Wetland Ecosystem Services- Experience of The UK National Ecosystem Assessment

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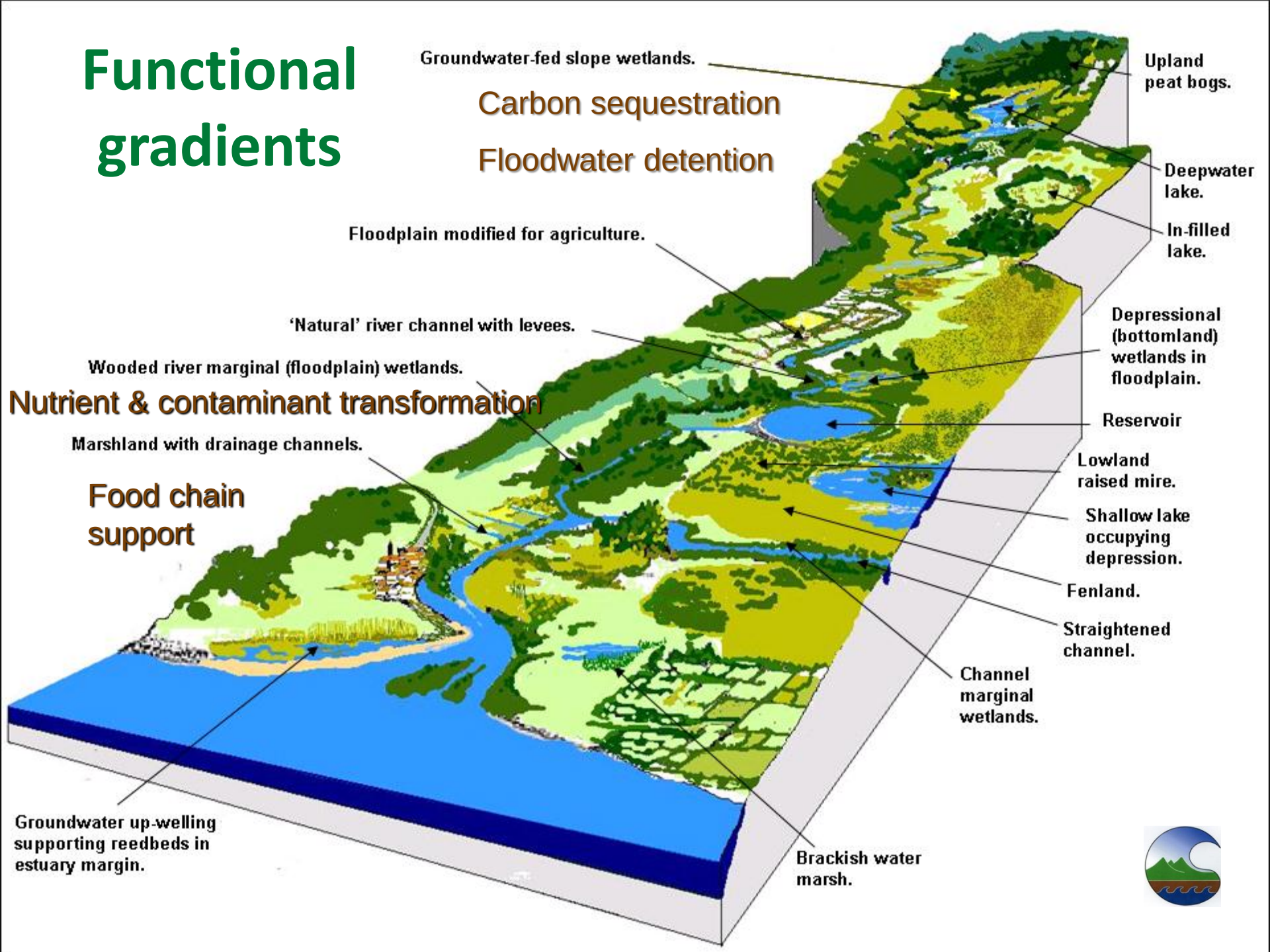
Policy Context

- Wetlands considered generally as components of nature conservation, sustainable use and environmental policy – often overridden by other sectoral interests
- Historical policy framework set by traditional conservation criteria rather than the wider water and socio-economic policy agenda
- Rapid global spread of wetland policies / strategies in tandem with important switch in emphasis from what wetlands ARE to what they (CAN) DO.
- Concept of ‘wise use’ with increasing functional emphasis
- Increasing recognition of wetland ecosystem services

Elements of new policy drivers

- Ecosystem approach
- Natural Capital
- Ecosystem services
  - Millennium Ecosystem Assessment (2005)
  - The Economics of Ecosystems & Biodiversity (2010)
  - UK National Ecosystem Assessment (2011)

Functional gradients

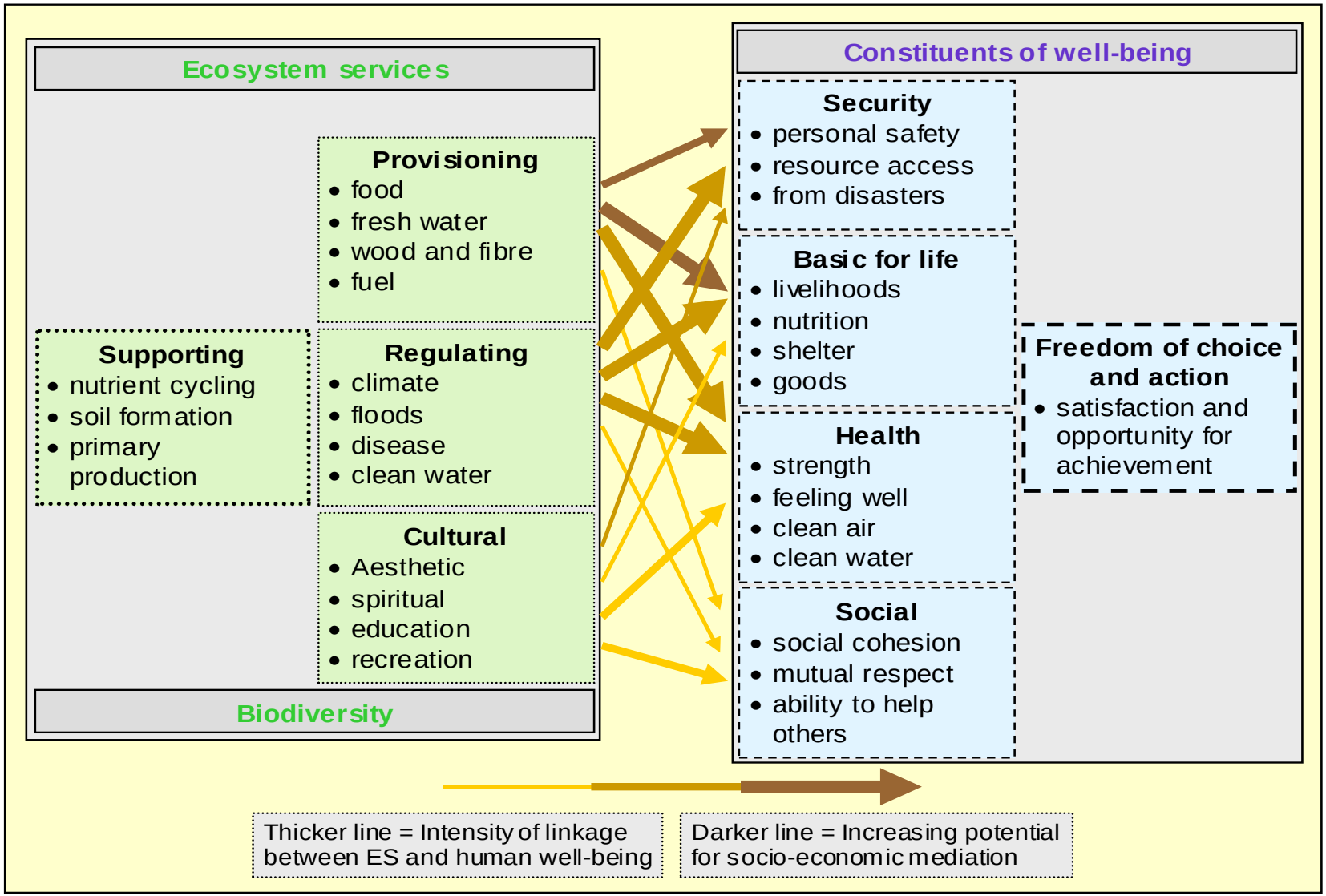


Ecosystem Services Derived from Inland Rivers, Lakes and Wetlands

Provisioning Services	Cultural Services
Food (fish, game, fruit, grain etc) Fresh water (storage, retention, provision) Fibre and Fuel (timber, fuel, peat, aggregates) Biochemicals (materials from living things) Genetic materials (medicine, resistance to pathogens, ornaments)	Spiritual (well-being, religion) Recreation (tourism, activities) Aesthetic (appreciation) Education (opportunities)
Supporting Services	**Regulating Services**
Biodiversity (habitats) Soil formation (retention, accumulation) Nutrient cycling (storage, processing) Pollination (habitat and support)	Climate (GHGs, temp, rain, CO_2) Hydrology (recharge, discharge, storage) Pollution (retention, removal, recovery) Erosion (protection, retention) Natural Hazards (floods, storms)

