grow through at least 2020;

The size of the Chinese economy has more than quadrupled in the last two decades and the energy consumption more than doubled. The drive for further industrialization over the next two decades will continue the trend on a much larger scale. The net increase in emissions from 1990 to 2001 amounted to 823 million tons of CO₂, accounting for 27 percent of the world's total.

- Increase in transregional agreements between China and India to safeguard their resource needs;
- Potential for Asian-African trade agreements to fulfil resource needs;
- Potential for resource competition to lead to direct military conflict over the next 15 years.
- Increased demand on natural resources;
- Increased environmental damage;
- Increased in water shortages
- Transportation cost increases
- Increased food prices in countries importing food products
- Change in national transportation
- Increased impact on global warming and climate change

Uncertainty as to whether Chinese culture can tolerate the individual desire to become rich and if the spirit of entrepreneurial success and failure will be socially acceptable.

- NRP Impacts:**
- Potential for increased environmental damage of global commons.
 - Offshoring of manufacturing and service activity to China and India could exacerbate the local impact on natural resources whilst improving the UK position.
 - Less control over environmental repercussions from economic development
 - Depends on environmental policies of BRIC countries

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: global economy, economy of BRIC, economy in 2050, G6 economy, spending in US dollars per nation, economy of China,

STEEP category: Economic: production

Source(s) citing this:

China's Industrialization and Reduction of Greenhouse Emissions

Dreaming with BRICs: The Path to 2050

Global Economics Paper No: 99

Twenty-first Century India

World Economic Forum: India Economic Summit

World Economic Forum: Knowledge Navigator

Citation date: 2003

Original research source and date: The Goldman Sachs Group, Inc.
<http://www.gs.com/insight/research/reports/99.pdf#search='Dr...%20The%20Path%20to%202050'>

Credibility of sources: Expert

Increasing dichotomy between environmental concerns and consumer aspirations. (2011-2015)

Description: 4036. Increasing dichotomy between public concern for the environment and increasing expectations in relation to consumption patterns. (now-2010)
World Wide Fund for Nature estimates trend continuation of greater consumption than resources and extrapolates that global average footprint will be 3.7 hectares per person
- or twice the earth's carrying capacity

Potential Impact(s): - As populations increase the need for increased food production could see an increase of use of pesticides and fertilizers as well as increased land taken into production.

- There will be increased pressure on biodiversity and wildlife
- potential for significant divergence between stated beliefs of consumers and actual behaviours

NRP Impacts: -Could increase problems drastically unless there is a clear framework to protect the interests of the environment;
-Potential reluctance to accept diversion of resources to NRP versus other areas of spending e.g. health and education;
- Difficulty of positioning NRP as a public cause in a similar manner to school meals or African poverty / debt relief.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: environmental concern, consumption patterns

STEEP category: Social: values

Source(s) citing this:

Global Environmental Outlook 2000 UNEP

Citation date: 2000

Original research source and date: Evidence and innovation: Defra's need from the sciences over the next 10 years. (PB 9227)

Credibility of sources: Expert

Food demand will increase with rising world population, and increased consumption of livestock products (2011 - 2015)

Description: 4043. Food demand will increase with rising world population, and increased consumption of livestock products (2011 - 2015). As the population of the developing world increases and the income levels rise, so too will the demand for food. Many commentators and analysts have voiced concerns about the planet's capacity to support global per capita consumption at the rates currently enjoyed by developed nations.

Potential Impact(s): - As food demand grows food prices are likely to increase

- Pressure on local agricultural production will increase and prices in local markets could be driven higher
- Tensions between the population's need for housing and agricultural production will increase
- Average world consumption of fish per person could grow from 16 kg a year in 1997 to 19-20 kg by 2030, raising total food use of fish to 150-160 million tonnes. The yearly sustainable yield of marine capture fisheries is estimated at no more than 100 million tonnes. The bulk of the increase in supply therefore will have to come from aquaculture.

NRP Impacts: - Increased land under cultivation

- Biodiversity threat
- Need to ensure that growing food demand doesn't lead to unsustainable farming techniques
- Competition and rising prices on world markets, coupled to pressure to reduce food miles could lead to increasing pressure to grow and source more food domestically

NRP Category: Megatrend

NRP Area Impacts:

- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Food demand, world population, livestock products

STEEP category: Economic: production

Source(s) citing this:

Effects of Food-Safety Perceptions on Food Demand and Global Trade - Changing Structure of Global Food Consumption and Trade

Global food projections to 2020: Implications for investment. 2020 Vision for Food, Agriculture, and the Environment Discussion Paper No. 5.

Citation date: 2004

Original research source and date: Evidence and innovation: Defra's need from the sciences over the next 10 years. (PB 9227)

Credibility of sources: Expert

Increasing recognition that economic value of managing ecosystems sustainably can be higher than conversion value (2011 to 2015).

Description: There is growing recognition that, the total economic value associated with managing ecosystems more sustainably can be higher than the value associated with the conversion of the ecosystem through farming, clear-cut logging, or other intensive uses. Relatively few studies have compared the total economic value (including values of both marketed and non-marketed ecosystem services) of ecosystems under alternate management regimes, but some studies such as the Millennium Ecosystems Assessment have found that the benefit of managing the ecosystem more sustainably exceeded that of converting the ecosystem.

Factoring in estimates of the economic losses associated with the depletion of natural assets significantly changes the balance sheet of countries with economies dependent on natural resources. For example, countries such as Ecuador, Ethiopia, Kazakhstan, Democratic Republic of Congo, Trinidad and Tobago, Uzbekistan, and Venezuela that had positive growth in net savings in 2001 actually experienced a loss in net savings when depletion of natural resources (energy and forests) and estimated damages from carbon emissions (associated with contributions to climate change) were factored into the accounts.

Potential Impact(s): - Increasing volume of research on true value of ecosystem resources, which could affect goal-setting, decision making, and resource use;
- Emergence of new businesses, products, and services related to sustainable ecosystem management.

NRP Impacts: - Could radically change the uses of, and impacts on, all natural resources;
- Potentially tighter management controls on natural resources in developing countries as true value accounting recognizes costs of asset depletion.
- Potential pressure / opportunity for UK to adopt ecosystem accounting measures to compare costs of sustainable management versus conversion.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: sustainability; managed ecosystems; sustainable accounting; environmental profitability; ecosystem conversion; natural resource depletion

STEEP category: Economic: production

Source(s) citing this:

Assessing the Economic Value of Ecosystem
Millennium Ecosystem Assessment

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Increasing pressure for elimination of subsidies which have negative ecosystem impacts (2007 - 2010).

Description: Increasing pressure for elimination of subsidies which have negative ecosystem impacts (2007 - 2010). Increasing support for the transfer of these subsidies to payments for non-marketed ecosystem services. Government subsidies paid to the agricultural sectors of OECD countries between 2001 and 2003 averaged over \$324 billion annually, or one third of the global value of agricultural products in 2000. A significant proportion of this total involved production subsidies that led to greater food production than global market conditions warranted and promoted overuse of fertilizers and pesticides. Compensatory mechanisms may be needed for poor people who are adversely affected by the removal of subsidies.

Potential Impact(s): - Slowing environmental degradation;
- Transformation of agricultural sector.

NRP Impacts: - Increased environmental improvements with no enforcement price tag
- Greater interest in adoption of ecosystem accounting measures and ecosystems services management models.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: biodiversity; agricultural production; agricultural damage; nitrogen run-off; marine ecosystem damage

STEEP category: Politics: policies

Source(s) citing this:

Millennium Ecosystem Assessment

Securing the Future - delivering UK sustainable development strategy

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Increase in trading schemes using economic instruments to change market behaviour towards the environment (2007 - 2010).

Description: Increase in trading schemes using economic instruments to change market behaviour towards the environment (2007 - 2010). The success of the recently launch EU carbon trading scheme, could lead to increased use of such trading schemes. Typically, these might feature instruments such as trading of emissions allotments, renewable obligations, landfill allowance trading schemes, and landfill tax escalators. Such instruments could include:

- Multiple-outcome auction of land-use change;
- Farming Finance: creating positive land-use change with a natural resource management leverage fund;
- Auction for landscape recovery;
- Cap and Trade for salinity: property rights and private abatement activities.
- Catchment Care, an auction process for biodiversity gains and water quality outcomes; and
- Green off-sets for sustainable regional development.

Types of regulatory instrument include:

- Controls on emissions, activities, use of resources and toxic substances, through bans, permits, quotas and licensing;
- Controls on the choice of technology or standards for the environmental performance of technology;
- Extended producer responsibility (where producers are made liable for the environmental effects of their products, or management of their products' packaging waste or used products);
- Mandatory environmental management standards and environmental audits;
- Mandatory environmental labelling or product standards;
- Mandatory training;
- Operator licensing (operators are required to demonstrate that they are a 'fit and proper' person to hold a license and must comply with certain licensing conditions).

Other trading schemes include:

- Charges or taxes on emissions or products (inputs to or outputs of production processes) where there are harmful substances;
- Tax/refund schemes whereby people receive refunds on environmental taxes they have paid in proportion to the improvement of their environmental performance relative to their competitors;
- Deposit/refund schemes that provide people with a disincentive to dump empty containers or used products;
- Tradable permits or quotas that are used to control the overall level of a particular type of pollution or the use of a particular resource but allow individuals to buy or sell permits to meet their own requirements;
- Public spending in the form of direct subsidies for environmental improvements; production subsidies with environmental pre-conditions capital allowances for environmental investments; tax rebates, grants or loans for environmental investments; financial support for advice services or voluntary initiatives; tax credits for those funding

approved environmental projects; and

- Enforcement incentives such as fines for non-compliance with regulations; legal liability for environmental damage; and environmental performance bonds (whereby operators have to place a deposit that is only returned to them once they have finished their operations and restored a site to a satisfactory condition).

Potential Impact(s): - Participants and public increasingly and broadly informed of the value of public goods;

- More direct incentives and disincentives for sustainable behaviour, more closely linked to the relevant product, service, or business sector;

- Increasing dissemination of sustainable practices throughout economy;

- Decreasing rate of damage to natural resources and ecosystems.

NRP Impacts: - Values certain ecosystem assets more highly than others;

- Long term transformation of economic institutions and practices towards sustainability.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: emissions; waste sites; recycling; consumption reduction; public-private partnerships; accountability; corporate social responsibility; economic sustainability; trading schemes; environmental derivatives.

STEEP category: Politics: policies

Source(s) citing this:

Securing the Future - delivering UK sustainable development strategy

The Government's Strategic Review of diffuse water pollution from agriculture in

England: Types of Environmental Policy Instruments

Citation date: 2005

Original research source and date:

Credibility of sources: Expert

Oil price forecast by Goldman Sachs to rise to \$105 per barrel within a few years (2007 - 2010)

Description: Oil price forecast by Goldman Sachs to rise to \$105 per barrel within a few years (2007 - 2010). The concern is that oil prices could continue to rise through a combination of factors, Firstly, strong and continued growth in global energy demand - driven in part by the emerging economies. Allied to this are concerns over the potential for reaching 'peak oil' within a decade and potential instability in oil producing countries with many not allowing independent verification of their reserves.

Potential Impact(s): Higher oil prices will have a range of impacts:

- Price increases act like a tax, raising product costs for any given output price;
- Some firms may simply not be able to pass on the costs if demand is highly price sensitive;
- Higher oil prices transfer income from oil-importing countries to oil producers, squeezing spending in the oil importers. Both the aggregate demand and aggregate supply curves shift backwards. Output falls, but the impact on underlying inflation, and hence the appropriate policy response from central banks is uncertain;
- Rising oil prices can make previously unviable deposits economically worthwhile to extract;

NRP Impacts: -Falling demand could reduce current levels of CO2 emissions;
- energy concerns could accelerate the switch to use of alternative energy sources e.g. bio-fuels, wind and hydro.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water supply and demand

Impact areas: Price of

- Fertilizers
- Food
- Transport
- Trade
- Industry
- Travel

STEEP category: Economic: production

Source(s) citing this:

Oil prices surge to new records- BBC.Com Report

Citation date: 2005

Original research source and date:

Credibility of sources: Popularist

Increase in global food demand (2016 - 2030)

Description: Increase in global food demand (2016 - 2030). There are three key drivers - increasing world population, growing affluence and ageing populations.

The International Food Policy Research Institute (IFPRI) projects global demand for:

- cereals to increase by 41 percent between 1993 and 2020 to reach 2,490 million metric tons
- meat demand to increase by 63 percent to 306 million tons
- roots and tubers demand to increase by 40 percent to 855 million tons

Developing countries projections are 40 percent population increase and an average annual income growth rate of 4.3 percent. Developing countries are projected to account for most of the increase in global demand for cereals and meat. Cereal growth will be concentrated in the relatively low productivity cereals in Sub-Saharan Africa. In parts of Asia, farmers are approaching economically optimum yield levels, making it more difficult to sustain the same rates of yield gains; and declining world cereal prices are causing farmers to switch from cereals to other, more profitable crops and are causing governments to slow their investment in agricultural research, irrigation, and other infrastructure.

With the exception of Latin America, all major developing regions are projected to increase their net cereal imports. The United States is forecast to provide almost 60% of the net cereal imports of developing countries in 2020, the European Union about 16 percent, and Australia about 10 percent

With continued population growth, rapid income growth, and changes in lifestyles, demand for meat is projected to increase by 2.8 percent per year during 1993–2020 in developing countries. The increase in per capita meat demand will be largest in China; by 2020, Chinese per capita consumption of meat will be eight times that of South Asia.

IFPRI believe a number of factors that are difficult to predict will influence the future food situation. These include:

- Increased grain price volatility;
- Policy decisions and changes in lifestyles and incomes in China and India, the world's two most populous countries
- The impact of short-term weather patterns and long-term climate change;
- Constraints imposed by water scarcity
- Negative trends in fertilizer use;
- Outcomes of ongoing globalisation efforts, including the upcoming WTO trade negotiations;
- Investments in agricultural research and the outcome of the current debate on the use of modern biotechnology for food and agriculture; and
- The impact of policy measures.

Potential Impact(s): Worldwide, per capita availability of food is projected to increase around 7 percent between 1993 and 2020, from about 2,700 calories per person per

day in 1993 to about 2,900 calories.

China and East Asia are projected to experience the largest increase.

Demand for food is influenced by population growth, income levels, urbanization, lifestyles, and preferences. Almost 80 million people are likely to be added to the world's population each year from 1995 - 2020 increasing world population by 35 percent (2billion).

Rural-urban migration lead to more diversified diets with shifts from basic staples such as sorghum, millet, and maize to other cereals such as rice and wheat that require less preparation and to livestock products, fruits, vegetables, and processed foods.

- Uncertain / unstable trends in commodity pricing - potentially leading to substantial increase in international food prices;

- Potentially increased divergence between nations over acceptance of GM products

NRP Impacts: - Increasing pressure on agricultural production and water demand

- Potential concerns over use of unsustainable farming techniques

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: food chain, consumer trends, global population

STEEP category: Economic: trade

Source(s) citing this:

Evidence and Innovation - Defra's needs from the sciences over the next 10 years
Global food projections to 2020: Implications for investment. 2020 Vision for Food, Agriculture, and the Environment Discussion Paper No. 5.

Citation date: 2004

Original research source and date: Evidence and Innovation - DEFRA

Credibility of sources: Expert

Increasing conflict between EU environmental protection goals and USA, China and other trading partners using WTO regulations to attempt to overturn EU legislation (2007 to 2010)

Description: Increasing conflict between EU environmental protection goals and USA, China and other trading partners using WTO regulations to attempt to overturn EU legislation (2007 to 2010). The principal points of conflict on trade and environmental linkages within the WTO are between the EU and the US on one hand, and developing nations on the other. The former favour both a flexible interpretation of Article XX, which lists the grounds on which trade restrictions are permissible.

The WTO could be one of major forces offering to rectify certain types of imbalances in economic trade and internalising environmental externalities – but this is not yet the case.

A frequently cited example is the major WTO dispute between the US and the EC over Beef Hormones where the US and Canada remained unconvinced that new EC scientific evidence justified an EU import ban on hormone-treated beef.

Potential Impact(s): EU is quite progressive on environmental affairs could regress environmental legislation and weaken current measures

NRP Impacts: - Pressure to ensure key environmental goals are not rolled back
- Clarity required on NRP strategy and absolute priorities

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water supply and demand

Impact areas: resource pressures, fisheries, air pollution, biodiversity

STEEP category: Economic: trade

Source(s) citing this:

Natural Resources and the Environment Panel Study (EU, IPTS)

Citation date: 1999

Original research source and date: http://www.wto.org/english/news_e/news_e.htm.
2001

Credibility of sources: Expert

Improvement in global governance expectations and standards (2016 to 2030)

Description: Improvement in global governance expectations and standards (2016 to 2030). Given the increasingly complex and global nature of issues being addressed across society, the expectation is of growing pressure on global institutions to meet societal expectations.

This is likely to lead to an increase in the creation and enforcement of resource protection initiatives by the International Governing Bodies.

One view is that the ultimate goal should be to create a global civic ethic based on a set of core values that can unite people of all cultural, political, religious, or philosophical backgrounds. This view is reinforced by the belief that governance should be underpinned by democracy and ultimately by the rule of enforceable law.

This view is countered by those who believe that democracy may not be the only viable organising model and who are concerned that such global institutions may be biased towards Western democratic models and not take sufficient account of the interests of emerging nations.

Key drivers for greater governance include:

- Criminal networks have grown and often involve cross border transactions which need to be controlled
- Global transmission of pathogens, HIV/AIDS, SARS, Avian flu made easier by open borders and mobility;
- Transborder pollution
- Global communications has created new expectations
- The Internet is the fastest growing instrument of communication and sets new requirements for legal cooperation
- Financial institutions through cross border transactions can impact nations
- Proliferation on nuclear and chemical weapons require international mechanisms for monitoring and controlling
- The importance of global trade has mean that new governance institutions have begun to emerge. (World Trade Organisation)

Potential Impact(s): - Governance in developing countries will have a significant influence on availability and management of natural resources.

- Governance in developed countries may continue to be confronted with new paradigms of equity and responsibility pushing back the constraints of national boundaries;
- Continued domestic debate over sovereignty and the extent to which governance should be ceded to regional or global institutions.

NRP Impacts: Global natural resources might be managed as a single global resource and global governance goals could identify key areas to impact e.g:

- Stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

- Implementation of conventions related to the conservation of biodiversity.
- Halving the proportions of people without access to water and sanitation by 2015.

NRP Category: Megatrend

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Greater consistency to be achieved in

- macroeconomic, trade, aid, financial and environmental policies

- Aim of expanding the benefits of globalisation.

- Conflict prevention, post-conflict peace-building, humanitarian assistance and development policies to be more integrated.

STEEP category: Politics: governance

Source(s) citing this:

Global Governance Initiative Annual Report 2005

Citation date: 1995

Original research source and date: Our Global Neighbourhood - Report of the Commission on Global Governance (ISBN 0-19-827998-1; Published by Oxford University Press, 1995)

Globalisation and Governance report www.un.org/millennium/sg/report/ch1.pdf

Credibility of sources: Expert

Appendix 7 - NRP Future Trends Study Fully Annotated Key Trends and Drivers

REF No.	Title of Annotated Trends	Timing
9	Decreasing arable land (2031-2050).	2031 - 2050
10	Air, water and chemical pollution worsening (2011-2015).	2011 - 2015
27	Increased life expectancy (2031-2050).	2031 - 2050
44	Continued but uneven growth in housing demand within the UK (now to 2006).	now to 2006
49	Rising volume of UK air travel services (2016-2030).	2016 - 2030
96	Changing patterns of development (2007-2010).	2007 - 2010
99	Shifting approaches to farming and agriculture (2011-2015).	2011 - 2015
104	Different visions emerge for the countryside (2011-2015).	2011 - 2015
105	Increasing genetic engineering of plants and animals (2011-2015).	2011 - 2015
115	Increasing affordability of solar energy (2011-2015).	2011 - 2015
119	Increasing pressure on landfills, waste disposal capacity (2007-2010).	2007 - 2010
126	Continued urbanisation (2011-2015).	2011 - 2015
132	Increased impacts on agriculture from global warming (now to 2006).	now to 2006
133	Increased pressure for tighter environmental controls (now to 2006).	now to 2006
160	Increased risk of exotic species appearing in the UK (now to 2006).	now to 2006
164	Increased urbanisation will increase light pollution (now to 2006).	now to 2006
175	Increasing shift in balance of power within supply chains from food producers to the major retailers (now to 2006).	now to 2006
176	Increases in the number and kind of actors in international governance, and the challenges to policy (now to 2006).	now to 2006
179	Increased innovations in governance and regulation to heighten transparency of decision-making (now to 2006).	now to 2006
182	Growing competition for marine and coastal resources (2007-2010).	2007 - 2010
185	Increase in 'precision farming' due to application of innovations (2007-2010).	2007 - 2010
186	Changing patterns of disease resistance and disease among wildlife, domestic animals, and plants (2007-2010).	2007 - 2010
187	Increased public concern over sustainability, biodiversity, wildlife protection and welfare (now to 2006).	now to 2006

Appendix 7 - NRP Future Trends Study Fully Annotated Key Trends and Drivers

REF No.	Title of Annotated Trends	Timing
261	Increasingly common closures of traditional fishing grounds (2007-2010).	2007 - 2010
264	Increasing risk of serious complications associated with food-borne disease (2007-2010).	2007 - 2010
274	New, emerging and re-emerging animal and zoonotic diseases (2007-2010).	2007 - 2010
280	New kinds of foodborne outbreaks emerge (2007-2010).	2007 - 2010
281	Rising meat demand in developing world (2016-2030).	2016 - 2030
420	Illegal fishing increasingly a problem for sea management (2011-2015).	2011 - 2015
448	International law, particularly European law, will have an increasing impact on UK domestic law (2007-2010)	2007 - 2010
520	By 2025, the population of countries that must import food, due to insufficient cropland per capita, could exceed 1 billion	2016 - 2030
523	Collisions between population and biodiversity intensify as human numbers and resource use expand (2011-2015).	2011 - 2015
544	Declining populations of terrestrial, freshwater and marine species worldwide (40% drop in the period 1970-2000) (2007 to 2010).	2007 - 2010
549	Overall volume of agricultural output is declining in British farming (since late 1990s).	2007 - 2010
3005	Continued growth in aquaculture (farmed fish and shellfish production) (2007-2010).	2007 - 2010
4018	An increasing requirement for reliable regional predications for realistic adaptation strategies and investigation of the risks of rapid climate change	2011 - 2015
4030	Increasing use of natural resources to produce renewable energy, including wind farms and biofuel (now to 2010).	2011 - 2015
4045	Increasing technical challenges to global agriculture from resource constraints and emerging environmental changes (now to 2010).	2011 - 2015
6057	Continued challenge of safe disposal of spent nuclear fuel (2016 - 2030).	2016 - 2030
7015	Growing "green architecture" movement: designs that focus on the long-term environmental impact of maintaining and operating a building (2016-2030).	2016 - 2030
9010	Growing pressure for technologies that could increase the production of food per unit area sustainably (2011-2015).	2011 - 2015
9101	Increasing synthetic nitrogen fertilizer run-off (2011 to 2015).	2011 - 2015
9104	Increasing costs of damage to UK from current agricultural practices (2016 to 2030).	2016 - 2030
9105	Increasing incidence of diseases of marine organisms and the emergence of new pathogens (2016 - 2030).	2016 - 2030
9106	Changes in institutional and environmental governance frameworks required for effective management of ecosystems (2007 - 2010).	2007 - 2010
9107	Increasing awareness that many services degraded are "public goods" (2011 - 2115).	2011 - 2015

Appendix 7 - NRP Future Trends Study Fully Annotated Key Trends and Drivers

REF No.	Title of Annotated Trends	Timing
9108	Increasingly coordinated international agreements for addressing ecosystem-related concerns (2016 - 2030).	2016 - 2030
9111	Increased use of new frameworks for decision-making and decision support to manage uncertainty and complex ecosystem impacts (2011 - 2015).	2011 - 2015
9112	Farming increasingly a net energy consumer (2007 - 2010)	2007 - 2010
9113	Continued decline in the quality of UK lowland habitats (2016 - 2030)	2016 - 2030
9115	Loss of resources beginning to be measured as loss of capital asset which should be added to GDP (2007 - 2010)	2007 - 2010
9116	Increasing use of science and innovation to improve policy and strategy for UK sustainable development (2007 - 2010)	2007 - 2010
9117	Loss of coast line will be an increasing threat to agricultural land and housing (2011 -2015)	2011 - 2015
9119	Increasing flood damage requires consensus on floodplain and flood risk (2007 - 2010)	2007 - 2010
9125	Increased impact on soil from climate change and carbon emissions from soil (2016-2030)	2016 - 2030
9126	UK outsourcing food production increases environmental footprint elsewhere (2011 -2015)	2011 - 2015
9128	Increased urbanization increases the overloading of water supply and sanitation infrastructure (2011 - 2015)	2011 - 2015
9130	Increasing over utilisation and pollution of aquifers (2007 to 2010)	2007 - 2010
9133	Heightened conflicts between conservation policies and other policy aims will lead to increased challenges to marine management (2007-2010)	2007 - 2010
9134	Greater reliance on scientific and technical support in management of resources (2007 to 2010)	2007 - 2010
9135	EU controls of agricultural subsidies and reduction of agricultural land may make the UK vulnerable to outside impacts and result in food shortages (2016 to 2030)	2016 - 2030
9136	Increase in severe weather events (2011 to 2015).	2011 - 2015
9137	Increased scientific understanding of the world consequences of current human activities (2007 to 2010)	2007 - 2010
9139	UK dependency on food imports causes increased vulnerability to transport disruption and epidemics (2007 to 2010)	2007 - 2010
9140	Increasing risk of Bioaccumulation and Biomagnification (2007 to 2010)	2007 - 2010
9142	'Virtual Water' (total water embedded in and consumed in producing a good or service) could change trading patterns and agricultural policy (2007 to 2010)	2007 - 2010
9144	New opportunities for renewables sector needs Government leadership	2007 - 2010
9145	Increasing complexity of issues between UK government departments (2007 to 2010)	2007 - 2010

Appendix 7 - NRP Future Trends Study Fully Annotated Key Trends and Drivers

REF No.	Title of Annotated Trends	Timing
9147	Loss of key skills in agricultural sector	2007 - 2010
9150	Wave power and water desalination increasingly important joint roles for energy and water supply (2016 to 2030)	2016 - 2030
9151	Peak Oil - cost of extraction rising along with increasing demand	2007 - 2010
9152	Rise of individualism negatively impacting public good and collective needs (2011 to 2115)	2011 - 2015
9153	The current reliance of food supply on fossil fuel may be unsustainable.	2016 - 2030
9154	Government VAT on all construction except greenfield sites puts pressure on rural environment	2007 - 2010
9155	Growing pressure for UK Government to spearhead investment in renewable energy (2007 to 2010)	2007 - 2010

Decreasing arable land (2031-2050).

