

**National Assembly of Wales, Environment & Sustainability
Committee**

Inquiry into Sustainable Land Management

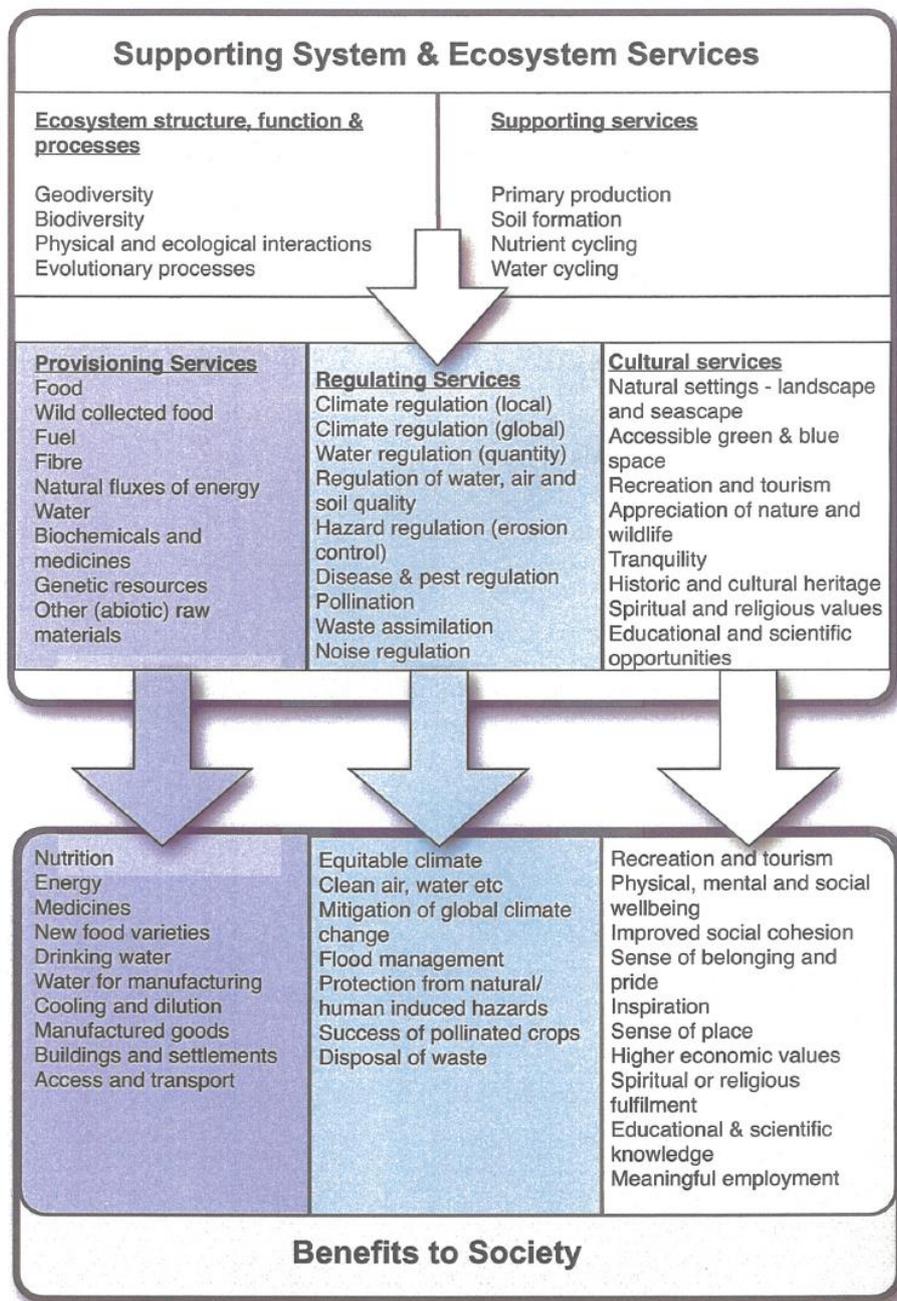
Evidence submission from Dr Shaun Russell

Dr Shaun Russell is Director of the Wales Environment Research Hub (WERH) a Welsh Government-sponsored unit with a science-into-policy remit, hosted at Bangor University (see Appendix 2). WERH is currently working on evidence provision in support of the Welsh Government's proposed Environment Bill and Biodiversity Strategy, and for the implementation of "integrated natural resource management" by the statutory environmental body – Natural Resources Wales. WERH collates existing published and non-published information and presents it to end users (predominantly government and academia) in a neutral and non-prejudicial manner. As this Inquiry seeks to contribute to the complex issue of the future wise management of land in Wales, it may have to take into account opinions and recommendations, as well as hard evidence and certainties. The views expressed here are therefore those of Dr Russell as a private citizen, and are not an "official position" of the Wales Environment Research Hub. Dr Russell also wishes to acknowledge the advice of colleagues: Dr Tim Pagella (Bangor University) and Charles Falzon (Environmental Consultant) in preparing this submission.

1. How do we define key ecosystems and ecosystem services in a way that makes sense for Wales?

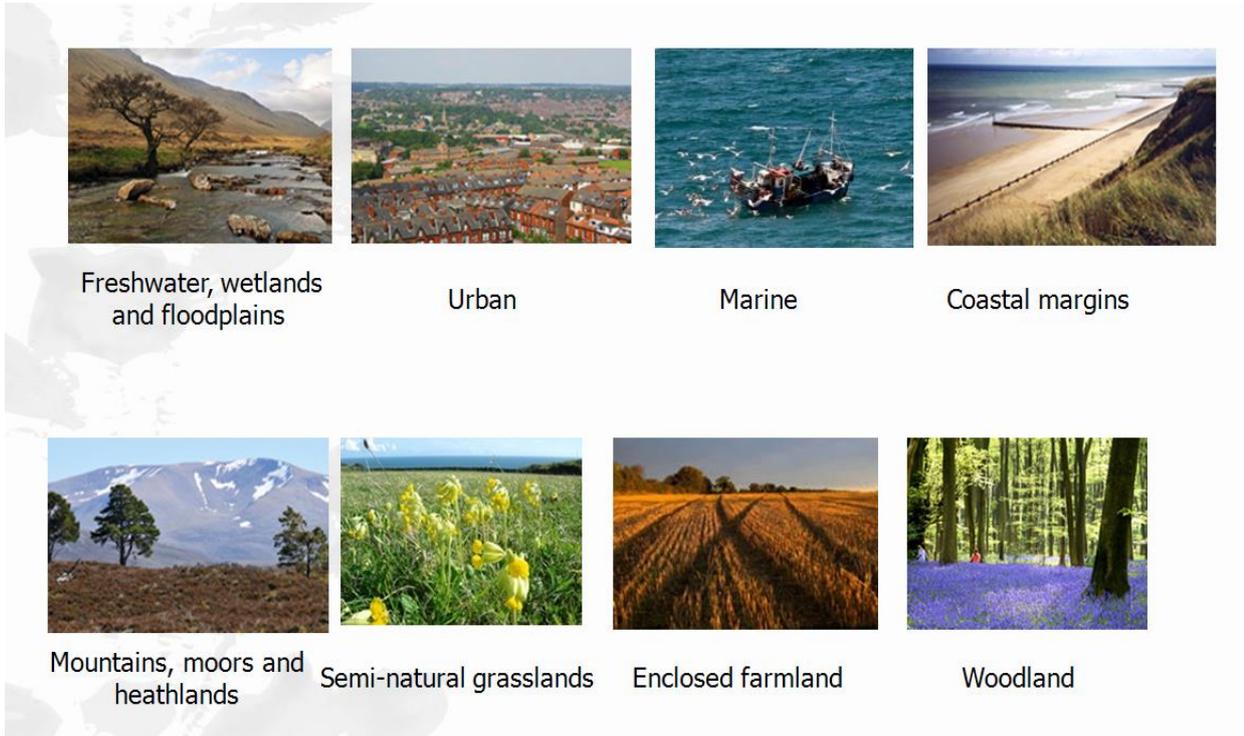
Some background on “ecosystem services” is given in Appendix 1. A functional and effective classification of the World’s ecosystem services was adopted by the global “Millennium Ecosystem Assessment” (2005) and was followed in 2011 by the UK National Ecosystem Assessment (UK-NEA). Wales’ statutory environment body - Natural Resources Wales - has adapted this classification for local relevance and use in Wales (Fig. 1). This scheme is adequate and can be adapted for different tasks and purposes (education, natural resources assessment, development planning and implementation). Some other examples of visual schemes for ecosystem services are shown in the accompanying document of supporting diagrammatic material.

Figure 1. Representation of Ecosystem Goods and Services prepared by Natural Resources Wales.



Natural Resources Wales uses the UK National Vegetation Classification and “Phase One” habitat survey as a basis for ecosystems (habitat) classification. The UK-NEA based its “Broad Habitats” on this system (Fig. 2).

Figure 2. Broad Habitats of the UK National Ecosystem Assessment



Natural Resources Wales has adapted this classification for use in Wales, by differentiating the marine habitat and allocating lowland heathland with grassland (Fig. 3).

Figure 3. Ten Broad Habitats for Wales

The 10 Broad Habitats for Wales			
Freshwater and wetlands	Urban	Marine Inter-tidal	Coastal Margins
		Marine Inshore	
		Marine Offshore	
Upland	Heathland and Grassland	Arable	Woodland

Ecosystems can occur at any scale and land management outcomes may be shaped by processes operating at different scales. All ecosystems that contribute to the livelihoods of people in Wales should therefore be considered in policy and decision-making, including ecosystems outside Wales where our demands are felt, e.g. food, fodder and fibre imports.

2. How do we develop a baseline from which to measure progress? This includes how we collect, coordinate and use data to support sustainable land management in Wales.

In Wales during the past 20 years, the UK-NEA estimated that 20% of habitat ecosystem services improved, while 49% deteriorated. Problem areas include marine fisheries, wild species diversity and some of the services provided by soils (Fig. 4). Examples of the kinds of “trade-offs” that we have made in Wales during the past century include the draining of peat moorlands for forestry, the conversion of most of our semi-natural grasslands to improved pasture, and the losses of sand dune areas to agricultural land, forestry, housing and tourism.

Figure 4. Poor land management can lead to soil loss and silting of water courses (B. Vaughn, NRW).