N.B. Not always compatible

Links between Ecosystem Services and human wellbeing

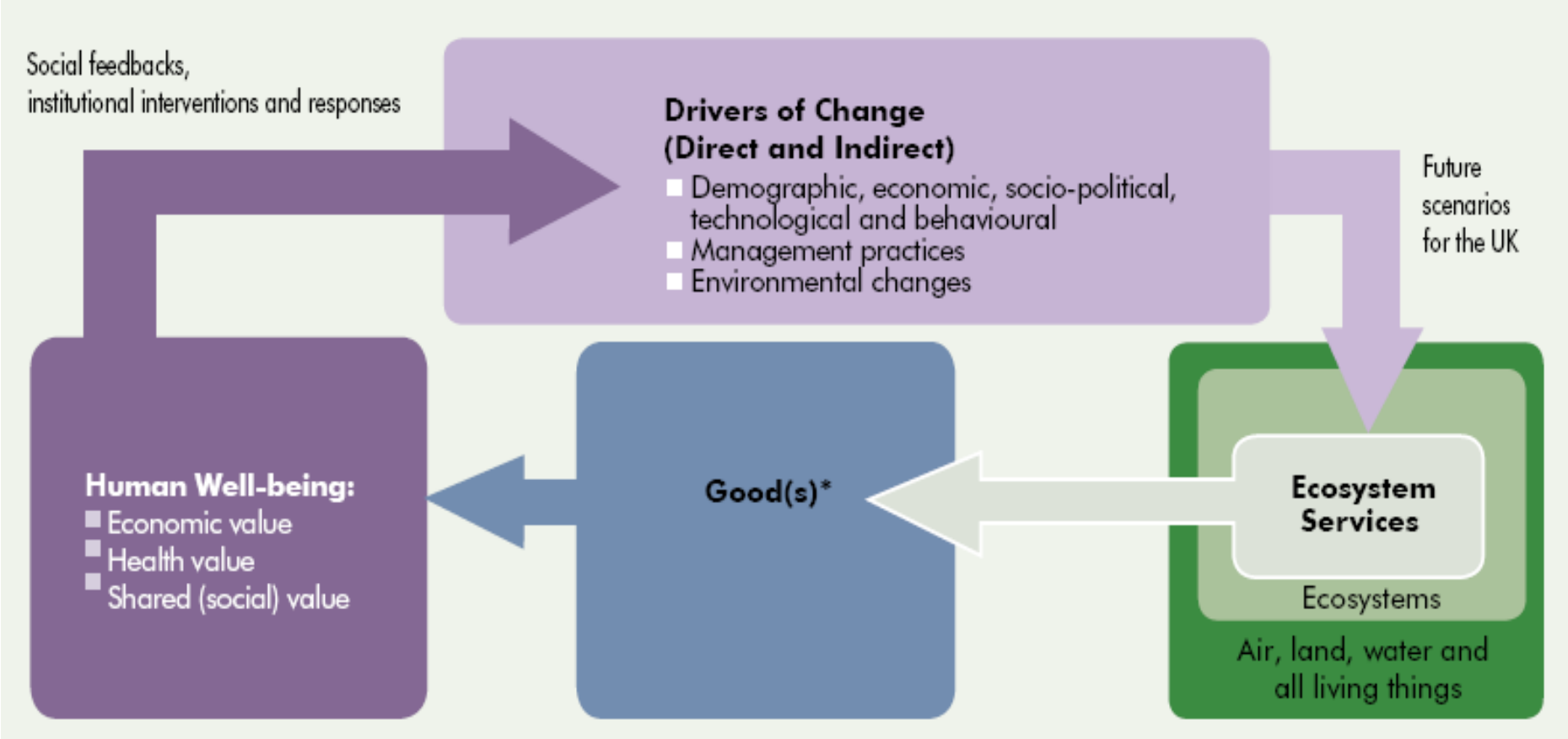


Adapted from Millennium Ecosystem Assessment

UK National Ecosystem Assessment

- House of Commons Environmental Audit Committee recommended that, *'ultimately the Government should conduct a full MA-type assessment for the UK to enable the identification and development of effective policy responses to ecosystem service degradation'.*
- *Scoping the potential benefits of undertaking an MA-style assessment for England*. 2008
- Hilary Benn announced Ecosystem Assessment for England in July 2008.
- Expanded to include Scotland, Wales & Northern Ireland but delayed start.

UK NEA Conceptual Framework



*Note that the term good(s) includes all use and non-use, material and non-material benefits from ecosystems that have value for people.

UK NEA Broad Habitats (ecosystems)

