

# UK National Ecosystem Assessment

## Synthesis of Key Findings

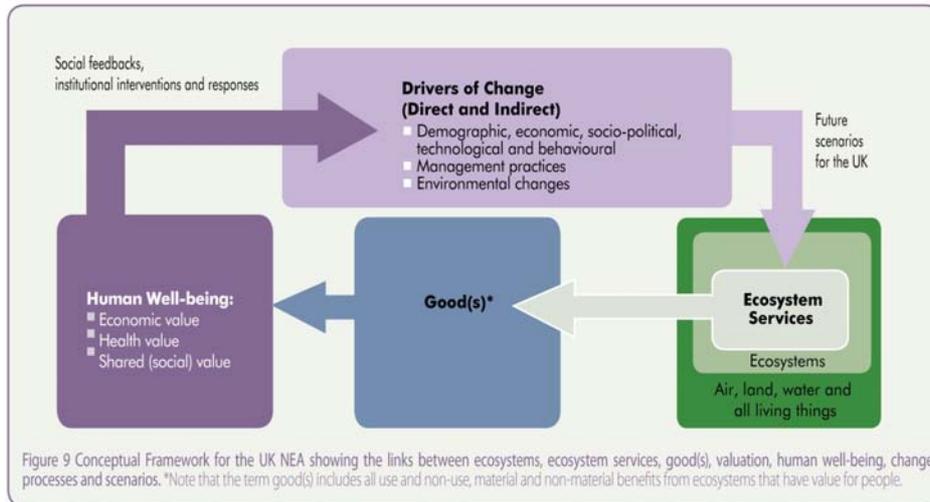
The Foundation for Science and Technology  
at The Royal Society  
13 July 2011



## NEA – Main Features

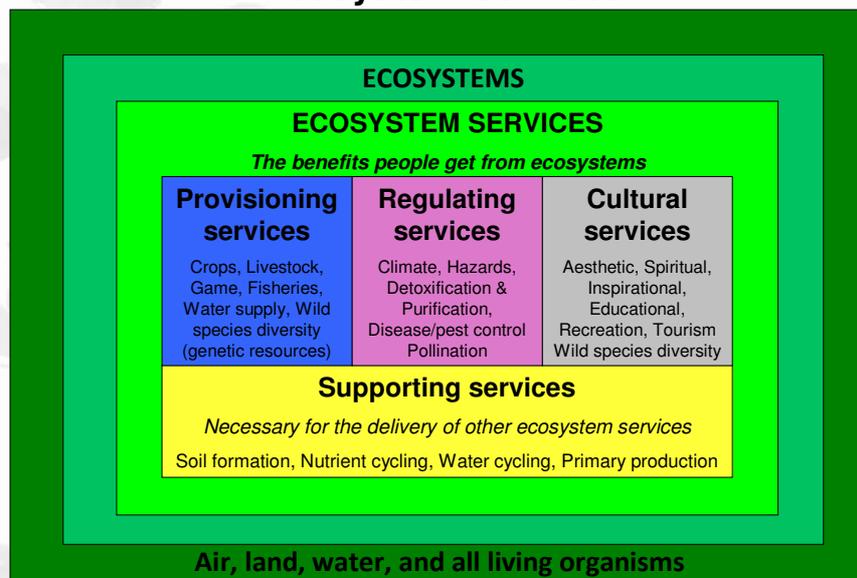
- **Independent Assessment**
  - Expert Panel chaired by Prof R Watson and Prof S Albon
  - Independent authors – over 500 involved
  - Peer Review of all Chapters
- **Status & Trends of UK Ecosystems & Ecosystem Services**
  - Look back 60 years
  - Look forward 50 years using 6 Scenarios
  - Economic assessment
  - Response Options
- **Two year study** – Synthesis Report published 2 June 2011

## Conceptual Framework of the UK National Ecosystem Assessment



UK National Ecosystem Assessment

## Ecosystem Services



UK National Ecosystem Assessment

# UK Ecosystems (Broad Habitats)

Mountains/Moors/Heaths



Semi-natural grasslands



Woodlands



Enclosed farmland



Freshwater/Wetlands



Urban (settlement)



Coastal margins



Marine



UK National Ecosystem Assessment

# Distribution of UK Habitats

## Box 3. The UK's Broad Habitats

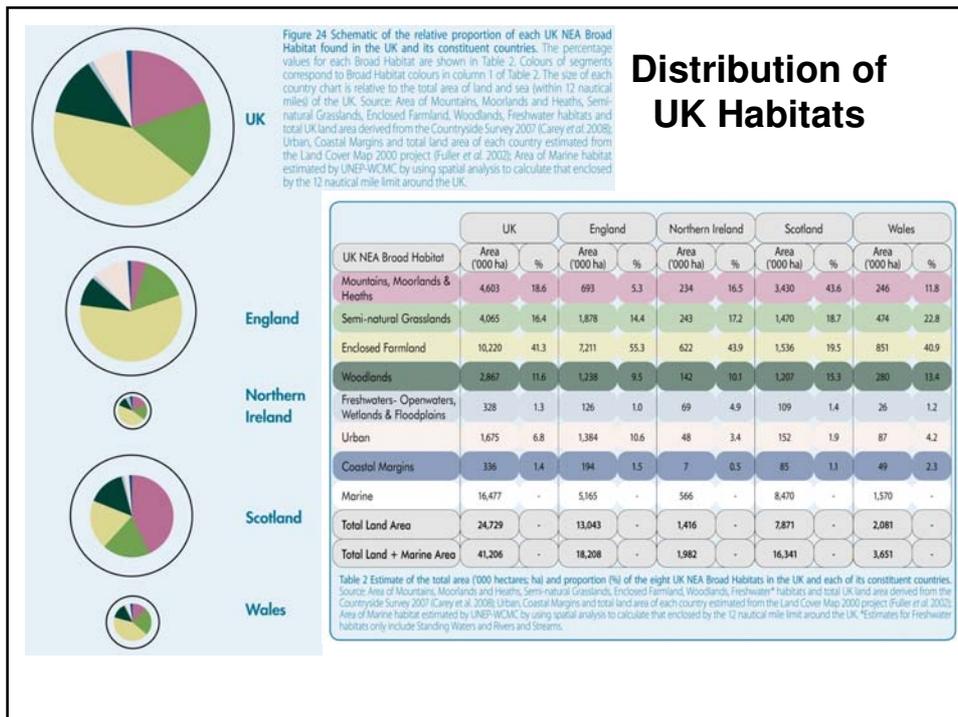
Although lacking in extremes – there are no high mountains, no true deserts and no major rivers – the UK is in fact remarkably variable biophysically, ecologically and socially, with complex underlying geology, a wide climatic range, from very wet to semi-arid, and large variations in the distribution of the human population, from extensive areas of near-wilderness (in Scotland) to one of the world's largest metropolitan areas (Greater London). In the UK NEA this diversity has been captured in eight Broad Habitat types (Figure 12):