The UK-NEA (2011) provides a snapshot of status and trends in the condition of habitats and ecosystem services in the UK including Wales. Processes and sites relevant for sustainable land management in Wales are monitored by many organisations, e.g. NRW and the Centre for Ecology and Hydrology (“State sector”); RSPB and Local Records Centres (NGOs); Dwr Cymru/Welsh Water (private sector). Monitoring itself is monitored by the UK Environmental Observation Framework: <http://www.ukeof.org.uk/>. Monitoring is still biased in favour of traditional targets such as species presence/absence or air/water quality for example. To provide baselines and robust trend data, there is a need to broaden the scope of measurement and monitoring of ecosystem services (e.g.

soil carbon and nutrient cycling). We especially need to map the **flows** of services from source to beneficiaries, if we are to inform wise choices and trade-offs for sustainable land management.

In measuring progress we will need to have defined objectives for sustainable land management, from which key indicators can be derived. We will need to continuously monitor the state of our ecosystems and their services against the state of human health and well-being. There is presently an over-reliance on traditional economic indicators of human progress and well-being. There needs to be more effort expended on monitoring human social and cultural variables, alongside environmental parameters. With one or two exceptions we have little expertise or capability in Wales for environmental economics, ecosystem services valuation and whole-cost environmental accounting.

Almost all natural resource management interventions are likely to change the balance of “winners” and “losers”, but “losers” will always be present. Social equity will therefore continue to be an important issue for policy and decision-makers.

3. *What incentives can we provide land managers to develop sustainable practices, and in particular, any new sources of investment we can attract to support these?*

Over 75% of the land and sea area of Wales has some kind of environmental or conservation designation, reflecting the high value placed on its natural and cultural features by our citizens, and by the millions of visitors to Wales. There is therefore a need to think more broadly about what we mean by “productive” land management, when incentivising land managers to protect and enhance a full range of ecosystem services for their own viability and the greater social good.

Incentives should be provided at all levels. Examples include:

- Supra-State – e.g. European ERDF, ESF, Horizon 2020, Life+ and CAP/RDP “greening” funds
- State - e.g. the Welsh Government’s “Nature Recovery” and “Ecosystem Resilience” Funds
- Private sector – e.g. Dwr Cymru/Welsh Water’s “Water Framework Directive” fund
- NGOs and civil society – volunteering, “citizen science”, membership and project funds. For example, the “Pont Bren” farm-based ecosystem services initiative in mid-Wales, and the Community Land Advisory Service Wales, both secured funding from the Heritage Lottery Fund:

http://www.pontbrenfarmers.co.uk/project_background.html

<http://wl.communitylandadvice.org.uk/>

A range of options for incentivising land managers to adopt more sustainable practices was tabled at the Wales Environment Research Hub’s workshop on “Missing Markets for Ecosystem Services” in 2010: <http://www.werh.org/EcosystemServicesMissingMarketsWorkshop.php>

An overview of how this might work, with some policy adjustment in a Welsh context, was provided by Paul Sinnadurai of the Brecon Beacons National Park:

“A combination of larger landscape-based projects and smaller ‘start up’ projects. Rather than the Government purchasing ecosystem services (PES) from the farmer or other landowner, the smaller projects would be invited to bid for a smaller start up ‘loan’ through the agri-environment scheme, in order to incubate new land management-based enterprises in soil, water, renewable energy, woodland and biodiversity management, as a means of improving the farm’s marque value of their food and livestock enterprises.”

<http://www.werh.org/documents/Sinnadurai-Anewbusinessmodelfordeployingagri-environmentschemes.pdf>

Snapshots of applied ecosystem services projects, including “Payment for Ecosystem Services” (PES) schemes across the UK, were provided at the European Conference on Ecosystems Management, co-sponsored by NRW in Bangor in October 2013: <http://www.wisenetwork.org/eeac2013/>

The presentation for England highlighted the Countryside Ecosystem Approach Toolkit; the Local Environment and Economic Development Toolkit; Natural England’s work on mapping ecosystem services; the Ecosystem Services Transfer Tool; the Upland Ecosystem Service pilot projects at Bassenthwaite, South Pennines and in the South West Uplands; and the Defra project on Place-based Payments for Ecosystem Services: http://www.wisenetwork.org/wise/wp-content/uploads/ESS-England_web.pdf

The presentation for Scotland highlighted the Scottish Strategic Research Programme (Ecosystems Theme) and flagged 20 ecosystems management projects across Scotland. Special attention was paid to the “Carse of Stirling” project and the Scottish Land Use Strategy Pilot Projects on carbon and climate change, recreation and tourism, and timber provision: http://www.wisenetwork.org/wise/wp-content/uploads/ESS-Scotland_web.pdf

The presentation for Wales by Dr Emyr Roberts, provided a background to Natural Resources Wales and flagged the following ecosystems management case studies: Anglesey & Llŷn fens; Berwyn & Migneint SACs; the Cambrian Mountains Initiative; the Pontbren project; Fish Map Mon; Larch in Wales; “Catchment Connectivity”; the Cwm Rhaiadr Forest, and the “Rainscape” and “First Milk” projects: http://www.wisenetwork.org/wise/wp-content/uploads/ESS-Wales_web.pdf

A promising methodology for applying PES to sustainable land management has been the “reverse auction” process. In the “River Fowey Improvement Auction” conducted in England, farmers bid progressively for ecosystem improvement funds from the South West Water company, for investment in items such as slurry stores and fencing, to improve water quality and so reduce the cost of drinking water treatment. This project was reported at the “Ecosystem Approach for Biodiversity and Human Well-being” workshop held in North Wales on 4-6 February, 2014:

<http://www.werh.org/PlasTan%20Y%20Bwlch/2014/Plastanybwlch2014.php.en>

The Wales Rural Observatory’s study of “Farmers Decision Making” (2011), sounded-out farmer’s responses to the idea of: “an integrated approach to the challenges of conservation, climate change adaptation and food security”. It found that: “Small, niche businesses, with a strong local consumer base, were particularly resilient and seen as an important model in the move towards low carbon economies”. It noted that: “A small grant scheme to support targeted conservation work on farms that are not appropriate for full inclusion in the Glastir agri-environment scheme, would provide an instrument for engaging more farmers with agri-environmental objectives”.

The report’s recommendations included:

- Encouragement for farmers to develop local markets for some of their produce
- A need to build local markets/outlets and increase support for branding products
- A need to bring back systems of planting, coppicing, use of local timber products, wood chipping and small scale hydro to feed into community systems
- Diversification into non-food products
- Small grants for field edge improvements, relocation of gates, separation of effluent/water run-off (sustainable drainage)
- More collective grant aiding, with insurance companies and water companies as potential sources of income.
- The handicaps that Welsh farmers face should be recognised and payments should reflect this.

Because of its geology, soils and climate, Wales can never be self-sufficient in food production at current population and consumption levels; we will always have to rely on imports. We should, however, be able to improve our import-export food balance and food chain efficiency, through a combination of efforts to lower consumption (with concomitant health and well-being benefits) and increases in production. During both World Wars arable production was doubled in Wales (Fig. 5), and “sustainable intensification” in the rural environment could provide similar benefits in the 21st Century. There is also great potential for “peri-urban” and “intra-urban” agriculture, aligned for example with recreation and biodiversity corridors in our urban landscapes. The expanding work of the Federation of City Farms and Community Gardens, and many other “allotments” organisations in the UK, are signs of interest and progress in this area.

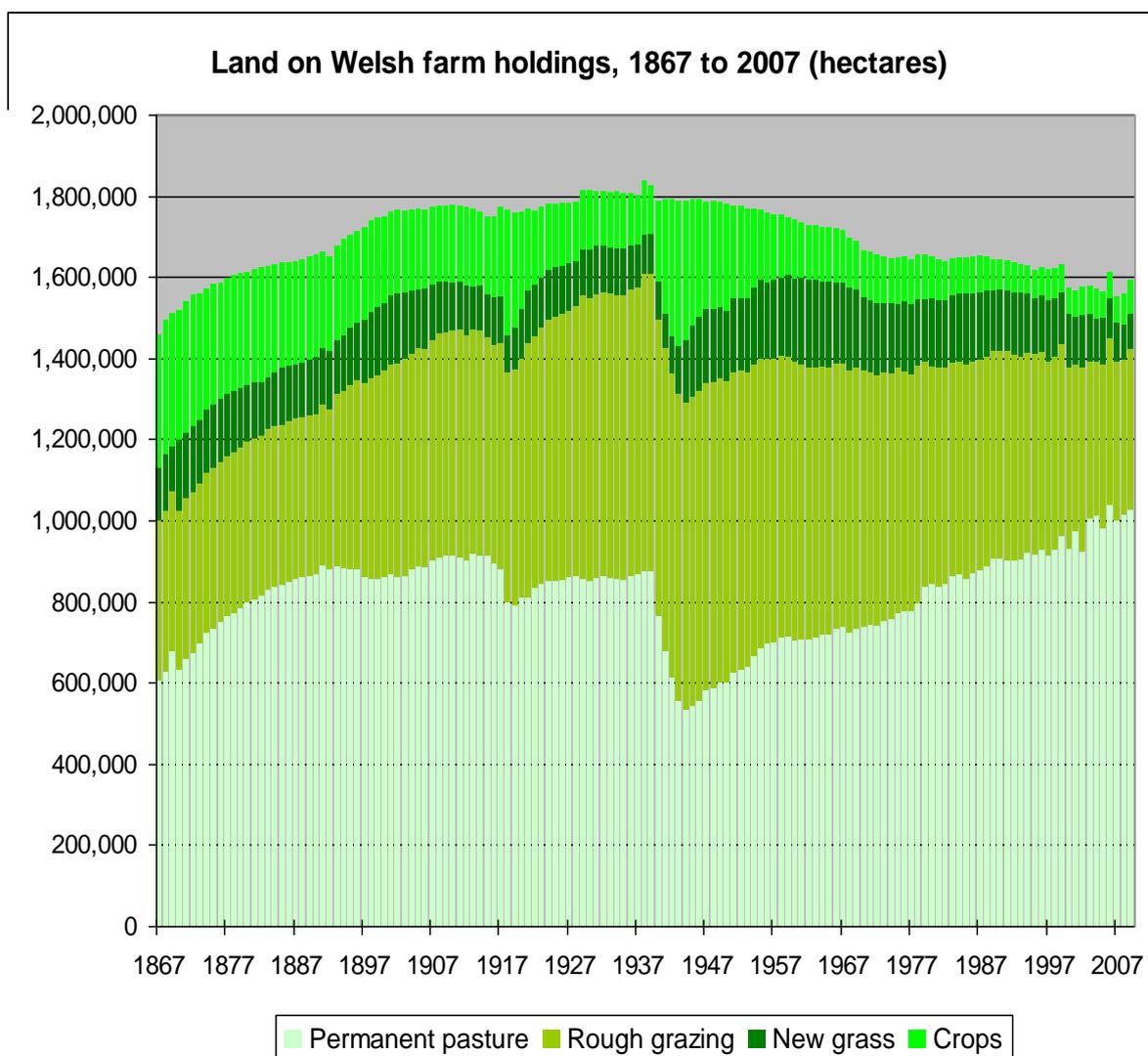


Figure 5. Land on Welsh farm holdings, 1867 to 2007 (hectares) – (Welsh Agricultural Survey, 2008)