Description: Arable land is increasingly pressured or scarce, especially in Africa and the Middle East. Increasing soil degradation includes not only erosion but also salination: by 2020 30% of the world's arable land will be salty and by 2050, 50% of it will be salty.

Potential Impact(s): - Increasing conflict between urban / suburban development and agricultural lands;

- Increasing land prices;
- Increasing food costs;
- Greater pressure for intensive agricultural practices;
- Less room for livestock.

NRP Impacts: - Increasing conflict between wildlife needs and agricultural crop land;

- Loss of biodiversity;
- Ecosystem transformations (soil degradation results in more austere ecosystems);
- Potential loss of topsoil in "dustbowl" effect.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Water supply and demand

Impact areas: environment; arable land; development; desertification; salination; food production

STEEP category: Environment: geosphere

Source(s) citing this:

BT Exact Technology Timeline
DEFRA Forward Look (PREST, TNO-STB, DEFRA)
How Can We Reduce Carbon Emissions From Transport?
Scenarios Europe 2010: Five Possible Futures for Europe (EU/FSU)
The Future and How to Think About it (PIU / Strategy Unit)

Citation date: 2002

Original research source and date: None listed in "The Future and How..."; none specifically cited in BT Exact Technology Timeline (2002). None cited in Forward Look (workshop).

Credibility of sources: Expert

Air, water and chemical pollution worsening (2011-2015).

Description: Air and water pollution is increasing in developing countries, but some progress has been made in developed countries: SO_x pollution in many Western European nations has dropped by 75% or more since 1980, and decreased by about one-quarter in the United States. Chemical pollution, however, is still rising or unaddressed in developed countries.

An estimated 75,000 chemicals are in commercial use today and the effects on human health and the environment are poorly understood. For example, background levels of phosphorus in the UK are estimated to be ten times higher than acceptable levels. Only an estimated 3% of chemicals in commercial use have been tested for carcinogens. In addition, the chemical impact on the environment of lifestyle products and other new contaminants is not yet fully understood.

Potential Impact(s): - The potential degradation of mammalian immune systems as a result of persistent background pollution;

- Increase in cancer, neurological conditions, hormone disorders, chronic pulmonary problems;
- Increased health costs -- for humans and livestock;
- Potential for lowered crop yields in the long-term;
- Increased health problems in older generations who have less resistance, placing a heavy burden on younger generations as baby boomers succumb to pollution-based diseases;
- Insurance carriers will begin to specialize in pollution-related diseases.

NRP Impacts: - Lower agricultural yields;

- Poor health in farm animals;
- Increased mutation rates in plants and animals;
- Increased infant mortality in plants and animals;
- Loss of biodiversity.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: environment; air pollution; water pollution; soil pollution; non-point source pollution; chemical pollution; pharmaceutical pollution; failed economy in areas of greatest pollution; "green" zones are created; social isolation due to polluted areas

STEER category: Environment: biosphere

Source(s) citing this:

Strategic Futures Thinking (Strategic Foresight / DERA)

The Future and How to Think About it (PIU / Strategy Unit)
Tomorrow's Markets: Global trends and their implications for business (WBCSD)

Citation date: 2000

Original research source and date: None listed in "The Future and How...".
Programme for Monitoring and Evaluation of the Long-Range Transmission of Air
Pollutants in Europe (EMEP), "Tables of anthropogenic emissions in the EOE region,"
at http://www.emep.int/emis_tables/tab1.html (link cited not working; try:
<http://reports.eea.eu.int/EMEPCORINAIR4/en>).

Credibility of sources: Expert

Increased life expectancy (2031-2050).

Description: By 2036 the average UK life expectancy of men will be 78.8 and women will be 83, compared with 76.1 and 80.8 (respectively) in 2003. Additionally, there is an imbalance across UK society where mortality is three times higher in Class V men than in Class I. This trend in the disparity between the classes is set to increase (the 'mortality gap' is widening).

Life expectancy increases (and the potential for class-based divides) will be reinforced by advances in lifestyle engineering to extend lifespan, as well as innovations in developmental biology (such as those emerging from telomerase research).

Globally, life expectancy will keep growing, although this is offset by the effect of HIV/Aids on mortality in some countries.

Potential Impact(s): - Decrease in rates of population growth slows as mortality rates decline;

- Increasing grey lobby to keep countryside untouched;
- Changes in patterns of resource consumption as sizes of age cohorts change;
- Potential for value shift towards increased emphasis on quality of life and decrease in materialism;
- More people in engage in life-long learning, resulting in better informed consumers and voters.

NRP Impacts: - Continued population pressures: increased population requires increased food and water;

- Potential for increased support for issues of sustainability, biodiversity, environmental quality, and maintaining the traditional countryside as seniors move out of urban environments;
- More active seniors place greater pressures on availability and quality of leisure and recreational resources, with potential for increased environmental damage side-by-side with an increased perception of the value of those resources;
- Healthier lifestyles (anti-aging regimen) put greater stress on fish and white meats, and enhance demand for alternative protein sources.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Water supply and demand

Impact areas: life expectancy; gender; health; disability; gerontology; anti-aging

STEEP category: Social: demographics

Source(s) citing this:

Britain in 2020 (Forethought, Labour Party)

Future Health Care Trends (Strategy Unit, DOH)

People and Connections: Global Scenarios to 2020 (Shell International Ltd.)

Short Survey of Published Material on Key UK Trends: 2001-2011 (Strategic Futures)

Strategic Futures Thinking (Strategic Foresight / DERA)
The Catalog of Tomorrow (TechTV, Que Publications)
Tomorrow's Markets: Global trends and their implications for business (WBCSD)

Citation date: 2003

Original research source and date: Tomorrow, p. 67.

Government Actuaries Department in DOH Future Health Care Trends.

In Tomorrow's Markets, UNPD, World Population Prospects. 1998, New York: UNPD.

World Development Indicators 2000.

Credibility of sources: Expert

Continued but uneven growth in housing demand within the UK (now to 2006).

Description: The southeast is expected (by 2006) to see a 15-18% increase in the number of new houses compared with 1989. Expected increases in other regions are circa 33% in East Anglia, 21% in the southwest, 19% in the East Midlands, and 12% in Yorkshire and Humberside. (By 2011) ...East Anglia may see up to a 40% rise in house numbers from 1989 and demand in the East Midlands may rise by as much as 24% on 1989 numbers, with equivalent projected estimates of approximately 26% in the southwest, 18% in the south-east and 15% in Yorkshire and Humberside.

Potential Impact(s): - Uneven development will challenge some suburban and rural areas in terms of congestion, quality of life, infrastructure, and environmental degradation, while leaving others relatively unscathed, but also economically underdeveloped;

- Shifts in traffic patterns and congestion, with need for new or expanded and improved roads;

- Increase in construction-related waste, trash, and pollution;

- Increased domestic energy usage.

NRP Impacts: - Loss of biodiversity due to reduced green belts and new builds on greenfield sites;

- Pressure on biodiversity from increased traffic and expanded transportation corridors, as well as increased air pollution;

- Increased pressure on water supplies and sewer systems with potential for increased pollution;

- Increased demand for energy generation with potential for heightened pollution (either air, water, or viewplane pollution, e.g., windfarms)

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Soils

Impact areas: housing, building, economic growth; regional inequalities

STEEP category: Economic: trade

Source(s) citing this:

Britain in 2020 (Forethought, Labour Party)

Britain towards 2010: the changing business environment. (Foresight Programme)

Short Survey of Published Material on Key UK Trends: 2001-2011 (Strategic Futures)

The Futures Project: Synthesis Report (IPTS, EU)

Citation date: 2003

Original research source and date: Richard Scase, Britain towards 2010, pp. 54-55, 81. (1999)

Credibility of sources: Expert

Rising volume of UK air travel services (2016-2030).

Description: It is estimated that 400 million people will be using UK air travel services per year by 2020. By 2030 this could rise to 500 million.

Potential Impact(s): - Increased demand for air transportation services necessitates the expansion of current airports and potentially the construction of new airports;

- Growth in local economies where new regional airports are sited;
- Increased automobile traffic to new air transport sites;
- Increased air and noise pollution;
- Likelihood of more frequent air accidents;
- Increased security needs;
- Increased expenses in providing air travel services.

NRP Impacts: - Negative impact on birds, and other wild life;

- Increased air pollution;
- Increased noise pollution;
- Increased night-time light pollution;
- Loss of biodiversity and biosphere impacts where airports are expanded or new airports constructed;
- Increased possibility of fuel spill or hazardous chemical accident near airports.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes

Impact areas: Transportation, infrastructure, air travel, air traffic, oil/fuel industry, service industry

STEEP category: Social: lifestyles

Source(s) citing this:

Britain in 2020 (Forethought, Labour Party)

Short Survey of Published Material on Key UK Trends: 2001-2011 (Strategic Futures)

Citation date: 2001

Original research source and date: DETR Air Traffic Forecasts. 2000

DfT future of Air Transport White Paper 2003

http://www.dft.gov.uk/stellent/groups/dft_aviation/documents...

Credibility of sources: Expert

Changing patterns of development (2007-2010).

Description: The present policy of concentrated development around urban centres may give way to more dispersed development, but will be opposed by many different interest groups. Other groups will champion the need for affordable accommodation for lower-income households. Builders will refuse to develop unless they make a profit.

Potential Impact(s): - Increasing tension arising over trade-offs between providing housing, and maintaining greenbelts and quality of the environment in the countryside;
- Decrease in available arable land and land under cultivation;
- Increase in traffic and transportation demands by commuters;
- Increased pressure on wildlife and biodiversity;
- More tax resources in rural areas as development diversifies;
- Increasing pressure on limited rural infrastructure (schools, hospitals, constabularies, etc.);
- Increased length of commutes, with associated increases in transportation-based pollution.

NRP Impacts: - Pressure on all environmental resources distributed more evenly throughout the UK;
- Increased construction-generated environmental impacts;
- Increased commute/transport-generated environmental impacts;
- Pressure on species in habitats near new transportation corridors (created by need for increased road-building or rail-laying).

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: demography, housing, development, affordable accommodation

STEEP category: Social: demographics

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

The State of the Countryside 2020 (The Tomorrow Project, The Countryside Agency)

Citation date: 2003

Original research source and date: None listed.

Credibility of sources: Expert

Shifting approaches to farming and agriculture (2011-2015).

Description: Farmed countryside will greatly diversify as farming becomes simply one among many uses of rural land. Global economic change and new technology will provide new opportunities for farming, but not for all farmers, and the present rate of exit from farming seems likely to continue.

Farming of UK wheat for biofuel may change the agricultural strategy.

Potential Impact(s): - Structural change in use of rural environmental resources;
- Potential polarisation of agriculture into large-scale farms focussed on world markets, and small-scale farms focussed on high-end niche markets and local markets;
- Farming increasingly knowledge- and network-based, with biotechnology and bioengineering potentially revolutionising production;
- Increased need for agricultural extension and research, and impacts research.

NRP Impacts: - More work to monitor a wider variety of potential impacts;
- Less agricultural pollution: less nitrogen in the soil where farmland is rededicated to other activities;
- More agricultural pollution where small farms are consolidated into large-scale, corporate agricultural production, less likely to be organic;
- More pressure on biodiversity and habitats.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Soils
- Water supply and demand

Impact areas: Farming; agriculture; technology; economy; diversification

STEEP category: Environment: biosphere

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

The State of the Countryside 2020 (The Tomorrow Project, The Countryside Agency)

Citation date: 2003

Original research source and date: None listed.

Credibility of sources: Expert

Different visions emerge for the countryside (2011-2015).

Description: Farming as the basis of meaning in the countryside has largely given way to a mosaic of different visions. 'Traditionalists,' 'idealists,' 'pragmatists' and 'visitors' will all attach different meanings to the countryside. The pragmatic view, that 'what works is best' seems likely to prevail, with mixed consequences for sustainability.

Potential Impact(s): - Increasing contention over development strategies, trade-offs, urbanisation or suburbanisation of the countryside;

- Potential mismatch between local development strategies and national goals;
- Risk of wide variations in crime, employment, economic performance and social cohesion;

- Use of the countryside for energy production or ecotourism.

NRP Impacts: - Increased policy challenges during difficult transitional period as public debate and consumer actions test conflicting views, creating a turbulent context for political decisions;

- More opportunities for dialogue on natural resource protection and sustainability to enter public debate and policy.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: rural policy; countryside, vision, traditionalists, idealists, pragmatists, visitors, sustainability

STEEP category: Social: values

Source(s) citing this:

The State of the Countryside 2020 (The Tomorrow Project, The Countryside Agency)

Citation date: 2003

Original research source and date:

Credibility of sources: Expert

Increasing genetic engineering of plants and animals (2011-2015).

Description: Widespread genetic intervention programs for animals and plants; many new forms of plants and animals result from genetic engineering.

Potential Impact(s): - Potential for designer life forms, especially in agricultural production;
- Potential for sweeping changes in livestock and seed stock, with resultant changes in food products;
- Higher crop yields;
- Shifting needs in fertilizer and water requirements, with resultant changes in patterns of agricultural pollution;
- Potential need to regulate the ethics, aesthetics, production, and care of designer pets.

NRP Impacts: - Some positive impacts with GM crops using less water and potentially fewer pesticides;
- Potential negative consequences on biodiversity, seed availability, farmers' reliance on manufacturers;
- Risk of crossover of genetically modified species' traits with wild species;
- Potential for industry-created global catalogue of domestic animals and plants, as a necessary step for useful agricultural bioengineering.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Soils
- Water quality
- Water supply and demand

Impact areas: genetic intervention, engineering, design, plants, animals; agro genetics

STEEP category: Science: technology

Source(s) citing this:

BT Exact Technology Timeline

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

The Business of Innovation: Technology Forecasts (Battelle Memorial Institute)

The Catalog of Tomorrow (TechTV, Que Publications)

Citation date: 2002

Original research source and date: None specifically cited.

Credibility of sources: Expert

Increasing affordability of solar energy (2011-2015).

Description: Increasing affordability of solar energy (2011-2015). Advances in solar energy technology offer a number of opportunities:

- Large-area solar cells with efficiency greater than 20%;
- Solar chimney power station (1.5 km tall);
- Clothes collect and store solar power;
- Multi-layer solar cells with efficiency over 50%;
- Solar reflector satellites bringing sunlight to major sun starved cities;
- Catalytic water decomposition by sunlight;
- Systems based on biochemical storage of solar electricity; and
- Space-based solar power stations.

Potential Impact(s): - Infrastructure redesign to adapt to increase solar power capabilities;

- More households 'seceding' from the grid;
- Less battery use resulting in less pollution;
- More exotic materials embedded in solar-enhanced clothing and small consumer items, eventually leading to exotic materials contamination in landfills;
- Less winter depression and changing patterns in plant growth, given 'beamed' sunlight technology.

NRP Impacts: - Decrease in fossil fuel based impacts on climate and sustainability;

- Potential increase in exotic materials contamination from solar cell production and discarded solar energy technologies, depending upon design and materials used;
- Possible accelerated move to hydrogen economy with feasibility of solar-powered catalytic water decomposition.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: energy, solar cells, solar power, solar chimney, solar reflector satellites, space

STEEP category: Science: technology

Source(s) citing this:

BT Exact Technology Timeline

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

The Business of Innovation: Technology Forecasts (Battelle Memorial Institute)

The Catalog of Tomorrow (TechTV, Que Publications)

Citation date: 2002

Original research source and date: None specifically listed in either.

Credibility of sources: Expert

Increasing pressure on landfills, waste disposal capacity (2007-2010).

Description: Landfills in London and surrounding region will soon be full; 70% of landfills in USA are full. The cost of landfill in EU will rise from 3 billion euros to 5 billion euros by 2010. Solid waste is increasing in the UK by up to 3% per year (equal to filling the Albert Hall every 30 minutes). By 2010 total controlled UK waste will be 250 million tonnes out of total of 434 million tonnes. Potential for development of bioreactors to generate energy from "LFG" (landfill gas).

Rising concern over potential health risks associated with accumulation of hazardous waste landfills such as birth defects in babies born nearby.

Potential Impact(s):

- Increasing groundwater pollution;
- Increasing insults to domestic and wild animal and plant health;
- Increasing pressures for recycling and minimalist packaging;
- Health risks associated with accumulation of hazardous waste landfills: birth defects in babies born nearby;
- Increasing requirements for manufacturers to take responsibility for solid waste at the end of their products' life, affecting both manufacturing and waste disposal practices (e.g., EU End of Life Vehicle Directive and EU WEEE directive, on waste from electronics).

NRP Impacts:

- Reduced land capacity for other uses;
- Increased costs of landfill management leading to increased fly tipping;
- Increased possibility of groundwater pollution from chemical and bacteriological seepage;
- Increased possibility of air pollution from spontaneous landfill fires.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Landscapes
- Soils
- Water quality

Impact areas: environment; waste; landfills

STEEP category: Environment: geosphere

Source(s) citing this:

BT Exact Technology Timeline

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

State of the World 2003

The Catalog of Tomorrow (TechTV, Que Publications)

The Futures Project: Synthesis Report (IPTS, EU)

UK Environment Agency Rolling Trends Register 2004

Citation date: 2002

Original research source and date: Coopers and Lybrand, 1996.

State of the World 2003, p. xxi, cites UK study announced 26/01/2002.

Credibility of sources: Expert

Continued urbanisation (2011-2015).

Description: By 2010, more than 50% of all people will live in urban areas. In developing countries, the proportion of urban dwellers will rise from less than 20% in 1950 to more than 40% in 2010. Nearly all the 2.2 billion people to be added to world population by 2030 will be in urban areas of the developing world.

The current addition of 60 million new urban citizens a year is equivalent to adding another Paris, Beijing, or Cairo every other month.

The global human population is growing by 3% per year up to 2030, with 95% of that growth in the developing world. By 2015, the world will be predominantly urban.

Potential Impact(s): - Continued rural economic uncertainties;
- Increased population and environmental pressure at urban/rural boundaries;
- Increasing urban density aggravates social pathologies and heightens crime, community conflicts, and anti-social behaviours of all types;
- Increasing need to tackle issues of urbanisation and sustainability at global levels.

NRP Impacts: - Potential 25% increase in household waste;
- Loss of 77,500 hectares greenfield land;
- Will increase pressure on natural resources - could be mitigated by intelligent design in high-rise housing builds.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Soils
- Water supply and demand

Impact areas: population growth; urbanisation; demographics
additional water needs, waste and Co2 emissions

STEEP category: Social: demographics

Source(s) citing this:

Britain in 2020 (Forethought, Labour Party)

BT Exact Technology Timeline

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts (CIA)

State of the World 2003

Strategic Futures Thinking (Strategic Foresight / DERA)

Tomorrow's Markets: Global trends and their implications for business (WBCSD)

UK Environment Agency Rolling Trends Register 2004

Citation date: 2002

Original research source and date: None specifically cited in BT Exact Technology Timeline.

Global Trends 2015, p. 19.

UNPD, World Population Prospects, 1999.

State of the World 2003, p. xxi, citing UN projection dated 20/03/2002.

Credibility of sources: Expert

Increased impacts on agriculture from global warming (now to 2006).

Description: Changes to growing seasons, altered rainfall patterns, and shifting distribution of crop belts, as well as increases in severe weather effects.

Potential Impact(s): - Grain belts shift northward;
- Change in food production;
- Shifts in trade patterns;
- Increased risk of flooding, forest fires and drought.

NRP Impacts: - Patterns of biodiversity will change regionally, as species die out or migrate to more viable climates;
- Extinction of those species unable to migrate;
- Possible contamination of freshwater resources due to increased severe weather events exacerbating storm surge;
- More frequent smog inversions with increase in high-temperature days in urban centres.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Global warming; agriculture; crop yields; crop belts; climate zones, soil erosion

STEEP category: Environment: geosphere

Source(s) citing this:

Strategic Trends (MOD)

Vital Signs 2004 (Worldwatch Institute)

Citation date: 2002

Original research source and date: ICLEI website

Credibility of sources: Expert

Increased pressure for tighter environmental controls (now to 2006).

Description: Continued environmental damage in developing world heightens policy impacts in developed world.

Potential Impact(s): - Increasing public outcry regarding environmental damage and crises;

- Global conscience and increased awareness mean tighter controls on emission of harmful chemicals into the environment;
- Increased fines for breaches in protocols and agreements;
- Increased research to find less harmful substitutes for harmful chemicals and materials;
- Increased production costs for industry;

NRP Impacts: - Prioritising areas for discussion, negotiation and regulation;

- Increasing public understanding of the importance and value of sustaining natural resources;
- More effective controls locally to curb environmental damage;
- Foundation for more effective global controls to curb environmental damage.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Environmental damage; environment controls

STEEP category: Politics: policies

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Strategic Trends (MOD)

The Catalog of Tomorrow (TechTV, Que Publications)

Citation date: 2002

Original research source and date: Global Environment Outlook 2000 UN Website

Credibility of sources: Expert

Increased risk of exotic species appearing in the UK (now to 2006).

Description: The mechanisms that transport exotic species around the world are likely to increase as world trade is liberalised, new global markets open up, and the movement of both people and goods around the world increases. Furthermore, warming attributable to climate change might mean that alien species migrate to the UK on their own, and that exotic species that do find their way here are more likely to survive and thrive.

Potential Impact(s): - Introduction of organisms, crops and livestock pests, human diseases, and parasites will affect the natural environment;
- Increased competition for a food source by introduction of 'alien' species;
- Containment and eradication costs will rise;
- Greater debate on what constitutes an 'alien' or 'native' species.
- New insect and disease pressures on crops may affect food security.

NRP Impacts: - Disruption of the balance of UK ecosystems;
- Decreased biodiversity;
- Increase in spread of pathogens and spread of animal, plant, and human diseases.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Marine environment

Impact areas: Exotic; species; trade; transport; travel; globalisation

STEEP category: Environment: biosphere

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Emerging Environmental Challenges (California EPA)

Citation date: 1998

Original research source and date: Andrew Cohen, 1998, breakout session Cal EPA.

Credibility of sources: Expert

Increased urbanisation will increase light pollution (now to 2006).