### Dominant UK NEA Broad Habitats (>50% by area per 1km cell)

- Mountains, Moorlands & Heaths
- Semi-natural Grasslands
- Enclosed Farmland
- Woodlands
- Freshwaters - Openwaters, Wetlands and Floodplains
- Urban
- Coastal Margins
- Marine



Figure 12 Distribution (%) of the UK NEA Broad Habitat types by area at 10x km resolution. Inset: Charting Progress 2, UK Regional Sea boundaries: 1) Northern North Sea; 2) Southern North Sea; 3) Eastern Channel; 4) Western Channel and Celtic Sea; 5) Irish Sea; 6) Minches and Western Scotland; 7) Scottish Continental Shelf; 8) Atlantic North West Approaches, Rockall Trough and Faroe/Orkney Channel. Source: Broad habitat distribution - data from Land Cover Map 2002 (Lowe et al., 2002); regional sea boundaries (HMMA) (2002). Coastline: World Vector Shoreline (National - Geospatial Intelligence Agency Source: NOAA, 1997).



## UK National Ecosystem Assessment: Key Messages 1

*The benefits that we derive from the natural world and its constituent ecosystems are critically important to human well-being and economic prosperity, but are consistently undervalued in economic analysis and decision-making*

*Ecosystem and ecosystem services are constantly changing, driven by societal changes – demographic, economic, socio-political, technological and behavioural – which influence demand for goods and services and the way we manage our natural resources.*

## UK National Ecosystem Assessment: Key Messages 2

*Ecosystems and their services have been directly affected by conversion of natural habitats, pollution of air, land and water, exploitation of terrestrial, marine and freshwater resources, invasive species and climate change*

*From the late 1940s onwards, emphasis in the UK was placed on maximising provisioning services to meet human needs for food, fibre, timber, energy and water*

*While productivity increased, there was a decline in the delivery of a wide range of ecosystem services, particularly those associated with biodiversity and air, water and soil quality*

*Changes in national policy and legislation, latterly often driven by EU policy, along with technological developments and changing attitudes and behaviour, have led to improvements in some ecosystem services, particularly in the past 10-20 years*

UK National Ecosystem Assessment

## Relative importance of Broad Habitats for Ecosystem Services and overall direction of change since 1990

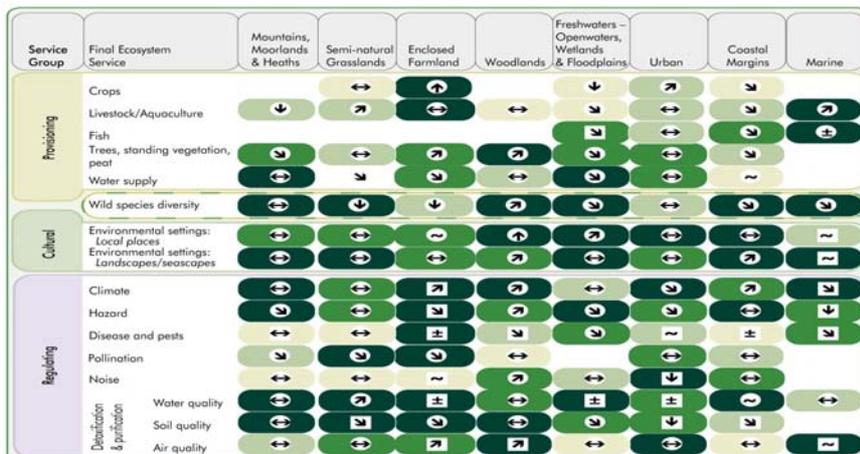


Figure 5 Relative importance of Broad Habitats in delivering ecosystem services and overall direction of change in service flow since 1990. This figure is based on information synthesised from the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5-16), as well as expert opinion. This figure represents a UK-wide overview and will vary nationally, regionally and locally. It will therefore also inevitably include a level of uncertainty; full details can be found in the Technical Report. Arrows in circles ↕ represent where there is high evidence for or confidence in the direction of service flow amongst experts; arrows in squares ↔ represent where there is less evidence for or confidence in the direction of service flow. Blank cells represent services that are not applicable to a particular Broad Habitat.

Importance of Broad Habitat for delivering the ecosystem service

High

Medium - High

Medium - Low

Low

Direction of change in the flow of the service

Improving

Some improvement

No net change

Improvement and/or deterioration in different locations

Some deterioration

Deterioration

Unknown

## Trends in UK Ecosystem Services (physical measures): 1945 to present

### Since 1945:

- Substantial increases in provisioning (food) services
- Decreases in many other ecosystem services

### Last 10-20 years:

- Some services still declining rapidly, especially some aquatic systems
- Others show a reduced rate of decline
- Others have begun to improve, especially woodlands

### 2010 status:

- About 35% of services are still declining (some from already low levels)
- About 20% are improving
- Remainder constant or unclear

## Increased Yield of Wheat from 1945-2010

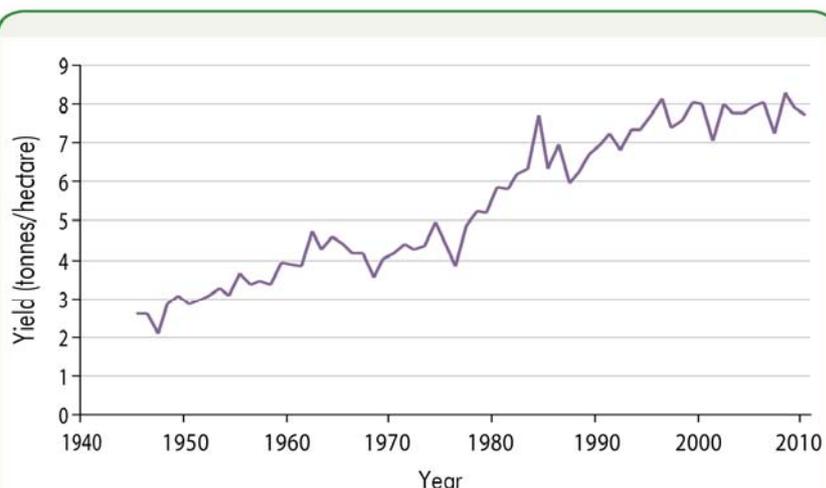


Figure 1 Average yield of wheat in the UK from 1945 to 2010. Source: Defra (2010). © Crown copyright 2010.