Sustainable intensification was also favoured in the 2009 report of the Land Use and Climate Change sub-Group of the Climate Change Commission for Wales. Again, diversification of the rural economy was recommended, with expansion of horticultural and greenhouse crops, and renewable energy generation from small-scale hydro, wind, biomass, solar, photovoltaic and ground-source heat. A major programme of woodland planting was envisaged alongside: “extensive mixed farming systems, maximising resource efficiency from on-farm production of feedstuffs, and reduction of fertiliser inputs. This reduction of inputs would be balanced by reduced demand for animal products through a reduction in consumption, and reduction of waste in the food chain. Such systems are often associated with greatly enhanced local food chains, greater self-reliance, and are seen as increasing environmental and social sustainability over time”. A controversial suggestion was fully housed, zero-grazing systems for stock animals, with methane capture to combat carbon emissions.

To mainstream and embed an ecosystem approach for sustainable land management in Wales will require: “a shift in ecological thinking that recognises the social as part of the ecosystem and the need for participatory approaches to identify and integrate ‘traditional’ human activities into conservation management”. Ways and means of achieving this have been piloted using the Farming and Wildlife Advisory Group’s “Integrated Local Delivery model (ILD) in Walmore, Gloucestershire. This rural initiative has similarities with the “community-led planning” approach familiar in urban environments.

A report on the ILD approach: “Inspiring and Enabling Local Communities: an integrated delivery model for Localism and the Environment” was prepared by the Countryside and Community Research Institute in 2010, and is also available through the Bangor European Ecosystems Management conference website: <http://www.wisenetwork.org/wise/wp-content/uploads/Jenny-Phelps.pdf>

4. *How do we ensure that our sustainable land management policies maintain vibrant rural communities and attract new entrants into the land-based sector?*

Perhaps there need to be measurable criteria for “vibrancy” and viability of rural communities, e.g. numbers of jobs, schools, shops, clinics, pubs, post-offices, chapels, cultural events, community projects, visitors etc.

Support training to ensure that sustainability is built into agricultural curricula.

Encourage collaborative farming systems that support local communities through a range of products including energy and recreational access as well as food.

Support experiments in new and traditional crop production, including at small scale for local markets.

Support on-farm and local processing of primary products.

Use planning policies to promote synergies between producers and local community outlets

5. *What are the most appropriate geographical scale(s) at which we should be delivering sustainable land management policies and practices in Wales?*

There are three scales at which decision making about ecosystem services provision are likely to be made:

Local scale - this is the scale at which ground level decisions about change in land use are made. The main actors at this scale are farmers, forest managers or other land users. It encompasses fields and farms up to a landscape scale of 10–1,000² km at which ecosystem services initially manifest (e.g. sub-catchments or habitat networks), and may be managed, through farmer co-operatives or other collectives covering a contiguous land area.

Regional scale - is defined as the scale between local and national. This is the scale at which many policy decisions relating to ecosystem services provision are currently made and is generally over 1,000 km², but sub-national.

National scale - is defined as the scale at which strategic decisions about ecosystem services are made. This encompasses supra-national, transboundary contexts in some locations (e.g. some major lakes and protected area networks). Assessments at national scale tend to use aggregated national datasets, which are generally very coarse in their spatial resolution. But ultimately, policy needs to be delivered at all scales where decisions are made.

NRW's "Landmap" tool is a good starting point for natural resources mapping, but deserves far greater resourcing for development and enhancement in support of decision-making that will need to consider ecosystem service stocks and flows.

6. *Are there key actions we can take to deliver short-term 'quick wins' and which actions should we be taking for the long-term?*

Although it may be administratively more challenging, promote links between local community as consumers and local farmers as producers.

Encourage a diversity of products.

Build on the work of the Cambrian Mountains and Pontbren initiatives.

Identify areas where ecological complexity can be reintroduced without impacting on farmer's livelihoods (at Pontbren for example, 120,000 trees were planted in 1000ha with no negative impacts on farming production).

Reduce the costs of farmers travelling to markets & selling direct - see the Farmers Markets in Wales website: <http://www.fmiw.co.uk/>

Consider the role of major supermarket chains in supporting or undermining local producers.

Use the planning system to discourage farm development that is disproportionate in scale to its environment in sensitive areas (e.g. "super-farms").

INQUIRY “KEY QUESTIONS”

What do we want sustainable land management in Wales to look like?

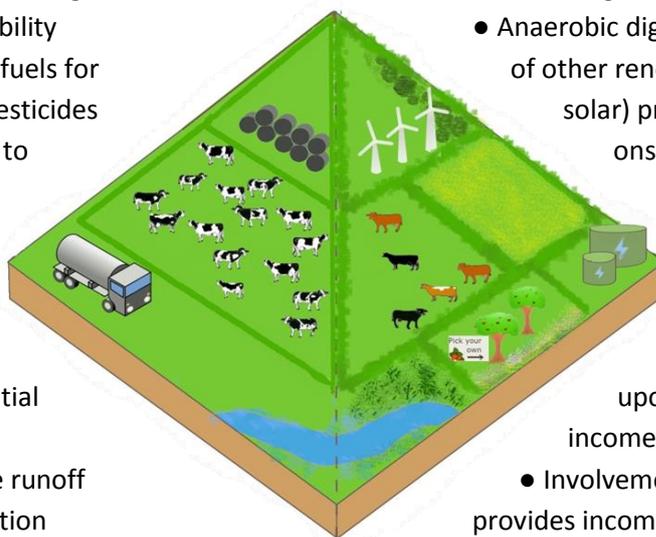
A diagram illustrating some of the shifts in emphasis needed for sustainable land management, is presented in Fig. 6, from Northern Ireland Environment Link:

<http://www.nienvironmentlink.org/cmsfiles/policy-hub/files/documentation/Agri/Documents/AFSB-presentation-FEB-2013FINAL.pptx>

Figure 6. A comparison of current and ecosystem services based approaches to farming in Northern Ireland.

Current farming approach:

- Specialisation – heavy influence upon livestock producing meat or milk
- Intensive agriculture, driven by subsidy conditions
- Single output leads to vulnerability to disease and market fluctuations
- CAP Single Farm payment significant determinant of farm viability
- Dependence on fossil fuels for energy, fertilisers and pesticides leaves farms vulnerable to price changes and security of supply
- Expensive management of animal wastes uses water and wastes potential energy and nutrients
- Phosphate and nitrate runoff contribute to river pollution



The ecosystems approach:

- Mixed farming – multiple outputs and goals
- Permanent pastureland acts as carbon store
- Crop rotation allows natural soil nutrient regeneration and reduces the need for pesticide application
- Use of land to store carbon helps to meet climate targets
- Anaerobic digestion of animal waste and use of other renewable energy sources (e.g. wind, solar) provides energy that can be used onsite or sold to the community
- Renewable generation provides energy, jobs and market drivers
- Alternative crops (e.g. biofuels, fruit) reduce reliance upon livestock as a single source of income
- Involvement in agri-environment schemes provides income to carry out environmentally beneficial practices including enhancement of archaeological and natural heritage sites
- Downstream flood risk minimised by river and flood plain management
- Rehabilitated hedgerows provide pollinators and natural pest control
- Income from providing access for recreation and tourism

What outcomes do we want to deliver in the short, medium and longer terms?

We need to fully reflect the true long term value of ecosystems and their services in decision making, i.e. maximising the benefits for people by looking at the whole range of environmental goods and services, while maintaining the integrity and functioning of ecosystems to avoid rapid and undesirable ecological change.

We should ensure a future where land and sea are managed for a “basket” of long-term benefits, rather than just one or two primary products with short-time horizons. We need a balance of nature conservation and “nature at work” providing for a greater diversity of business opportunities than under single-commodity subsidy regimes, while maintaining the resilience of nature to adapt to future threats such as climate change.

Application of the ecosystem approach could see a Wales with sustainable food and fibre production in the countryside, and with marine resources protected and harvested within viable limits at sea. More green space would improve the quality of life in towns, with ponds and reed beds balancing storm flow and providing sustainable drainage options. Further tree-planting would improve air quality along busy roads and provide a range of water, carbon and biodiversity benefits on valley sides. Diversified, renewable energy sources would be carefully sited on land and at sea, and “environmental mitigation measures” for road schemes would be designed for multiple ecosystem benefits. There would be no backsliding on protected landscapes and nature reserves, but progress towards building biodiversity and conservation enhancements across the entire landscape, through sympathetic planning regimes that balance attractive places to work with spaces for rest, recreation and enjoyment. This would, in turn make Wales a healthier and more desirable place to live, work, and visit, not least for the expanding tourism sector of the Welsh economy.

The ecosystem approach is a way to achieve a “Living Wales” that balances the needs of all sectors of society, while sustaining the underlying natural systems upon which we all depend for our survival. How successful the new approach turns out to be will depend on how willing we all are to engage with the concept and embrace its inclusive and long-term vision in our everyday lives.

Figure 7. Applying the ecosystem approach to land use.