Freshwaters - Openwaters, Wetlands and Floodplains

Urban

Marine

Coastal Margins

Mountains, moors and heathlands

Semi-natural grasslands

Enclosed farmland

Woodlands

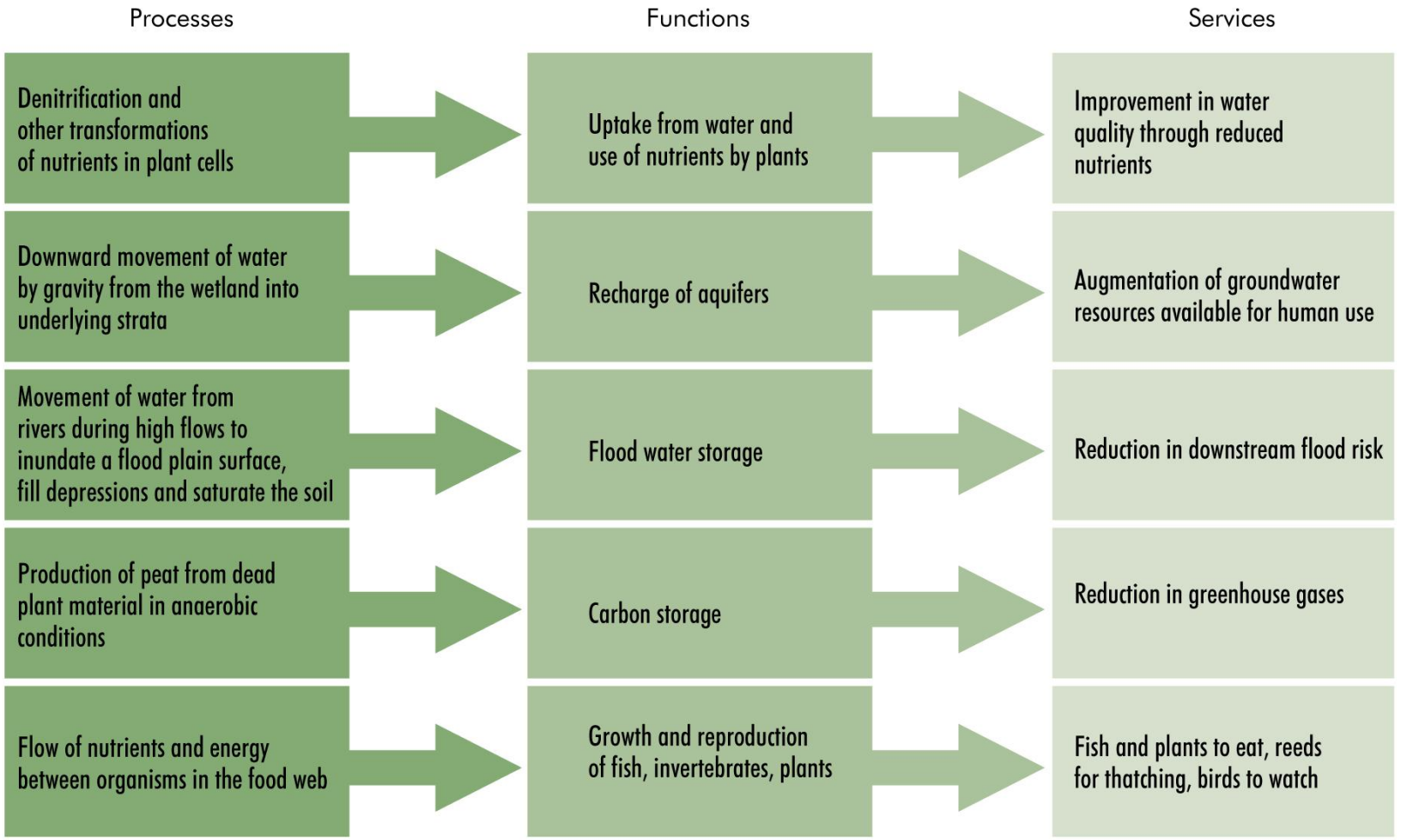


Figure 9.3 Relationship between the processes, functions and ecosystem services of Freshwater habitats. Source: adapted from Maltby *et al.* (1994), Acreman & Mountford (2009) and Maltby (2009a).

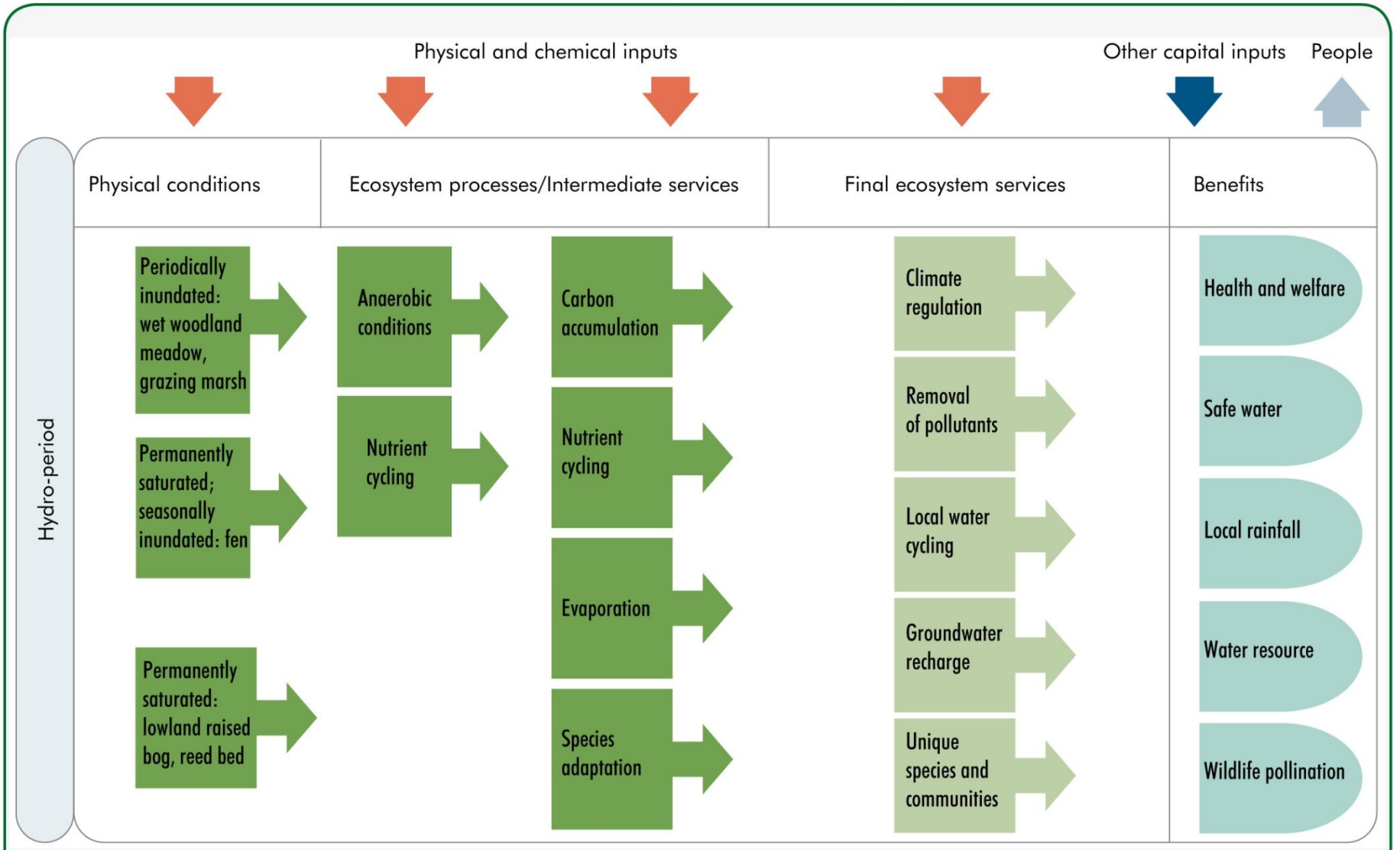


Figure 9.2 Schematic diagram of the relationship between the physical conditions, ecosystem services and benefits of Wetlands. Schematic follows the philosophy of the UK NEA Conceptual Framework (Chapter 2), and is adapted from Fisher *et al.* (2008).

Table A9.4.1 Ecosystem service delivery by key lowland wetland types.