### Farmland Bird Index between 1970 and 2009

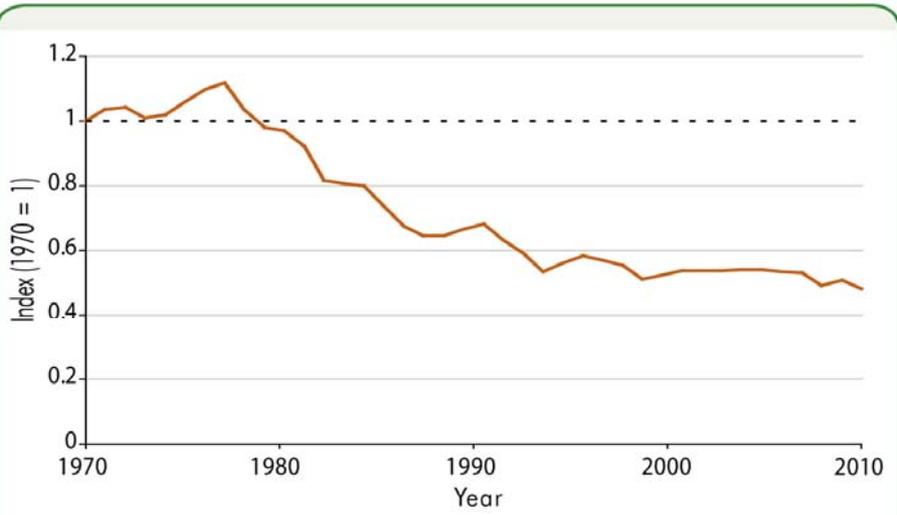


Figure 3 The UK Farmland Bird Index, 1970 to 2009, calculated on data from 19 individual farmland bird species. Source: RSPB, BTO, JNCC, Defra (2010).

### Decreased Landings of Fish between 1960 and 2008

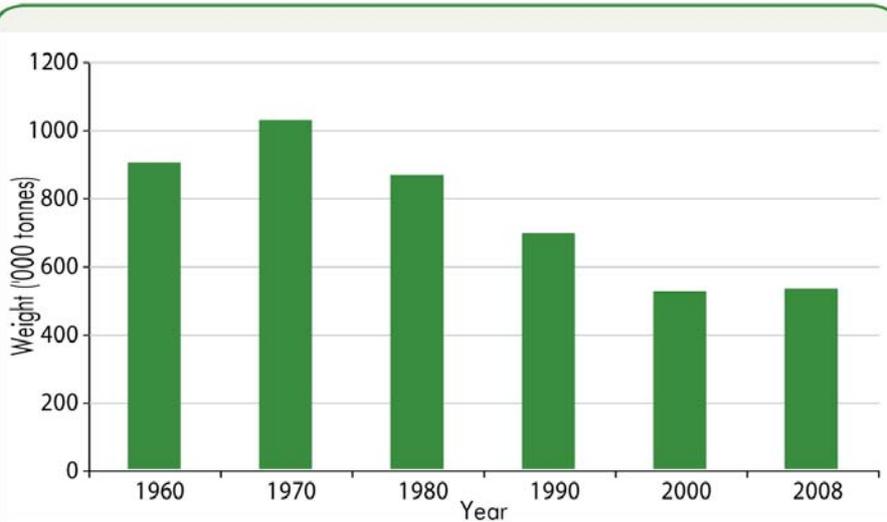


Figure 2 Landings of fish and shellfish into the UK by UK and foreign vessels between 1960 and 2008. Source: MMO (2010).

## Proportion of Finfish Harvested Sustainably

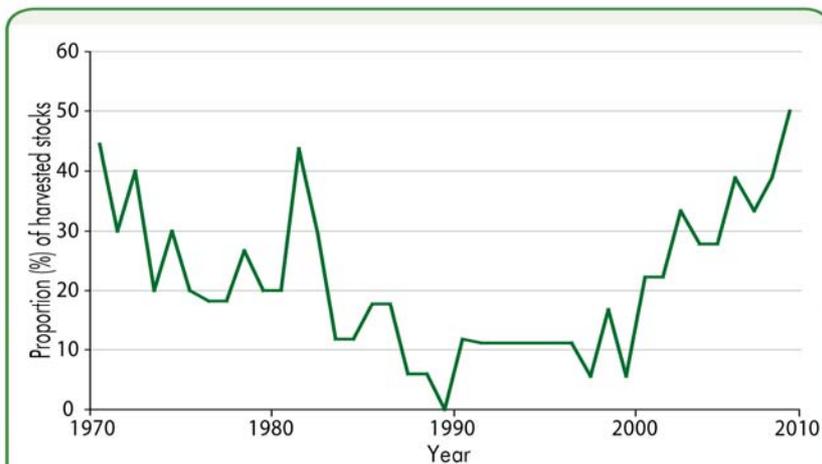


Figure 4 Proportion (%) of harvested finfish stocks around the UK which are at full reproductive capacity and harvested sustainably, 1970 to 2008. Source: Armstrong & Holmes (2010), CEFAS. © Crown copyright 2011.

## Importance and Trends in Drivers Affecting Habitats

UK NEA Broad Habitat	Habitat Change*	Pollution & Nutrient Enrichment	Overexploitation	Climate Change	Invasive Species
Mountains, Moorlands & Heaths	↗	→	↗	↗	→
Semi-natural Grasslands	↘	→	↗	↑	→
Enclosed Farmland	→	↘	→	↗	↗
Woodlands	→	→	↘	↗	↗
Freshwaters – Openwaters, Wetlands & Floodplains	→	↘	↗	↗	↗
Urban	→	→	↗	↗	↗
Coastal Margins	↗	→	↘	↑	↗
Marine	↗	↘	↗	↑	↑

Figure 13 Relative importance of, and trends in, the impact of direct drivers on UK NEA Broad Habitat extent and condition. Cell colour indicates the impact to date of each driver on extent and condition of Broad Habitats since the 1940s. The arrows indicate the current (since the 1990s) and ongoing trend in the impact of the driver on extent and condition of the Broad Habitat. Change in both impacts or trends can be positive or negative. This figure is based on information synthesized from each Broad Habitat chapter of the UK NEA Technical Report (Chapters 5–12) and expert opinion. This figure presents UK-wide impacts and trends, and so may be different from those in specific sub-habitats or regions; however more details can be found in the individual Broad Habitat chapters. \*Habitat change can be a result of either land use change or deterioration/improvement in the condition of the habitat.