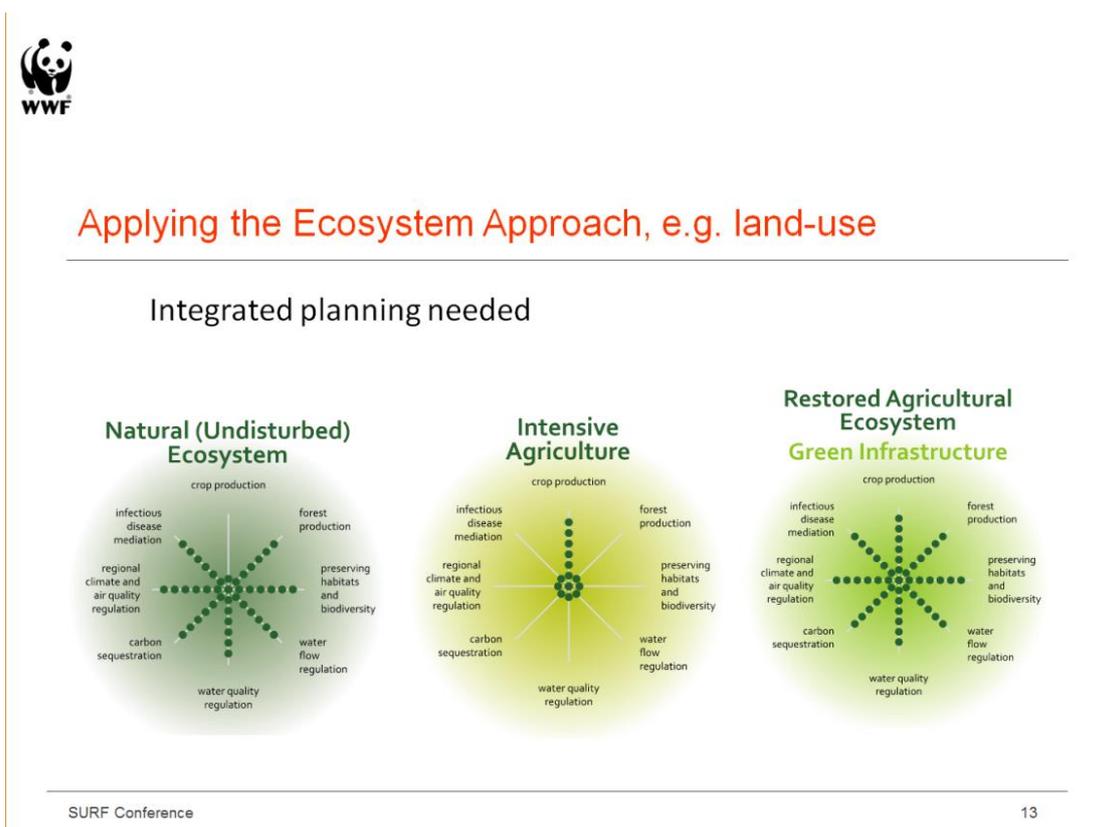
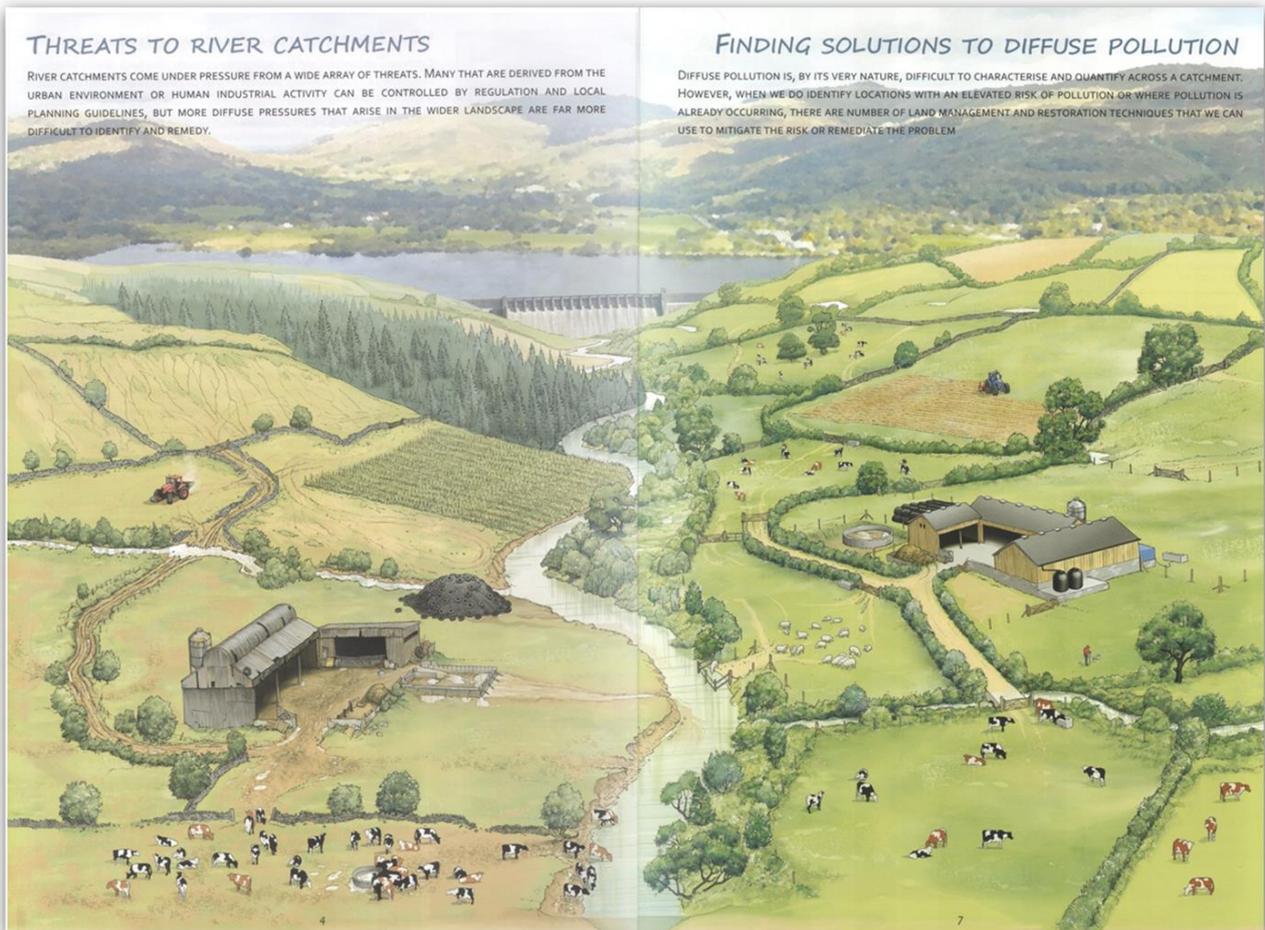


Figure 8. “Spot the difference”. Ten damaging approaches to land management in the left-hand half of the illustration, and ten actions that enhance ecosystem services and sustainability to the right (West Country Rivers Trust).



What are the barriers preventing us from delivering these outcomes now?

Entrenched and outdated views, laws and regulations.

An enlightened view on the environmental/societal problems that we face, and means by which we can overcome them, was provided by Bangor University graduate Professor Jacquie McGlade (former Chief Executive of the European Environment Agency and now Senior Adviser to the United Nations Environment Programme) at the recent European Conference on Ecosystems Management: <http://www.youtube.com/watch?v=rtXd2ccvMzw&list=PLnEOoLwKbaUMBh2Ub7-KwtUxJlrsgf279&index=4>

Prof McGlade also co-authored the lead “Comment” article in the journal “Nature” on 16th January 2014, on alternatives to traditional GDP-based measures of human progress that have relevance for Wales, as a: “small, green country, leading by example on sustainable development” (Attachment).

How do we overcome these challenges?

The ecosystem approach means fully reflecting the true long term value of ecosystems and their services in decision making, i.e. maximising the benefits for people by looking at the whole range of environmental goods and services, while maintaining the integrity and functioning of ecosystems to avoid rapid and undesirable ecological change.

Education of policy-makers, their agents and wider society is required to embed the ecosystem approach.

Identify wellbeing requirements and assess current and future risks, while bringing this into the public sphere (through education and the media). Capitalise on debates around natural resource management issues such as flooding, to open up the debate

Rules will need to change. Two small examples:

- 1) More flexibility in applying the rules regarding planting of non-native tree species in Wales, so that fast-growing species may be employed for energy generation and bio-fuels, and for adaptation to environmental change.
- 2) Glastir agri-environment payments to be flexible and adaptable to specific farm and field-level needs.

What are the main policy drivers?

Direct drivers are those which directly impact on biodiversity and ecosystems, e.g. land use and climate change. Indirect drivers are those which influence the direct drivers of change, e.g. economic and population growth resulting in increased demands for food, fibre, water and energy (UK NEA 2011). The range and nature of drivers affecting the Welsh environment are numerous, and many are shared with other areas of the UK.

Direct drivers include:

- the impacts of global warming and the environmental consequences of climate change such as sea-level rise, changes in temperature and precipitation and extreme events such as storms, drought and floods, which may trigger irreversible changes of state in systems
- habitat destruction—direct physical loss due to land-use conversion by the plough, the axe and the bulldozer
- habitat degradation—due to neglect, overgrazing, fertiliser and pesticide use
- non-native species—alien introductions and invasives
- eutrophication—on land mainly due to fertilisers; more complex sources in fresh water and the sea

- air quality—e.g. particulates, nitrogen oxides, sulphur dioxide, etc
- wild harvesting—e.g. damage to marine fish stocks by overharvesting and by-catch effects
- toxic chemicals—pollutants and new substances with little-known effects, e.g. nanoparticles
- soil erosion and compaction.

Indirect drivers include:

- social and demographic change, e.g. population growth and movement, increased affluence and consumption
- national and supra-national policies, e.g. European agricultural subsidies
- competition for financial resources to support environmental initiatives.

Policy drivers in Wales include the full range of legislation (economic, social and environmental) that impacts on the ecosystems of Wales (European Directives, UK and Welsh government statutes, regulations and bye-laws, frameworks, strategies, “route-maps”, plans, guidance and advice notes).

How can these policy drivers be shaped to overcome these challenges?

By continuing work in international fora, in Europe and at Westminster, and on the floor of the Assembly, to re-align policy priorities towards true sustainability and through applying the ecosystem approach as a “policy gateway” and in policy impact assessment.

Appendix 1. Background on “Ecosystem Services”.

We have become used to the words “environment” and “ecology” in our mainstream vocabulary, and we have started to see jargon words such as “biodiversity” (the wealth of life with which we share the planet) coming into regular use. Now the terms “ecosystem services” and the “ecosystem approach” are being heard more frequently, and the former Welsh Environment Minister John Griffiths stated his priority to implement the new “ecosystem approach” in communities across Wales. So what is the ecosystem approach and how might it affect the management of our landscapes and seas in Wales in the future?