Description: Urbanisation, increased building density, more extensive highway and road lighting, safety considerations, and temporal shifts in human activity (the emergence of the 24/7/365 society) mean more light pollution in the environment, as buildings, highways, streets and houses are lit around the clock.

Potential Impact(s): - Aesthetic impacts including inability to see the night sky;
- Increased impacts on human health, e.g., sleep patterns;
- Increased disruptions to the habitats, behavior patterns, and health of wildlife.

NRP Impacts: - Heightened impacts on nocturnal species;
- Changes to animal hunting patterns;
- Changes to reproductive patterns in certain species.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity

Impact areas: light; pollution; environment; human activity; urbanisation;

STEEP category: Social: lifestyles

Source(s) citing this:

City-Region 2020 (CURE, University of Manchester)

Emerging Environmental Challenges (California EPA)

Citation date: 1998

Original research source and date: none cited

Credibility of sources: Expert

Increasing shift in balance of power within supply chains from food producers to the major retailers (now to 2006).

Description: Technological change makes customers increasingly fleet of foot vis-a-vis shifting from one supplier, producer, or brand, to another; major retailers increasingly have knowledge management systems to track customer purchasing, giving them an advantage in deciding what to sell, and therefore what to order from primary producers.

Potential Impact(s): - Possible increase in failure rate of farm businesses;
- Increased need to renegotiate and restructure relationships between UK food producers, suppliers, and retailers;
- Potential for increased number of producer cooperatives, and innovations in food supply chain structures.

NRP Impacts: - Increasing impacts on the management and use of land as more farmers go out of business;
- Increase in monoculture with increased susceptibility to disease;
- Possibility of increased use of 'factory farm' meat production, with subsequent erosion of quality of life and health of domestic farm animals.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Landscapes
- Soils
- Water supply and demand

Impact areas: food; brand; consumer; food producers; food suppliers; food retailers

STEEP category: Economic: production

Source(s) citing this:

Current Trends and Uncertainties for the Future of Agriculture (US APHIS/CEI)
DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Citation date: 2004

Original research source and date: None listed.

Credibility of sources: Expert

Increases in the number and kind of actors in international governance, and the challenges to policy (now to 2006).

Description: Increased potential for challenges to international regulatory and policy environments with increases in number and kind of actors in international governance: increasingly 'multi-level governance' -- more international, national, and sub-regional or local policy-makers, regulatory bodies, and private organisations challenging injustices, inequities, and cultural differences in regulations and standards.

Potential Impact(s): - Shifting regulatory environment places more demands on Defra policy-makers, and on regulatory and standards enforcement;
- Increased possibility for cross-cultural conflicts and value disputes in policy discussions where concerns of international actors must be accommodated.

NRP Impacts: - Support for improvement of natural resource protection;
- Wider critical review of Defra policies and performance;
- Requirement for increased communication with external stakeholders on Defra projects and policies.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: governance; international standards; international regulations; trading blocs

STEEP category: Politics: governance

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Millennium Institute: Publications

People and Connections: Global Scenarios to 2020 (Shell International Ltd.)

Scenarios Europe 2010: Five Possible Futures for Europe (EU/FSU)

Strategic Futures Thinking (Strategic Foresight / DERA)

Citation date: 2001

Original research source and date: Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts (CIA), December 2000; Strategic Future Context for Defence (MOD), 2001

Credibility of sources: Expert

Increased innovations in governance and regulation to heighten transparency of decision-making (now to 2006).

Description: Increased participation in policy-making by experts, stakeholders, and the public; legislation facilitating freedom of information; greater use of electronic channels for delivery of information and services; greater and more explicit use of evidence; and new combinations of deliberative and participatory (physical and electronic) methods of policy-making.

Potential Impact(s): - Increased potential for interest-group conflict and manipulation of policy process;
- Increased public satisfaction with policies;
- Increased concerns over security and reliability of electronic channels – particularly if used to for voting and opinion testing;
- Uncertain impact of delivering freedom of information legislation on resource requirements and public perceptions;
- New skill requirements for policy and regulatory staff;
- Increased pressure on government budgets.

NRP Impacts: - Local interests are more likely to be protected, although public goods may be adversely affected;
- Increase in single-issue politics, including environmental issue politics;
- Increased opportunity for a well-organised lobby group to influence environmental policies, which either environmentalists or anti-environmentalists could use to their advantage;
- Increased public ability to access scientific documentation on environmental policy and participate in setting environmental goals and priorities for sustainability.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: transparency; decision-making; participatory decision-making; evidence-based decision-making

STEEP category: Politics: governance

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Global Governance Initiative Annual Report 2005

Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts (CIA)

Citation date: 2004

Original research source and date: None listed.
Credibility of sources: Expert

Growing competition for marine and coastal resources (2007-2010).

Description: Growth in use of both coastal and marine resources and space, e.g., for offshore wind parks, ocean farming, deep-sea fishing, leisure and recreation.

Potential Impact(s): - Increase in conflicts over shore / coastal / marine resources at both local and international levels;

- Heightened need for use planning, marine zoning, and other regulatory measures;
- Increased need for policy, monitoring, and policing resources for increasingly congested marine environment;
- Increasingly valuable coastal resources could become targets for terrorists and organised crime;
- Accelerated decline of major fisheries, of which 14 are now in danger.

NRP Impacts: - An increased need for protected areas to be defined rapidly;

- Increased need for international policy to be clarified;
- Necessity of educating consumers on marine products.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Marine environment

Impact areas: coastal resources; marine resources; offshore; ocean farming; deep sea fishing

STEEP category: Economic: production

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)
The Effects of Fishing on Marine Ecosystems

Citation date: 2004

Original research source and date: None listed (workshop).

Credibility of sources: Expert

Increase in 'precision farming' due to application of innovations (2007-2010).

Description: Microsensing arrays, remote sensing, advanced biosystems analysis, and genomic analyses allow farmers to conserve resources and inputs while heightening productivity.

Potential Impact(s): - Better use of scarce resources;

- Less use of chemicals with resultant gains in quality of environment, water, and food;
- Need for retraining / reskilling among agricultural workers to keep up with innovations;
- Need for more agricultural extension programs;
- Shifting labour needs in agriculture.

NRP Impacts: - Enhances possibility of increased agricultural production with fewer negative impacts on biodiversity, e.g., use of remote sensing to focus pesticide application to limit negative impacts on beneficial insects;

- Healthier agricultural outputs;
- Less non-point-source agricultural pollution;
- Better use of resources.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Soils
- Water supply and demand

Impact areas: precision farming; microsensing; remote sensing; biosystems modelling; genomic analysis

STEEP category: Science: technology

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Multispectral remote sensing and site-specific agriculture: Examples of current technology and future possibilities

Citation date: 2004

Original research source and date: None listed (workshop).

Credibility of sources: Expert

Changing patterns of disease resistance and disease among wildlife, domestic animals, and plants (2007-2010).

Description: With increased amounts of non-point source chemical background pollution degrading animal immune systems coupled with increased antibiotic use in agriculture producing more antibiotic-resistant microbes, new types and patterns of disease and disease resistance will emerge among wildlife, domesticated animals, and plants.

Potential Impact(s): - Demand for new breeds of plants and animals;
- Changes in antibiotic formulation and application;
- Increased import/export wariness and alien species controls;
- Need for enhance quick response team / crisis management for animal and plant diseases / epidemics.

NRP Impacts: Potential for increasing pressure to:
- Regulate farm animal habitat and conditions;
- Review transportation and slaughterhouse practices and routes;
- Diversify animal husbandry to avoid overcrowding in animal intensive farming.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity

Impact areas: disease; disease resistance; animal health; plant health; agriculture; antibiotics; non-point-source pollution

STEEP category: Environment: biosphere

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Citation date: 2004

Original research source and date: None cited (workshop).

Credibility of sources: Expert

Increased public concern over sustainability, biodiversity, wildlife protection and welfare (now to 2006).

Description: Public increasingly aware of animal and habitat endangerment, degradation, and loss, with increased availability of data on animal and environmental viability and welfare. The environment becomes a stronger political issue, with protection of wildlife, biodiversity and security of food chains becoming of greater public concern. Individuals and organizations continue to speak out on the effects of pollution and on need for regulation.

Potential Impact(s): - Increasing politicisation of environment, countryside, wildlife, agriculture, and food issues;
- Increase in regulations and in complexity of regulatory environment, with possible dampening effect on some economic activities, offset by creation of new niche markets;
- Potentially greater willingness of society to accept controls on consumption, waste disposal and behaviour to achieve sustainability goals.

NRP Impacts: - Increased public demand for more protection, more prevention;
- Pressure for relevant agencies to widen their scope of concerns;
- Increased public costs for sustainability programs and wildlife stewardship;
- Potential for increased use of public support to assist in maintaining wildlife reserves.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: technology; wildlife protection organizations; alternate energy sources and development; environment; ecosystem; sustainability; biodiversity; consumer values

STEEP category: Social: values

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)
Public Attitudes Towards Recycling and Waste Management

Citation date: 2004

Original research source and date: None listed (workshop).

Credibility of sources: Expert

Increasingly common closures of traditional fishing grounds (2007-2010).

Description: The future will hold increasingly common closure, or temporary ban, of fishing in traditional fishing grounds (US data) as fish stocks are pressured. Despite the UN Law of the Sea, the loss of biological resources in the marine realm do not appear in national accounts and the only country that enforces the law is Namibia which polices protected exclusion zones.

Potential Impact(s): - Depressed fishing industry;
- Increasing competition for remaining open grounds;
- Higher price of fish;
- Aquaculture becomes more competitive.

NRP Impacts: - Long-term recovery of fish stocks in closed grounds;
- Long-term recovery of sea bed environment;
- Pile-up of dead fish on sea floor as a result of ordered throw back;
- Over fishing in foreign and distant fishing grounds.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Marine environment

Impact areas: marine fish stocks; commercial fishing; fishing bans

STEEP category: Politics: policies

Source(s) citing this:

Current Trends and Uncertainties for the Future of Agriculture (US APHIS/CEI)
Fish of the Day Can consumers help save UK fisheries?

Citation date: 1998

Original research source and date: None cited in Current Trends (APHIS/CEI).

Credibility of sources: Expert

Increasing risk of serious complications associated with food-borne disease (2007-2010).

Description: Increasing risk of serious complications associated with food-borne disease as greater proportion of the population incurs depressed immune systems due to increased age, drugs, and disease.

Potential Impact(s): - Increase in patients developing secondary long-term illnesses after recovering from initial food-borne infection;
- Increased financial impacts from food-borne illness due to medical costs, productivity losses from missed work as well as from premature death;
- Increased expense in processing and packaging food;
- Major economic disruption;
- Disruption of food supply.

NRP Impacts: - Potential increase in damage to farm and wild animals as well as humans;
- Loss of confidence in UK food supply - consumers resorting to other sources for food supply (see BSE).

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity

Impact areas: food; contamination; food-borne disease; food processing; epidemiology

STEEP category: Environment: biosphere

Source(s) citing this:

Current Trends and Uncertainties for the Future of Agriculture (US APHIS/CEI)
Effects of Food-Safety Perceptions on Food Demand and Global Trade - Changing Structure of Global Food Consumption and Trade

Citation date: 1998

Original research source and date: None listed in Current Trends (APHIS/CEI).

Economic Research Service

www.ers.usda.gov/Briefing/FoodborneDisease/overview.htm

Credibility of sources: Expert

New, emerging and re-emerging animal and zoonotic diseases (2007-2010).

Description: Increased possibility of new, emerging and re-emerging animal and zoonotic diseases. This is potentially due to ecological change and growing economic, agricultural and social forces that drive vast movements of hosts together.

Potential Impact(s): - Potential for epidemic-based economic crisis in domestic agriculture, e.g., BSE and foot-and-mouth;
- Increased pressure for new practices in meat production, including size limitations on herds, changed transport practices, etc.;
- Increased research on comparative breed vulnerability to new and re-emerging diseases.

NRP Impacts: - Potential for certain breeds to be hit harder than others, or made completely extinct (e.g., in plants, Dutch Elm disease);
- Potential cross-over to wild animal populations;
- Potential drastic losses in agricultural livelihood and subsequent farm closures;
- Need for research on infection vectors, with subsequent costs to remove vectors from environment, or severely constrain them.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity

Impact areas: animal diseases; animal production practices; animal transport

STEEP category: Environment: biosphere

Source(s) citing this:

Current Trends and Uncertainties for the Future of Agriculture (US APHIS/CEI)
UK Environment Agency Rolling Trends Register 2004

Citation date: 1998

Original research source and date: APHIS Time line,
www.aphis.usda.gov/history.html.

Steele, JH. "History of veterinary public health in the United States of America." Rev Sci Tech Off Int Epiz 1991;10:951-983.

Kaplan, MM and Bogel, K. "Historical perspective of the origins and development of international veterinary public health in the World Health Organization." Rev Sci Tech Off Int Epiz 1991;10:915-931.

Grossklaus, D. "The future role of the veterinarian in the control of zoonoses." The Vet Quart 1987; 9:321-331.

Credibility of sources: Expert

New kinds of foodborne outbreaks emerge (2007-2010).

Description: New kinds of foodborne outbreaks, which are more diffuse and widespread, have appeared due to changes in the way food is produced and distributed. Traditional outbreaks tend to be acute and highly local, with a high inoculum dose, high attack rate and typically follow a social event. The new kind of outbreaks are the result of low-level contamination of a widely distributed commercial food product.

Potential Impact(s): - Disproportionate impacts on elderly, ill, and young (low-level contamination has a higher impact on people with weak immune systems);
- Potential for "rolling contamination outbreaks" causing widespread weakening of immune system in population, and general degradation of public health;
- Productivity costs due to missed work;
- Potential for broader acceptance of more extreme hygienic techniques such as irradiation;
- Decline of sales for related brands and products.

NRP Impacts: - Heightened public awareness of importance of good farm and food practices;
- Heightened public outcry against industrial or factory farming;
- Potential for crossover contamination to natural environment and wildlife.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity

Impact areas: food contamination; widespread disease outbreaks

STEEP category: Environment: biosphere

Source(s) citing this:

Current Trends and Uncertainties for the Future of Agriculture (US APHIS/CEI)
Effects of Food-Safety Perceptions on Food Demand and Global Trade - Changing Structure of Global Food Consumption and Trade

Citation date: 1998

Original research source and date: Special Issue on Food Safety, Emerging Infectious Diseases 1997; Vol. 3, no. 4.

Credibility of sources: Expert

Rising meat demand in developing world (2016-2030).

Description: In developing regions such as Latin America, North Africa, the Middle East, and much of Asia (including China, Taiwan, and South Korea), rising incomes are leading to rising meat demand. Consumption of meat and milk in developing countries will grow between 2.8% and 3.3% per year respectively from 1993 to 2020. The International Food Policy Research Institute (IFPRI) forecasts a 58 per cent increase in meat demand between 1995 and 2020. To meet this demand, the UNFAO forecasts that world meat production will grow to more than 300 million tons by 2020.

Potential Impact(s):

- Increased developing world meat production;
- Strong meat demand will double developing countries' feed-grain demand, and farmers will have to produce 40 per cent more grain in 2020 to meet increased feed-grain demand, with four-fifths coming from yield increases rather than farmland expansion;
- Increased export potential for UK producers;
- Potential need to vary product and processing for different markets;
- Increased pollution and environmental impacts: manure from hog factories, chicken houses and cattle feed lots can contaminate groundwater and rivers and can pollute the air. Cattle contribute to climate change by producing methane gas, and can decimate grasslands through overgrazing.

NRP Impacts:

- Increased nitrogen pollution;
- Increased groundwater and river contamination from manure;
- Increase in cattle-generated methane contributing to greenhouse gases;
- Degradation of grasslands due to overgrazing;
- Increased poaching of wild animals as meat supply
- Increased pressure on wildlife;
- Increased destruction of habitat and rainforest as land is cleared for ranching.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Soils
- Water quality
- Water supply and demand

Impact areas: cattle; meat exports; global agricultural sales; feed grain; nitrogen pollution; methane pollution;

STEEP category: Social: lifestyles

Source(s) citing this:

Current Trends and Uncertainties for the Future of Agriculture (US APHIS/CEI)
Tomorrow's Markets: Global trends and their implications for business (WBCSD)
Vital Signs 2004 (Worldwatch Institute)

Citation date: 1998

Original research source and date: Dees, SP. "The changing global marketplace," speech at the Agricultural Outlook Forum, 1996.
gopher://usda.mannlib.cornell.edu:70/00/reports/waobr/aof/aof96/dees.asc
Delgado, C, Rosegrant, M, et al. "Livestock to 2020: The Next Food Revolution." 1999, Washington DC: International Food Policy Research Institute.

Credibility of sources: Expert

Illegal fishing increasingly a problem for sea management (2011-2015).

Description: Catches of commercially valuable fish species in some places will surpass permitted levels by 300%. Increasing corporate use of high seas dragnets is damaging fish stocks.

Potential Impact(s):

- Accelerated change in the structure of marine habitats and the diversity, composition, biomass and productivity of the associated biota;
- Increasing direct effects of fishing such as the scraping, scouring, and resuspension of substratum;
- Increasing impacts in sheltered areas where complex habitats develop at minimal depth, such as coral reefs;
- Increasing indirect impacts on related species, e.g., removal of some prey that piscivorous fishes, birds, and mammals would otherwise consume, or removal of predators that would otherwise control prey populations;
- Potential impacts from reductions in the density of some species that affect competitive interactions, resulting in the proliferation of non-target species.

NRP Impacts:

- Increased marine ecosystem and biota degradation;
- Increased damage to coral reefs;
- Increased disruption in fish stocks with secondary impacts on related species; marine predator-prey relationships, including birds; and opportunistic growth of non-target species to fill emptying ecological niches;
- Decreased marine biodiversity.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Marine environment

Impact areas: fisheries; fish stocks; fishing fleets; dragnets; illegal catches; maritime agreements

STEEP category: Environment: ocean

Source(s) citing this:

- Fish of the Day Can consumers help save UK fisheries?
- The Effects of Fishing on Marine Ecosystems

Citation date: 2001

Original research source and date: WWF report, "Fish of the Day."

Credibility of sources: Expert

International law, particularly European law, will have an increasing impact on UK domestic law (2007-2010)

Description: The process of globalisation is pushing nation-states to harmonise their legal systems to deal with issues that transcend borders.

Potential Impact(s): - Increasing need for cooperation and negotiation with other states;
- Opportunity for Britain to help influence the legal and political affairs of other jurisdictions at the same time;
- Increasing integration with other countries' legal systems, leading to freer conduct of business and movements of people and goods among nations;
- Process of agreeing international law may be slowed down as the issues at stake touch on issues considered to be at the heart of national sovereignty;
- Potential for rebellion against EU or for counter-entity to emerge;
- Increasing challenges keeping local issues and EU issues balanced;
- Changing influence of immigrant populations;
- Intensifying awareness of detractors and need to earn the public confidence;
- Potential increase in ability to unite EU resources to handle threats originating from outside the EU;
- Challenge of learning practices and 'cultural norms' of new criminal groups.

NRP Impacts: - Mixed some benefits to environmental protection, with some increasing impacts on population growth through EU enlargement;
- Potential for conflict between the need for fishery reserves and Common Fishing Policy.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Marine environment
- Water quality
- Water supply and demand

Impact areas: EU expansion; single market law; security and defence policy; crime;
- May help enforce some of the environmental protection directives
- May negatively impact UK food and agricultural policy by CAP type agreements
- Increasing complexity coordinating UK policies with EU legal strictures, economic policies, and foreign and security agreements as well as health/environment issues;
- Increased trans-border labour flows;
- Increasing potential for protests, civic actions, and conflict related to EU - UK tensions;
- Potential for entry of criminal groups from enlargement countries.

STEEP category: Politics: governance

Source(s) citing this:

Future Health Care Trends (Strategy Unit, DOH)

Interest Group Influence of Trade Policy - in a Multilevel Polity - Analysing the EU position at the Doha WTO ministerial Conference
Strategic Trends (MOD)
The Future and How to Think About it (PIU / Strategy Unit)

Citation date: 2003

Original research source and date: <http://www.dti.gov.uk/sustainability/weee/>

None listed in "The Future and How..." or 'Strategic Trends' or DOH FHCT.

Credibility of sources: Expert

By 2025, the population of countries that must import food, due to insufficient cropland per capita, could exceed 1 billion (2016 – 2030)

Description: By 2025, the population of countries that must import food, due to insufficient cropland per capita, could exceed 1 billion, more than double the current figure of 420 million (2010-2030). Fertile cropland is being lost at an alarming rate. Nearly one-third of the world's cropland (1.5 billion hectares) has been abandoned during the past 40 years because erosion has made it unproductive.

Most replacement of eroded agricultural land is now coming from marginal and forest land. The pressure for agricultural land accounts for 60 to 80 percent of the world's deforestation. Despite such land replacement strategies, world cropland per capita has been declining and is now only 0.27 ha per capita; in China only 0.08 ha now is available. This is only 15 per cent of the 0.5 ha per capita considered minimal for a diverse diet similar to that of the U.S. and Europe. The shortage of productive cropland combined with decreasing land productivity is, in part, the cause of current food shortages and associated human malnutrition.

Potential Impact(s): The USDA Food Security Assessment report forecasts that per capita food consumption is projected to decline in 47 of the 66 study countries in the next decade, and 39 countries are projected to be unable to meet their minimum nutritional requirements. Sub-Saharan Africa is identified as the most food-insecure region, with further deteriorations projected during the next decade;

- Increased malnutrition, and increased mortality from starvation and increased vulnerability to infection and diseases;
- Decreased economic productivity;
- Accelerated deforestation;
- Increased pressure on water supplies;
- Aggravated environmental degradation.

NRP Impacts: - Increased need to maintain agricultural resources in the UK and to maintain the skill base needed to produce food;
- Increased deforestation, pressure on water supplies, and environmental degradation.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: cropland; agricultural production; food supply; famine

STEEP category: Economic: production

Source(s) citing this:

Food Security Assessment: Why Countries Are At Risk
State of the World 2003

Citation date: 2003

Original research source and date: State of the World 2003, p. 5.

Credibility of sources: Expert

Collisions between population and biodiversity intensify as human numbers and resource use expand (2011-2015).

Description: Collisions between population and biodiversity intensify as human numbers and resource use expand. Irreparable loss of biodiversity is a serious threat, habitat loss caused by human activity being the main cause: 25% of mammal and reptile species are threatened or nearly threatened with extinction, as are 21% of amphibians and 30% of fish.

For biodiversity, it is even more important to save poor-quality land than prime cropland. Ecologist Michael Huston points out in his book *Biological Diversity* that the poorest lands harbour the greatest variety of wildlife species, all over the world. Good quality land typically has thriving populations of a few wild species. In rain forests and swamps, the tough conditions force wildlife into narrow niches - producing lots of species.

Potential Impact(s): - Increasing loss of habitats;
- Increasing extinction of species;
- Increasing productivity costs due to resource loss.

NRP Impacts: - Increased difficulties in maintaining priority to preserve wildlife in the face of need to feed increasing populations;
- Increased need to devise valuation system for environmental tangibles and intangibles in order to operationalise extent of loss in economic terms.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: population; development; investment; infrastructure; ecosystems; species; extinction; water systems; aquifers; wetlands; rainforests; coastal zones; coral reefs

STEEP category: Environment: biosphere

Source(s) citing this:

Meeting the Demands of a Growing Population
State of the World 2003

Citation date: 2003

Original research source and date: State of the World 2003, pp. 56, 15-16.

Credibility of sources: Expert

Declining populations of terrestrial, freshwater and marine species worldwide (40% drop in the period 1970-2000) (2007 to 2010).

Description: The IUCN Red List is widely recognized as the most authoritative and objective system for classifying species at high risk of extinction. The methodology for calculating Red List Indices charts changes in the overall threat status of a species group over time. The indices are based on the number of species in each Red List category, and the number changing categories between assessments as a result of genuine improvement or deterioration in status. The Red List Index for the world's birds from 1988 to 2004 shows that their overall status has deteriorated steadily through this period (see red list <http://www.redlist.org/>).

The WWF reports that fifty-one per cent of freshwater species, from fish and frogs to river dolphins, are declining in numbers (1999 Living Planet Report by WWF).

Potential Impact(s):

- Fundamental restructuring of species relationships and ecological niches;
- Fundamental change in rainforest, wetland, and other terrestrial ecosystems, and in coral reef and other marine ecosystems;
- Potential emerging epidemiological threats as previously untouched ecological niches are disturbed and contaminated;
- Loss of new pharmaceutical compounds;
- Loss of genetic resources;
- Loss of future food resources.