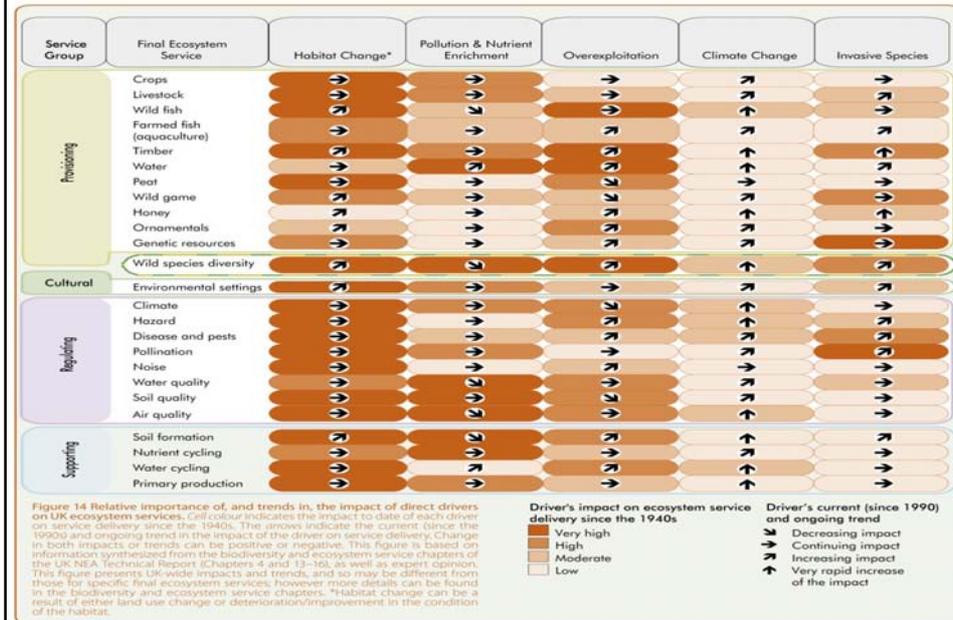
Driver's impact on extent and condition of Broad Habitats since the 1940s

- Very high
- High
- Moderate
- Low

Driver's current (since 1990) and ongoing trend

- ↘ Decreasing impact
- Continuing impact
- ↗ Increasing impact
- ↑ Very rapid increase of the impact

## Importance and Trends in Drivers Affecting Services



## UK National Ecosystem Assessment: Key Messages 3

*Despite improvements many ecosystem services are still far below their full potential – often as a consequence of long-term declines in habitat extent or condition, or both – and some continue to deteriorate, with adverse impacts on human well-being*

*A growing population and the increasing impacts of climate change mean that the future is likely to bring more challenges.*

*The UK will remain an active trading nation, with substantial flows of biomass across its borders, generating a substantial ecological 'footprint' overseas and continuing to be affected by social, economic and ecological changes elsewhere*

## Projected Changes in Precipitation and Temperature by 2060: High Emissions Scenario

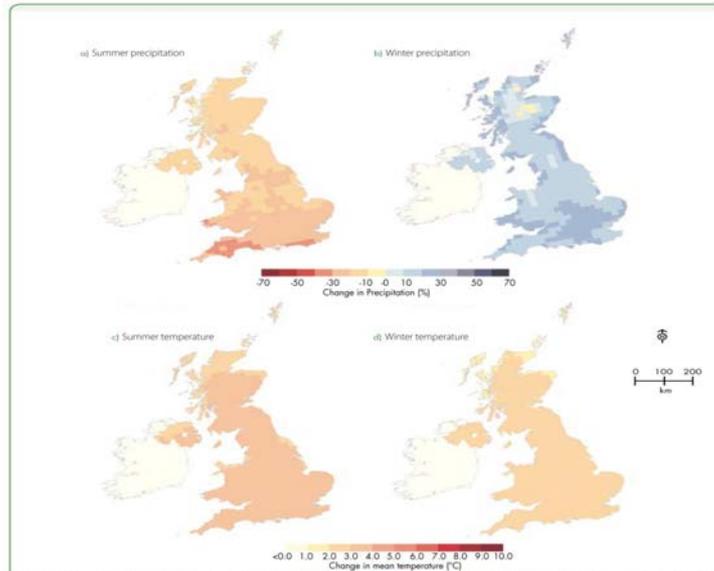


Figure 7 Projected change in precipitation (%) and temperature (°C) patterns for the 2060s (high emissions climate change scenario, 50% probability) in the UK at 25025 km resolution. a) Summer precipitation. b) Winter precipitation. c) Summer temperature. d) Winter temperature. Summer: June, July, August; Winter: December, January, February. Source: adapted from data supplied by UK Climate Projections (UKCP09, 2011).

## UK Dependence on non-UK Ecosystems

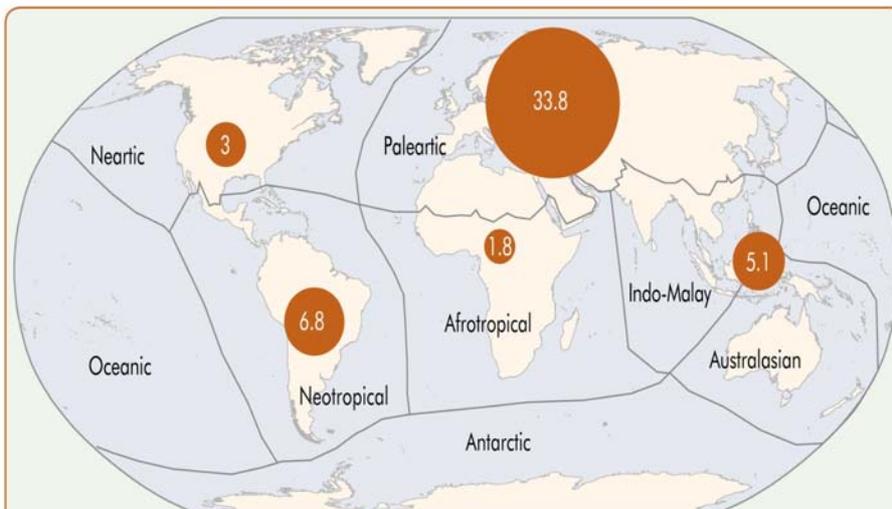


Figure 15 Source of biomass (millions of tonnes) imported into the UK by Biogeographical Realms in 2008. Source: data from HMRC (2008); underlying map based on Olson *et al.* (2004).