“Ecosystems” are the webs of life found in habitats (fields, woodlands, rivers, beaches) and the non-living components of those habitats, such as soil, water, air and sunlight. Ecosystem services are the benefits that humans receive from these ecosystems, including goods such as food, water, fibre, biofuels and medicines, which are often valued and traded as commodities. Other benefits from nature are less obvious, but no less important, such as the cleansing of water supplies by filtration through soils, protection from flooding by sand dunes, marshes and woodlands, the creation and purification of the atmosphere by plankton and vegetation, the locking-up of carbon in peatlands, grasslands and forests, and the pollination of food crops by insects.

These so-called “regulating services” keep the Earth’s whole ecosystem functioning, but they rely on even more fundamental supporting processes including the cycles of water, carbon and nitrogen. Many scientists also regard biodiversity as a supporting service, as it underpins most if not all other ecosystem services.

Nature also provides a range of cultural benefits for humans, such as spiritual upliftment and aesthetic pleasure, and the health and educational benefits of leisure, recreation and tourism.

We now know that much human progress has come at the expense of damage to our ecosystems. We have been using up our store of “natural capital” faster than the Earth can replace it, partly due to our view of many natural resources as “free goods” with no direct monetary value. Recently, efforts have been made to assess the damage we have caused to ecosystems and to place a value on the natural assets that we have left. The UN-sponsored “Millennium Ecosystem Assessment” estimated that 60% of the Worlds’ ecosystems were in a damaged or declining state. The UK Government has sponsored a more detailed “National Ecosystem Assessment” (NEA), which reported in 2011 that about 20% of the services delivered by the UK’s main ecosystems were improving, 50% were in neutral condition and 30% were declining.

In Wales during the past 20 years, the NEA estimated that 20% of habitat ecosystem services improved, 31% showed no net change and 49% deteriorated. Problem areas include marine fisheries, wild species diversity and some of the services provided by soils. Examples of the kinds of “trade-offs” that we have made in Wales during the past century include the draining of peat moorlands for forestry, the conversion of most of our semi-natural grasslands to improved pasture, and the losses of sand dune areas to agricultural land, forestry, housing and tourism.

Would we make the same decisions if we had a better understanding of the full value and range of benefits that we receive from ecosystems? The annual value of the World’s ecosystem services used as “free goods” by society is estimated at double the level of global GDP. The damage to ecosystems and biodiversity is costing the global economy trillions of dollars annually, and in the UK our habitats and ecosystem services are worth billions of pounds every year to the economy. In Wales, the environment has been estimated to

contribute £8.8 billion annually to the Welsh economy, a figure that would be much higher if the full range of values of ecosystem services to Welsh society were included. Studies are now underway in Wales and internationally, to estimate the “true environmental costs” of human development and progress.

The “Living Wales” Green Paper proposed the adoption of an “ecosystem approach” in Wales. Put simply it means fully reflecting the true long term value of ecosystems and their services in decision making, i.e. maximising the benefits for people by looking at the whole range of environmental goods and services, while maintaining the integrity and functioning of ecosystems to avoid rapid and undesirable ecological change.

Through its “Living Wales” programme, the Welsh Government intends to develop a clear set of national priorities, including institutional and regulatory changes, and to drive a system of integrated local delivery mechanisms for the management of our natural resources. Changes are already afoot to simplify regulatory regimes in Wales and a Single Environment Body “Natural Resources Wales” has been created to undertake this work. A series of pilot projects will test how the ecosystem approach will work and how to balance priorities around issues such as water quality, water resources, biodiversity, planning and development.

Appendix 2. [Wales Environment Research Hub \(WERH\)](#)

WERH is a science-into-policy evidence-gathering unit, funded by the Welsh Government and hosted by Bangor University and the Centre for Ecology and Hydrology in Bangor. Its Steering Board is composed of representatives from those organisations and Natural Resources Wales. At present, WERH has two members of staff (a Director and an Administrator) and is currently recruiting a science communications officer. WERH organises workshops and conferences to bring scientists and policy makers together to share the latest information on environment and sustainability issues in Wales. WERH also carries out briefings and reviews on policy-relevant environmental topics. WERH was established in 2007 and initially worked to the themes of the Welsh Government’s 2006 Environment Strategy (climate change; sustainable resource use; distinctive biodiversity, landscapes and seascapes; local environmental quality and environmental hazards). It was therefore not encouraged to work in the area of land management (which came under the separate Department of Rural Affairs) or duplicate the effort of the Wales Rural Observatory. WERH’s recent work has focussed on ecosystem services, integrated land management, climate change and environmental monitoring.

The Director of WERH - Dr Shaun Russell - has a background in training and research in the environmental sciences, including biodiversity conservation, protected area management, environmental impact assessment and responsible tourism. After an early career spent in Africa, he worked for the British Antarctic Survey, the British Council, the Durrell Institute of Conservation and Ecology at the University of Kent, the International Centre for Protected Landscapes at Aberystwyth University and the Centre for Arid Zone Studies at Bangor University. He has been the Director of the Wales Environment Research Hub since the unit was established in 2007.

Ecosystem Services (benefits to humans from nature)

Supporting services

- soil formation
- nutrient cycling
- water cycling
- primary production

Regulating services

- climate
- hazard control (flood/erosion)
- pests & disease
- pollination
- pollution (noise/toxic)
- air/soil/water quality