NRP Impacts:

- Increased economic concerns over potential productivity and livelihood losses;
- Increased public agitation for effective action protecting natural resources.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Marine environment

Impact areas: biodiversity; wildlife; extinction; ecological niche

STEEP category: Environment: biosphere

Source(s) citing this:

Living Planet Report 2004

Citation date: 2004

Original research source and date: Living Planet 2004, pp. 1-2.

Credibility of sources: Expert

Overall volume of agricultural output is declining in British farming (since late 1990s).

Description: As of 2005, the gross contribution of agriculture to the economy is in decline. A weak Euro makes exports to Europe more difficult and world prices in general for agricultural commodities have fallen. In the UK, BSE, swine fever, and foot and mouth disease have in the past hampered UK agriculture's ability to export with consequent pressure on prices.

Potential Impact(s): - Increased farm failures;
- Increased transition of countryside economics;
- Accelerating transformation of traditional rural and countryside lifestyles;
- Loss of agricultural skills: loss of knowledge and new crop skills;
- Potential acceleration of loss of green belt as with loss of farms.

NRP Impacts: - Decreased food security;
- Land management challenges.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Water supply and demand

Impact areas: cereals; beef; dairy; farm productivity; agriculture; farm prices

STEEP category: Economic: production

Source(s) citing this:

Collaborative Supply Chain Investment: An Imperative for British Farming?

Citation date: 2004

Original research source and date: Collaborative Supply Chain Investment, p. 2.

Credibility of sources: Expert

Continued growth in aquaculture (farmed fish and shellfish production) (2007-2010).

Description: Rising demand for fish and shellfish and declining productivity of marine and freshwater ecosystems have driven the modernization and fast growth of aquaculture: farmed fish and shellfish production has grown in volume more than tenfold since 1970, rising from 3.5 million to 42.8 million metric tons.

In 1998, total world production of finfish, crustaceans (shrimps, prawns, crabs etc.), and molluscs (e.g. clams, oysters, mussels), from capture fisheries and aquaculture reached 117.2 million mt. A quarter of the fish eaten in the world now comes from aquaculture.

Asia accounted for over 90% of world aquaculture output in the late 1990s. Much of this was in China where the year-on-year increase was around 15%. In the rest of Asia, growth has been closer to 3% per year, similar to that in Europe and North America (3 - 4%).

Potential Impact(s): - Some problems of over-fishing addressed;
- Potential for high environmental costs in coastal land use, water pollution in near-shore environment, and use of ocean-caught fish in fish feeds;
- Potential for rising opposition from animal activists and local communities.

NRP Impacts: - Increased pressure on coastal zone environment;
- Increased pollution in near-shore marine environment.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Marine environment
- Water quality

Impact areas: fish catch; fish production; shellfish production; coastal land use; water pollution

STEEP category: Economic: production

Source(s) citing this:

EarthTrends: The Environmental Information Portal (World Resources Institute)

Tomorrow's Markets: Global trends and their implications for business (WBCSD)

Citation date: 2002

Original research source and date:

Credibility of sources: Expert

An increasing requirement for reliable regional predications for realistic adaptation strategies and investigation of the risks of rapid climate change (2011-2015)

Description: 4018. An increasing requirement for reliable regional predications for realistic adaptation strategies and investigation of the risks of rapid climate change. (now-2010)

Potential Impact(s): Can allow relocation of wildlife and plant species if at risk

NRP Impacts: - good predictive capacity will mitigate lack of response based on prior experience of over pessimistic predictions

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: reliable regional predications, adaptation strategies, climate change

STEEP category: Environment: geosphere

Source(s) citing this:

Evidence and Innovation - Defra's needs from the sciences over the next 10 years

Citation date: 2004

Original research source and date: Evidence and innovation: Defra's need from the sciences over the next 10 years. (PB 9227)

Credibility of sources: Expert

Increasing technical challenges to global agriculture from resource constraints and emerging environmental changes (now to 2010).

Description: Increasing technical challenges to global agriculture from resource constraints and environmental degradation, new pests and diseases, and climate change.

Conversion of prime agricultural lands into other uses has placed tremendous pressure on the agricultural sector to increase productivity per unit area. Productivity has been affected by poor soil fertility, the incidence of pests and diseases, abiotic stresses such as drought caused by El Niño, and climatic factors, especially typhoons.

Potential Impact(s): - Lowered agricultural productivity;
- Potential for permanent degradation of soil fertility;
- Increase in erosion;
- Increase in agricultural R&D to use energy effectively and improve plant yields, crop monitoring, water administration and pest control.

NRP Impacts: - New technology could make current agricultural land under management more productive, thus decreasing pressure on wildlife resources, however it could also enable use of land not currently cultivated;
- Increased need for technology impact assessment to prevent or ameliorate unintended consequences of new agricultural technologies.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: global agriculture; technology; R&D; resource constraints; environmental degradation; pests; disease; climate change

STEEP category: Economic: production

Source(s) citing this:

Knowledge transfer initiative on impacts and adaptation to climate change in agriculture

Philippines: Challenges, Opportunities, and Constraints in Agricultural Biotechnology

Citation date: 2004

Original research source and date: Evidence and innovation: Defra's need from the sciences over the next 10 years. (PB 9227)

<http://www.fao.org/ag/magazine/0504sp3.htm>

Credibility of sources: Expert

Continued challenge of safe disposal of spent nuclear fuel (2016 - 2030).

Description: The challenge of safe disposal of spent nuclear fuel continues. Although it becomes more benign as time passes, even after 100 years it is still lethal: such materials require guaranteed isolation for several hundred thousand years. A total of 125 commercial nuclear reactors have operated in the USA, and \$6bn has been spent developing a huge nuclear waste storage facility inside Yucca Mountain, Nevada.

About 270,000 tonnes of spent fuel is in storage in Australia, much of it at reactors. Annual arisings of spent fuel are about 12,000 tonnes, and 3,000 tonnes of this goes for reprocessing (Australian - Uranium Information Centre).

Potential Impact(s): - Potential for accidents in transit from nuclear facility to waste disposal site;

- Potential containment failure, with any resulting seepage causing groundwater contamination and soil contamination;
- Potential for long-term poisoning of biosphere and ongoing genetic damage;
- Increasing regulatory constraints result in rising costs for nuclear power.

NRP Impacts: - Areas of storage of nuclear waste will be no-go areas;

- Increased danger of potential seepage into water and soil;
- Increased danger of biosphere contamination and loss of biodiversity through genetic damage.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Soils
- Water quality

Impact areas: nuclear waste; waste disposal; long-term planning; nuclear storage facilities

STEEP category: Science: technology

Source(s) citing this:

Technology Review: MIT's Magazine of Innovation

Waste Management in the Nuclear Fuel Cycle - Nuclear Issues Briefing Paper 9

Citation date: 2004

Original research source and date: Technology Review, December 2004, pp. 38-44.

Credibility of sources: Popularist

Growing "green architecture" movement: designs that focus on the long-term environmental impact of maintaining and operating a building (2016-2030).

Description: The growing "green architecture" movement focuses on the long-term environmental impact of maintaining and operating a building. Formalised in standards such as the UK's BREEAM and the USA's LEED, similar standards have been adopted in New Zealand, Australia, and Canada, with Beijing aiming to host the first zero-net-emissions Olympic Games.

Green architecture recoups its building costs with operating savings; increases worker productivity via provision of natural light; and increases sales in commercial spaces. Architecture software is being designed to incorporate environmental design considerations.

Potential Impact(s): - Lowered productivity costs due to increased worker health and efficiency;
- Decreased energy demand;
- Reduction in waste and more efficient utilisation of urban resources.

NRP Impacts: - Reduced impacts on land used for building;
- Reduced water and energy consumption.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Soils
- Water quality
- Water supply and demand

Impact areas: green architecture; BREEAM; LEED; environmental quality; sick buildings

STEEP category: Science: technology

Source(s) citing this:

Technology Quarterly (The Economist)

Citation date: 2004

Original research source and date:

http://www.economist.com/science/tq/displaystory.cfm?story_i...; see also

http://www.bre.co.uk/services/BREEAM_and_EcoHomes.html ;

http://www.usgbc.org/leed/leed_main.asp ; and

<http://www.heinz.org/index.asp?loc=E,E5,E5a>

Credibility of sources: Popularist

Growing pressure for technologies that could increase the production of food per unit area sustainably (2011-2015).

Description: Agricultural expansion will continue to be one of the major drivers of biodiversity loss well into the 21st century. Development, assessment, and diffusion of technologies that could increase the production of food per unit area sustainably without harmful tradeoffs due to excessive consumption of water or use of nutrients or pesticides would significantly lessen pressure on other ecosystem services.

The world's annual cereal yield growth rate has declined from an average of 2.2 percent in the 1970s to 1.1 percent in the 1990s. This global slowdown has raised concerns that yield growth may have reached a plateau or begun to decline in many of the world's most fertile areas. Compensation of this by over application of inorganic and organic fertilizers is estimated to have boosted nutrient capacity in the soil but oversupply of nutrients can lead to environmental contamination. In the United Kingdom, some 1.6 million people get water with nitrate levels that exceed guidelines.

Genetic research has begun to identify the genes responsible for such nitrogen fixation and assimilation. Further research offers the opportunity of altering or developing micro organisms that can fix nitrogen in non-leguminous plants, such as cereals. As with leguminous plants, plant nitrogen needs could be partially met by the plant itself, such that farmers could then simply need to top up crops with inorganic nitrogen fertilizers.

Potential Impact(s): - Greater investment in sustainable agricultural practices;
- R&D budget allocations required to develop environmentally benign approaches to increasing agricultural productivity;
- Increased interest group and public pressure for tighter limits on use of chemicals in agriculture;
- Potential for growing use of genetically modified crops despite public opposition.

NRP Impacts: - Lessens impact on biodiversity, wild species and habitats;
- Lessens soil and water pollution;
- Increases ability to maintain soil fertility long-term;
- Decreases pressure on water supplies.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: food supply; soil fertility; water pollution; genetic engineering of plants

STEEP category: Environment: biosphere

Source(s) citing this:

Integrated Nutrient Management, Soil Fertility, and Sustainable Agriculture: Current Issues and Future Challenges
Millennium Ecosystem Assessment

Citation date: 2000

Original research source and date:

Credibility of sources: Expert

Increasing synthetic nitrogen fertilizer run-off (2011 to 2015).

Description: Since 1960, flows of reactive (biologically available) nitrogen in terrestrial ecosystems have doubled, and flows of phosphorus have tripled. More than half of all the synthetic nitrogen fertilizer (which was first manufactured in 1913) ever used on the planet has been used since 1985.

Land disposal of manure adds considerable nitrogen to the land since most of the nutrients in feed go to manure. For example, about 70 percent of the nitrogen in the feed consumed by dairy cows, swine, and layers is excreted. Broilers are more efficient: only about half of the nitrogen in their feed ends up in manure.

Potential Impact(s): Potential effects across the life cycle of synthetic nitrogen fertiliser include:

- global warming due to the production and application of fertiliser;
- damages due to air pollutants emitted during the production of fertiliser;
- increased eutrophication of lakes and streams due to leaching of applied fertiliser;
- pollution of drinking water (NO₃) due to leaching of applied fertiliser and concomitant health hazards; and
- damages due to release of volatile substances (especially NH₃) from applied fertiliser.

- Potential for increased use of 'no-till' agriculture: Ploughing to control weeds is replaced by mulching crop materials, which are left on the surface, and controlling weeds by herbicides; after several years this approach produces a soil structure highly resistant to erosion, run-off and leaching: nitrate loss from a fertilized no-till field is approximately 12–20% of that from the equivalent ploughed field.

NRP Impacts: Increasing risks of damages from fertiliser over-use:

- accelerated soil degradation;
- contaminated drinking water;
- increased CO₂ emissions;
- marine pollution and transformation of marine ecosystems.
- transformation of marine ecosystems and marine biodiversity impacts.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Marine environment
- Soils
- Water quality

Impact areas: nitrogen; nitrates; fertilizer; run-off; leaching; water supply; water contamination; 'no-till' agriculture; manure; phosphorus

STEEP category: Environment: biosphere

Source(s) citing this:

Damage Costs of Nitrogen Fertiliser and Their Internalization

Millennium Ecosystem Assessment

Citation date: 2004

Original research source and date: Millennium Ecosystem Assessment

<http://faostat.fao.org/faostat/servlet/XteServlet3?Areas=347...>

Credibility of sources: Expert

Increasing costs of damage to UK from current agricultural practices (2016 to 2030).

Description: In 1996, the costs to the U.K. resulting from the damage that agricultural practices cause to water (pollution and eutrophication, a process whereby excessive plant growth depletes oxygen in the water), air (emissions of greenhouse gases), soil (off-site erosion damage, emissions of greenhouse gases), and biodiversity was \$2.6 billion, or 9% of average yearly gross farm receipts for the 1990s. Similarly, the damage costs of freshwater eutrophication alone in England and Wales (involving factors including reduced value of waterfront dwellings, water treatment costs, reduced recreational value of water bodies, and tourism losses) was estimated to be \$105–160 million per year in the 1990s, with an additional \$77 million a year being spent to address those damages.

The costs of agricultural (environmental and health costs) damage include: i) treatment or prevention costs incurred to clean up the environment and restore human health to comply with legislation or to return these to an undamaged state; and ii) administration and monitoring costs incurred by public agencies for monitoring environmental, food and health. For example, it costs water companies £120 million each year to remove pesticides – not completely, but to a level stipulated in law as acceptable (0.1 mg/litre for a single product and 0.5 mg/l for total pesticides). Water companies do not pay this cost; they pass it on to those who pay water bills.

Potential Impact(s): - Increased public opposition to current agricultural practices, which will translate into changes in food purchasing patterns towards sustainably produced foods;
- Increasing R&D into more sustainable practices;
- Increasing economic competitiveness of alternative and sustainable agricultural practices;
- More farmers engaged in sustainable agriculture.

NRP Impacts: - Increasingly, limited public environmental management resources tied up in identifying, addressing, and ameliorating agricultural damage;
- Long term, the potential for transformation of agricultural practice towards sustainability, decreasing overall damage to natural resources.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: agriculture; externalised costs; sustainable agriculture; organic agriculture; soil erosion; eutrophication

STEEP category: Environment: biosphere

Source(s) citing this:

Millennium Ecosystem Assessment

The Real Cost of Farming: An assessment of the total external costs of UK agriculture

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Increasing incidence of diseases of marine organisms and the emergence of new pathogens (2016 - 2030).

Description: The incidence of diseases of marine organisms and the emergence of new pathogens is increasing, and some of these, such as ciguatera, harm human health. Episodes of harmful (including toxic) algal blooms in coastal waters are increasing in frequency and intensity, harming other marine resources such as fisheries as well as human health.

Novel pathologies of coral reef organisms have escalated during the decade between 1987 and 1997. These emerging diseases have appeared with progressively greater frequency and over wider distribution. Corals are vulnerable to sedimentation, nutrient overloading, and chemical pollution from agricultural, urban, and domestic sources.

Potential Impact(s): - Increasing possibility of cross-species disease transfer and 'horizontal gene transfer' (the transfer of genes by infection, between species that do not interbreed and are unrelated) as a result of decreased resistance of marine organisms due to contaminant impact on immune systems;
- Increasing public concerns about the safety of seafood;
- Potential loss of consumer demand for seafood and resulting depression of fishing industry;
- Loss of many sea areas as food and economic resources;
- Increasing public concerns about the rise of new diseases.

NRP Impacts: - Marine environment increasingly at risk from disease, novel pathologies, and reduced resistance caused by human-generated contamination;
- Increased interconnectivity between health and viability of marine environment and current agricultural policy and practice, with resulting increase in need to review marine management in the context of agricultural policy.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Marine environment

Impact areas: marine environment; marine pollution; sea life; marine pathologies; disease; ciguatera; algal blooms; red tides; coral health

STEEP category: Environment: atmosphere

Source(s) citing this:

Emerging Marine Diseases Climate Links and Anthropogenic Factors - SCIENCE VOL 285 3 SEPTEMBER 1999
Millennium Ecosystem Assessment

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Changes in institutional and environmental governance frameworks required for effective management of ecosystems (2007 - 2010).

Description: Many existing institutions, both global and national, have the mandate to address the degradation of ecosystem services but the need exists for greater cooperation across sectors and coordinated responses. However, the historically new issue of the environment is not taken into account in the design of today's institutions. In particular, existing national and global institutions are not well designed to deal with the management of common pool resources, a characteristic of many ecosystem services.

Issues of ownership and access to resources, rights to participation in decision-making, and regulation of particular types of resource use or discharge of wastes can strongly influence the sustainability of ecosystem management and are fundamental determinants of who benefits and who suffers from changes in ecosystems. Weak systems of regulation and accountability are unhelpful.

There are no more "resource frontiers." Virtually every change of land use, new development, or expansion of any resource use now involves conflict (Ayling and Kelly 1997). Natural resource use also continues to be an aggravating factor in armed conflicts around the globe.

Potential Impact(s): - Improved management of public goods;
- Potential for increased disillusionment at local level;
- Improved leverage within international environmental dialogues and decision-making.

NRP Impacts: - Improved international governance can ensure greater protection of global public goods;
- Widened stakeholder participation in international governance can improve equity of access to natural resources, use rights, and shared stewardship.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: natural resource management; governance; decision-making; stakeholder participation; cross-departmental dialogue

STEEP category: Politics: governance

Source(s) citing this:

Millennium Ecosystem Assessment

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Increasing awareness that many services being degraded are “public goods” (2011 - 2115).

Description: Often more degradation of ecosystem services takes place than is in society’s interests because many of the services degraded are “public goods.” Although people benefit from ecosystem services such as the regulation of air and water quality or the presence of an aesthetically pleasing landscape, no formal market exists for these services and no one person has an incentive to pay to maintain the good. When an action results in the degradation of a service that harms other individuals, no market mechanism exists (nor, in many cases, could it exist) to ensure that the individuals harmed are compensated for the damages they suffer.

Potential Impact(s): - Potential for increase in court challenges and litigation of polluting companies and organisation for redress of damage to environment "public goods," and subsequent compensation for loss;
- Potential for government enactment of incentive / disincentive systems to safeguard environmental "public goods;"
- Increasingly challenging business environment vis-a-vis natural resource use, and heightened cost of doing business.

NRP Impacts: - Improvement of environmental conditions;
- Government departments will be increasingly more focussed on environmental impact.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: tragedy of the commons; public goods; public resources; environmental resources; environmental degradation; management of the commons

STEEP category: Politics: governance

Source(s) citing this:

Millennium Ecosystem Assessment

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Increasingly coordinated international agreements for addressing ecosystem-related concerns (2016 - 2030).

Description: Coordination among multilateral environmental agreements and between environmental agreements and other international economic and social institutions is on the increase. Examples of calls for international agreements come from all the environmental sectors, e.g., Prospective International Agreements for Mountain Regions is an international forest convention (IFC) to ensure that all of the world's forests are sustainably managed for their many goods and services. Such agreements encompass a means of monitoring requirements as well as enforcing compliance.

Potential Impact(s): - Decreasing ability of worst perpetrators of environmental degradation to sidestep environmental regulations by exporting damaging activities;
- Potential for constrained economic growth in a global resources context increasingly constrained by effective multilateral resource management and protection;
- Potential for increasing alienation and sense of disenfranchisement of local stakeholders who see their circumstances as relatively far from the stage of global environmental decision making.

NRP Impacts: - Decreasing rate of degradation of global environment and enhanced effectiveness of environmental stewardship;
- Increasing potential for clashes between local priorities for environmental stewardship, management, and use and priorities established by coordinated international multilateral agreements.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: climate change; biological diversity; maritime protection; environmental treaties; multilateral agreements

STEEP category: Politics: governance

Source(s) citing this:

Millennium Ecosystem Assessment

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Increased use of new frameworks for decision-making and decision support to manage uncertainty and complex ecosystem impacts (2011 - 2015).

Description: Frameworks and methods to make better decisions in the face of uncertainties in data, prediction, context, and scale will be more widely used. 'Active adaptive management' will help reduce uncertainty about ecosystem management decisions. Commonly used decision-support methods include cost-benefit analysis, risk assessment, multicriteria analysis, the precautionary principle, and vulnerability analysis. These tools will be used to test hypotheses about how components of an ecosystem function and interact prior to the implementation of policies and programmes.

Potential Impact(s): - Reduced uncertainty about the system achieved more rapidly than would otherwise occur
- Risk of over-reliance on modelling and analysis versus judgement and opportunity seeking;

NRP Impacts: Better decision making through new technology applications in public policy

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: more buy in from population
more reliable tools for decision making

STEEP category: Politics: policies

Source(s) citing this:

Millennium Ecosystem Assessment

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Farming increasingly a net energy consumer (2007 - 2010)

Description: Farming has been the traditional source of energy harvesting for humans but farming increasingly is a net energy consumer.

Intensive production of a single pound of beef can consume $\frac{3}{4}$ of a gallon of oil, the range of energy input as compared to out put for modern production ranges from 0.5 (where chickens range freely and find much of the food they consume) to 35 (again for intensive beef). Input: output ratios for rice and wheat span 0.1-0.4, fruit and vegetables 0.5-10 (though winter production of tomatoes in the Netherlands reaching as high as 500), whilst milk spans 0.8 – 8, eggs range from 0.5 – 10 (ten times the energy input as compared to content of eggs produced by battery systems with imported feeds), and fish spanning 1 (extensive coastal fisheries) to 250 (mechanised open ocean fleets)

Potential Impact(s): - Potentially the most radical step to internalising real environmental costs by proxy of energy costing;

-Can help determine what types of crops to incentives farmers to produce or how to price or tax them;

- Potential public concern over energy usage relative to competing demands;

NRP Impacts: Positive step for natural resources if food costs included externalities - less transportation, less salination, less impact on biodiversity with monocropping

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Landscapes
- Soils
- Water quality
- Water supply and demand

Impact areas:

STEEP category: Economic: trade

Source(s) citing this:

UK Environment Agency Rolling Trends Register 2004

Citation date: 2005

Original research source and date:

Credibility of sources: Expert

Continued decline in the quality of UK lowland habitats (2016 - 2030)

Description: 31% of the area of lowland SSSIs is in unfavourable condition. The main pressures on lowland wildlife responsible for this poor condition are agricultural intensification, lack of appropriate management, water quantity and quality problems, and the effects of development, invasive species, atmospheric pollution, and climate change.

The UK Biodiversity Action Plan (BAP) has stimulated a systematic programme for the recovery of rare and threatened habitats and species.

Potential Impact(s): - Potential for growing public concern and pressure to address and arrest the decline;
- Intensified debate likely over trade offs between economic development and environmental impacts;

NRP Impacts: loss of biodiversity

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Soils
- Water quality

Impact areas: Biodiversity, water quality, public concern

STEEP category: Environment: biosphere

Source(s) citing this:

State of Nature - Lowlands Future landscapes for Wildlife

Citation date: 2005

Original research source and date: English Nature - State of Nature Lowlands future landscapes for wildlife

Credibility of sources: Expert

Loss of resources beginning to be measured as loss of capital asset which should be added to GDP (2007 - 2010)

Description: The degradation of ecosystem services represents loss of a capital asset. Both renewable resources such as ecosystem services and non-renewable resources such as mineral deposits, some soil nutrients, and fossil fuels are capital assets. Yet traditional national accounts do not include measures of resource depletion or of the degradation of these resources. As a result, a country could cut its forests and deplete its fisheries, and this would show only as a positive gain in GDP (a measure of current economic wellbeing) without registering the corresponding decline in assets (wealth) that is the more appropriate measure of future economic well-being. Moreover, many ecosystem services (such as fresh water in aquifers and the use of the atmosphere as a sink for pollutants) are available freely to those who use them, and so again their degradation is not reflected in standard economic measures.