#### **UK National Ecosystem Assessment: Key Messages 4**

*Reversing declines in ecosystem services will require the adoption of more resilient ways of managing our ecosystems, and a better balance between production and other ecosystem services – one of the major challenges is to increase food production, but with a smaller environmental footprint through sustainable intensification.*

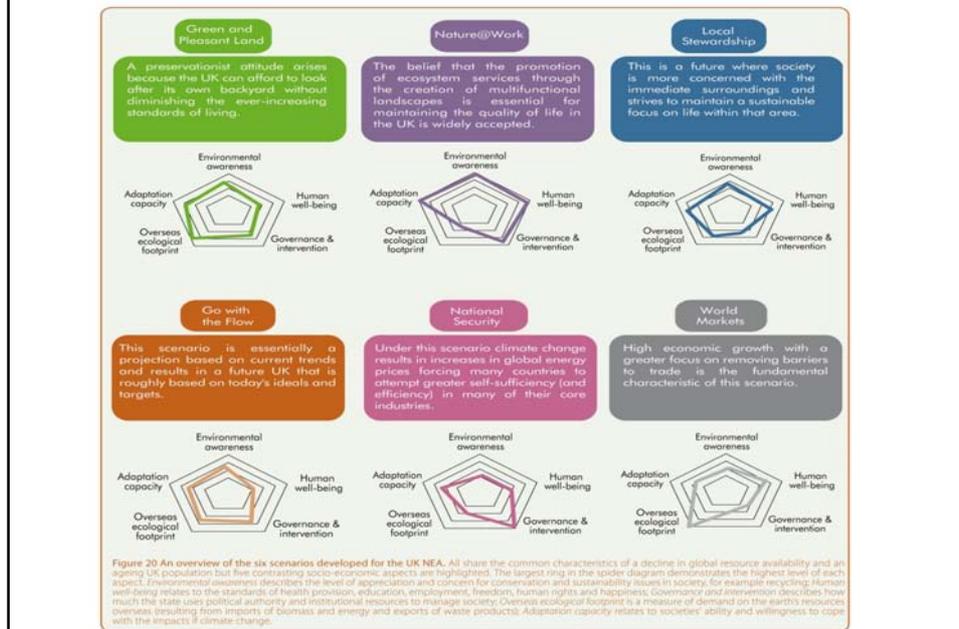
*Contemporary economic and participatory techniques allow us to take into account the monetary and non-monetary values of a wide range of ecosystem services. These techniques need to be adopted in everyday decision-making practice.*

#### **UK National Ecosystem Assessment: Key Messages 5**

*Failure to include the valuation of non-market goods in decision-making results in less efficient resource allocation, with negative consequences for social well-being. Recognizing the value of ecosystem services would allow the UK to move towards a more sustainable future, in which the benefits of ecosystem services are better realized and more equitably distributed.*

*Exploring some of the plausible futures open to us shows that there is a huge range of potential outcomes for the state of the nation, its people and its ecosystems in the coming decades. Decisions that we all make now and in the immediate future will have a major impact on these outcomes*

## Implications of Storyline on Ecosystem Services



## Implications of Storyline on Ecosystem Services

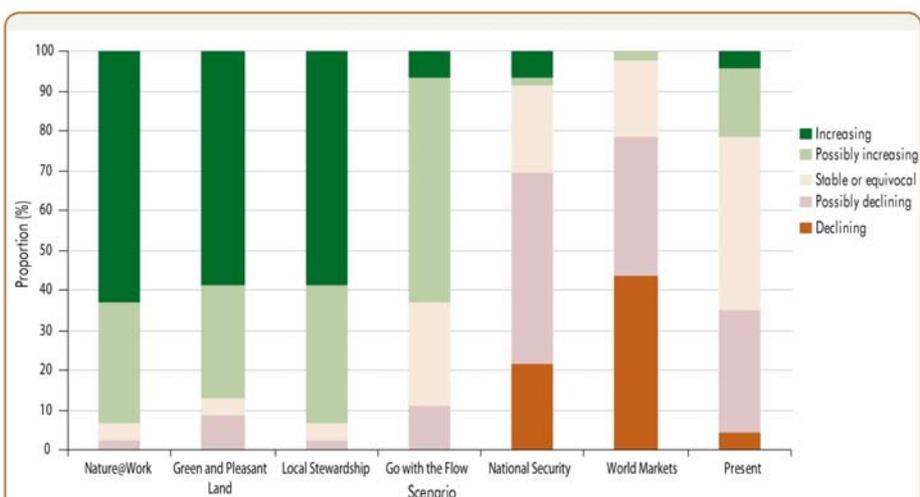


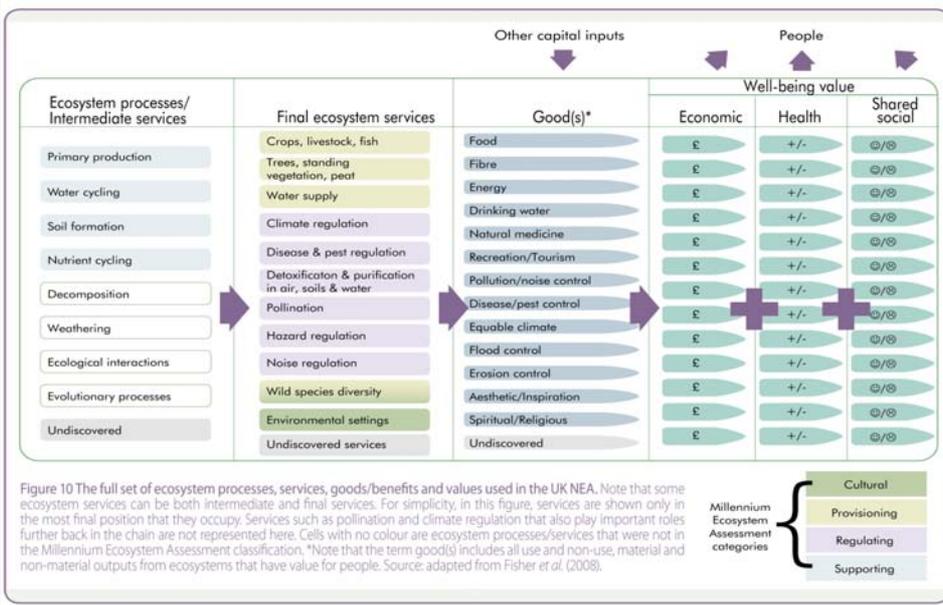
Figure 21 Preliminary comparison of storylines in terms of the projected trends in ecosystem services. Bars show proportion of services in each scenario with increasing or decreasing trajectories. Scenarios are ordered from left to right in terms of increasingly unfavourable impacts. A comparison with the present is shown. All services were treated as equally important and the outputs were not weighted according to the contributions made by each UK NEA Broad Habitat or the differences in the effects of the high and low climate change impacts for each scenario.