	Service	Floodplains		Fens	Reedbeds	Grazing marsh	Lowland raised bogs	Headwater wetlands
		Natural	Managed					
Provisioning services	**Crops, plants, livestock, fish, etc. (wild and domesticated)**	Light grazing, wild game, sedge for thatching ↘2	Intense grazing of livestock (meat and wool) and crop production ↗1	Grazing of livestock, sedge for thatching ↓1	Grazing of livestock, reeds for thatching etc. ↓1	Potentially intense grazing of livestock ↓1	Bulb fibre, sphagnum for hanging baskets ↓1	Managed grouse moors, extensive grazing ↓1
	Trees, standing vegetation and peat	Timber, some peat, other vegetation ↘2	Short-term vegetation for agricultural production ↗1	Natural vegetation, peat ↘4	Some standing vegetation and organic soils ↓1	Maybe some peat/organic soil horizons ↓1	Peat accumulation ↓1	Peatlands ↓1
Provisioning and regulatory services	**Water quantity**	Natural buffer zone, flood defence by natural flooding regime ↘1	Often embanked to prevent flooding, promotes flooding downstream. Fertiliser inputs etc. degrade water quality ↘2	Provides clean water ↘2	Flood protection, water purification potential ↓2	Flood protection, aquifer recharge ↓1	Provides clean water ↓1	Major source/ shallow aquifer ↘4
	Wild species diversity including microbes	High biodiversity ↘1	Low biodiversity ↘1	Rare and some degree of diverse habitat ↘1	Rare but not particularly diverse habitats ↓1	Grazing restrictions (e.g. July onwards) promotes increased plant diversity ↓1	Rare but not particularly diverse habitats ↓1	Rare habitats ↔4
Regulatory services	**Climate regulation**	High carbon sequestration ↘1	Low carbon sequestration ↓1	Carbon sequestration (peat soils) ↓1	Carbon sequestration in soils ↓2	Local temperature and humidity regulation ↓2	Carbon sequestration (peat soils) ↓1	Carbon sequestration (peat soils) ↓1
	Hazard regulation: vegetation and other habitats	Natural flooding regime helps prevent downstream flooding ↘1	Does little to prevent flooding or climate stress ↘1	Prevent flooding if on floodplain ↔2	Some erosion protection potential, little flood prevention, some carbon sequestration ↓2	Flood protection potential, aquifer recharge ↓1	Some erosion protection potential, little flood prevention, high carbon sequestration ↓2	Flood protection potential, aquifer recharge ↓4
	Waste breakdown and detoxification	Natural processes can break down wastes ↘1	More likely a source than a sink ↘1	Natural buffer zone system ↘1	Natural buffer zone system ↓2	Breakdown of animal wastes and of contaminants in runoff ↓2	Natural buffer zone system ↓2	Natural buffer zone system ↘4
	Purification	Natural buffer zone ↘1	Buffer zone qualities lost due to intensification/ embankment ↓1	Natural buffer zone system ↘1	Natural buffer zone system ↓2	Breakdown of animal wastes and of contaminants in runoff ↓2	Natural buffer zone system ↓2	Natural buffer zone system ↘4
Cultural services	**Meaningful places including green and blue space**	Integral components of evolving river systems, diversity of processes, spawning areas for fish species, art, folklore ↘1	Development pressures have been intense due to high productivity, flat topography, proximity to navigable routes and potable water. Biological degradation and isolation of habitats ↓1	Unique self-supporting landscapes created by alliances of humans and nature, 'sense of place', religious significance; folklore and mythology, art, language, place-names, family histories ↘2	Landscape that regularly flood, coastal reedbeds act as natural buffers ↓2	A once common feature, species-rich habitat, support for wide variety of insects and birds; aesthetic and spiritual value ↓2	Unique self-generated landscapes, 'sense of place', religious significance; folklore and mythology, art, language, place-names, family histories ↓2	Unique self-generated landscapes, 'sense of place', religious significance; folklore and mythology, art, language, place-names, family histories ↘4
	Socially valued landscapes and waterscapes	Traditional landscape uses (wet meadows, osier beds, mill leats, fisheries); 'living landscape'—mosaic of habitat created at a landscape scale ↘1	Natural landscape-scale rhythms lost; fragmented habitats, species isolation, increased flood risk due to enhanced 'flashiness' ↓1	Artefacts of the past, traditional water and land-use, traditional medicine and ethno-botany, educational resource ↘2	One of the forgotten crops of the British countryside thatching industry, sedge, constructed reedbeds as environmentally-sensitive water treatment systems' bird habitat (e.g. the bittern) ↓2	Traditional agricultural practices evolved over centuries, flood alleviation, rich source of biodiversity ↓2	Rare but not particularly species-diverse habitats; artefact preservation (trackways, bog people) palaeontological records of environmental and climate change ↓2	Rare but not particularly species-diverse habitats; artefact preservation (trackways, bog people) palaeontological records of environmental and climate change ↘4

Degree of importance of ecosystem service: High level Medium level Low level
Direction of change: ↑ Improving ↗ Some improvement ↔ Equivocal changes ↘ Some deterioration ↓ Deteriorating
Confidence: 1 – High agreement, high evidence 2 – High agreement, low evidence 3 – Low agreement, high evidence 4 – Low agreement, low evidence

Table A9.4.2 Trade-off matrix for natural Floodplains. The assumption is that the Floodplain is pristine, that is, it is predominantly diverse mixed woodland. This means that for many of the services they are being optimally performed and can not be improved; therefore, the trade-off is neutral as nothing would change. The trade-off is determined by considering how optimisation of the policy lever would affect the responding factor.

Policy lever		Responding factor →										
		Crops, plants, animals	Trees, standing vegetation, peat	Water quantity	Climate regulation	Hazard regulation	Waste break-down	Wild species diversity	Purification	Meaningful places	Valued landscapes	
	Crops, plants, animals		↓ ***	↓ ***	↓ ***	↓ ***	↓ ***	↓ ***	↓ ***	↓ ***	↓ ***	1
	Trees, standing vegetation, peat	↔		↑*	↔	↔	↔	↓ *	↓ *	↓ *	↓ *	2
	Water quantity	↔	↔		↔	↔	↔	↔	↔	↔	↔	3
	Climate regulation	↔	↑ *	↔		↔	↔	↓ *	↓ *	↓ *	↓ *	4
	Hazard regulation	↔	↔	↔	↔		↔	↔	↔	↔	↔	5
	Waste breakdown	↓ *	↓ *	↑ *	↓ *	↔		↓ **	↑ *	↓ *	↓ *	6
	Wild species diversity	↑ *	↓ *	↔	↔	↔	↔		↔	↑ *	↑ *	7
	Purification	↓ *	↓ *	↑ *	↓ *	↔	↑ *	↓ **		↓ *	↓ *	8
	Meaningful places	↔	↔	↔	↔	↔	↔	↔	↔		↔	9
	Valued landscapes	↔	↔	↔	↔	↔	↔	↔	↔	↔		10

Direction of change: ↑ Increase ↓ Decrease ↔ No change
Degree to which change would occur: * Low ** Medium *** High

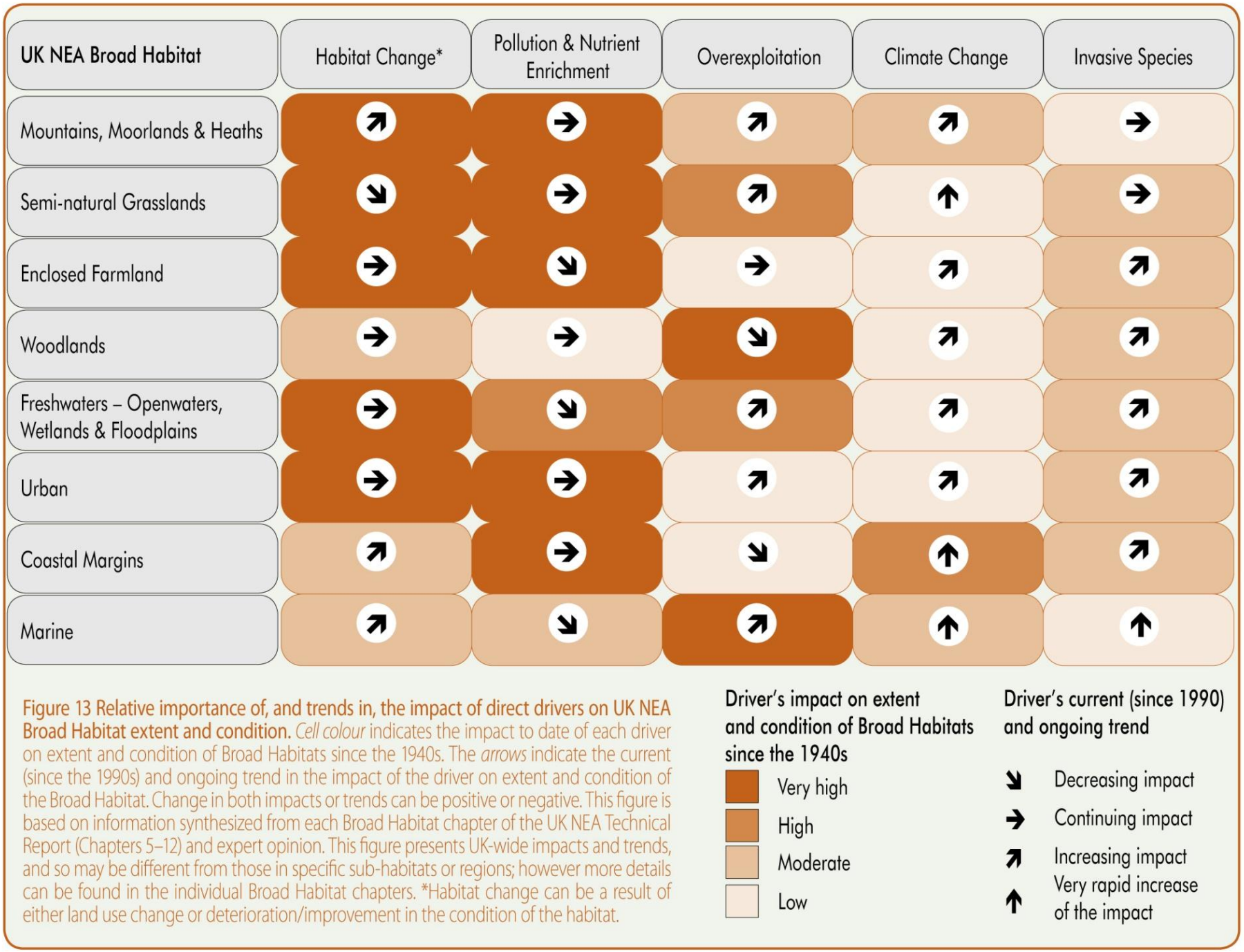


Figure 13 Relative importance of, and trends in, the impact of direct drivers on UK NEA Broad Habitat extent and condition. *Cell colour* indicates the impact to date of each driver on extent and condition of Broad Habitats since the 1940s. The *arrows* indicate the current (since the 1990s) and ongoing 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.