Raluca Dan, WWF Rumania

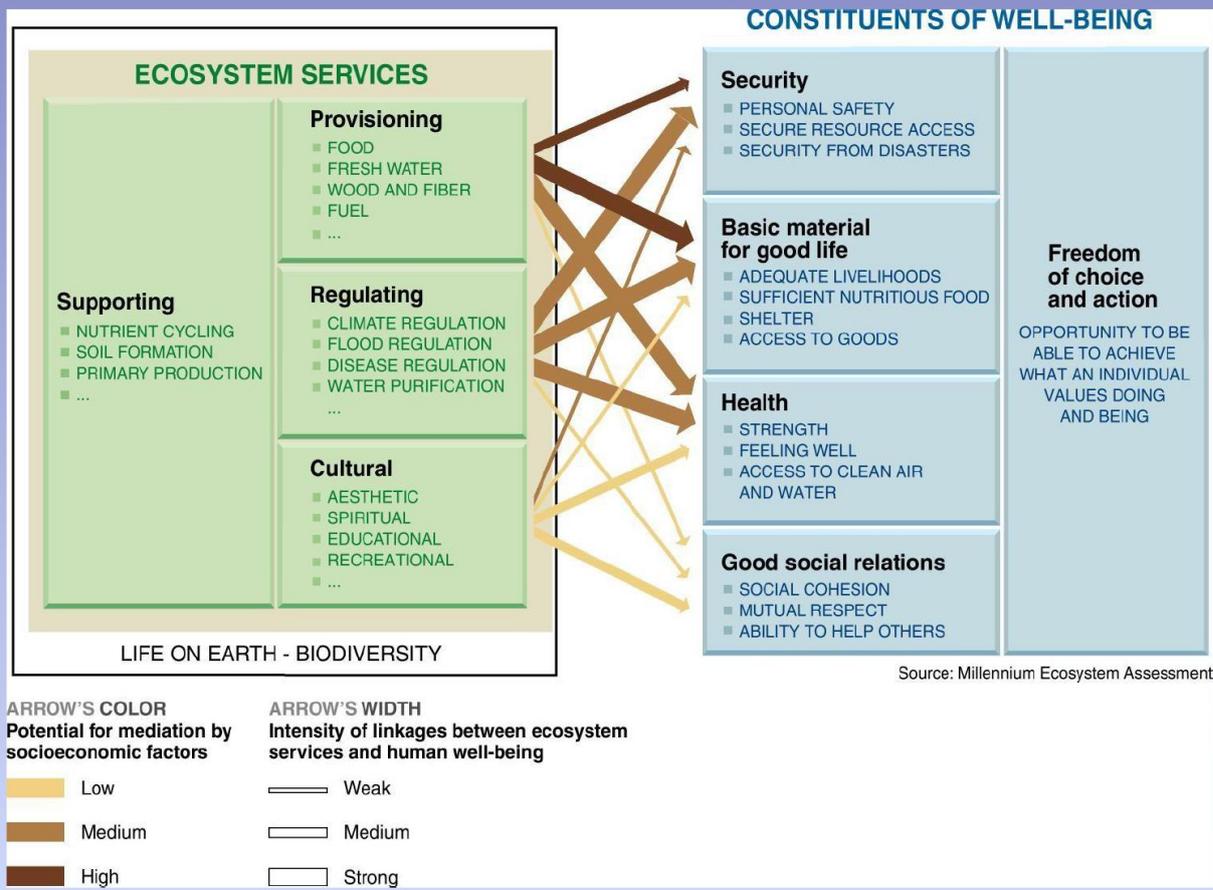
Provisioning services

- food
- fibre
- fuel
- bio-materials
- water

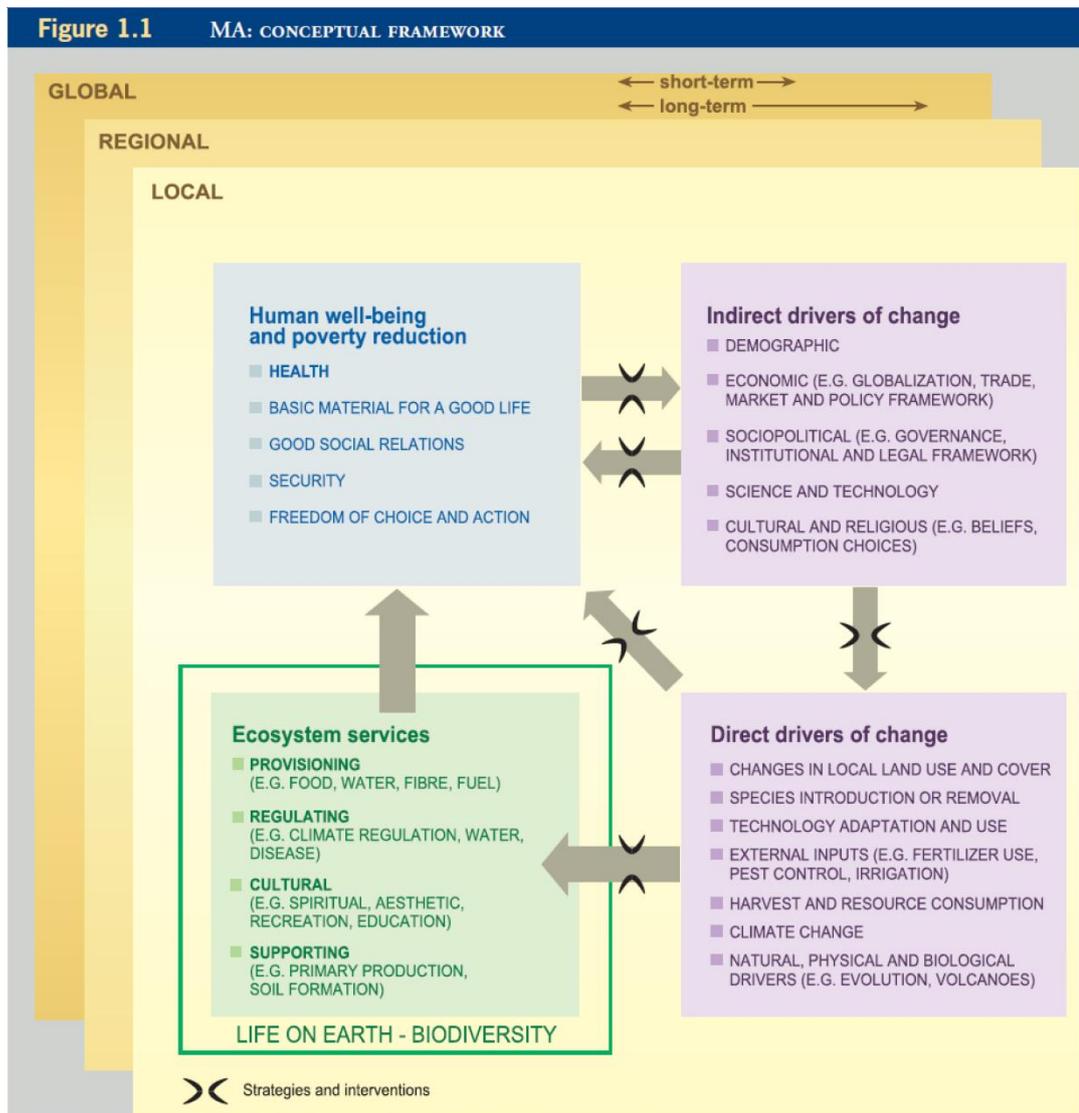
Cultural services

- aesthetic
- cultural heritage/sense of place
- education
- health
- recreation
- spiritual/religious
- tourism

Ecosystem Services and Human Well-being



Relationships between ecosystem services and human health and wellbeing (from the Millennium Ecosystem Assessment)



Relationships between ecosystem services, human wellbeing and drivers of change (Millennium Ecosystem Assessment).

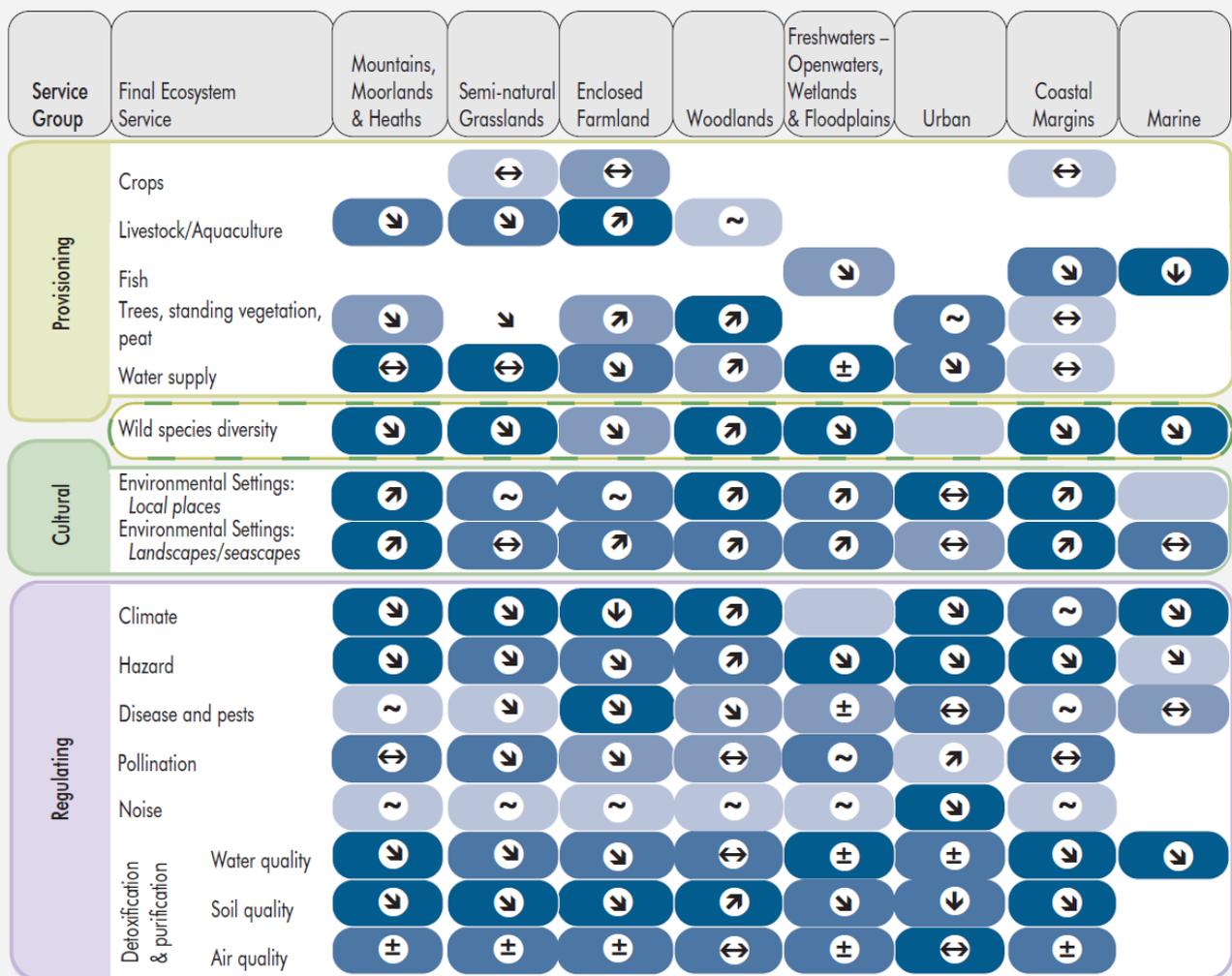


Figure 20.38 Relative importance of UK NEA Broad Habitats in delivering ecosystem services and overall direction of change in service flow in Wales since 1990. This figure is based on information synthesized from this chapter and the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5–16), as well as expert opinion. This figure represents an overview in Wales and will vary regionally and locally. It will therefore also inevitably include a level of uncertainty. 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

Status of ecosystem services in Wales (from UK National Ecosystem Assessment, Chapter 20).

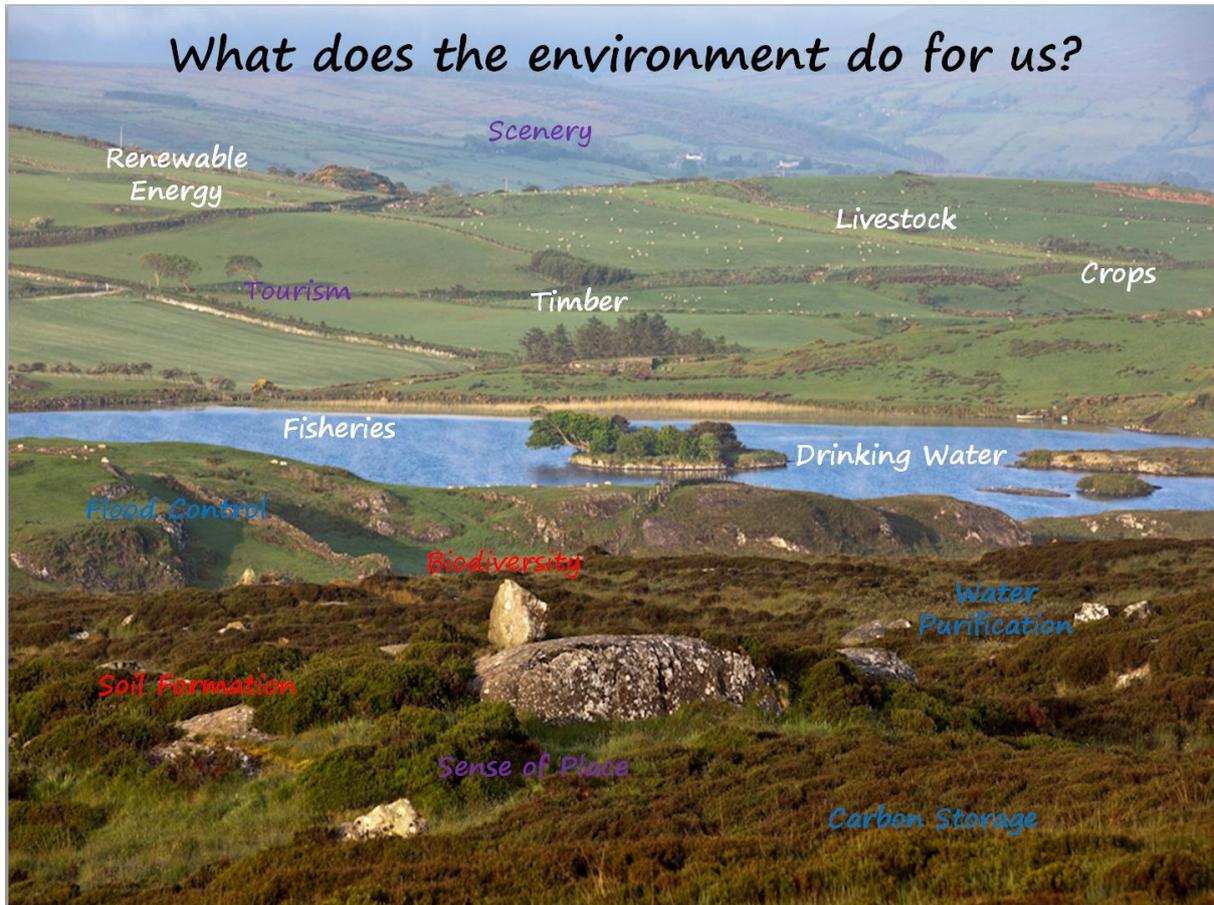


Diagram of ecosystem services in the landscape (Northern Ireland Environment Link).