# Economic Analysis of UK Natural Environment and Ecosystem Services

## Why bother?

- Free, competitive markets are highly efficient allocators of market priced resources
- But many high value sectors of the economy and many major sources of wellbeing rely upon natural environment resources whose market prices are either poor reflections of value or entirely missing
- E.g. Water quantity and quality, flood defence, recreation and tourism, fisheries, forestry, etc.
- This makes it very likely that decisions are not optimal and do not maximise values
- It also means that, in the longer term, decisions may not be sustainable.

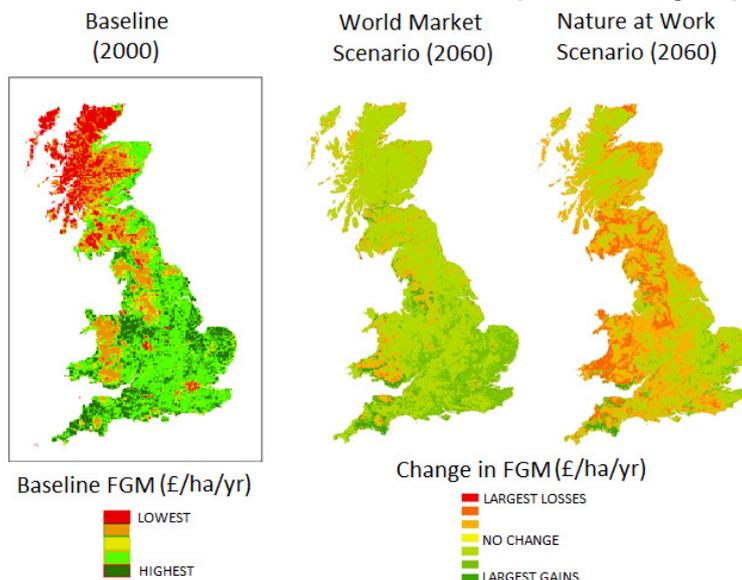
## Conceptual Framework for Valuing Ecosystem Services



## NEA: Ecosystem Service and Environmental Resource Related Goods

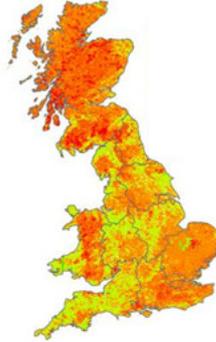
- Food production (agricultural, marine, other) Valued via adjusted market prices
- Biodiversity: Use values (pollination, pest control, wildlife, sport) Valued via contribution to output
- Biodiversity: Non-use values (existence values)
- Raw materials (timber, aggregates, other) Valued via avoided costs
- Climate regulation (carbon storage, GHG)
- Water quantity and quality Valued via observed behaviour
- Flood prevention (inland and coastal)
- Pollution remediation Valued via stated preferences
- Energy
- Amenity values (landscape, urban greenspace, climate amenity, etc)
- Recreation and tourism
- Environmental effects upon health

## Decision support: Impact of options on **market** and environmental values (farm output)

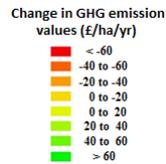
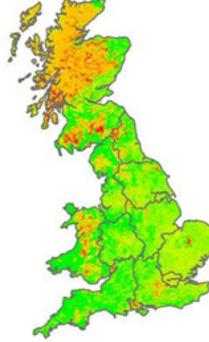


## Decision support: Impact of options on market and **environmental** values (greenhouse gases)

World Market Scenario (2060)

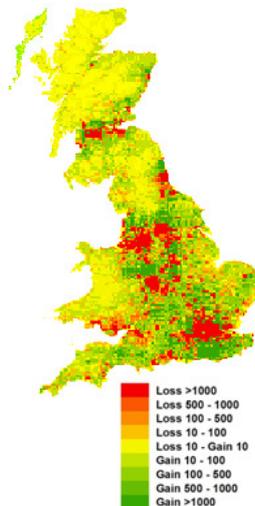


Nature at Work Scenario (2060)

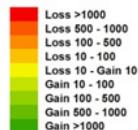


## Decision support: Impact of options on market and **environmental** values (recreation)

World Market Scenario (2060)



Nature at Work Scenario (2060)

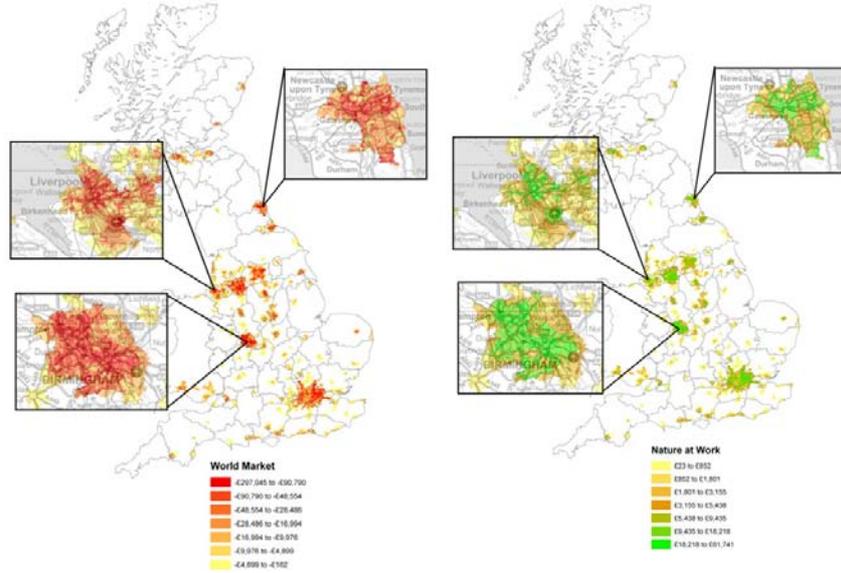


Change in recreation value (£'000/5km cell/yr)