Potential Impact(s): -By accounting for usage of natural resources there is a more complete valuation of real economic value creation or destruction;
- could lead to a reassessment of national assets;
- would herald greater public awareness and debate on resource management;

NRP Impacts: - Assessment of these assets will be problematic and at times controversial but helpful in the overall undertaking
- Increasing respect for natural assets

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Marine environment
- Soils
- Water supply and demand

Impact areas: Corporate voluntary or legislative changes
Agricultural guidelines or regulation
Household waste and water usage

STEEP category: Environment: biosphere

Source(s) citing this:

Millennium Ecosystem Assessment
Vital Signs 2005 (Worldwatch Institute)

Citation date: 2005

Original research source and date: Millennium Ecosystem Assessment

Credibility of sources: Expert

Increasing use of science and innovation to improve policy and strategy for UK sustainable development (2007 - 2010)

Description: The aim is to ensure that true triple bottom line assessments are made across all policy areas, through:

- Integration of UK sustainable development strategy through different departments - transport, energy, economic, legal;
- Greater use of sustainability evaluations and impact assessments of key policies;
- International collaboration for scientific inquiry into the interrelationship of the environmental system

Potential Impact(s): - Greater acknowledgement of SD as a goal across policy domains

- Improved governance of programs
- Ownership of scientific advance
- Growth and scale of scientific knowledge
- Heavier demands on DEFRA

NRP Impacts: Scientific inquiry across sectors and subjects will, if collaborative, give more complete means of addressing environmental damage

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: sustainable development, policy making

STEEP category: Science: technology

Source(s) citing this:

Evidence and Innovation - Defra's needs from the sciences over the next 10 years

Citation date: 2004

Original research source and date: Evidence and Innovation - Defra

Credibility of sources: Expert

Loss of coast line will be an increasing threat to agricultural land and housing (2011 -2015)

Description: Loss of coastline can also cause loss of agricultural land and housing. A long-term vision needs to include a sustainable and functional coastline for England; create space for those habitats and species that require a coast allocation and ensure provision for those that do not. recognise the benefits to society including the reduction of flood and erosion risk to people and property.

Potential Impact(s): A sound knowledge of cliff retreat processes allows judgment of whether cliff retreat can be managed, by a process of monitoring and selected slope remediation, or it may suggest that cliff retreat would be futile and too expensive to prevent in the local context.

An overall gain in the area of functional ecosystems, changes in the distribution of coastal wildlife habitats and more effective coastal management would provide benefits for coastal communities and visitors

- potential loss of agricultural land driving up land prices in 'safe' areas;
- higher insurance premiums;
- growing public concern over loss of amenity and flooding risk;

NRP Impacts: Increasing pressure on land for construction and agriculture as coastal land disappears

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Marine environment

Impact areas: costal protection, climate change, insurance premiums, housing stock, agriculture

STEEP category: Environment: ocean

Source(s) citing this:

Developing English Nature's Maritime Strategy

Learning from the past to influence future

Securing the Future - delivering UK sustainable development strategy

Citation date: 2003

Original research source and date:

Credibility of sources: Expert

Increasing flood damage requires consensus on floodplain and flood risk (2007 - 2010)

Description: There is a lack of consensus over what is meant by a 'floodplain', with increasing use of terms such as 'flooding limit'. Thus the government's paper 'Development and Flood Risk' (Planning and Policy Guidance Note No.25) states that the limits of floodplains cannot be defined precisely and that floodplains '...are often delineated by the estimated peak water level of an appropriate flooding event' (e.g. a flood with a 1% annual exceedance limit, or 1 in 100-year return-period).

Potential Impact(s): Risk of homeowners building housing in flood plain areas - where there is lack of consensus on risk

The new guidelines on flood risk, issued in the government's Planning and Policy Guidance Note 25, clearly state that susceptibility to flooding is a major planning consideration and that planning decisions should 'avoid such risk where possible and manage it elsewhere'. The implication is that any new development must be accompanied by a viable flood risk management strategy, and there is a requirement on the scientific community to deliver the information on which such planning decisions are to be based.

The severe floods of the past few years have stimulated a ferment of research into the scientific and societal aspects of floodplains in the UK, with organisations such as DEFRA and the Environment Agency playing a leading role in developing strategies to mitigate the effects of flooding. The Environment Agency's River Trent Strategy document (unpublished draft, June 2002), lists no less than 19 options for flood management. They range from direct intervention, such as the construction of flood banks (particularly in existing urban areas), the re-routing of the main channel and excavation of flood reservoirs, to more natural measures.

NRP Impacts: Preventative planning based on good knowledge of areas to be impacted by flooding could protect property, lives and biodiversity

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Flood risk
- Soils

Impact areas: coastal regions, land flooding, insurance

STEEP category: Environment: ocean

Source(s) citing this:

Learning from the past to influence the future

Citation date:

Original research source and date:

Credibility of sources: Expert

Increased impact on soil from climate change and carbon emissions from soil (2016-2030)

Description: Positive and negative impacts of increased temperatures on soil
At a National level UK is trying to mitigate Carbon dioxide emissions
But half of the worlds carbon emission is soil – as described in a research paper in Nature on the management of soil 2005 showing impact of release of carbon from soil
The Soil Action Plan for England discusses management of arable land cultivation may decrease carbon content or disturb the soil less

Potential Impact(s): Increased temperatures may lead to more decomposition of soil organic matter;
Increased plant growth due to the CO₂ fertilization effect may cause other plant nutrients such as N and P to become in short supply; however, CO₂ increase would stimulate mycorrhizal activity (making soil phosphorus more easily available), and also biological nitrogen fixation (whether or not symbiotic).
Through increased root growth there would be extra weathering of the substratum, hence a fresh supply of potassium and micronutrients;
The CO₂ fertilization effect would produce more litter of higher C/N ratio, hence more organic matter for incorporation into the soil as humus litter with high C/N decomposes slowly and this can act as a negative feedback on nutrient availability;
The 'CO₂ anti-transpirant' effect would stimulate plant growth in dry land areas, and more soil protection against erosion and lower topsoil temperatures, leading to an 'anti-desertification effect'.

NRP Impacts: Extremely difficult to reverse soil degradation thus prevention is essential

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Soils
- Water quality
- Water supply and demand

Impact areas: Agricultural output, product quality, growing seasons

STEEP category: Environment: biosphere

Source(s) citing this:

Global climate change and agricultural production. Direct and indirect effects of changing hydrological, pedological and plant physiological processes

Citation date: 1996

Original research source and date:

Credibility of sources: Expert

UK outsourcing food production increases environmental footprint elsewhere (2011 - 2015)

Description: Intensive agricultural practices are currently damaging to environment unless using sustainable agricultural techniques. As UK imports much of its food requirements the locations producing the food are likely to be increasingly polluted

Potential Impact(s): Short-term cheaper access to food product

Negative long term cost and sourcing implications

Food commodity price increases

Litigation

NRP Impacts: May increase UK food production requiring effective pre-planning to limit UK environmental damage through, crop choice, irrigation monitoring, crop rotation, effective water resource management and limiting fertilizer and pesticide use

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Depletion of natural resources: water, fisheries, forests and the loss of bio-diversity: water tables are falling around the world. In India's Punjab they are declining by half a metre per year while in China's northern, which supplies 40% of the country's grain harvest, they are falling by one to 1.5 metres each year. Declines are also occurring in North America, North Africa, and the Arabian Peninsula. With regards to fisheries, more than a 1/4th of the 200 main marine fisheries world-wide are exploited, depleted or recovering, while another 2/5ths are fully exploited. Fisheries are collapsing in some parts of the world, and international disputes over fish stocks are increasing. Tropical forests are being converted at a rate of 15.4 hectares per year. Small-scale, poor farmers clearing land for agricultural to meet food needs account for roughly 2/3rds of deforestation. Deforestation has important local and global consequences, ranging from increased soil and water degradation to greater food insecurity, escalating carbon emission and loss of bio-diversity

STEEP category: Economic: trade

Source(s) citing this:

Millennium Ecosystem Assessment

Citation date: 2005

Original research source and date: Millennium ecosystem assessment

Credibility of sources: Expert

Increased urbanization increases the overloading of water supply and sanitation infrastructure (2011 - 2015)

Description: The problems of water supply have forced many urban authorities to over-exploit fragile sources, such as aquifers, and there are many examples of falling water levels in many cities (e.g. in Manila)

Potential Impact(s): Further increases in urban centres are projected so further pressure on water resources will continue

Limitation of water use

Increased price of water

Increased threat from epidemic

NRP Impacts: Needs effective water management over resources and recycling of resource

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Soils
- Water quality
- Water supply and demand

Impact areas: Large urban centres

STEEP category: Environment: ocean

Source(s) citing this:

The UN World Water Development Report - Water for People, Water for Life.

Citation date: 2003

Original research source and date: UN Water Development Report

Credibility of sources: Expert

Increasing over utilisation and pollution of aquifers (2007 to 2010)

Description: Widespread quality deterioration of shallow aquifers in areas of rapid urbanization and agricultural intensification. When aquifers become polluted contamination is persistent and difficult to reverse

Currently, the unit price for water paid by water abstractors only has to cover the administration costs of the licensing by the Environment Agency. This is an obstacle to water saving - there is little incentive for the water companies to become efficient.

Potential Impact(s): Desertification, loss of water supply, price increases Impacting poor

Water companies given a legal duty to conserve water

NRP Impacts: Core resource at risk creating conflicting needs.

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Soils
- Water quality
- Water supply and demand

Impact areas: Agriculture

Water available for households

Wildlife

STEEP category: Social: demographics

Source(s) citing this:

The UN World Water Development Report - Water for People, Water for Life.

Citation date: 2003

Original research source and date: UN World Water Development Report

Credibility of sources: Expert

Heightened conflicts between conservation policies and other policy aims will lead to increased challenges to marine management (2007-2010)

Description: Heightened conflicts between conservation policies and other policy aims; failure of fisheries management to curb high levels of fishing; increasing debate over cost-benefit trade-offs in managing fisheries, e.g., value of sector or biodiversity versus cost of management/protection.

Some fish stocks at risk from over fishing, change in size of fish surviving and, environmental factors. EU cod stocks in decline (Defra. Increasing dependency on imported fish and shellfish, contributing to global stock declines and resource depletion in developing countries.

Potential Impact(s): Need for increased public participation in debating costs /benefits; increasing conflict between stewardship and economic needs. Potential changes to the marine environment; changes to the social environment, e.g., rise of alternative food production industries; emigration; reskilling of related labour.

NRP Impacts: Need to ensure effective marine protection measures are in place for the long term

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Marine environment

Impact areas: fisheries management; biodiversity fish; shellfish; fish stocks; declining marine resources

STEEP category: Environment: ocean

Source(s) citing this:

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Citation date: 2004

Original research source and date:

Credibility of sources: Expert

Greater reliance on scientific and technical support in management of resources (2007 to 2010)

Description: A number of advances will facilitate enhanced resource management including;

- Satellite policing of farming subsidies;
- Extensive remote sensing used in environmental management, including autonomous underwater vehicles to monitor marine and coastal resources;
- New research into Ground Water Resources through innovative algorithms to estimate land surface evapo-transpiration (ET) using satellite remotely sensed data is evolving.
- Evapotranspiration is a critical component of the regional water and energy balance.

Potential Impact(s): Real-time monitoring of environmental change, endangered species, regulatory compliance.

NRP Impacts: Can ensure better yields, less water usage, less energy usage, less wastage

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: remote sensing, satellite, environmental management, agriculture

STEEP category: Environment: ocean

Source(s) citing this:

BT Exact Technology Timeline

DEFRA Forward Look (PREST, TNO-STB, DEFRA)

Citation date: 2001

Original research source and date: BT Exact Technology

Credibility of sources: Expert

EU controls of agricultural subsidies and reduction of agricultural land may make the UK vulnerable to outside impacts and result in food shortages (2016 to 2030)

Description: If the EU decides that the UK should not subsidise certain agricultural production and the UK has less land under agricultural production this may increase the vulnerability of the UK to outside impacts causing food shortages.

Potential Impact(s): - increased food prices, popular unrest;
- loss of skills may make it difficult for people to scale up farming activity quickly;
- concerns over security of food supply;

NRP Impacts: increased need for UK agricultural development
more investment in R& D for effective use of land and land management

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Soils
- Water supply and demand

Impact areas: food prices, agricultural land, new training and skills for new agricultural techniques, R and D

STEEP category: Economic: production

Source(s) citing this:

OECD Expert Meeting on Agricultural Soil Erosion and Soil Biodiversity Indicators - Summary and Recommendations

Citation date: 2003

Original research source and date: OECD

Credibility of sources: Expert

Increase in severe weather events (2011 to 2015).

Description: Increased frequency of extreme weather events. Detrimental impacts of climate change on the natural world and society are likely to become increasingly severe.

Between 1980 and 2001, a total of 10,867 weather-related disasters have caused more than 575,000 deaths and entailed costs of more than \$1 trillion (in 2001 dollars). The frequency of severe weather events is clearly on the rise. In the US, the number of weather-related disasters has increased fivefold since the 1970s. Worldwide, the number of big weather catastrophes has quadrupled since the 1960s. Klaus Topfer, UNEP, believes that the number of environmental refugees could double to 50 million by 2010. If current trends continue, UNEP forecast that economic losses from natural disasters will reach \$150 billion annually within the next decade

Potential Impact(s): Increased strain on insurance and reinsurance markets, including danger of bankruptcy; growing inability of frequently-hit communities to bounce back; increased need for disaster preparedness planning and disaster relief systems; increased need for weather-proofing critical infrastructure against catastrophic weather events.

Potential Impact(s): The UK's DTI Foresight report Flooding to 2104 - need for control on building in flood-risk areas and enhanced long-term flood management. Under extreme scenario, annual cost of damages could increase 20x from the current level, and risk of flooding from rainfall increasing between three and six times. In pessimistic scenario, the annual cost of damage from flooding could rise from the present level of £1 billion to as much as £21 billion and the number of people at a high risk from flooding rising from 1.6 million today to between 2.3 and 3.6 million by the 2080s.

NRP Impacts: Needs increased forestry management, flooding prevention programmes, soil erosion protection, dykes or sea break management

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Flood risk
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Impacts have substantive economic implications (between £700 and £750 million)

STEEP category: Environment: atmosphere

Source(s) citing this:

Evidence and Innovation - Defra's needs from the sciences over the next 10 years
UK Environment Agency Rolling Trends Register 2004

Vital Signs 2004 (Worldwatch Institute)

Citation date: 2004

Original research source and date: Wirtz, A., Munich Reinsurance Company, email to author, 28 January 2003.

"Global Climate Change Threatens the Insurance Industry," E/The Environmental Magazine, August 2002.

"Insurers See More Disasters Due to Climate Change," Reuters, 2 November 2001.

Topfer cited in Townsend, M., "Environmental Refugees," The Ecologist, June 2002.

UNEP, "Financial Sector, Governments and Business Must Act on Climate Change or Face the Consequences," press release, 8 October 2002. Evidence and innovation:

Defra's need from the sciences over the next 10 years. (PB 9227)

Credibility of sources: Expert

Increased scientific understanding of the world consequences of current human activities (2007 to 2010)

Description: Greater scientific understanding is needed to map the consequences of current human activities. This will lead to more robust scenario development which will in turn strength the technical case for international action.

Potential Impact(s): Better management of natural resource assets
Proactive in understanding and managing environmental resources

NRP Impacts: Better decision making on which and how human activity can continue without using resources unsustainably

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: scientific understanding, climatic consequences, quotas for resource harvesting, product specifications

STEEP category: Environment: biosphere

Source(s) citing this:

National Assessment of the Consequences of Climate Variability and Change for the United States

Citation date: 2004

Original research source and date: Evidence and innovation: Defra's need from the sciences over the next 10 years. (PB 9227)

Credibility of sources: Expert

UK dependency on food imports causes increased vulnerability to transport disruption and epidemics (2007 to 2010)

Description: In the event of a major upheaval such as increased oil price, disruption of air and sea transport, or major epidemic, the UK is vulnerable due to its dependency on importation of food

Potential Impact(s): hunger, riots, increased local production and distribution
MI5 forecasts major disruption could result from adverse environmental conditions, major accidents, epidemics, or deliberate terrorist or electronic attack.

NRP Impacts: It would be preferable to plan the food and agricultural needs of the UK rather than have a wild dash to produce should a constraint on importation occur

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Increased importance of UK agricultural sector
distribution networks

* large scale loss of life;

* serious impact on the national economy;

The Government considers that there are ten "sectors" of economic, political and social activity in which there are critical elements. They are:

Communications, Emergency Services, Energy, Finance, Food
Government and Public Service, Public Safety, Health,
Transport
Water

STEEP category: Politics: policies

Source(s) citing this:

The 2000 Oil Crisis and its Consequences in the EU Energy Sector

Citation date: 2005

Original research source and date: UK MI5 report

<http://www.mi5.gov.uk/output/Page76.html>

Credibility of sources: Expert

'Virtual Water' (total water embedded in and consumed in producing a good or service) could change trading patterns and agricultural policy (2007 to 2010)

Description: The Virtual Water Concept is the amount of water that is embedded in food or other products needed for its production. Trade in virtual water allows water scarce countries to import high water consuming products while exporting low water consuming products and in this way making water available for other purposes.

Showing people the 'virtual water' content of various consumption goods will increase the water awareness of people. The total 'water footprint' of a nation is a useful indicator of a nation's call on the global water resources. At consumers level it is useful to show people's individual footprint as a function of food diet and consumption patterns.

Potential Impact(s): Changes global trading patterns

Enables better understanding of water needs where virtual water is added to resources

NRP Impacts: valuing water creates more measured use of this resource in a sustainable manner determines what products to import or produce locally

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Water supply and demand

Impact areas:

STEEP category: Environment: ocean

Source(s) citing this:

Vital Signs 2005 (Worldwatch Institute)

Citation date: 2005

Original research source and date: Vital Signs

http://www.worldwatercouncil.org/virtual_water.shtml

Credibility of sources: Expert

New opportunities for renewables sector needs Government leadership (2007 – 2010)

Description: There is a whole new market to develop in new energies ,moving away from reliance on fossil fuels. Biofuel production is just the first step in product from bio-refineries – other fractions can be removed from the wheat such as fibres, proteins – chemical, food stock, pharmaceuticals, nutri, plastics - but the first condition is that there needs to be a mass-market product. It is the fractions that in part make oil refinery profitable. The other markets need to evolve Animal feed could be the first additional product.

Potential Impact(s): Loss of potential new economic wealth
Loss of associated job creation

NRP Impacts: Opportunity to use effectively and sustainably UK natural resources

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water supply and demand

Impact areas: Fuel prices, agricultural land management

STEEP category: Politics: governance

Source(s) citing this:

CLEAN GOVERNMENT: Options for Governments to Buy Renewable Energy

Citation date: 2002

Original research source and date: The Energy Review -A Performance and Innovation Unit Report - February 2002

<http://www.number-10.gov.uk/su/energy/10.html>

Credibility of sources: government

Increasing complexity of issues between UK government departments (2007 to 2010)

Description: Different departments represent different agendas. Increased cohesion between strategic aims could improve policy making on an issue.

Potential Impact(s): Long-term environmental agenda could be compromised by shorter-term trade issues.

DTI and DEFRA may have different drivers on the question of bio oil and fossil fuel oil

NRP Impacts: Management of natural resources could receive more financial support if the resources were valued in GDP / GNP - on UK plc balance sheet and on UK government balance sheet

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: DEFRA could be listened to in Cabinet in a more effective manner. The DTI could have a more measured place in the decision-making hierarchy. There needs to be a realistic appreciation of what would happen when and if industry ceased to function effectively because of a lack of available natural resources

STEEP category: Politics: governance

Source(s) citing this:

Evidence and Innovation - Defra's needs from the sciences over the next 10 years

Citation date: 1999

Original research source and date: Cross-cutting Issues Affecting Local Government - Full Report, 1999

http://www.odpm.gov.uk/stellent/groups/odpm_localgov/documen...

Credibility of sources: Expert

Loss of key skills in agricultural sector (2007-2010)

Description: The combination of low food prices because the real cost of production, manufacturing, packaging and transportation is not being factored into price of food. The agricultural sector in the UK is reducing and weakening. A lack of investment in Research and Development and political decision-making on future energy sources, reduce the UK's ability to compete in the future renewable energy sector in bio- fuels.

Potential Impact(s): The loss of agricultural production in the UK is not irreversible but to reverse the loss of skills and infrastructure would need a long time frame

NRP Impacts: loss of key skills will impact knowledge of how to tackle new and changing needs in the agricultural/ natural resource sector

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Landscapes
- Soils

Impact areas: Impacting on future ability to produce renewable energy from bio oils and skills for future food production

STEEP category: Politics: governance

Source(s) citing this: Interview

Citation date: 2000

Original research source and date: UK Parliament <http://www.parliament.the-stationery-office.co.uk/pa/cm20000...>

Credibility of sources: Expert

Wave power and water desalination increasingly important joint roles for energy and water supply (2016 to 2030)

Description: Using wave power for energy and for desalination may be an effective means of addressing two core needs.

Potential Impact(s): Maintaining health, hygiene and human presence in areas that have water shortages or are threatened desertification

NRP Impacts: Could be important for areas of UK prone to water shortages and long term supply of renewable energy

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Marine environment
- Soils
- Water supply and demand

Impact areas: water supply, agriculture, human habitation, health, animal husbandry

STEEP category: Environment: ocean

Source(s) citing this:

Wave Power: Moving towards Commercial Viability

Citation date: 1998

Original research source and date: Energies from the Sea à Towards 2020, Marine Foresight Panel, DTI/Pub 4064/2k/3/99/NP, April 1999

Thorpe, TW, An Overview of Wave Energy Technologies, ETSU 1998

Credibility of sources: Expert

Peak Oil - cost of extraction rising along with increasing demand (2007-2010)

Description: Peak Oil is the simplest label for the problem of energy resource depletion, or more specifically, the peak in global oil production. Oil is a finite, non-renewable resource, one that has powered phenomenal economic and population growth over the last century and a half. The rate of oil 'production,' meaning extraction & refining (currently about 83 million barrels/day), has grown in most years over the last century, but once we go through the halfway point of all reserves, production becomes ever more likely to decline, hence 'peak'. Peak Oil means not 'running out of oil', but 'running out of cheap oil'. For societies leveraged on ever increasing amounts of cheap oil, the consequences may be dire. Without significant successful cultural reform, economic and social decline seems inevitable.

Potential Impact(s): Replacement fuels needed or increasing prices or decreasing demand

The core needs of society's infrastructure as currently constructed requires energy to function. For example - treatment stations for waste water need pumping stations which use electricity, the way rivers are managed need energy, traffic lights and infrastructure would breakdown without energy provision.

The UK might need to change its reliance on current energy usage for food distribution, people using transport to go to work, perhaps a radical rethink in the way society is run. It is key to be conscious that:

- * Oil refined for gasoline and diesel is critical to run the tractors, combines and other farm vehicles and equipment that plant, spray the herbicides and pesticides, and harvest/transport food and seed
- * Food processors rely on the just-in-time (gasoline-based) delivery of fresh or refrigerated food
- * Food processors rely on the production and delivery of food additives, including vitamins and minerals, emulsifiers, preservatives, colouring agents, etc. Many are oil-based. Delivery is oil-based
- * Food processors rely on the production and delivery of boxes, metal cans, printed paper labels, plastic trays, cellophane for microwave/convenience foods, glass jars, plastic and metal lids with sealing compounds. Many of these are essentially oil-based
- * Delivery of finished food products to distribution centres in refrigerated trucks. Oil-based, daily, just-in-time shipment of food to grocery stores, restaurants, hospitals, schools, etc., all oil-based; customer drives to grocery store to shop for supplies, often several times a week

The UK is today dependent on oil for supply of food

NRP Impacts: Increased cost of fertilizer and plastic prices - less environmental damage

More use of coal increased global warming

Need for alternative energy capacity - renewables

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Landscapes
- Marine environment
- Soils
- Water quality

Impact areas: New technologies could change the way we use energy.

The water industry is a heavy energy user pumping water into homes then out as waste water then treated to be able to reused

Agricultural importation where for example greenhouse Dutch tomatoes use 200 times more energy than a tomato grown in ordinary UK conditions or the fact that beef needs is 20 to 1 times more energy than soya as protein

STEEP category: Science: technology

Source(s) citing this:

Peaking of World Oil Production: Impacts, Mitigation, & Risk Management

Citation date: 2005

Original research source and date: Dr. M. King Hubbert, geophysicist, is well known as a world authority on the estimation of energy resources and on the prediction of their patterns of discovery and depletion. He predicted in 1949, that the fossil fuel era would be of very short duration. "Energy from Fossil Fuels, Science"

Credibility of sources: Expert

Rise of individualism negatively impacting public good and collective needs (2011 to 2115)

Description: Nonexcludability and nonrivalrous (or collective) consumption, taken together, these characteristics mean that, once supplied, a public good provides benefits for everyone, but that those individuals who are so inclined may be able to avoid paying their fair share of the costs, and thus act as “free riders”. Therefore, the profit-seeking private sector will supply a sub optimal quantity of the good, if it supplies it at all. Unless the government supplies the good and taxes the citizens accordingly, as community spirit is replaced by the rise of individualism, public goods will become harder to deliver.