What Nature Does for us

Mountains, Moors & Heaths

- Area: 186,362 hectares; 13% of NI
- Updated blanket bog in NI is a large proportion of the UK. Bog resource
- Support low levels of livestock grazing
- Opportunities for renewable energy
- Important stores of carbon in peat and vegetation
- Store and purify water and help prevent flooding
- High scenic and recreational value



Enclosed Farm Lands

- Area: 423,092 hectares; 40% of NI
- Intensive grassland farms producing meat and dairy annual value £3.4 billion
- Arable crops, mainly grain for animal feed and potatoes, annual value £60 million
- Opportunities for renewable energy
- Hedges are important for biodiversity
- Landscape with strong cultural heritage



Woodlands

- Area: 141,551 hectares; 10% of NI
- Conifer plantations produce timber; annual value £7.5 million
- 35,000 ha of ancient broadleaved woodlands, mostly in plots <2 ha
- Support biodiversity and soil formation
- Regulate climate, flooding, noise, and air quality
- Cultural heritage, amenity, health, recreation and tourism assets



Marine

- Area: 11,000 hectares (450,000 hectares to 12 Nautical Miles)
- Fish, shellfish and aquaculture; annual value over £20 million
- Opportunities for renewable energy
- Important role in nutrient, carbon and water cycles
- High biodiversity value
- Strong cultural associations and heritage, scenic and recreation value



Coastal Margins

- Area: 3,378 hectares; 0.25% of NI
- Habitats include sea cliffs, shingle, sand dunes and coastal / salt lagoons
- Provide protection against flood and storm damage
- Significant biodiversity, especially seabirds and invertebrates
- Important nursery grounds for fish
- High tourism and recreation value



Freshwaters

- Area: 95,700 hectares; 7% of NI
- Large and small lakes, rivers, tanks and raised bogs
- Source of 95% of drinking water
- Control water quality and quantity
- Abundant and varied biodiversity
- Important tourism and recreation assets; angling alone is worth over £40 million annually



Semi-Natural Grasslands

- Area: 261,763 hectares; 18.5% of NI
- Highly fragmented habitats
- Mostly used for low intensity grazing for cattle and sheep
- Important store of carbon
- Species rich grasslands very high in biodiversity, internationally important
- High in wildlife value



ECOSYSTEM SERVICES

The social, economic & environmental benefits that nature provides

Ecosystems and the services they provide underpin our existence. They are essential for human well-being and economic prosperity. We depend upon them to enable us to produce and gather food, regulate our water, purify our air, filter pollution and manage our climate. They also provide us with recreational space, sources of renewable energy and the ability to create wealth. Despite our dependence on the services provided by ecosystems they are consistently undervalued in economic analysis and decision-making. Any decline in the condition and stability of ecosystems directly affects us and our future prosperity as we will not be able to benefit from the direct and indirect services that they provide, which are essential to life on earth.

The National Ecosystem Assessment was completed in 2011 and provides a comprehensive overview of the state of the natural environment and highlights the vast range of services provided by it. For more information on the Northern Ireland chapter of this report visit www.nienvironmentlink.org



Urban

- Area: 105,049 hectares; 7.5% of NI

- Includes both urban areas and rural buildings
- Urban vegetation purifies air and reduces flood risk
- Urban parks and gardens are important habitats for biodiversity
- Contact with nature supports mental health, physical well-being and increases social cohesion

Designed by Sustainable Northern Ireland

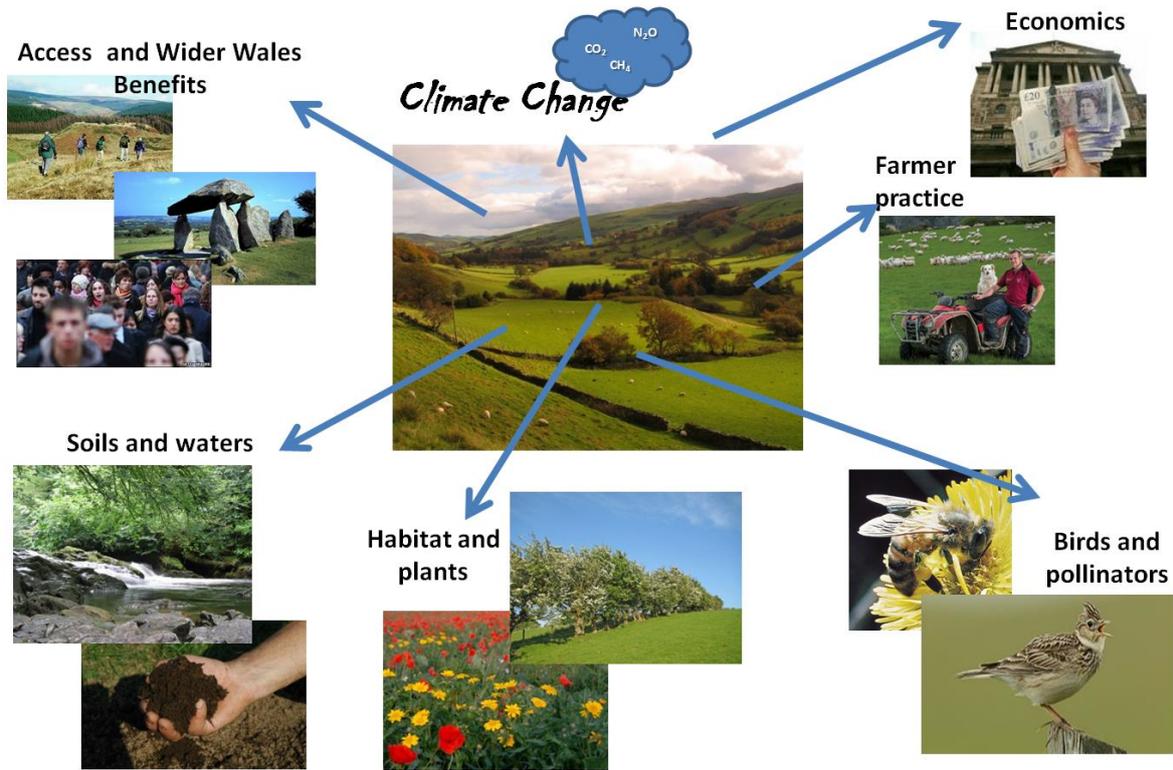
sustainable NI

Responsible Northern Ireland's national campaign for sustainable and better communities that can be used to demonstrate the value of what nature does for us.

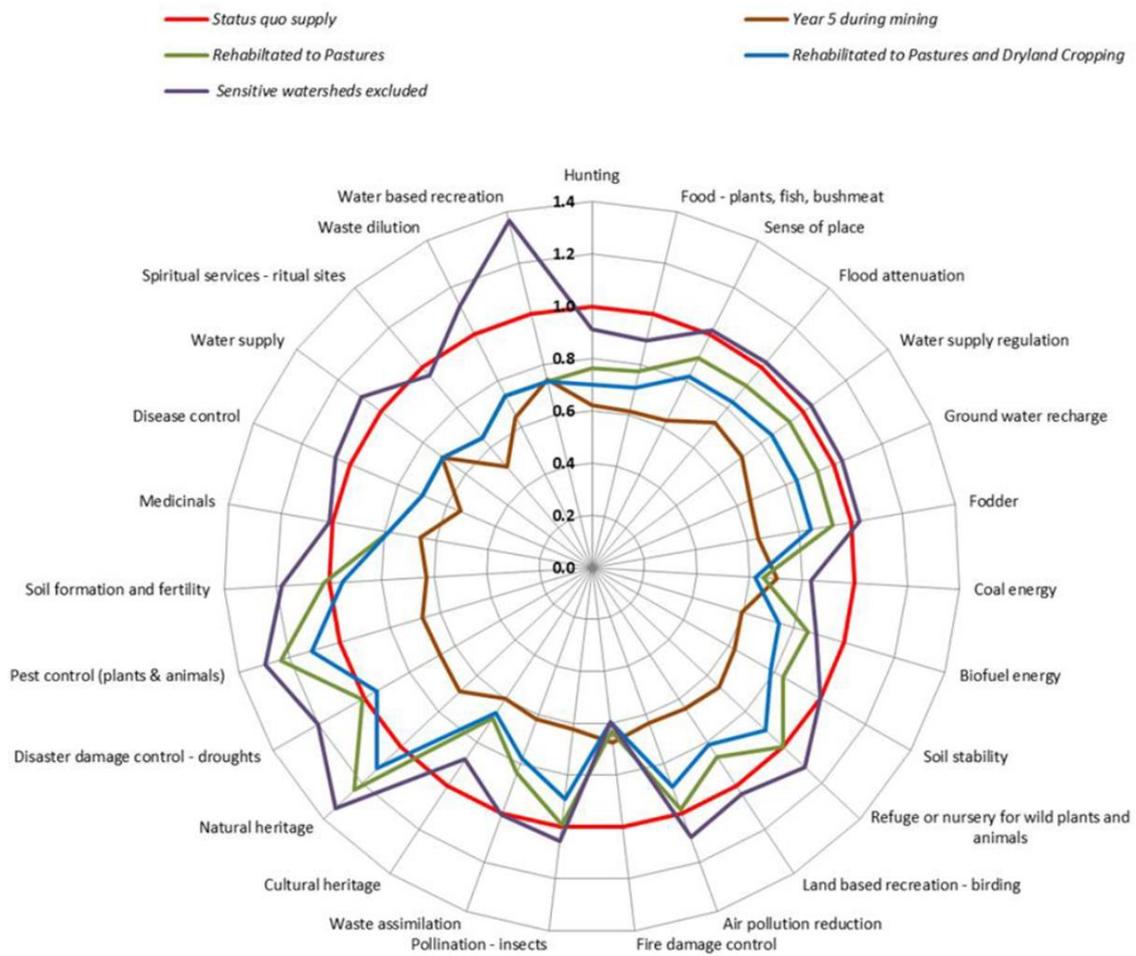
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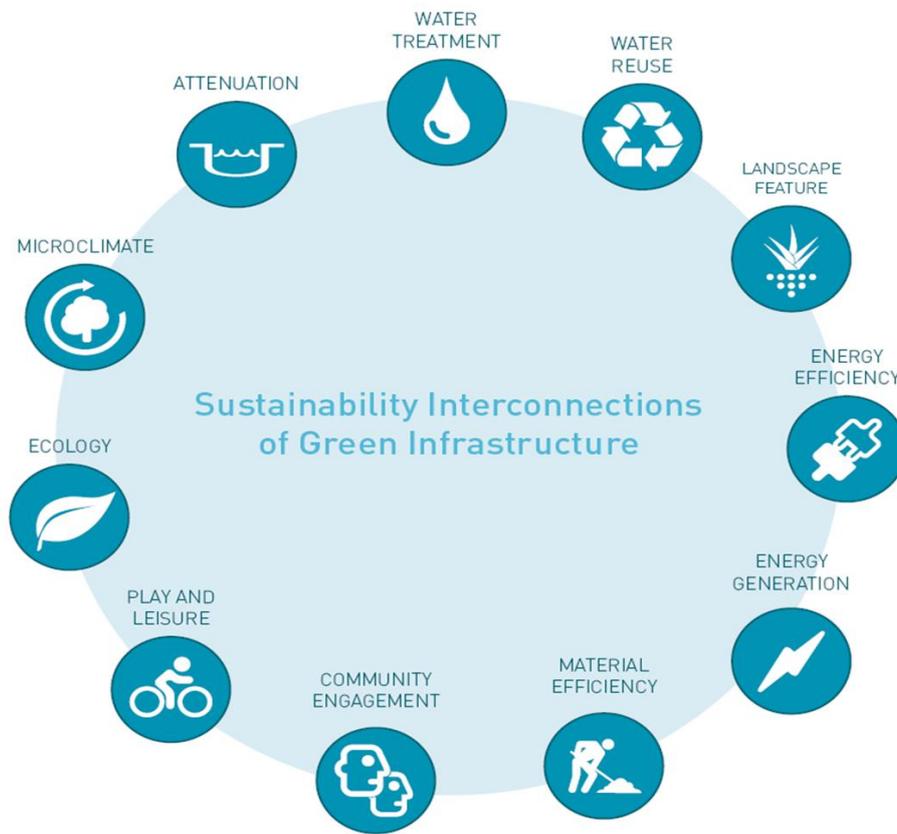
Poster on broad habitats and ecosystem services prepared for Northern Ireland Environment Link).