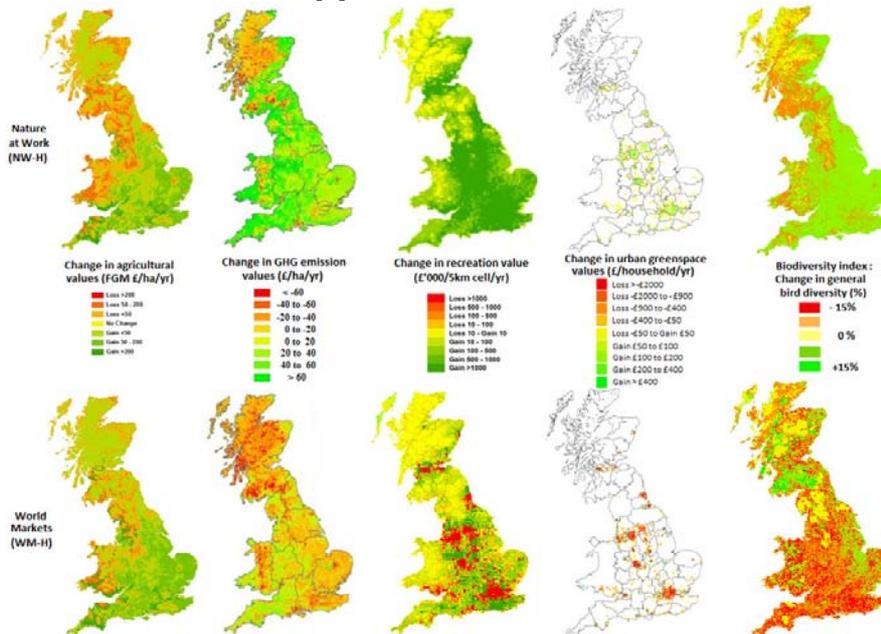
# Decision support: Impact of options on market and environmental values (urban greenspace)

World Market

Nature at Work



# Decision support: Distribution of effects



## Economic Implications of Storylines

Table 1 Summary impacts for the changes from the 2000 baseline to 2060 under each of the UK NEA Scenarios (low climate change scenario) in Great Britain (£million per year). Positive numbers indicate improvements from the baseline (negative numbers indicate worsening situations). The last but one row ranks the Scenarios when only their market values are considered (1= highest value; 6 = lowest values with green values being positive and purple indicating negatives). The final row repeats this ranking when all values (market and non-market) are considered. Scenarios are as follows: GF = Go with the Flow; GPL = Green and Pleasant Land; LS = Local Stewardship; NS = National Security; NW = Nature@Work; WM = World Markets

	GF	GPL	LS	NS	NW	WM
Market agricultural output values *	220	-290	350	680	-510	420
Non-market GHG emissions †	-800	2,410	-100	3,590	4,590	-2,130
Non-market recreation ‡	5,710	6,100	1,540	4,490	24,170	5,040
Non-market urban greenspace ¶	-1,960	2,350	2,160	-9,940	4,730	-24,000
<b>Total monetised values §</b>	<b>3,170</b>	<b>10,570</b>	<b>3,950</b>	<b>-1,180</b>	<b>32,980</b>	<b>-20,670</b>
Rank: Market values only	4	5	3	1	6	2
Rank: All monetary values	4	2	3	5	1	6

\* Change in total Great Britain farm gross margin.

† Change from baseline year (2000) in annual costs of greenhouse gas (GHG) emissions from Great Britain terrestrial ecosystems in 2060 under the UK NEA Scenarios (millions £/year); negative values represent increases in annual costs of GHG emissions

‡ Annual value change for all of Great Britain.

¶ Undiscounted annuity value; negative values indicate losses of urban greenspace amenity value.

§ We acknowledge some double counting between urban recreation and urban greenspace amenity value. Further data is needed to correct for this.

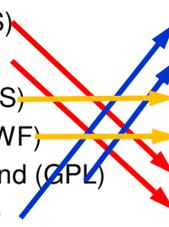
## Decision support: Ranking of option values

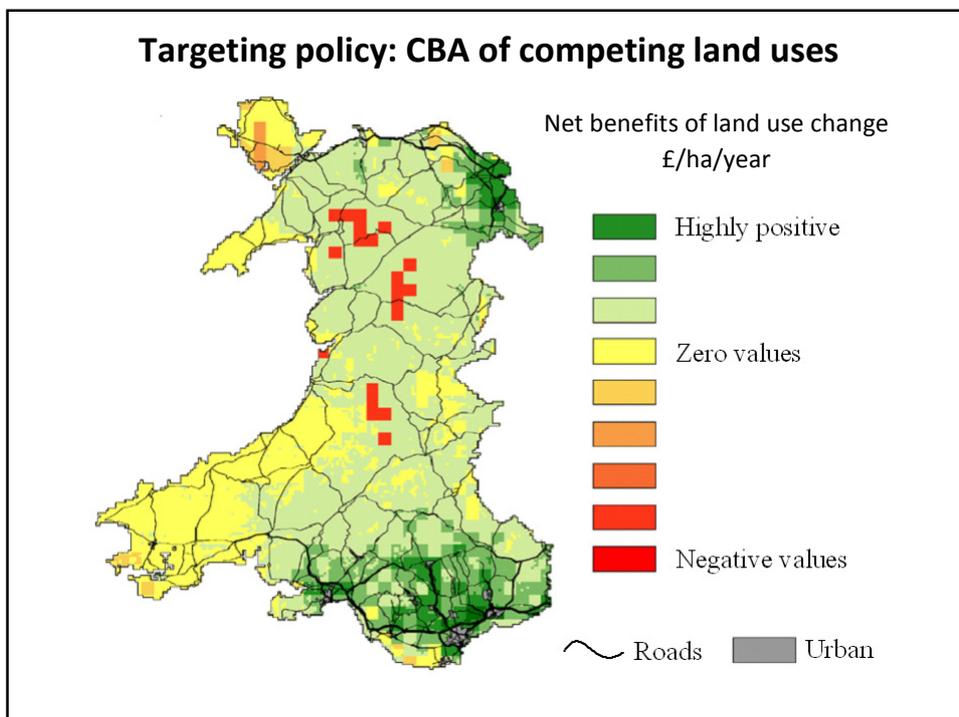
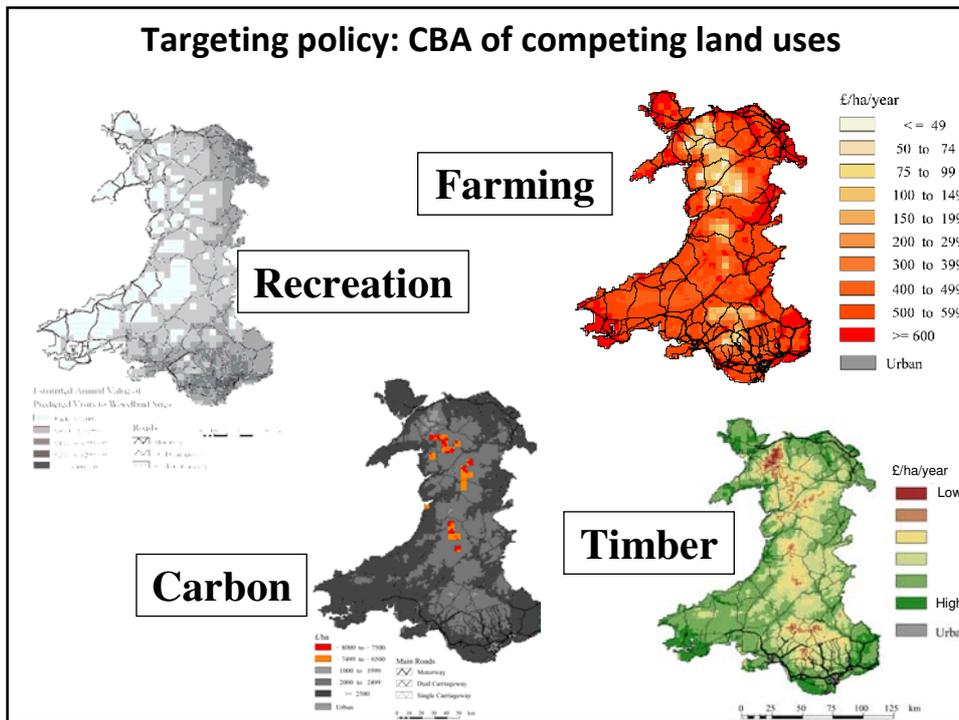
### Market values only