Impediments to change include local population, as we have a 200-year model of development where capitalism has created vested interests. The difficulty is that there is no provision for collective benefits for public goods in current economic model – where benefits are individual

Potential Impact(s): Increasing degradation of public goods, air, water tables, ozone layer, biodiversity

NRP Impacts: Individualism negatively impacts NRP except if incentives and penalties are enforced. Collective pressure is helpful for maintaining public goods

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Flood risk
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: air, water, fuel, food, biodiversity, protection of the species

STEEP category: Social: values

Source(s) citing this:

Environmental Philosophy and the Public Interest

Citation date: 2005

Original research source and date: Environmental Philosophy and the Public Interest: A Pragmatic Reconciliation Minter Ben A. Source: Environmental Values, February 2005, vol. 14, no. 1, pp. 37-60(24)

Credibility of sources: Expert

The current reliance of food supply on fossil fuel may be unsustainable. (2016 – 2030)

Description: The unsustainability of the contemporary food system can be understood by the ratio of energy outputs - the energy content of a food product (calories) - to the energy inputs.

The latter is all the energy consumed in producing, processing, packaging and distributing that product.

The energy ratio (energy out/energy in) in agriculture has decreased from around 100 for traditional pre-industrial societies to less than 1 in most cases in the present food system.

Potential Impact(s): Upheaval of world trading, economic, social, scientific, technical and agricultural patterns.

NRP Impacts: Real current cost of food does not factor in the potential increases of cost of fossil fuel based processes and products used in current food provision. The cost of alternatives to fossil oil based fertilizer, plastic wrapping, additives, transport and chilling, freezing and distribution costs will change the price of food. It might therefore change the impetus of agricultural production in the UK

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water quality
- Water supply and demand

Impact areas: Energy use

Food supply security

STEEP category: Economic: trade

Source(s) citing this:

Effects of Food-Safety Perceptions on Food Demand and Global Trade - Changing Structure of Global Food Consumption and Trade
Food Security Assessment: Why Countries Are At Risk

Citation date: 2005

Original research source and date:

Credibility of sources: Expert

Government VAT on all construction except greenfield sites puts pressure on rural environment (2007 – 2010)

Description: The Government rate of VAT on building work covering the repair, maintenance and improvement of housing and historic buildings provides a perverse incentive to neglect maintenance of existing homes and build on greenfield sites.

Potential Impact(s): Remove pressure on greenfield sites
Reduce energy wastage in older buildings through regeneration and renovation

NRP Impacts: NRP strategy needs clear policy guidance on approach to brownfield vs. greenfield debate

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Biodiversity
- Landscapes
- Water supply and demand

Impact areas: Urban regeneration with the following positive features:

Energy use in the home could be decreased to Zero fossil energy, low energy demand, Super insulation, 'A' -rated white goods, on-site waste CHP/pyrolysis plant

- By policy changes homes could be closer to working sites and this would instigate sustainable travel, 40% journey reduction, majority of journeys by foot/cycle, 85% reduction in car miles, home office and local employment
- House materials could be changed into ZED-type homes, embodied energy as present, more insulation and inert materials, reclaimed, recycled and locally sourced materials extensively used
- Shared infrastructure for reduced transport and energy infrastructure, less waste landfill and processing, reduced water infrastructure, reduced material extraction and transport infrastructure, increased material recycling and reclaiming facilities, fewer airports and infrastructures
- Waste and consumer items could be reclaimed and recycled goods promoted, 25% reduced consumption, 25% lower packaging levels, 25% less waste than UK average (of which 25% recycled, 25% composted, 25% converted to energy in CHP and 25% sent to landfill)
- Water consumption reduced (47 litres/person/day, on-site grey water processing, rainwater harvesting to meet external water demand

STEEP category: Politics: laws & regs

Source(s) citing this:

Expert Interview

Citation date: 2001

Original research source and date: Royal Institute of British Architects 2005
UK government Pre- budget report 2001
http://www.hm-treasury.gov.uk/pre_budget_report/prebud_pbr01...
Credibility of sources: Expert

Growing pressure for UK Government to spearhead investment in renewable energy (2007 to 2010)

Description: There is growing demand for the UK to accelerate and promote the investment in renewables. The current energy white paper commitment is to deliver 20% of total demand through renewables. There is a growing concern that these targets may not be high enough and that they may not be met.

Potential Impact(s): - would help build a viable UK renewable industry;
- would ensure reliable sourcing for UK fuel requirements;

NRP Impacts: Will increase natural resource importance and will create a difficult trade off between energy needs and landscape and natural reserves

NRP Category: Key Trend / Driver

NRP Area Impacts:

- Air quality
- Biodiversity
- Landscapes
- Marine environment
- Soils
- Water supply and demand

Impact areas: Agricultural sector, scientific advances

Increases in long-term employment

STEEP category: Politics: governance

Source(s) citing this:

Response to the Government's 'Energy Policy: Key Issues for Consultation'

Citation date: 2002

Original research source and date:

Credibility of sources: Expert

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A National Vision of America's Transition to a Hydrogen Economy — To 2030 and Beyond United States Department of Energy Hydrogen Vision Meeting - Washington November 2001 http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/vision_doc.pdf	2001
A Review of the Hydrogen Futures Literature for SHEC Policy Studies Institute Forecasts Scenarios Visions Backcasts and Roadmaps to the Hydrogen Economy www.psi.org.uk	2004
Agricultural Baseline Projections: Global Agricultural Trade, 2005-2014 US Department of Agriculture - Economic Research Service http://www.ers.usda.gov/briefing/baseline/trade.htm	
An Overview of Wave Energy Technologies: Status, Performance and Costs Institute of Mechanical Engineers Report Wave Power: Moving towards Commercial Viability http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1860583059.html	1999
Assessing the economic value of ecosystem conservation Vol. 1 of 1 The World Bank http://www-wds.worldbank.org/servlet/WDS_IBank_Servlet?pcont=details&eid=000012009_20041208104054	2004
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Common Implementation Strategy For The EU Water Framework Directive (2000/60/EC) European Union http://europa.eu.int/comm/environment/water/water-framework/index_en.html	2000
Damage Costs of Nitrogen Fertiliser and Their Internalization Ecoles des Mines, Paris and Institute of Control and System Research, Bulgaria Bulgarian Academy of Sciences, Sofia, Bulgaria. and Dept. of Economics and International Development, University of Bath, UK SusTools Tools for Sustainability: Development and Application of an Integrated Framework http://www- cep.ensmp.fr/english/themes/impact/papers/WP4_N_Fertil%20FinalReport.pdf	2004
Defra Baseline Scan - Scan of Scans Conducted under Defra's Horizon Scanning Programme Fast Future www.escience.defra.gov.uk/horizonscanning	2005
Dena Report - Planning of the Grid Integration of Wind Energy in Germany Onshore and Offshore up to the Year 2020 Deutsche Energie-Agentur GmbH Dena Grid Study http://www.wind-energie.de/fileadmin/dokumente/Themen_A- Z/Netzausbau/stud_summary-dena_grid.pdf	2005
Developing English Nature's Maritime Strategy - One Year on English Nature Maritime Strategy http://www.english-nature.org.uk/pubs/publication/PDF/Maritimeprogrep.pdf	2003
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Appendix 8 – Natural Resources Protection Future Trends Study Reference Sources

Title / Organisation / Project / URL	Date
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The Effects of Fishing on Marine Ecosystems School of Biological Sciences, University of East Anglia, Centre for Environment, Fisheries & Aquaculture Science http://www.sos.bangor.ac.uk/~oss405/amb.html	2003
The final energy crisis Pluto Press Andrew MacKillop - Editor http://plutobooks.com/cgi-local/nplutobrows.pl?chkisbn=0745320929&main=	2005
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The Last Oasis: Facing Water Scarcity Worldwatch Institute Environmental Alert Series http://www.worldwatch.org/pubs/books/4/	1992
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Appendix 8 – Natural Resources Protection Future Trends Study Reference Sources

Title / Organisation / Project / URL	Date
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Appendix 9 - NRP Futures – Mega Trends, Key Trends and Drivers By STEEP Category and earliest impact timeframe

Time Horizon	Socio-Demographic	Technological and Scientific	Economic	Environmental	Political
Now – 2006	<p>Megatrends</p> <ul style="list-style-type: none"> New patterns of consumption in non-Western countries <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Increase in number of UK households. Increased UK traffic and car ownership. Increased UK rail demand. Increased urbanisation will increase light pollution. Increased public concern over sustainability, biodiversity, wildlife protection and welfare. Heightened public expectations of agriculture. 	<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Increasing water treatment capability. Evolution of building materials. Evolution of personal transport. 	<p>Megatrends</p> <ul style="list-style-type: none"> Increasing global product competition Rising Chinese economic strength. <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Continued UK economic growth. Biotechnology increasingly used in agriculture. Increasing shift in balance of power within supply chains from food producers to the major retailers. Increase in marine shipping. Increasing competition and reduced subsidies in farming due to deregulation Worldwide meat consumption growing by 2%; has doubled since the 1970s. Rapid growth of industrial animal agriculture - 'factory farming' - worldwide for pigs Global passenger car market growing at over 4% per year - a five-fold increase since 1950. Continued growth in housing demand within the UK. Falling foreign direct investment inflows to industrial countries falling. 	<p>Megatrends</p> <ul style="list-style-type: none"> Growing concerns over global warming <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Decreasing UK lead pollution. Increasing background concentrations of ozone in the lowest levels of the atmosphere reducing plant growth and crop productivity Continued rise in atmospheric carbon dioxide; rates of increase have more than doubled since 1960. Increased risk of exotic species appearing in the UK. Increasing concern over UK fish stock decline. Crops irrigated with sewage including raw sewage Increased impacts on agriculture from global warming. 	<p>Megatrends</p> <ul style="list-style-type: none"> Uncertain impact of accession of Eastern European states on EU Common Agricultural Policy. <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Increases in the number and kind of actors in international governance and the challenges to policy. Increased innovations in governance and regulation to heighten transparency of decision-making. The importance of NGOs is increasing as they step in to fill the gaps left by governments. Number of violent conflicts worldwide remains unchanged. Military expenditures worldwide increasing: spending rose by 20% in 2002 and 2003. Increased pressure for tighter environmental controls. Increased challenges to marine management. Mixed progress on reducing nuclear arsenals; reduction to less than 30% of total built.
2007 – 2010	<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Changing patterns of development Ecotourism growing at 10-30% annually. 	<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Increasing health risks due to bioaccumulation of certain toxins affecting food chains. Increasing use of fuel cells. Increase in 'precision farming' due to application of innovations. Increasing use of science and innovation to improve policy and strategy for UK sustainable development 	<p>Megatrends</p> <ul style="list-style-type: none"> Increasing conflict between EU environmental protection goals and USA, China and other trading partners using WTO regulations to attempt to overturn EU legislation Oil price forecast by Goldman Sachs to rise to \$105 per barrel within a few years <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Peak Oil - cost of extraction rising along with increasing demand Increasing economic growth of the countryside. Growing competition for marine and coastal resources. Growing expectations within the UK for improved environmentally benign transport. Overall volume of agricultural output is declining in British farming (since late 1990s) Continuing degradation of agricultural land worldwide. Continued growth in aquaculture (farmed fish and shellfish production). Wind power installation growing fastest in the EU, which added 5703 megawatts in 2004. 	<p>Megatrends</p> <ul style="list-style-type: none"> Energy use and transport emissions will continue to be the largest contributors to production of greenhouse gases Increasing potential for global environmental management. <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Increasing over utilisation and pollution of aquifers Decreased UK NOx pollution. Major negative implications for the well-being of the water environment across Europe due to hydromorphological changes Management of ozone concentrations and impacts on plant growth Rate of change in global temperature since 1976 has been triple that for century as a whole. Changing patterns of disease resistance and disease among wildlife domestic animals and plants. Increasing risk of serious complications associated with food-borne disease. New emerging and re-emerging animal and zoonotic diseases. New kinds of foodborne outbreaks emerge. Declining populations of terrestrial freshwater fish Loss of natural capital 	<p>Megatrends</p> <ul style="list-style-type: none"> Expanding EU. Increasing pressure for elimination of subsidies which have negative ecosystem impacts Increase in trading schemes using economic instruments to change market behaviour towards the environment <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> International law particularly European law will have an increasing impact on UK domestic law Public commitments that governments have made to environmental targets will allow an unprecedented opportunity for the public to apply pressure towards and hold them accountable for failing those goals Increasing demands for transparency and accountability in all organisations. Changes in institutional and environmental governance frameworks are required for effective management of ecosystems Increasing need for adapting energy policies to new circumstances New opportunities for renewables sector needs Government leadership Increasing complexity of issues between UK government departments Transition phase between fossil fuel and alternative sources of energy

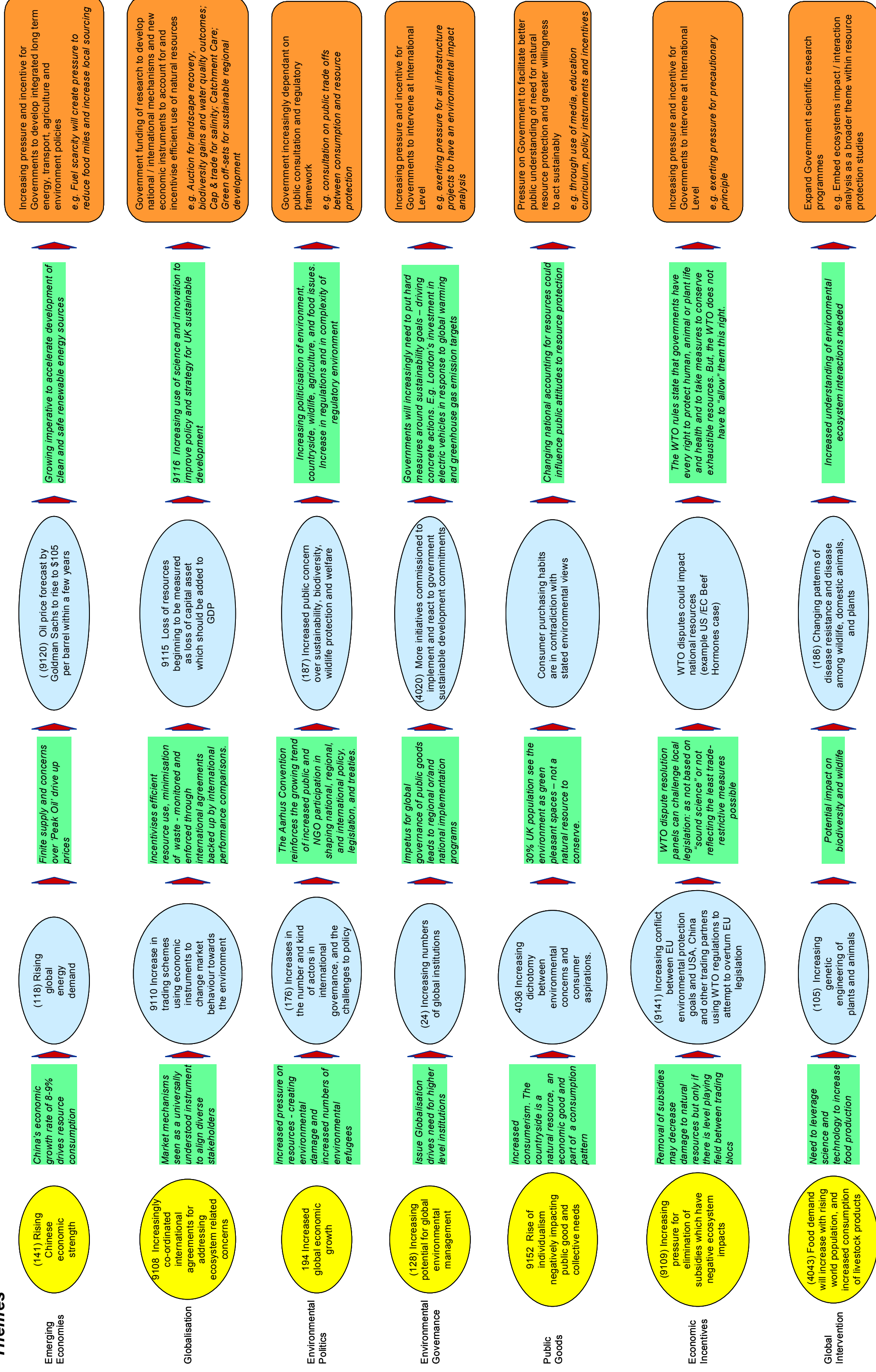
Time Horizon	Socio-Demographic	Technological and Scientific	Economic	Environmental	Political
<p>2011 – 2015</p>	<p>Increasing dichotomy between environmental concerns and consumer aspirations.</p> <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Continued urbanisation. Net UK population growth and an increasing number of households concentrated in 'economically dynamic' areas Increasing wealth and per capita GDP both in the UK and globally leading to increasing use of consumer products and energy such that benefits from technical eco-efficient improvements are insufficient Growing disparity in levels of consumption between rich and poor countries and within developing countries Counter-urbanisation increasingly driving social change and developmental pressures in rural areas Strong tourism growth Continues with a doubling in arrivals forecast between 2005 and 2020. 	<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> More national research programmes will align with International programmes to reduce research duplication and increase delivery of enhanced synergies across the EU Science: basic research Increasing genetic engineering of plants and animals. Increasing affordability of solar energy. Sustainability gains from ICT. Evolution of transportation systems. Evolution of architecture. Improved surveillance and monitoring technologies to increase the Probability and reducing the cost of detecting hazardous events Increasing global agricultural technical challenges from resource constraints and environmental degradation, new pests/disease and climate change 	<ul style="list-style-type: none"> Solar photovoltaic cells are the world's fastest growing energy source at 32% per year. World biofuel market growing rapidly; could quadruple to over 120 billion litres by 2020. Global production of crude steel surging as China's output nearly triples. Farming increasingly a net energy consumer World trade rises sharply growing at over 15%. Increasing European growth of wind power 	<ul style="list-style-type: none"> Potential for GM corn fields to 'co-exist' with non-GM crops. Loss of resources beginning to be measured as loss of capital asset which should be added to GDP Increased scientific understanding of the world consequences of current human activities Increasing risk of Bioaccumulation and Biomagnification Increasing loss of world's wetlands. Forest loss continues with global forest cover halved from its original extent in 6000 BC. Increasing pressure on landfills waste disposal capacity. Increasing interdependence of environmental goals Increasing flood damage requires consensus on floodplain and flood risk Heightened conflicts between conservation policies and other policy aims will lead to increased challenges to marine management Greater reliance on scientific and technical support in management of resources "Virtual Water" (total water embedded in and consumed in producing a good or service) could change trading patterns and agricultural policy <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Continued changes in the ozone layer. Severe weather events on the rise. Increase in severe weather events. Air water and chemical pollution worsening. Shifting approaches to farming and agriculture. Shifting countryside exploitation patterns Increased deforestation. Collisions between population and biodiversity intensify as human numbers and resource use expand The growing problem of malaria Over exploitation of a natural Resource leading to climate change and increasing the risk of breaching environmental limits Growing pressure for development, assessment, promotion and diffusion of technologies that could increase the production of food per unit area sustainably without harmful tradeoffs related to excessive consumption of water or use of nutrients or pesticide Increasing synthetic nitrogen fertilizer run-off Within the next five decades mammals 	<ul style="list-style-type: none"> Loss of key skills in agricultural sector Growing pressure for UK Government to spearhead investment in renewable energy Rapid increase in UN peacekeeping expenditures and staff. Government VAT on all construction except greenfield sites puts pressure on rural environment Increasingly common closures of traditional fishing grounds. Governance initiatives to improve the water environment and the sustainable use of water UK dependency on food imports causes increased vulnerability to transport disruption and epidemics Increasingly 'green' Chinese economic development; China institutes sustainability policies.
	<p>Megatrends</p> <ul style="list-style-type: none"> Increasing numbers of global institutions. There will be little progress in the development of independent supranational enforcement mechanisms to force states to obey international law More initiatives commissioned to implement and react to government sustainable development commitments <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Expanding global institutions. Strong governmental thrust to stimulate public participation observation and understanding of changes in the environment Increase in number and enforcement of resource protection initiatives by the International Governing Bodies Increasing awareness that many services degraded are "public goods" - possibly leading to litigation and subsequent compensation for loss Increase in attention to the explicit use of evidence to support and improve policy making and delivery Greater scientific understanding of the climatic consequences of current human 	<p>Megatrends</p> <ul style="list-style-type: none"> The "Dash to Gas" in power generation. Food demand will increase with rising world population, and increased consumption of livestock products Total economic value of managing ecosystems sustainably is often higher than conversion value Economic growth in Asia could spur massive car production and sales Increasing recognition that economic value of managing ecosystems sustainably may be higher than conversion value <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> The UK economy is likely to grow close to the trend rate of G7 competitors and will remain one of the world's largest economies up to at least 2015 Continued transition from manufacturing to information economy Increasing application of ICT in farming. The European Commission granted approval for genetically modified maize 	<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Continued changes in the ozone layer. Severe weather events on the rise. Increase in severe weather events. Air water and chemical pollution worsening. Shifting approaches to farming and agriculture. Shifting countryside exploitation patterns Increased deforestation. Collisions between population and biodiversity intensify as human numbers and resource use expand The growing problem of malaria Over exploitation of a natural Resource leading to climate change and increasing the risk of breaching environmental limits Growing pressure for development, assessment, promotion and diffusion of technologies that could increase the production of food per unit area sustainably without harmful tradeoffs related to excessive consumption of water or use of nutrients or pesticide Increasing synthetic nitrogen fertilizer run-off Within the next five decades mammals 	<p>Megatrends</p> <ul style="list-style-type: none"> Increasing numbers of global institutions. There will be little progress in the development of independent supranational enforcement mechanisms to force states to obey international law More initiatives commissioned to implement and react to government sustainable development commitments <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Expanding global institutions. Strong governmental thrust to stimulate public participation observation and understanding of changes in the environment Increase in number and enforcement of resource protection initiatives by the International Governing Bodies Increasing awareness that many services degraded are "public goods" - possibly leading to litigation and subsequent compensation for loss Increase in attention to the explicit use of evidence to support and improve policy making and delivery Greater scientific understanding of the climatic consequences of current human 	

Time Horizon	Socio-Demographic	Technological and Scientific	Economic	Environmental	Political
	<ul style="list-style-type: none"> Different visions emerge for the countryside. Increased consumer expectation for choice and freedom to exercise high levels of personal consumption Increased demand for improved local quality of life and healthincluding Rise of individualism negatively impacting public good and collective needs 		<p>developed by US corporation Monsanto</p> <ul style="list-style-type: none"> Growth in municipal waste production over the period to 2015. Increasing use of natural resources to produce renewable Energy including onshore and off shore wind farms and biofuel Increased pressure for continued infrastructure development linked to the number of households wealth and needs related to the UK's international competitiveness Growing debate over approach of peak oil production: one decade or two? In recent years 54 low-cost airlines have been started in Europe UK outsourcing food production increases environmental footprint elsewhere 	<p>such as the chimpanzee may be extinct in the wild.</p> <ul style="list-style-type: none"> Increased frequency of extreme weather events and detrimental impacts of climate change on the natural world and society is likely to become increasingly severe An increasing requirement for reliable regional predications for realistic adaptation strategies and investigation of the risks of rapid climate change Illegal fishing is a major problem for sea management Overharvesting of fish stocks Loss of coast line will be an increasing threat to agricultural land and housing Increased urbanization increases the overloading of water supply and sanitation infrastructure The water crisis is set to worsen Global ice melting accelerating as temperatures in the Arctic rise at twice the global average. 	<p>activities</p> <ul style="list-style-type: none"> Increased governmental thrust to break link between economic growth and increasing use of resources and environmental impacts New frameworks for decision making to include cost benefit and precautionary principle and risk assessment
2016 - 2030	<p>Megatrends</p> <ul style="list-style-type: none"> India's level of urbanization is expected to rise from 28 per cent in 2001 to 36 per cent by 2026 <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Urbanisation of the developing world. Increasing numbers of people live in areas prone to chronic drought Rising volume of UK air travel services. Increased human habitation of oceans and space. Rising meat demand in developing world. Dramatically increasing road / air travel; decreasing share of travel by mass transit. 	<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Rising temperatures could diminish the yields of some crops Genomic sciences transform healthcare. Ozone depletion and local air sea and land pollution Gardens meld natural and artificial. The fuel of the next generation of cars is hydrogen produced renewably stored underground and carried to cities and factories by pipeline Ongoing challenge of safe disposal of spent nuclear fuel Increasing popularity of "full-hybrid" cars Growing "green architecture" movement: designs that focus on the long-term environmental impact of maintaining and operating a building. 	<p>Megatrends</p> <ul style="list-style-type: none"> Rising global energy demand. Increased global economic growth. Wind power the world's fastest growing source of energy. Global energy demand will increase significantly (especially due to South and East Asia). UK likely to become more dependent on imported natural gas for electricity generation. Energy prices become more unstable to 2015. China plans to raise its GDP from one trillion Fossil fuel use will continue to increase Oil will remain available for the next 30 years but is likely to cost more and experience larger price variations after 2015. Increase in global food demand <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> By 2025 the population of countries that must import food due to insufficient cropland per capita could exceed 1 billion Agribusiness is consolidating (larger farms fewer in number) and agriculture is industrialising World grain production remains adequate but availability hampered by inadequate distribution. EU controls of agricultural subsidies and reduction of agricultural land may make the UK vulnerable to outside impacts and result in food shortages 	<p>Megatrends</p> <ul style="list-style-type: none"> Global water scarcity will increase <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> As a result of climate change smaller and smaller changes to ecosystems will provoke larger unforeseen consequences. The incidence of diseases of marine organisms and the emergence of new pathogens is increasing Increasing international levels of other non- CO2 greenhouse gases and sulphates As global development and consumption increase the pressure on natural resources will increase as they ultimately reach their environmental limit. Costs of damage to UK from current agricultural practices Continued decline in the quality of UK lowland habitats Increased impact on soil from climate change and carbon emissions from soil Wave power and water desalination have potentially increasingly important joint roles as energy provider and new source of water 	<p>Megatrends</p> <ul style="list-style-type: none"> Improvement in global governance expectations and standards <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Legal responses in response to damage caused by global warming. Increasingly co-ordinated international agreements for addressing ecosystem related concerns Potential for re-nationalisation of agricultural land and water infrastructure globally due to scarcity of food and water