Present challenges & future outlook

- 30% of services are in decline or a degraded state

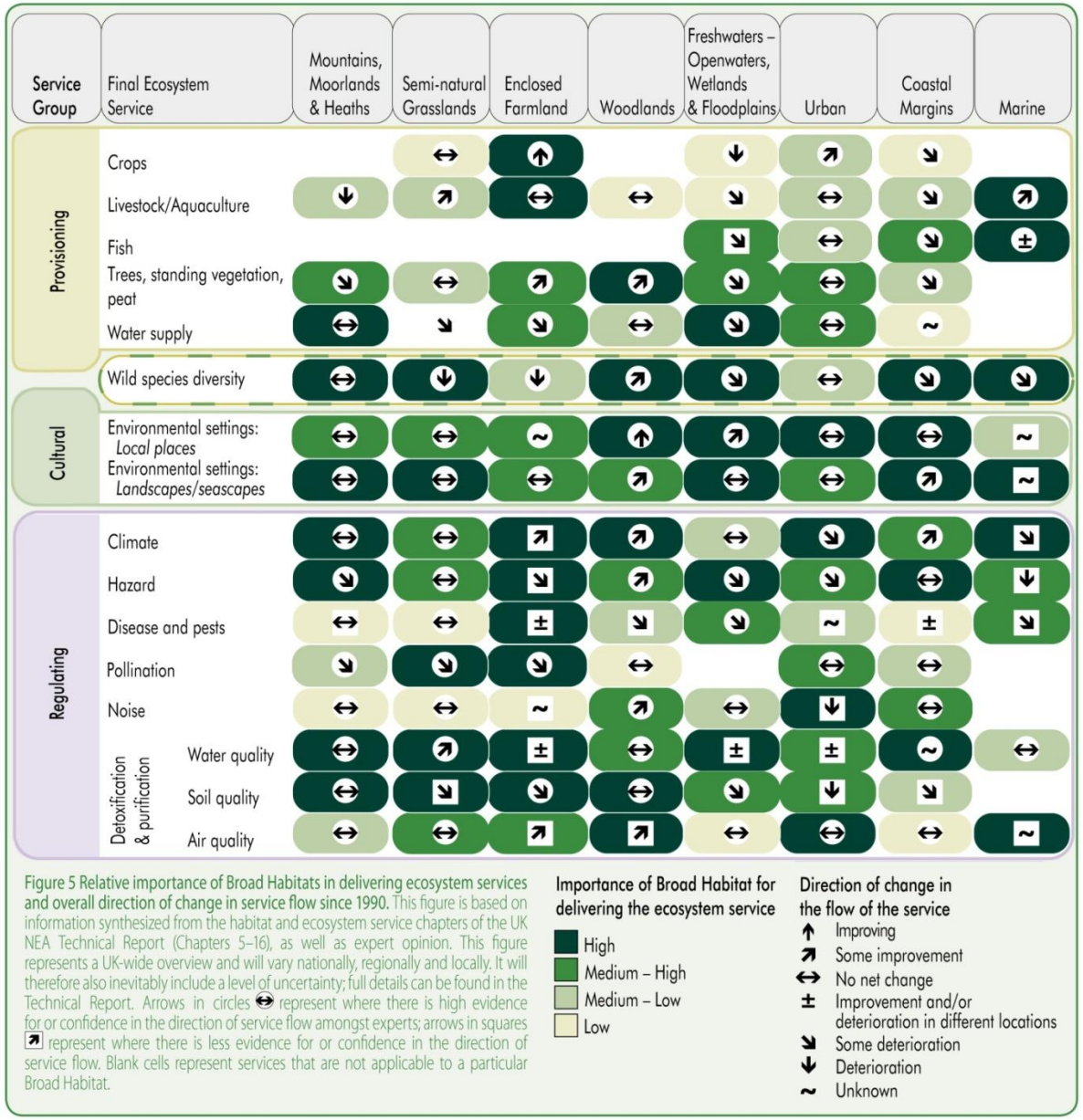


Figure 5 Relative importance of Broad Habitats in delivering ecosystem services and overall direction of change in service flow since 1990. This figure is based on information synthesized from the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5–16), as well as expert 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.

Freshwaters – open waters, wetlands & floodplains

Key findings:

- Major services but benefits inadequately valued
- Originally connected ecosystems now fragmented
- No pristine ecosystems remain
- Uncertainty about relationships between ES and ecosystem structure, functioning, spatial organisation
- Despite multiple benefits wetlands lost / converted to incompatible uses
- Mapping has not been based on ES delivery
- Particularly vulnerable to regime shifts, loss of ES, difficult to restore
- Integrity traded-off against alternative management

continued.....

Freshwaters – open waters, wetlands and floodplains

Key findings continued....

- Linkages among processes regulating ES remain challenging
- Only small proportion of wetlands part of formal protection networks
- Sustainable management requires better tools
- Restoration / re-creation necessary to gain benefits of ES provided

Coastal Margins – key findings

- Only 0.6% UK land area but ES worth 3.46% GNI (£48b)
- Habitat losses due to sea level rise relatively small but may reach 8% by 2060
- Quality of habitats declined since 1945
- Cultural services very important – seaside tourism £17b
- Coastal defence most important regulatory service
- Carbon sequestration high due to rapid soil development / sediment
- High biodiversity with specialist and rare species
- Main conflicts between services associated with disturbance vs stability
- Sustainable development needs to be holistic.

Responding to the challenges

- Plausible future scenarios
- Scenarios developed to gain understanding of what the future might hold

❑ Six storylines

➢ Emphasis ranged from:

- Environmental awareness and ecological sustainability
- National self sufficiency and economic growth

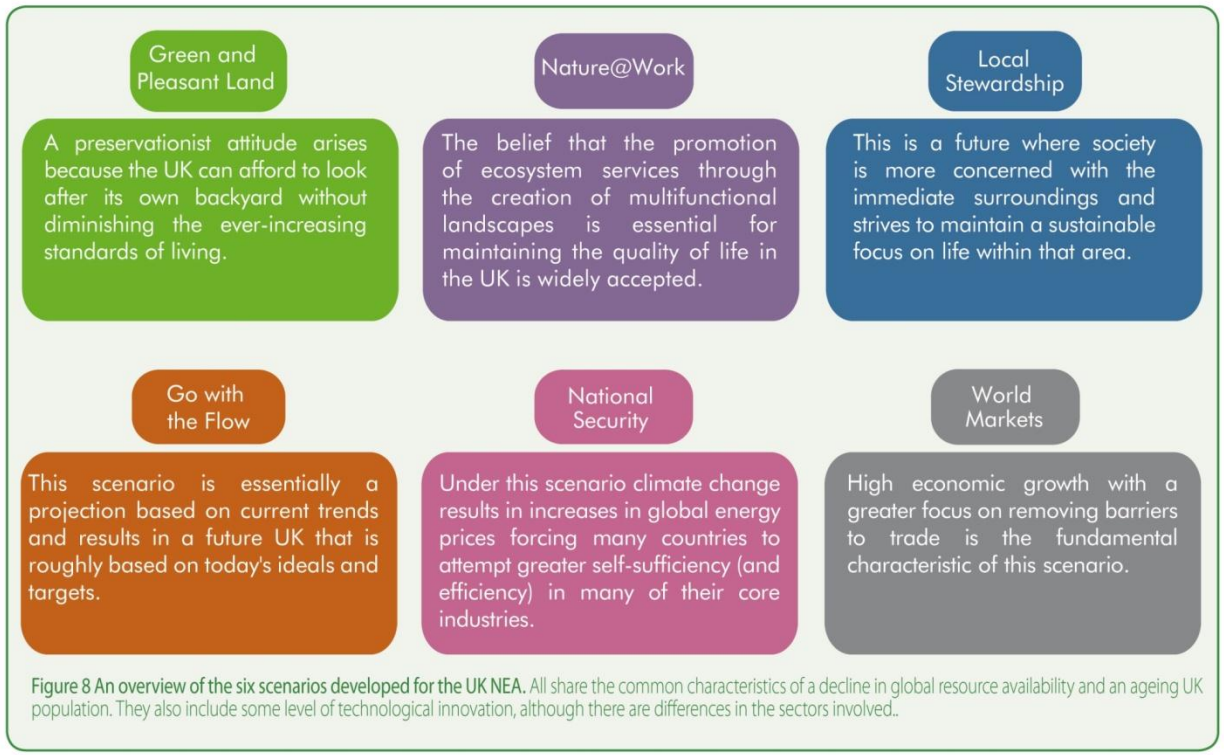


Figure 8 An overview of the six scenarios developed for the UK NEA. All share the common characteristics of a decline in global resource availability and an ageing UK population. They also include some level of technological innovation, although there are differences in the sectors involved..