1. National Security (NS)
2. World Markets (WM)
3. Local Stewardship (LS)
4. Go With the Flow (GWF)
5. Green & Pleasant Land (GPL)
6. Nature At Work (NW)

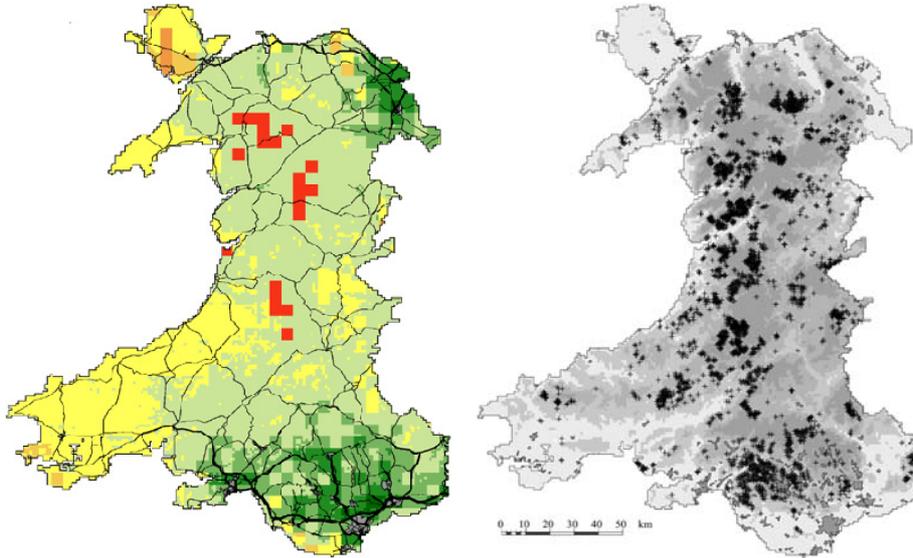
### Market & environmental values

1. Nature At Work (NW)
2. Green & Pleasant Land (GPL)
3. Local Stewardship (LS)
4. Go With the Flow (GWF)
5. National Security (NS)
6. World Markets (WM)





## Comparison with untargeted present land use



## UK National Ecosystem Assessment: Key Messages 6

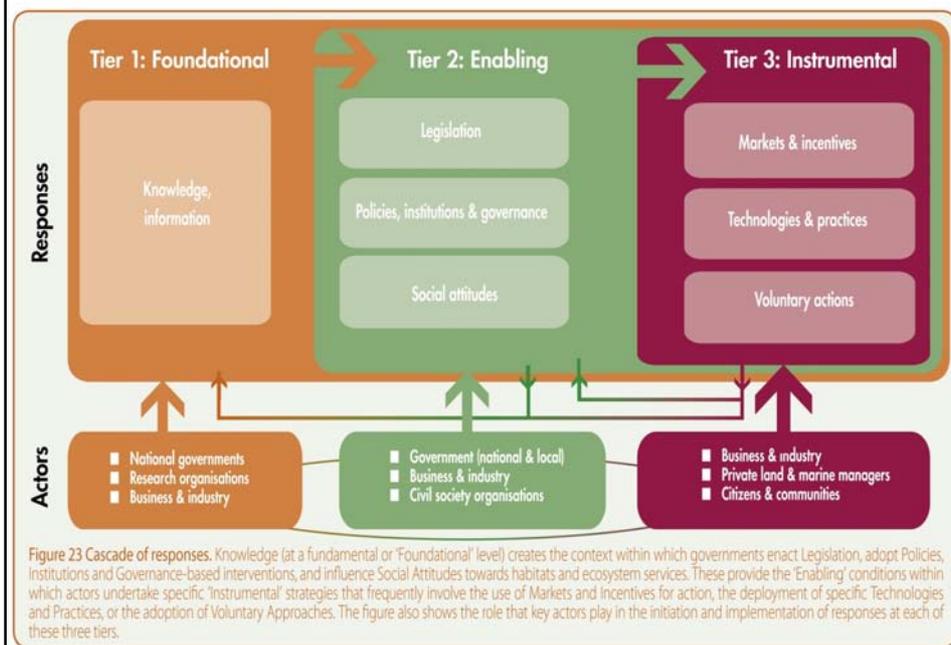
*A move to sustainable development will require changes in individual and societal behaviour and adoption of a more integrated approach to ecosystem management*

*This will require an appropriate enabling environment (regulations, incentives and behaviour change) and the involvement of a wide range of different actors, including government, the private sector, voluntary organizations and civil society at large*

## What is needed to promote the ecosystem approach?

- **INTEGRATION:** responses that are initiated within a single sector often impact on other sectors and services; key element of ecosystem service based thinking
- **THINKING ACROSS SCALES:** spatial and temporal
- **COLLABORATION:** responses may be initiated by particular actors, but usually require engagement with others; collaborative partnerships between stakeholders
- **MULTIPLE RESPONSES:** require a mix of approaches, e.g. legislation and regulations supporting attitudinal changes, underpinning markets and incentives, technological innovation and voluntary compliance

## Actors and Response Options



## Conclusions

*We already have enough information to manage our ecosystems more sustainably and good evidence of the benefits of doing so*

*Nonetheless improving our understanding of how changes in our ecosystems, in particular halting the loss of biodiversity, influences the delivery of services remains a priority*

*Finally, while we have illustrated how considering both the market and non-market benefits from ecosystem services can influence economic prosperity, we have to explore ways of also taking account of benefits to health and social values in decision making.*

*Plans are being discussed for a follow-on phase to the NEA*