Time Horizon	Socio-Demographic	Technological and Scientific	Economic	Environmental	Political
2031 - 2050	<p>Megatrends</p> <ul style="list-style-type: none"> Global population rising to 8.9Bn by 2050. India's population to reach 1.5 billion by 2050 <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Increased life expectancy 	<p>Megatrends</p> <ul style="list-style-type: none"> Shift to a Hydrogen energy economy may hampered by technological barriers and lack of political will <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Expanding use of alternative energy sources in the EU 	<ul style="list-style-type: none"> The current reliance of food supply on fossil fuel may be unsustainable. <p>Megatrends</p> <ul style="list-style-type: none"> Combined BRIC economies of China, India, Russia and Brazil exceed G6 economies by 2039. China's economy larger than US by 2041. By 2050 the annual increase in US dollar spending by the BRIC countries would overtake the G6 nations. <p>Key Trends and Drivers</p> <ul style="list-style-type: none"> By 2050 Brazil's GDP growth rate could average 3.6% the Brazilian economy overtakes Italy by 2025 overtakes France by 2031 overtakes Germany by 2036 	<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Changes to animal breeding and plant growing seasons due to climate change Rising temperatures - (1 °C by 2040) would diminish the yields of some crops Migratory species at risk through climate change Increasing incidence of forest fires in UK due to climate change Decreasing arable land. Global decrease in potable water. 	
2051+				<p>Key Trends and Drivers</p> <ul style="list-style-type: none"> Increase in forest fires in UK due to drier summers UK further changes to animal breeding and plant growing season due to climate change UK soil erosion due to wetter winters and increased rainfall 	
wildcard (any time)	<ul style="list-style-type: none"> Growing religious environmentalism 			<ul style="list-style-type: none"> Polar ice cap breaks up -- oceans rise one hundred feet Outbreak of new virulent infectious disease quickly kills millions (wild card) Rapid Amazon deforestation caused by ecosystem collapse Collapse of the Gulf Stream due to Greenland ice melting 	

Appendix 10 - Megatrend Relationships

Megatrend Themes



Appendix 11 - Natural Resource Protection – Future Trends Project – Evaluation of Impact Pathways

Theme	Key Resource Demand / Impact Drivers	Resultant Resource Pressures	Policy Challenges	Solution Enablers	Solution Impediments	Potential Local Impact on Natural Resources and Human Behaviours
UK Population	<p>27. Increased life expectancy</p> <p>4032 Net UK population growth and an increasing number of households, concentrated in 'economically dynamic' areas</p> <p>The UK economy is likely to grow close to the trend rate of G7 competitors and will remain one of the world's largest economies up to at least 2015</p>	<p>126. Continued urbanisation.</p> <p>44 Continued growth in housing demand within the UK</p> <p>9128 Increased urbanization increases the overloading of water supply and sanitation infrastructure</p>	<p>Address additional housing needs yet maintain greenfield areas</p> <p>Ensuring resource consumption stays within sustainable development targets</p> <p>Managing societal expectations around consumption and growth</p> <p>Promoting environmentally sustainable approaches to property construction and maintenance</p> <p>Ensuring appropriate range of incentives (e.g. tax, grants, rebates) for use of appropriate materials and / or processes</p>	<p>7015 Growing "green architecture" movement: designs that focus on the long-term environmental impact of maintaining and operating a building.</p> <p>240 Evolution of building materials.</p> <p>239 Evolution of architecture</p>	<p>9154 Government VAT on all construction except greenfield sites puts pressure on rural environment</p>	<p>Decreases land reserved for wildlife</p> <p>Increases production intensity on already reduced area of arable land</p> <p>Increases fertiliser usage with potential increase in run off to marine environment</p> <p>Increased use of materials with a lower overall resource consumption footprint (energy, waste, water) throughout their lifecycle</p>
Global Population	<p>1 Global population rising to 8.9Bn by 2050.</p> <p>Growing disparity in levels of consumption between rich and poor countries and within developing countries</p> <p>520 By 2025, the population of countries that must import food, due to insufficient cropland per capita, could exceed 1 billion</p>	<p>4043 Food demand will increase with rising world population, and increased consumption of livestock products</p> <p>1043 By 2026, the amount of cereal crops needed for India's population will be 250 million tons</p> <p>523 Collisions between population and biodiversity intensify as human numbers and resource use expand</p> <p>9130 Increasing overutilisation and pollution of aquifers</p> <p>Forest loss continues with global forest cover halved from its original extent in 6000 BC.</p>	<p>Global increased demand for food will put pressure on UK food pricing</p> <p>Land constraints will require a more productive use of resources in the agricultural sector</p> <p>Need to balance use of ever-more intensive farming techniques with long-term health of farmlands</p> <p>Imperative to focus on agriculture / food science and technology research which delivers environmentally benign productivity improvements and innovations</p> <p>Water management increasingly important to address increased need</p>	<p>256. Ubiquitous sensors enable real-time monitoring and new productivity measures.</p> <p>156. Biotechnology increasingly used in agriculture.</p>	<p>9124 Rising temperatures would diminish the yields of some crops</p> <p>9125 Increased impact on soil from climate change and carbon emissions from soil</p> <p>Distrust in some sections of the public of GM / biotech</p>	<p>More precision in agricultural processes can mean increased crops with only minimal use of essential fertilizers. Less land under cultivation but better adapted to specific crops</p> <p>New technologies will monitor more effectively early signs of environmental change (2004 State of the Future)</p>
Climate Change	<p>377 Growing concerns over global warming</p> <p>Continued rise in atmospheric carbon dioxide; rates of increase have more than doubled since 1960.</p>	<p>9136 Increased Severe Weather Events</p> <p>379 Global water scarcity will increase</p> <p>8 Global decrease in potable water</p> <p>9122 Rising temperatures - (1 °C by 2040) would diminish the yields of some crops</p> <p>Increased impacts on agriculture from global warming.</p>	<p>Increasing need to mitigate and adapt to climate change</p> <p>Clear impact evaluation tools and decision making frameworks will be required to support increasingly difficult decisions about resource protection priorities and trade-offs</p> <p>Anticipation of possible problem areas that could cause damage to human life and property.</p> <p>Countries or populations adversely affected by climate change may seek legal redress</p>	<p>9150 Wave power and water desalination have potentially increasingly important joint roles as energy provider and new source of water</p>	<p>9119 Increasing flood damage requires consensus on floodplain and flood risk</p> <p>383 The Gulf Stream dramatically switches off, cooling the UK (wild card)</p>	<p>Changes to species, animal breeding and plant growing seasons due to climate change</p> <p>Changing / shifting biomes</p> <p>Might require moving people to areas where flooding less likely which might mean pressure on land allocation to wildlife</p> <p>Anticipation of decreased water supplies – may require</p>

Appendix 11 - Natural Resource Protection – Future Trends Project – Evaluation of Impact Pathways

Theme	Key Resource Demand / Impact Drivers	Resultant Resource Pressures	Policy Challenges	Solution Enablers	Solution Impediments	Potential Local Impact on Natural Resources and Human Behaviours
The Growth Economies	<p>2007 China plans to raise its GDP from one trillion (US) to four trillion in the next twenty years</p> <p>1001 China's economy larger than US by 2041.</p> <p>1009 India's economy will grow at over 5% for the next three decades.</p> <p>Global production of crude steel surging as China's output nearly triples.</p> <p>Combined BRIC economies of China, India, Russia and Brazil exceed G6 economies by 2039.</p>	<p>4021 Increasing wealth and per capita GDP, both in the UK and globally, leading to increasing use of consumer products and energy, such that benefits from technical eco-efficient improvements are insufficient</p> <p>169 New patterns of consumption in non-Western countries.</p> <p>1043 By 2026, the amount of cereal crops needed for India's population will be 250 million tons</p> <p>389 Global energy demand will increase significantly (especially due to South and East Asia).</p> <p>293 Fossil fuel use will continue to increase</p>	<p>Need to facilitate to the global debate about the relationship between growth, resource consumption, environmental limits and sustainability</p> <p>Developing a resource protection policy that recognises competition with emerging economies for current resources and in collaboration with the new economies for resource protection and development of new cleaner, renewable energy sources</p> <p>Working with the emerging economies and the international community to reduce and mitigate CO2 emissions and other environmental impacts whilst still enabling those economies to grow</p> <p>9144 Understanding new opportunities from renewables sector needs Government leadership</p>	<p>Increasingly 'green' Chinese economic development; China institutes sustainability policies.</p> <p>Use of scientific and technological advances (e.g. materials science / nanotech) to reduce resource requirements</p> <p>4030 Increasing use of natural resources to produce renewable energy, including onshore and off shore wind farms and biofuel</p> <p>9156 Increasing European growth of wind power</p> <p>115 Increasing affordability of solar energy</p> <p>9150 Wave power and water desalination have potentially increasingly important joint roles as energy provider and new source of water</p>	<p>584 Energy prices become more unstable to 2015.</p> <p>6057 The ongoing challenge of safe disposal of spent nuclear fuel</p>	<p>instigation of water savings programmes</p> <p>9162 Changes to animal breeding and plant growing seasons due to climate change</p> <p>Positive and negative impacts of changing use of natural resources.</p> <p>Increased land use</p> <p>More understanding of the value of these resources – changes will impact landscape, and marinescape</p> <p>Increasing incentive to switch farms to growth of bio fuels</p>
The European Union	<p>(177) Uncertain impact of accession of Eastern European states on EU Common Agricultural Policy (CAP)</p>	<p>(549) Overall volume of agricultural output is declining in British farming (since late 1990s)</p> <p>(9112) Farming increasingly a net energy consumer</p> <p>547 Increasing competition and reduced subsidies in farming due to deregulation</p>	<p>Development of EU strategy for food and farming in tandem with likely impact of climate change on energy and transport and associated policies</p> <p>Difficulty in maintaining agricultural know-how as the sector reduces and declines.</p> <p>While the market value of crops does not reflect the real costs of energy, water or environmental externalities, it may be difficult to maintain public support for the agricultural sector.</p> <p>The need to maintain an agricultural</p>	<p>9010 Growing pressure for development, assessment, promotion and diffusion of technologies that could increase the production of food per unit area sustainably without harmful tradeoffs related to excessive consumption of water or use of nutrients or</p>	<p>9147 Loss of key skills in agricultural sector</p> <p>448 International law, particularly European law, will have an increasing impact on UK domestic law</p>	<p>Importing bio-oils may mean that UK rural areas will be contributing less economic value and competitive advantage may be lost in late entry to this market</p> <p>Neglect in lowlands likely to continue on land not managed by farmers</p> <p>EU CAP likely to decrease grazing pressure on uplands</p> <p>Changes in focus of EU CAP</p>

Appendix 11 - Natural Resource Protection – Future Trends Project – Evaluation of Impact Pathways						
Theme	Key Resource Demand / Impact Drivers	Resultant Resource Pressures	Policy Challenges	Solution Enablers	Solution Impediments	Potential Local Impact on Natural Resources and Human Behaviours
			<p>knowledge base for this industry becomes increasingly important in the face of uncertainty over the impact of futures actions on climate change mitigation and adaptation and prices of imported foods – e.g. will we see a growth in locally sourced produce?</p>	<p>pesticide</p> <p>448 International law, particularly European law, will have an increasing impact on UK domestic law</p>		<p>could increase environmental stewardship</p>
Marine Population	<p>544 Declining populations of terrestrial, freshwater and marine species worldwide (40% drop in the period 1970-2000)</p> <p>420 Illegal fishing is a major problem for sea management</p> <p>9105 The incidence of diseases of marine organisms and the emergence of new pathogens is increasing</p>	<p>182 Growing competition for marine and coastal resources</p> <p>448 International law, particularly European law, will have an increasing impact on UK domestic law</p> <p>559 Sovereignty and environmental security may increasingly be in conflict.</p>	<p>Increasing demand for EU / international collaboration and demand for legal frameworks to protect the marine environment</p> <p>Balancing the long-term interests of the fishing industry and creation of protected marine areas. The transition period between short and long term solutions is likely to be accompanied by financial and job losses in fishing and dependent industries</p> <p>Challenge of helping local fishing communities understand clearly what tradeoffs the government has agreed to at an EU level – to protect UK fish stocks while balancing this with local community needs and what reinvestment will be made to replace lost activity in fishing communities thereby preventing illegal fishing</p> <p>Incentives required to bring about environmentally friendly changes in fishing methods</p>	<p>593 Increasing demands for transparency and accountability in all organisations.</p> <p>The Aarhus Convention reinforces the growing trend of public and NGO's shaping national, regional, and international policy, legislation and treaties</p>	<p>9133 Heightened conflicts between conservation policies and other policy aims will lead to increased challenges to marine management</p> <p>Difficulty of policing international waters</p> <p>Economic impact on fishing communities</p> <p>Market premiums for rare species can drive up demand</p>	<p>261 Increasingly common closures of traditional fishing grounds.</p> <p>Risk of species extinction or collapse</p> <p>Well chosen and defined Marine Protection Zones should help protect remaining fish populations, biodiversity and habitats</p> <p>Seabird populations may be negatively impacted through loss of food supply</p> <p>Disruption of food chain relationships of marine ecosystems. E.g. marine species that are either dependent on or associated with the fish population</p>
UK Farming	<p>549 Overall volume of agricultural output is declining in British farming (since late 1990s)</p> <p>132 Increased impacts on agriculture from global warming.</p> <p>99 Shifting approaches to farming and agriculture.</p> <p>Farming increasingly a net energy consumer</p>	<p>9101 Over usage of synthetic nitrogen fertilizer</p> <p>9 Decreasing arable land</p> <p>9134 Greater reliance on scientific and technical support in management of resources</p> <p>Changes in farmed species</p>	<p>To use new technologies to assist in mitigating negative environmental impact on land and marine environment and eutrophication.</p> <p>To ensure appropriate scientific advice and technical guidance is available for increasingly complex needs</p> <p>Diversification of strategies to decrease pressure on ecosystems and ecosystems services whilst balancing the needs of local communities and habitats</p> <p>Development of interventions to help support farmers in adapting to changing economic and environmental demands</p>	<p>(9010) Growing pressure for development, assessment, promotion and diffusion of technologies that could increase the production of food per unit area sustainably without harmful tradeoffs related to excessive consumption of water or use of nutrients or pesticide</p> <p>156 Biotechnology increasingly used in agriculture</p>	<p>Heightened public expectations of agriculture</p> <p>4045 Increasing global agricultural technical challenges from resource constraints and environmental degradation, new pests/disease and climate change</p> <p>Increasing shift in balance of power within supply chains from food producers to the major retailers.</p> <p>Distrust in some sections of the public of</p>	<p>Reduced pollution levels from agriculture and increased nutrition levels in food produced</p> <p>Local habitats and biodiversity less impacted from human intervention</p>

Appendix 11 - Natural Resource Protection – Future Trends Project – Evaluation of Impact Pathways						
Theme	Key Resource Demand / Impact Drivers	Resultant Resource Pressures	Policy Challenges	Solution Enablers	Solution Impediments	Potential Local Impact on Natural Resources and Human Behaviours
Public Attitudes, Values and Beliefs	9152 Rise of individualism negatively impacting public good and collective needs	10 Air, water and chemical pollution worsening. 9118 Energy use and transport emissions will continue to be the largest contributors to production of greenhouse gases	Linking individual use of resources to environmental damage remains a challenge at local and national level Need to raise societal awareness of the need for Natural Resource Protection and the trade offs between resource protection and consumption	Increased demand for improved local quality of life and health including a clean environment and access to green space and biodiversity 212 Growing expectations within the UK for improved, environmentally benign transport	GM / biotech Lobbying from interest groups	Increased air, water and soil pollution Heavy metal pollution Landfill waste pollution Unsustainable consumption of natural resources
Global Resource Governance	9152 Rise of individualism negatively impacting public good and collective needs Countered by 542 Pledge of governments at the 2002 World Summit on Sustainable Development to significantly reduce loss of biodiversity by 2010 Increased scientific understanding of the world consequences of current human activities	546 Loss of natural capital	Delivering a coherent natural resource protection strategy while meeting current economic growth plans Developing governance and accountability to ensure effective decision making and follow through on natural resource protection	9115 Loss of resources beginning to be measured as loss of capital asset which should be added to GDP Total economic value of managing ecosystems sustainably is often higher than conversion value 593 Increasing demands for transparency and accountability in all organisations. 560 Legal responses in response to damage caused by global warming. Improved surveillance and monitoring technologies to increase the probability and reducing the cost of detecting hazardous events	445 There will be little progress in the development of independent supranational enforcement mechanisms to force states to obey international law	Rising risk of biodiversity loss. E.g. Extinction debt is a long- term biodiversity issue – but difficult to quantify. Many of the habitats found in Britain have been reduced in area very dramatically in the past 50 years, e.g. meadows, lowlands, heaths and bogs. Over time many of the populations in these habitats could die out because of lack of critical mass
Transport	Increased UK traffic and car ownership. Increased UK rail demand. 49 Rising volume of UK air travel services.	216 Continued changes in the ozone layer. 9139 UK dependency on food imports increases vulnerability to transport disruption and epidemics Energy use and transport emissions will continue to be the largest contributors to production of greenhouse gases	Balancing popular desire to have cheap travel with the impact on energy demand, resource consumption, impact on global warming and air pollution Implementing polluter pays policies through appropriate tax, regulatory and market instruments to ensure a sustainable transport infrastructure	Increasing use of fuel cells. 4019 Increased governmental pressure for emission reduction from transport and energy sector, in response to climate change	Strong tourism growth Continues with a doubling in arrivals forecast between 2005 and 2020. 560 Legal responses in response to damage caused by global warming.	As different concerned groups resort to legal action to protect against damage, natural resources may then be regarded more protectively Measures to contain spread of infectious diseases could lead to restrictions on travel

Appendix 11 - Natural Resource Protection – Future Trends Project – Evaluation of Impact Pathways						
Theme	Key Resource Demand / Impact Drivers	Resultant Resource Pressures	Policy Challenges	Solution Enablers	Solution Impediments	Potential Local Impact on Natural Resources and Human Behaviours
	<p>427 The low-cost airline sector is predicted to grow by 20-30% a year for the next five years, with corollary benefits for tourism, especially the “new” destinations</p> <p>Global passenger car market growing at over 4% per year - a five-fold increase since 1950.</p>			<p>229 Evolution of transportation systems.</p> <p>Investment in environmentally-benign transport technologies and intelligent management of transport infrastructure</p>	<p>387 Outbreak of new virulent infectious disease quickly kills millions (wild card)</p> <p>Potential public opposition to attempts to reduce vehicle use or encourage switching of transport modes</p>	
Energy	<p>389 Global energy demand will increase significantly (especially due to South and East Asia).</p> <p>4021 Increasing wealth and per capita GDP, both in the UK and globally, leading to increasing use of consumer products and energy, such that benefits from technical efficient improvements are insufficient</p>	<p>9151 Peak Oil - cost of extraction rising along with increasing demand</p> <p>389 Global energy demand will increase significantly (especially due to South and East Asia).</p> <p>584 Energy prices become unstable to 2015.</p> <p>Oil will remain available for the next 30 years but is likely to cost more and experience larger price variations after 2015.</p> <p>293 Fossil fuel use will continue to increase</p> <p>9153 The current reliance of food supply on fossil fuel may be unsustainable. The energy ratio (energy out/energy in) in agriculture has decreased from around 100 for traditional pre-industrial societies to less than 1 in most cases in the present food system.</p>	<p>Development of clear energy policy that reflects environmental, transport and economic growth objectives</p> <p>Long term – government many need to address rules for allocation of scarce resources amongst sectors of the economy</p> <p>Confrontation between economic advice on free trade versus security of supply</p>	<p>4030 Increasing use of natural resources to produce renewable energy, including onshore and off shore wind farms and biofuel</p> <p>World biofuel market growing rapidly; could quadruple to over 120 billion litres by 2020.</p> <p>Wind power installation growing fastest in the EU, which added 5703 megawatts in 2004.</p> <p>115 Increasing affordability of solar energy</p> <p>Solar photovoltaic cells are the world's fastest growing energy source at 32% per year.</p> <p>9150 Wave power and water desalination have potentially increasingly important joint roles as energy provider and new source of water</p>	<p>Agribusiness is consolidating (larger farms, fewer in number) and agriculture is industrialising</p>	<p>Consolidation of Agribusinesses could lead to more energy intensive farming methods</p> <p>Depends on scientific and expert advice on management of water resources - could lead to better resource management</p> <p>Lobbying by farming interests could impact wildlife negatively.</p> <p>Decisions on whether to monocrop or maximise diversity could have a significant impact</p>

Appendix 11 - Natural Resource Protection – Future Trends Project – Evaluation of Impact Pathways

Theme	Key Resource Demand / Impact Drivers	Resultant Resource Pressures	Policy Challenges	Solution Enablers	Solution Impediments	Potential Local Impact on Natural Resources and Human Behaviours
Use of Science	<p>9137 Increased scientific understanding of the world consequences of current human activities</p> <p>9116 Increasing use of science and innovation to improve policy and strategy for UK sustainable development</p>	<p>Increasing quality of evidence base and risk assessment tools for decision making on resource protection and management</p>	<p>Different sectors want different solutions that may be diametrically opposed to each other. The population is now sceptical of the use of scientific advice following high profile BSE type situations</p>	<p>9111 New frameworks for decision making to include cost benefit and precautionary principle and risk assessment</p>		<p>A wider array of decisions taking into consideration local ecosystems and environmental protection needs.</p>
Water Demand	<p>9129 The water crisis is set to worsen</p> <p>9130 Increasing overutilisation and pollution of aquifers</p>	<p>UK seen as traditionally having no water constraints. It is hard for the population to understand a water saving policy</p>	<p>Restrictions may prove unpopular, particularly as the water industry is now privatised and people may mistrust the motives behind corporate decision-making.</p>	<p>9150 Wave power and water desalination have potentially increasingly important joint roles as energy provider and new source of water</p> <p>9142 Adoption of the 'Virtual Water' concept (total water embedded in and consumed in producing a good or service) could change trading patterns and agricultural policy</p>	<p>9127 Major negative implications for the well-being of the water environment across Europe due to hydromorphological changes</p>	<p>Diverse impacts depending on type of local conditions of aquifers and type of water usage. May mean restrictions on agricultural crops that can be planted in certain areas.</p>
Toxins and Pollutants	<p>9140 Increasing risk of Bioaccumulation and Biomagnification (2007 to 2010)</p>	<p>Poisoning of organisms in sea and land – plastics, chemical pollution and medical pollutants such as the hormone disrupting chemicals are increasingly identified as perturbing the natural environment</p>	<p>Requires better understanding of the benefits and negative effects of different potential uses of nanotechnology. Requires clear policy stance on endocrine disrupting chemicals (EDCs) that can cause adverse effects by interfering in some way with the body's hormones. The transboundary nature of pollution will create imperative to regularly re-negotiate and monitor global agreements to control persistent organic pollutants (POPs)</p>	<p>9111 New frameworks for decision making to include cost benefit and precautionary principle and risk assessment</p>	<p>10 Air, water and chemical pollution worsening.</p>	<p>Potentially negative impacts on food chains Rainbow trout, roach and flounder are showing signs of exposure to exogenous oestrogens while salmon does not appear to be impacted. Some persistent pollutants. Some areas are especially vulnerable because these substances are redistributed to the colder northern regions in a process termed 'global redistillation' or the 'grasshopper' effect.</p>
Conflict and Disease	<p>264 Increasing risk of serious complications associated with food-borne disease.</p>	<p>Environmental causes of conflicts are expected to become more significant as environmental deterioration increases the number of environmental refugees. This could in</p>	<p>Balancing desire for free trade and globalisation with increased risks associated from rapid movements of population and disease</p>	<p>560 Legal responses in response to damage caused by global warming.</p>	<p>Number of violent conflicts worldwide remains unchanged. 547 Increasing</p>	<p>Environmental refugees could lead to further resource / habitat destruction</p>