Rural land management impacts and influences in Wales. Prof Bridget Emmett, NERC Centre for Ecology and Hydrology, Bangor.



Ecosystem services impact “star diagram” for a mining development in South Africa (courtesy, Miles Mander, Futureworks and Eco-futures, South Africa).



Courtesy Gary Grant, The Green Roof Consultancy.

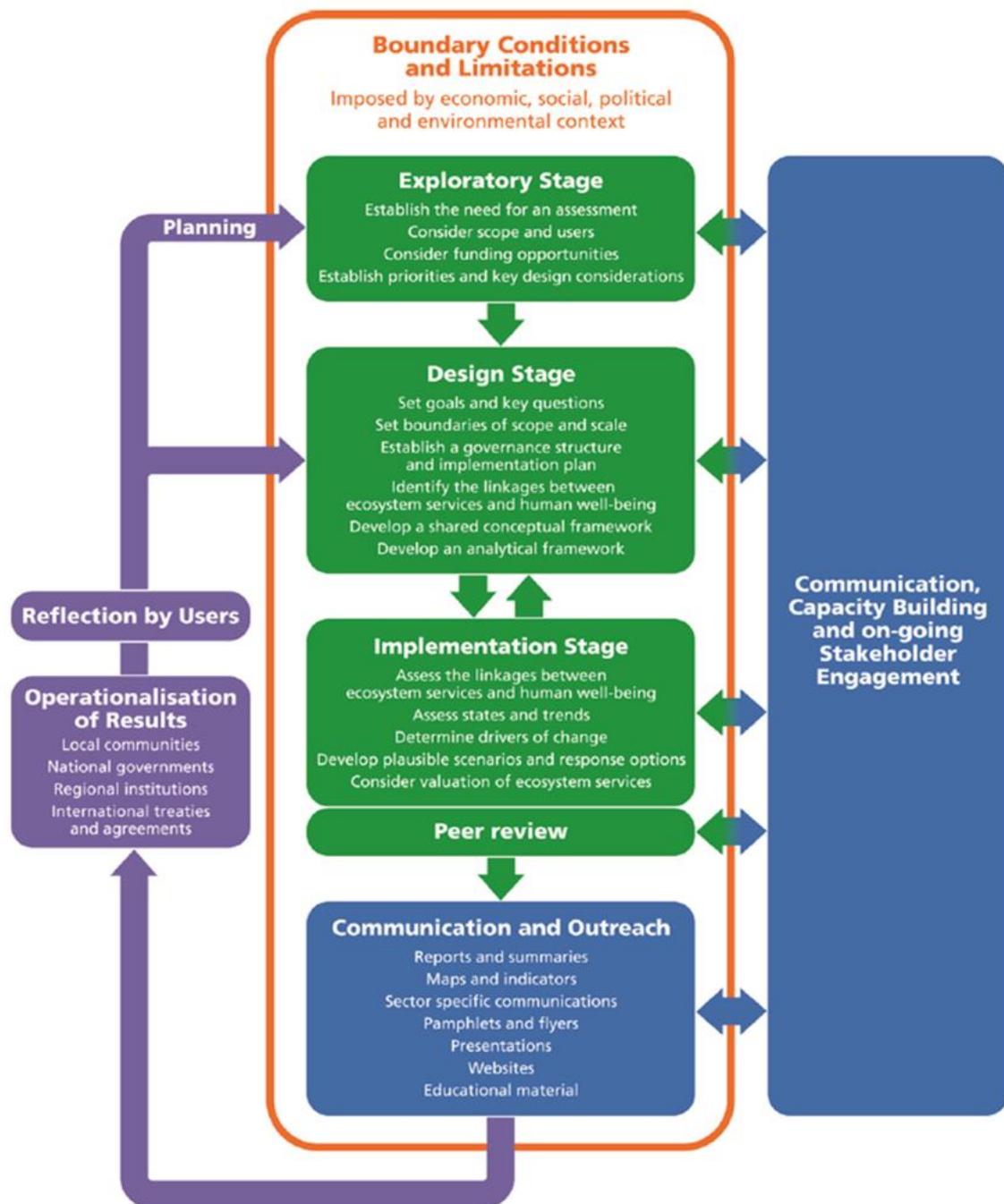
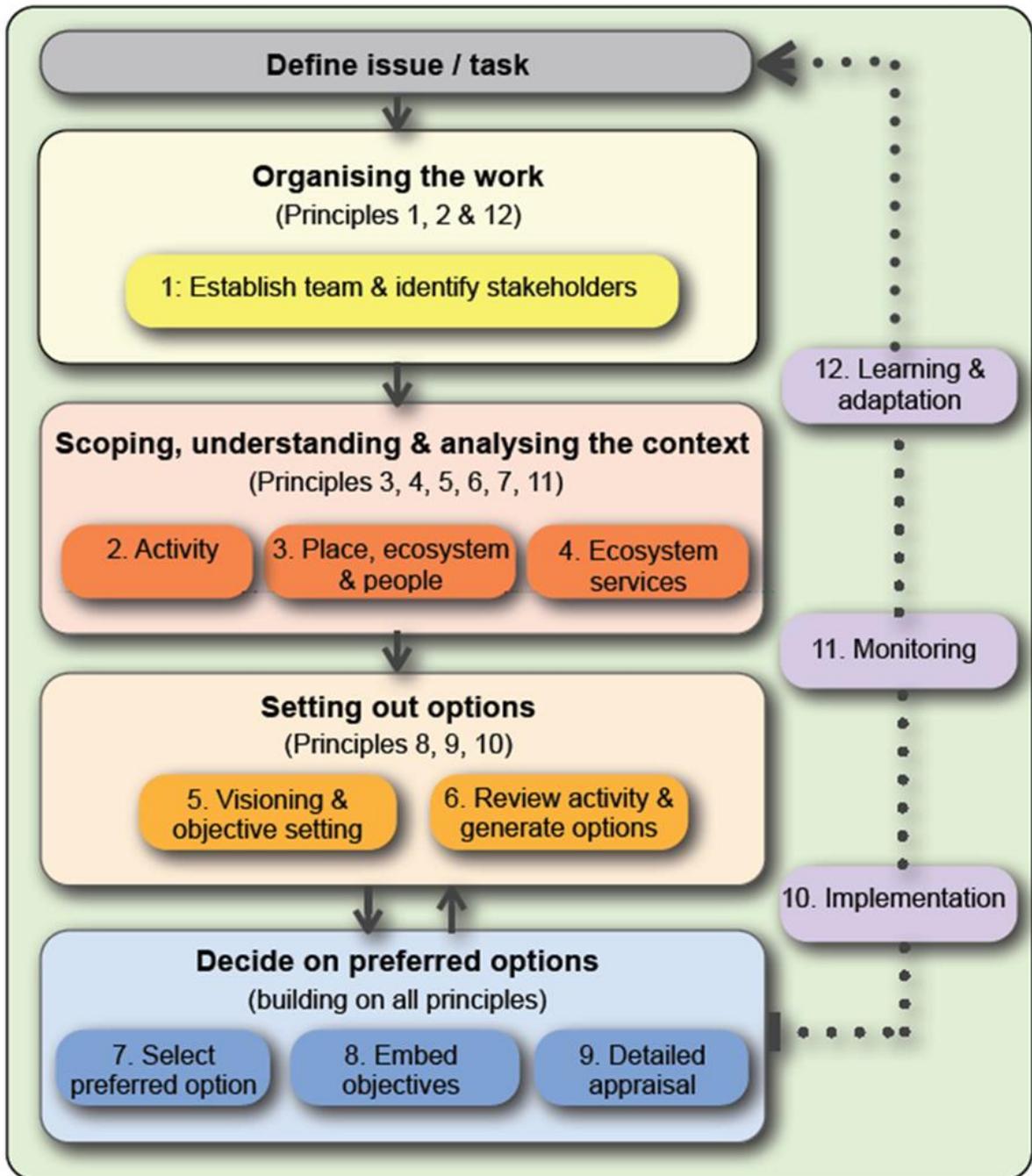


Figure 1. Ecosystem Assessment Framework (modified from Ash et al., 2010).

Ash et al. (2010). Ecosystems and Human Well-being: A manual for assessment practitioners. Island Press. Washington, D.C.



Draft schema for applying the ecosystem approach in the working of Natural Resources Wales (courtesy Steve Spode, Welsh Government).