Responding to the challenges

Significant gains in ecosystem service delivery under storylines that emphasized environmental awareness

- Challenge:

How to capture benefits of each scenario to create best value?

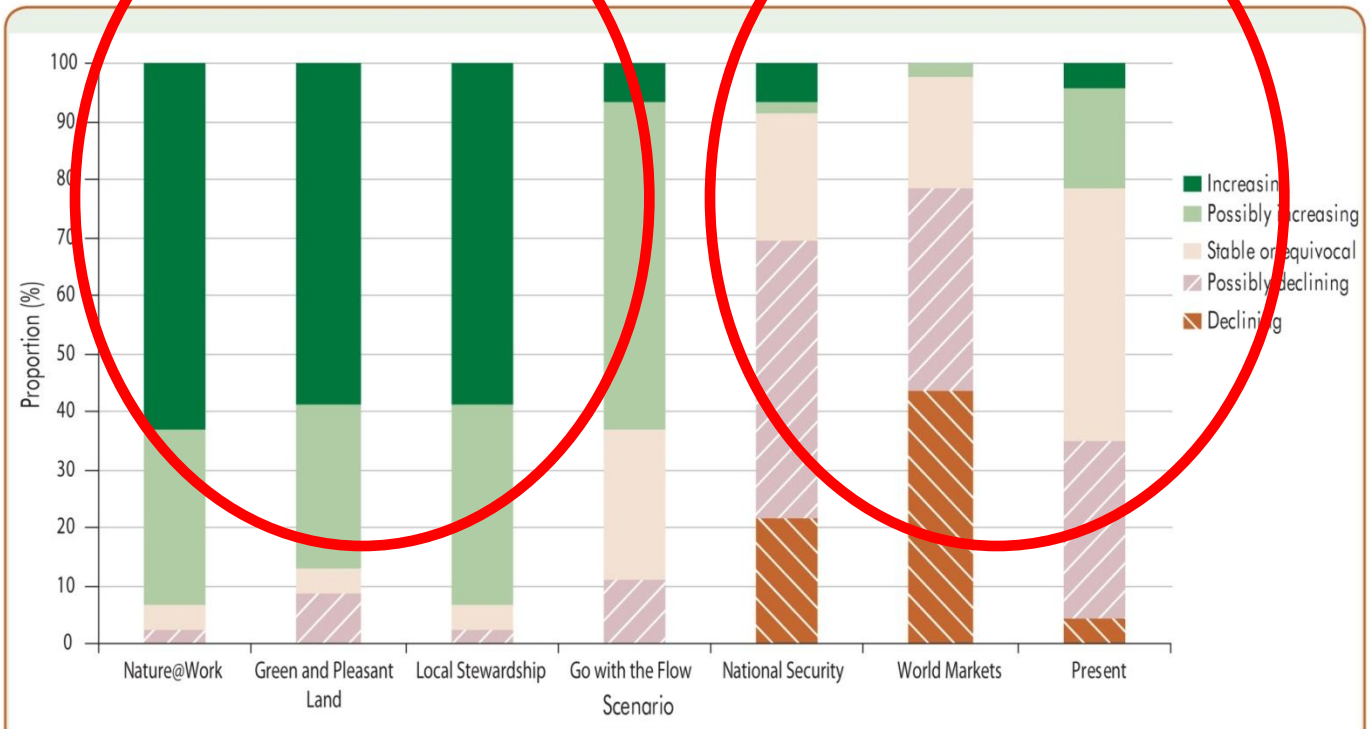


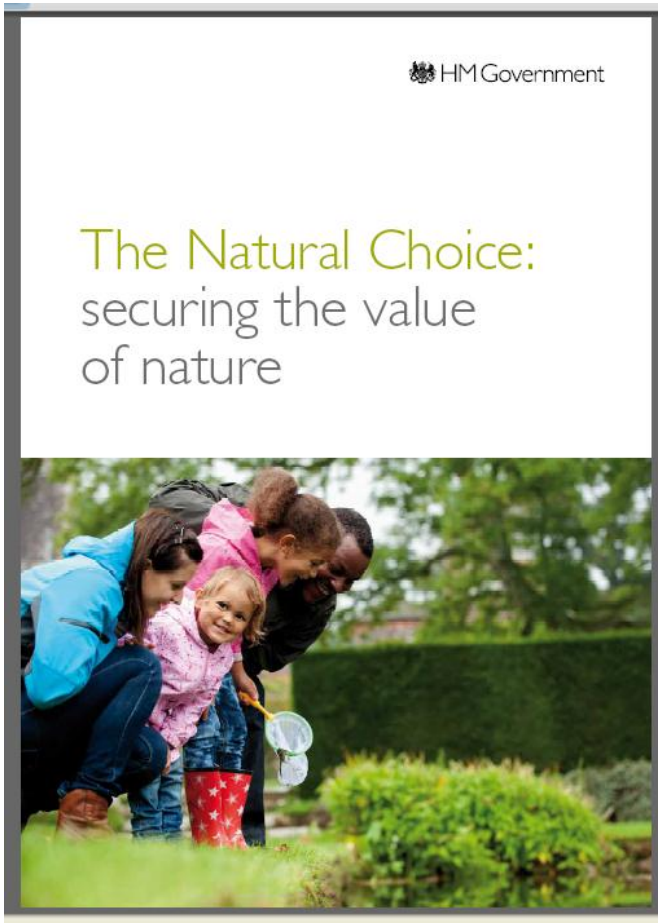
Figure 21 Preliminary comparison of storylines in terms of the projected trends in ecosystem services. Bars show proportion of services in each scenario with increasing (solid bars) or decreasing (hatched bars) trajectories.. Scenarios are ordered from left to right in terms of increasingly unfavourable 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.

Responding to the challenges

- Economic analysis demonstrates that:
  - Failure to include valuation of non-market goods in decision making leads to poor resource management
  - Value of ecosystem services varies spatially
- If recognize the value of ecosystem services, UK can move towards a more sustainable future and services that are equitably distributed

The Natural England White Paper

- Outlines plans for the next 50 years
- The Government's response to the evidence base set out in the UK NEA
- Joining up the Government's environmental monitoring, to enhance understanding the of ecosystem services



Real policy impacts

- Cost of ecosystem protection may yield returns many times higher than existing systems
- Natural capital at the centre of economic thinking and to include within the UK Environmental Accounts – Independent Natural Capital Committee
- Action Plan to expand markets and schemes for PES – business led task force
- International and EU leadership
  - EU to become world's largest green economy and market for environmentally sustainable goods and services → greening of CAP
    → new EU Biodiversity Strategy
    → low C & resource efficient growth (EU 2020 Strategy)
- Monitoring and reporting on state of English environment

Ecosystem Service valuations

- UK fish landings £ 600 m
- Aquaculture £ 300 m
- Marine biodiversity £ 1700 m (WTP)
- Water quality (inland wetlands) £ 1500 m
- River water quality improvement £ 1100 m
- Climate change induced loss of water availability £ 350- 490 m
- Cost in land use change less than benefits from reduced pollution (but rural vs urban)
- Amenity value wetlands £ 1300 m