Appendix 11 - Natural Resource Protection – Future Trends Project – Evaluation of Impact Pathways						
Theme	Key Resource Demand / Impact Drivers	Resultant Resource Pressures	Policy Challenges	Solution Enablers	Solution Impediments	Potential Local Impact on Natural Resources and Human Behaviours
	<p>280 New kinds of foodborne outbreaks emerge.</p> <p>552 Increased threat of exotic infectious disease.</p> <p>Increased risk of exotic species appearing in the UK.</p>	<p>turn increase the number and scale of migration related conflicts.</p> <p>Crops irrigated with sewage including raw and untreated waste now account for up to one-tenth of the world's total crops. Contaminated regions include developing nations</p>	<p>Establishing more stringent monitoring, tests and import controls for deliberate and inadvertent import of non-native species</p> <p>Increasing interdependence of consequences environmental impacts</p> <p>Need for collaborative innovation</p>	<p>5014 Public-private partnership has produced a promising candidate for a useful vaccine against the malaria parasite Plasmodium falciparum.</p>	<p>competition and reduced subsidies in farming due to deregulation</p> <p>2019 Crops irrigated with sewage, including raw and untreated waste now account for up to one-tenth of the world's total crops.</p> <p>Contaminated regions include developing nations</p> <p>9139 UK dependency on food imports increases vulnerability to transport disruption and epidemics</p> <p>385 Deliberate contamination of UK food or water supply by terrorists or agents of a hostile state (wild card)</p>	

Appendix 12 – Mapping of Mega Trends and Key Trends to NRP Key Themes

ID no.	Title	Timing	Air Quality	Biodiversity	Flood risk	Landscapes	Marine Environment	Soils	Water Quality	Water Supply & Demand
1	Global population rising to 8.9Bn by 2050. (2031 - 2050)	2031 - 2050	X	X	X	X	X	X	X	X
17	Increasing global product competition (now to 2006).	now to 2006	X	X			X	X		X
23	Expanding EU (2007-2010).	2007 - 2010	X	X		X	X	X		
24	Increasing numbers of global institutions (2011-2015).	2011 - 2015	X	X	X	X	X	X	X	X
118	Rising global energy demand (2016-2030).	2016 - 2030	X	X	X		X	X	X	X
128	Increasing potential for global environmental management (2007-2010).	2007 - 2010	X	X	X	X	X	X	X	X
134	The "Dash to Gas" in power generation (2011-2015).	2011 - 2015	X	X	X	X	X	X	X	X
141	Rising Chinese economic strength (now to 2006).	now to 2006	X	X	X		X			
169	New patterns of consumption in non-Western countries (now to 2006).	now to 2006	X	X		X	X	X	X	X
177	Uncertain impact of accession of Eastern European states on EU Common Agricultural Policy (CAP) (now to 2006).	now to 2006	X	X	X	X	X	X	X	X
194	Increased global economic growth (2016-2030).	2016 - 2030	X	X	X	X	X	X	X	X
293	Fossil fuel use will continue to increase (2016 - 2030).	2016 - 2030	X	X	X		X		X	X
294	Wind power the world's fastest growing source of energy (2016-2030).	2016 - 2030	X	X		X	X			
377	Growing concerns over global warming (Now to 2006)	now to 2006	X	X	X	X	X	X	X	X
379	Global water scarcity will increase (2016 - 2030)	2016 - 2030		X			X	X	X	X
391	Oil will remain available for the next 30 years but is likely to cost more and experience larger price variations after 2015. (2016 - 2030)	2016 - 2030		X	X	X		X		
392	UK likely to become more dependent on imported natural gas for electricity generation. (2016 - 2030)	2016 - 2030		X				X	X	X
445	There will be little progress in the development of independent supranational enforcement mechanisms to force states to obey international law (now-2010)	2011 - 2015	X		X	X	X	X	X	X
584	Energy prices become more unstable to 2015.	2016 - 2030	X	X	X	X	X	X	X	X
1000	Combined BRIC economies of China, India, Russia and Brazil exceed G6 economies by 2039.	2031 - 2050								
3101	Polar ice cap breaks up -- oceans rise one hundred feet (wild card).	Wild card (any time)		X	X	X	X	X		
4036	Increasing dichotomy between environmental concerns and consumer aspirations.	2011 - 2015	X	X	X	X	X	X	X	X
4043	Food demand will increase with rising world population, and increased consumption of livestock products (2011 - 2015)	2011 - 2015		X		X	X	X	X	X
9103	Total economic value of managing ecosystems sustainably is often higher than conversion value. (2011 to 2015)	2011 - 2015								
9109	Increasing pressure for elimination of subsidies which have negative ecosystem impacts (2007 - 2010)	2007 - 2010		X			X	X	X	X
9110	Increase in trading schemes using economic instruments to change market behaviour towards the environment (2007 - 2010)	2007 - 2010	X	X	X	X	X	X	X	X
9120	Oil price forecast by Goldman Sachs to rise to \$105 per barrel within a few years (2007 - 2010)	2007 - 2010	X	X		X	X	X	X	
9121	Increase in global food demand (2016 - 2030)	2016 - 2030	X	X		X	X	X		
9123	Shift to a Hydrogen energy economy may hampered by technological barriers and lack of political will (2031 - 2050)	2031 - 2050	X				X	X		X
9141	Increasing conflict between EU environmental protection goals and USA, China and other trading partners using WTO regulations to attempt to overturn EU legislation (2007 to 2010)	2007 - 2010	X	X	X	X	X	X	X	X
9149	Improvement in global governance expectations and standards (2016 to 2030)	2016 - 2030	X	X	X	X	X	X	X	X

Appendix 12 – Mapping of Mega Trends and Key Trends to NRP Key Themes

ID no.	Title	Timing	Air Quality	Biodiversity	Flood risk	Landscapes	Marine Environment	Soils	Water Quality	Water Supply & Demand
8	Global decrease in potable water (2031-2050).	2031 - 2050		X		X		X	X	X
9	Decreasing arable land (2031-2050).	2031 - 2050		X		X				X
10	Air, water and chemical pollution worsening (2011-2015).	2011 - 2015	X	X	X		X	X	X	X
27	Increased life expectancy (2031-2050).	2031 - 2050		X		X				X
44	Continued growth in housing demand within the UK (now to 2006).	Now to 2006		X		X		X		
49	Rising volume of UK air travel services (2016-2030).	2016 - 2030	X	X		X				
52	Decreased UK NOx pollution (2007-2010).	2007 - 2010	X	X		X		X	X	
54	Decreasing UK lead pollution (now to 2006).	Now to 2006	X	X		X		X	X	
94	Increase in number of UK households (now to 2006).	Now to 2006	X	X	X	X		X	X	X
96	Changing patterns of development (2007-2010).	2007 - 2010	X	X	X	X		X	X	X
98	Increasing economic growth of the countryside (2007-2010).	2007 - 2010	X	X	X	X		X	X	X
99	Shifting approaches to farming and agriculture (2011-2015).	2011 - 2015		X		X		X		X
101	Shifting countryside exploitation patterns (2011-2015).	2011 - 2015	X	X	X	X		X	X	X
104	Different visions emerge for the countryside (2011-2015).	2011 - 2015	X	X		X		X	X	X
105	Increasing genetic engineering of plants and animals (2011-2015).	2011 - 2015		X		X		X	X	X
115	Increasing affordability of solar energy (2011-2015).	2011 - 2015	X	X	X	X		X	X	X
119	Increasing pressure on landfills, waste disposal capacity (2007-2010).	2007 - 2010				X		X	X	
126	Continued urbanisation (2011-2015).	2011 - 2015	X	X	X	X		X		X
132	Increased impacts on agriculture from global warming (now to 2006).	Now to 2006		X	X	X		X		X
133	Increased pressure for tighter environmental controls (now to 2006).	Now to 2006	X	X	X	X		X	X	X
156	Biotechnology increasingly used in agriculture (now to 2006).	Now to 2006	X	X		X		X	X	
160	Increased risk of exotic species appearing in the UK (now to 2006).	Now to 2006		X						
164	Increased urbanisation will increase light pollution (now to 2006).	Now to 2006	X	X						
175	Increasing shift in balance of power within supply chains from food producers to the major retailers (now to 2006).	Now to 2006				X		X		X
176	Increases in the number and kind of actors in international governance, and the challenges to policy (now to 2006).	Now to 2006	X	X	X	X		X	X	X
179	Increased innovations in governance and regulation to heighten transparency of decision-making (now to 2006).	Now to 2006	X	X	X	X		X	X	X
180	Increasing concern over UK fish stock decline (now to 2006).	Now to 2006				X				
182	Growing competition for marine and coastal resources (2007-2010).	2007 - 2010				X				
185	Increase in 'precision farming' due to application of innovations (2007-2010).	2007 - 2010		X		X		X		X
186	Changing patterns of disease resistance and disease among wildlife, domestic animals, and plants (2007-2010).	2007 - 2010		X						
187	Increased public concern over sustainability, biodiversity, wildlife protection and welfare (now to 2006).	Now to 2006	X	X	X	X		X	X	X
216	Continued changes in the ozone layer (2011-2015).	2011 - 2015	X	X	X	X		X	X	X
217	Increased deforestation (2011-2015).	2011 - 2015	X	X	X	X		X	X	X
239	Evolution of architecture (2011-2015).	2011 - 2015	X	X	X	X		X	X	X
240	Evolution of building materials (now to 2006).	Now to 2006	X	X		X		X	X	X
243	Increased human habitation of oceans and space (2016-2030).	2016 - 2030				X			X	X
261	Increasingly common closures of traditional fishing grounds (2007-2010).	2007 - 2010				X			X	
264	Increasing risk of serious complications associated with food-borne disease (2007-2010).	2007 - 2010		X						
274	New, emerging and re-emerging animal and zoonotic diseases (2007-2010).	2007 - 2010		X						
280	New kinds of foodborne outbreaks emerge (2007-2010).	2007 - 2010		X						

Appendix 12 – Mapping of Mega Trends and Key Trends to NRP Key Themes NRP Key Trends and Drivers

ID no.	Title	Timing	Air Quality	Biodiversity	Flood risk	Landscapes	Marine Environment	Soils	Water Quality	Water Supply & Demand
281	Rising meat demand in developing world (2016-2030).	2016 - 2030		X		X		X	X	X
283	Ecotourism growing at 10-30% annually (2007-2010).	2007 - 2010		X		X	X			
300	Dramatically increasing road / air travel; decreasing share of travel by mass transit (2016-2030).	2016 - 2030	X	X	X	X		X	X	X
387	Outbreak of new virulent infectious disease quickly kills millions (wild card)	Wild card (any time)		X		X				X
405	The UK economy is likely to grow close to the trend rate of G7 competitors and will remain one of the world's largest economies up to at least 2015	2011 – 2015	X	X	X	X		X	X	X
420	Illegal fishing is a major problem for sea management (2011-2015)	2011 - 2015					X			
448	International law, particularly European law, will have an increasing impact on UK domestic law (2007-2010)	2007 - 2010	X	X	X	X		X	X	X
512	The importance of NGOs is increasing as they step in to fill the gaps left by governments.	Now to 2006	X	X	X	X		X	X	X
513	The world's reservoirs lose storage capacity as deforestation causes erosion and sedimentation behind dams (2007 - 2010)	2007 - 2010			X				X	X
520	By 2025, the population of countries that must import food, due to insufficient cropland per capita, could exceed 1 billion	2016 - 2030		X		X		X	X	X
521	Increasing numbers of people live in areas prone to chronic drought (2016 – 2030)	2016 – 2030							X	X
522	Increasing health risks due to bioaccumulation and biomagnification of certain toxins (2007 – 2010)	2007 – 2010	X	X			X	X	X	
523	Collisions between population and biodiversity intensify as human numbers and resource use expand (2011-2015)	2011 - 2015	X	X	X	X		X	X	X
525	Commercial and conservation interests increasingly come together in agricultural products, seen as the popularity of 'ethical' consumption of shade-grown coffee (and 'Fair Trade' products in the UK) (2007 - 2010)	2007 - 2010								X
530	The growing problem of malaria (now-2010)	2011 - 2015				X			X	
543	Public commitments that governments have made to environmental targets will allow an unprecedented opportunity for the public to apply pressure towards and hold them accountable for failing those goals	2007 - 2010								
544	Declining populations of terrestrial, freshwater and marine species worldwide (40% drop in the period 1970-2000)	2007 - 2010		X					X	
546	Loss of natural capital	2007 - 2010	X	X		X		X	X	X
547	Increasing competition and reduced subsidies in farming due to deregulation (Now - 2006)	Now to 2006					X			
549	Overall volume of agricultural output is declining in British farming (since late 1990s)	2007 - 2010		X		X				X
550	Agribusiness is consolidating (larger farms, fewer in number) and agriculture is industrialising	2016 - 2030		X		X		X	X	X
560	Legal responses in response to damage caused by global warming. (2016 to 2030)	2016 - 2030	X	X	X	X		X	X	X
593	Increasing demands for transparency and accountability in all organisations. (2007-2010)	2007 - 2010	X	X	X	X		X	X	X
2019	Crops irrigated with sewage, including raw and untreated waste now account for up to one-tenth of the world's total crops. Contaminated regions include developing nations (Now - 2006)	Now to 2006						X	X	
3004	Continuing degradation of agricultural land worldwide (2007-2010).	2007 - 2010				X		X	X	X
3005	Continued growth in aquaculture (farmed fish and shellfish production) (2007-2010).	2007 - 2010				X		X	X	
3109	Growing religious environmentalism (wild card).	Wild card (any time)	X	X	X	X		X	X	X
4014	Strong governmental thrust to stimulate public participation, observation and understanding of changes in the environment	2011 - 2015	X	X	X	X		X	X	X
4018	An increasing requirement for reliable regional predictions for realistic adaptation strategies and investigation of the risks of rapid climate change	2011 - 2015	X	X	X	X		X	X	X
4021	Increasing wealth and per capita GDP coupled with greater income disparity both in the UK and globally (now-2006)	Now to 2006	X	X	X	X		X	X	X

Appendix 12 – Mapping of Mega Trends and Key Trends to NRP Key Themes NRP Key Trends and Drivers

ID no.	Title	Timing	Air Quality	Biodiversity	Flood risk	Landscapes	Marine Environment	Soils	Water Quality	Water Supply & Demand
4028	Increased governmental thrust to break link between economic growth and increasing use of resources and environmental impacts (2011 – 2015)	2011 – 2015	X	X	X	X	X	X	X	X
4029	As a result of climate change smaller and smaller changes to ecosystems will provoke larger unforeseen consequences. (2016 – 2030)	2016 – 2030	X	X	X	X	X	X	X	X
4032	Net UK population growth and an increasing number of households, concentrated in 'economically dynamic' areas (2011 – 2015)	2011 – 2015	X	X	X	X	X	X	X	X
4034	Increased demand for improved local quality of life and health, including a clean environment and access to green space and biodiversity (2011 – 2015)	2011 – 2015	X	X	X	X	X	X	X	X
4041	Counter-urbanisation increasingly driving social change and developmental pressures in rural areas (2011 – 2015)	2011 – 2015	X	X	X	X	X	X	X	X
4045	Increasing global agricultural technical challenges from resource constraints and environmental degradation, new pests/disease and climate change	2011 - 2015	X	X	X	X	X	X	X	X
6057	The ongoing challenge of safe disposal of spent nuclear fuel	2016 - 2030								
7015	Growing "green architecture" movement: designs that focus on the long-term environmental impact of maintaining and operating a building.	2016 - 2030		X				X	X	X
9010	Growing pressure for development, assessment, promotion and diffusion of technologies that could increase the production of food per unit area sustainably without harmful tradeoffs related to excessive consumption of water or use of nutrients or pesticide	2011 - 2015		X		X		X	X	X
9101	Over usage of synthetic nitrogen fertilizer (2011 to 2015)	2011 - 2015		X			X	X	X	
9102	Overharvesting of fish stocks (2011 – 2015)	2011 - 2015					X			
9104	Decrease in cost of damage to UK from current agricultural practices (2016 to 2030)	2016 - 2030		X		X		X	X	X
9105	The incidence of diseases of marine organisms and the emergence of new pathogens is increasing (2016 - 2030)	2016 - 2030		X			X			
9106	Changes in institutional and environmental governance frameworks are required for effective management of ecosystems (2007 - 2010)	2007 - 2010	X	X		X		X	X	X
9107	Increasing awareness that many services degraded are "public goods" - possibly leading to litigation and subsequent compensation for loss (2011 - 2115)	2011 - 2015	X	X		X		X	X	X
9108	Increasingly co-ordinated international agreements for addressing ecosystem related concerns (2016 - 2030)	2016 - 2030	X	X		X		X	X	X
9111	New frameworks for decision making to include cost benefit and precautionary principle and risk assessment (2011 - 2015)	2011 - 2015	X	X		X		X	X	X
9112	Farming increasingly a net energy consumer (2007 - 2010)	2007 - 2010				X		X	X	X
9113	Continued decline in the quality of UK lowland habitats (2016 - 2030)	2016 - 2030		X				X		
9115	Loss of resources beginning to be measured as loss of capital asset which should be added to GDP (2007 - 2010)	2007 - 2010		X			X	X		X
9116	Increasing use of science and innovation to improve policy and strategy for UK sustainable development (2007 - 2010)	2007 - 2010	X	X		X		X	X	X
9117	Loss of coast line will be an increasing threat to agricultural land and housing (2011 -2015)	2011 - 2015		X		X				
9119	Increasing flood damage requires consensus on floodplain and flood risk (2007 - 2010)	2007 - 2010			X			X		
9122	Governance initiatives to improve the water environment and the sustainable use of water (2007 - 2010)	2007 - 2010							X	X
9125	Increased impact on soil from climate change and carbon emissions from soil (2016-2030)	2016 - 2030		X				X	X	X
9126	UK outsourcing food production increases environmental footprint elsewhere (2011 -2015)	2011 - 2015	X	X		X		X	X	X
9128	Increased urbanization increases the overloading of water supply and sanitation infrastructure (2011 - 2015)	2011 - 2015						X	X	X
9130	Increasing overutilisation and pollution of aquifers (2007 to 2010)	2007 - 2010						X	X	X
9132	Potential for re-nationalisation of agricultural land and water infrastructure globally due scarcity of food and water (2016 to 2030)	2016 - 2030						X		X

Appendix 12 – Mapping of Mega Trends and Key Trends to NRP Key Themes

ID no.	Title	Timing	Air Quality	Biodiversity	Flood risk	Landscapes	Marine Environment	Soils	Water Quality	Water Supply & Demand
9133	Heightened conflicts between conservation policies and other policy aims will lead to increased challenges to marine management (2007-2010)	2007 - 2010					X			
9134	Greater reliance on scientific and technical support in management of resources (2007 to 2010)	2007 - 2010	X	X	X	X	X	X	X	X
9135	EU controls of agricultural subsidies and reduction of agricultural land may make the UK vulnerable to outside impacts and result in food shortages (2016 to 2030)	2016 - 2030		X		X		X		X
9136	Increased Severe Weather Events (2011 to 2015)	2011 - 2015		X	X		X	X	X	X
9137	Increased scientific understanding of the world consequences of current human activities (2007 to 2010)	2007 - 2010	X	X	X		X	X	X	X
9139	UK dependency on food imports increases vulnerability to transport disruption and epidemics (2007 to 2010)	2007 - 2010		X			X	X		X
9142	Adoption of the 'Virtual Water' concept (total water embedded in and consumed in producing a good or service) could change trading patterns and agricultural policy (2007 to 2010)	2007 - 2010								X
9144	Short-termism in government is the greatest impediment to understanding new opportunities from renewables sector (2007 to 2010)	2007 - 2010	X	X		X	X	X		X
9145	Better internal management of issues between UK government departments (2007 to 2010)	2007 - 2010	X	X		X	X	X	X	X
9146	Intermediary trend where fossil fuel still available but when it is a key need to build rapidly alternative sources (2007 to 2010)	2007 - 2010		X		X	X	X		X
9147	Loss of key skills in agricultural sector impacting on future ability to produce renewable energy from bio oils (2007 to 2010)	2007 - 2010				X		X		
9148	Migratory species at risk through climate change (2031 to 2050)	2031 - 2050		X		X		X	X	
9150	Wave power and water desalination have potentially increasingly important joint roles as energy provider and new source of water (2016 to 2030)	2016 - 2030		X			X	X		X
9151	Responding to 'Peak Oil' will require fundamental changes to consumption patterns (2011-2015)	2011 - 2015				X	X	X	X	
9152	Rise of individualism negatively impacting public good and collective needs (2011 to 2115)	2011 - 2015	X	X	X	X	X	X	X	X
9153	The current reliance of food supply on fossil fuel may be unsustainable. The energy ratio (energy out/energy in) in agriculture has decreased from around 100 for traditional pre-industrial societies to less than 1 in most cases in the present food system.	2016 - 2030								
9154	Government VAT on all construction except greenfield sites puts pressure on rural environment	2007 - 2010		X		X				X
9155	Growing pressure for UK Government to spearhead investment in renewable energy (2007 to 2010)	2007 - 2010	X	X		X	X	X		X
9159	Increasing international levels of other non- CO2 greenhouse gases and sulphates	2016 - 2030	X	X	X	X	X	X	X	X
9160	Increasing incidence of forest fires in UK due to drier summers resulting from climate change (2031-2050)	2031 – 2050	X	X	X	X	X	X	X	X
9162	Changes to animal breeding and plant growing seasons due to climate change (2031 – 2050)	2031 – 2050		X						X
9164	UK soil erosion due to wetter winters and increased rainfall (2051+)	2051+		X				X		
9166	Collapse of the Gulf Stream due to Greenland ice melting (Wild Card)	Wild Card	X	X	X	X	X	X	X	X
9201	Worldwide meat production growing by 2%; has doubled since the 1970s. (Now to 2006)	Now to 2006								X
9202	Rapid growth of industrial animal agriculture - 'factory farming' - worldwide for pigs, chicken and beef. (Now to 2006)	Now to 2006								X

Appendix 12 – Mapping of Mega Trends and Key Trends to NRP Key Themes
NRP Key Trends and Drivers

ID no.	Title	Timing	Air Quality	Biodiversity	Flood risk	Landscapes	Marine Environment	Soils	Water Quality	Water Supply & Demand
9209	Solar photovoltaic cells are the world's fastest growing energy source at 32% per year. (2007 – 2010)	2007 – 2010	X			X				
9210	World biofuel growing rapidly; could quadruple to over 120 billion litres by 2020. (2007 – 2010)	2007 – 2010	X	X	X	X				X
9211	Continued rise in atmospheric carbon dioxide; rates of increase have more than doubled since 1960. (Now to 2006)	Now to 2006	X	X	X	X	X	X	X	X
9212	Rate of change in global temperature since 1976 has been triple that for century as a whole. (2007 – 2010)	2007 - 2010	X	X	X	X	X	X	X	X
9213	Increasingly 'green' Chinese economic development; China institutes sustainability policies. (2007 – 2010)	2007 - 2010	X	X	X	X	X	X	X	X
9227	Within the next five decades, mammals such as the chimpanzee may be extinct in the wild. (2011 – 2015)	2011 – 2015		X						
9228	Global ice melting accelerating as temperatures in the Arctic rise at twice the global average. (2011 – 2015)	2011 – 2015	X	X	X	X	X	X	X	X
9229	Increasing loss of world's wetlands. (2007 – 2010)	2007 - 2010	X	X	X	X		X	X	X