Challenge

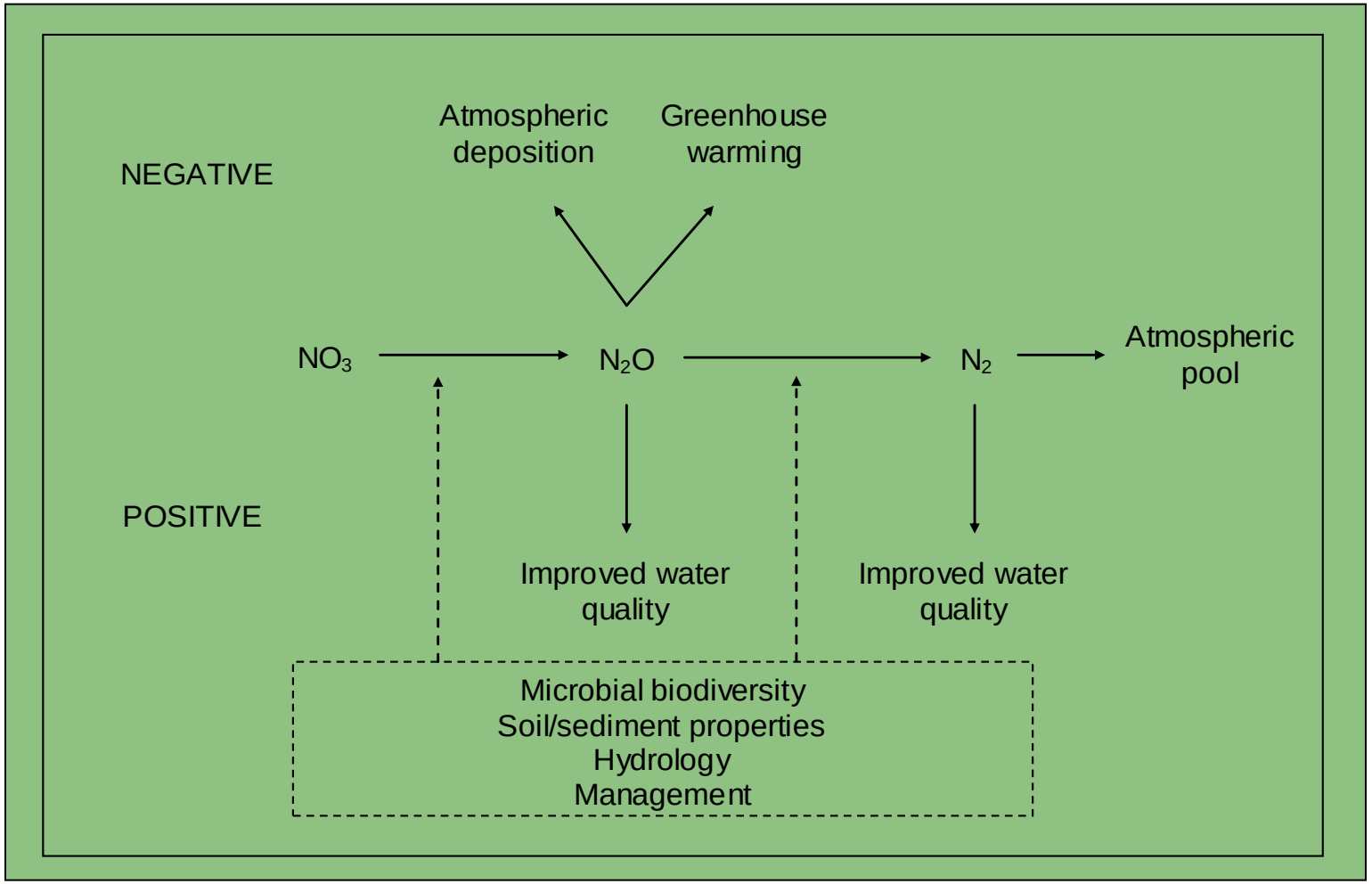
Can we properly account for the contribution of water and wetlands across the landscape in the delivery of all ecosystem services?

- Value in wetness
- Trade-offs
- Balance

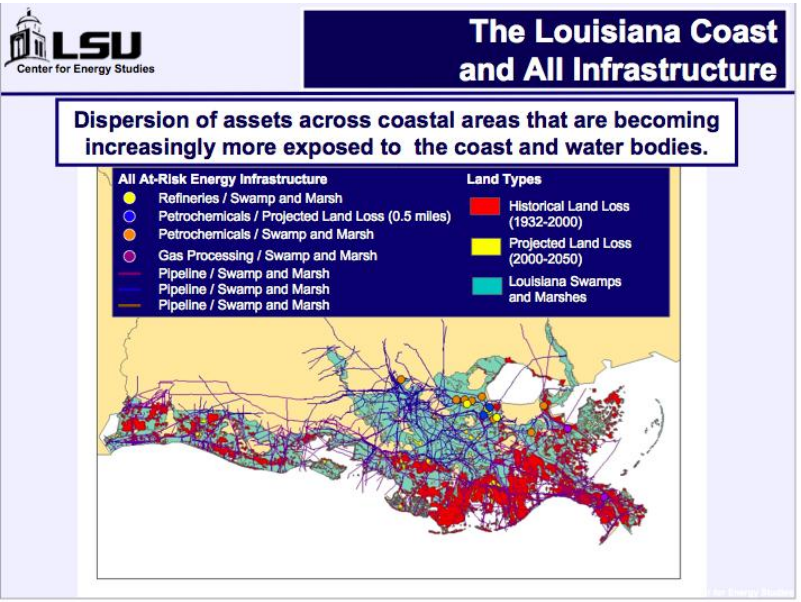
Trade-offs

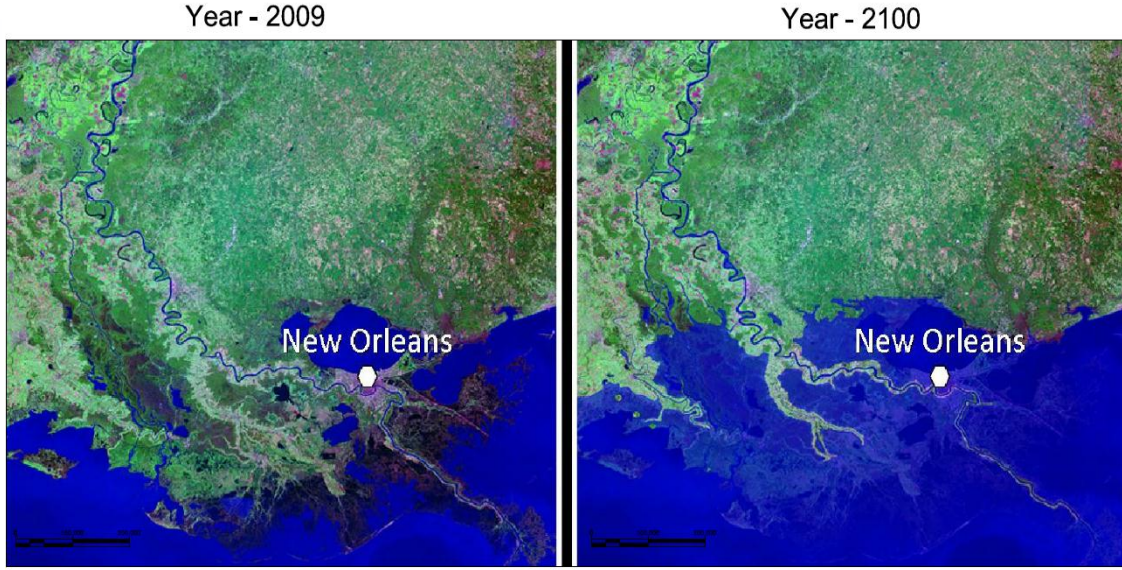
Temporal	Benefits now – costs later
Spatial	Benefits here – costs there
Beneficiary	Some win – others lose
Service	Manage for one – lose another

Water quality vs climate change

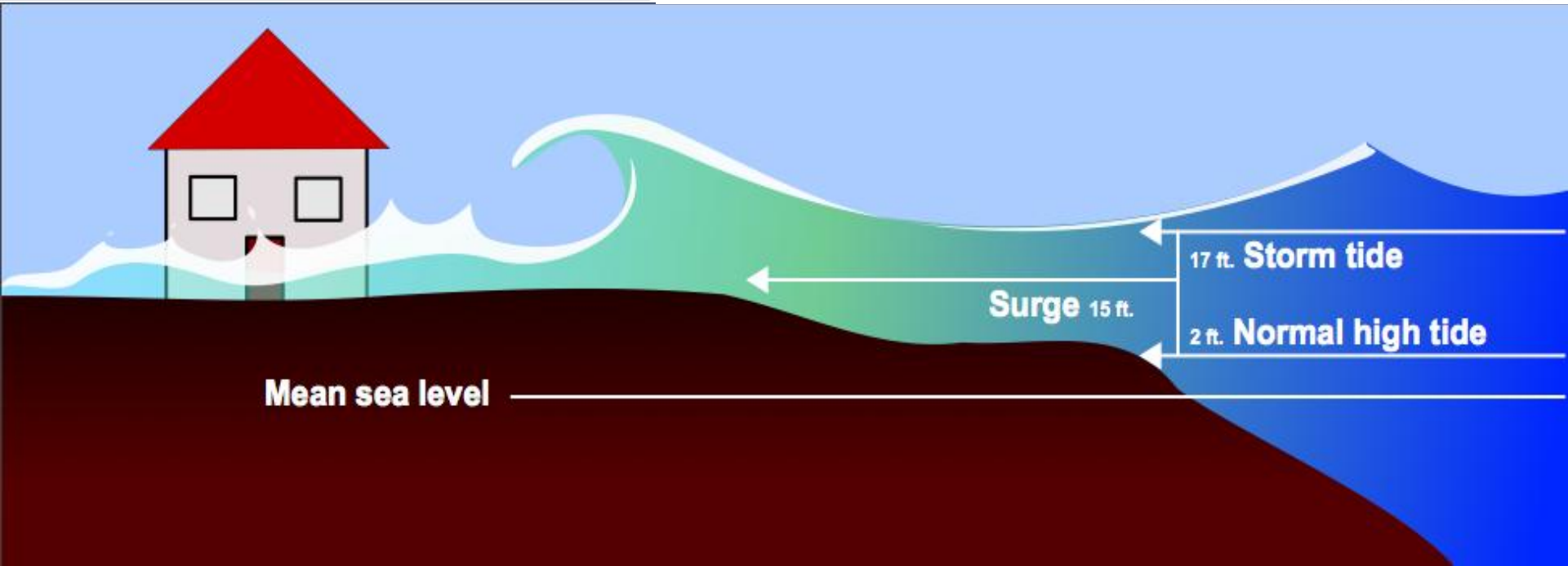


The relative sea level rise impacts to Coastal Louisiana TODAY represent the future impacts of most other coastal landscapes TOMORROW





Map: Blum, M.D., and H.H. Roberts (2009), Drowning of the Mississippi delta due t
insufficient sediment supply and global sea-level rise, *Nat. Geosci.*, 2, 488-491.



Louisiana survey

Climate change? (Y) 78.5%

Esp. 18-24 / non-white / high school / < $30 / female / New Orleans

Importance coastal wetlands 87.5%
(very 67.6/somewhat 19.9)

Esp. 45-54 / white / < high school / < $30k / male / S. Louisiana

Importance to personal well-being 80.7%

Esp. 45-54 / white / < high school / < $30k / male / New Orleans

Why are Louisiana coastal wetlands important?

Services identified:

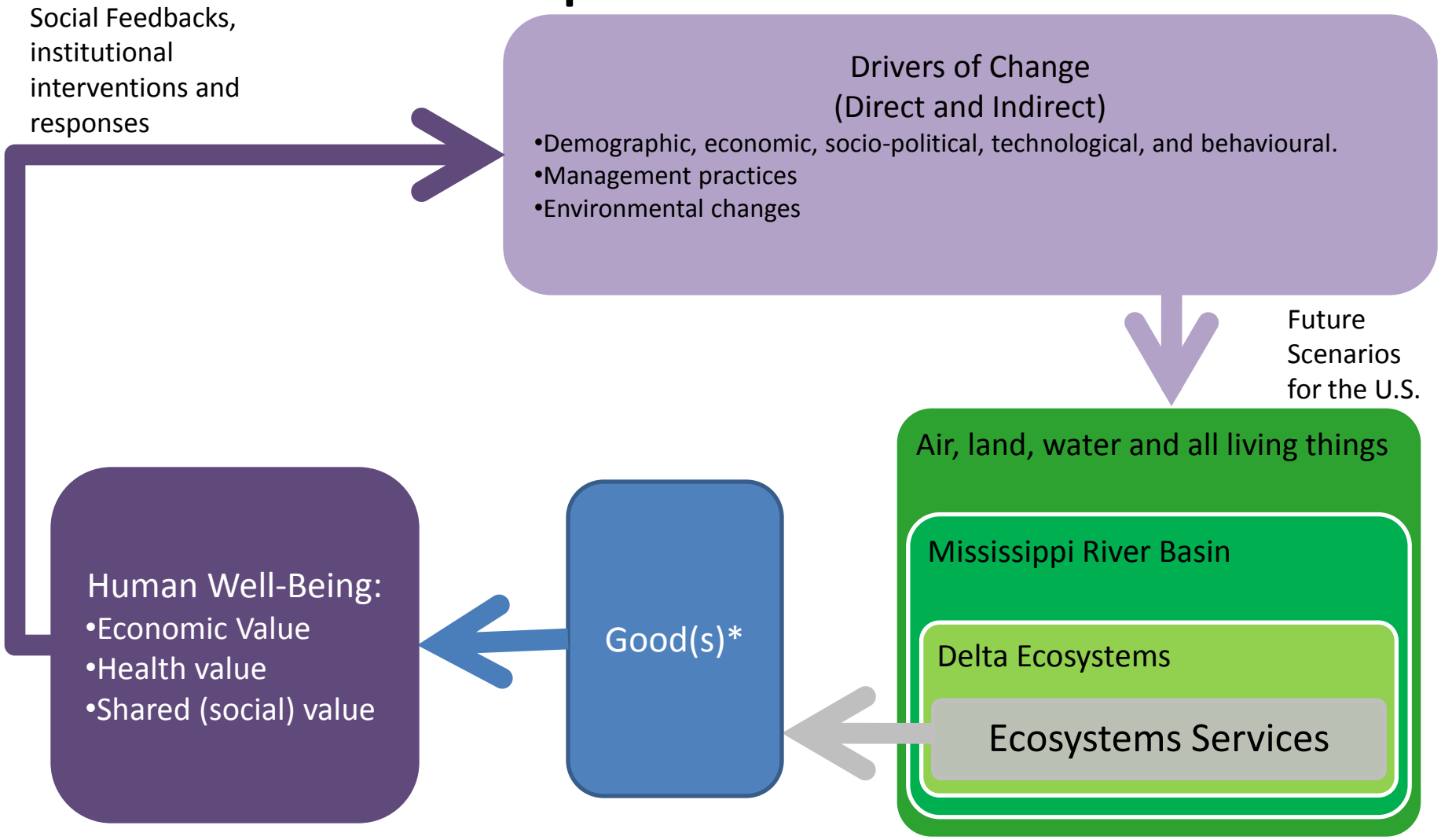
- Provisioning 30.2 %
- Regulating 30.0 %
- Cultural 30.6 %
- Supporting 9.1 %

Individual Project Comparisons

Ecosystem Services (Example: Upper Breton Diversion 250,000 cfs)

	Alligator	Carbon Sequestration	Coastal Wildlife	Freshwater Availability	Freshwater Fisheries	Nature Based Tourism	Oysters	Saltwater Fisheries	Shrimp	Storm Surge/ Waves	Waterfowl	Crawfish
Upper Pontchartrain												
Mid Pontchartrain												
Lower Pontchartrain												
Upper Barataria												
Lower Barataria												
Birdsfoot Delta												

Conceptual Framework



*Note that the term good(s) includes all use and non-use, material and non-material benefits from ecosystems that have value for people.

Fishing

Mekong Delta

Provisioning

Cultural

Mississippi Delta