



**Cyfoeth
Naturiol
Cymru**
**Natural
Resources
Wales**

**The State of Natural Resources
Report (SoNaRR): Assessment
of the Sustainable Management
of Natural Resources.
Technical Report.
Chapter 8. Assessment of the
sustainable management of
natural resources.**

Natural Resources Wales

Final Report

About Natural Resources Wales

We look after Wales' environment so that it can look after nature, people and the economy.

Our air, land, water, wildlife, plants and soil – our natural resources - provide us with our basic needs, including food, energy, health and enjoyment.

When cared for in the right way, they can help us to reduce flooding, improve air quality and provide materials for construction. They also provide a home for some rare and beautiful wildlife and iconic landscapes we can enjoy and which boost the economy.

But they are coming under increasing pressure – from climate change, from a growing population and the need for energy production. We aim to find better solutions to these challenges and create a more successful, healthy and resilient Wales.

Evidence at Natural Resources Wales

Natural Resources Wales is an evidence based organisation. We seek to ensure that our strategy, decisions, operations and advice to Welsh Government and others are underpinned by sound and quality-assured evidence. We recognise that it is critically important to have a good understanding of our changing environment.

We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

The State of Natural Resources Report (SoNaRR) Report Contents

This document is one of eight chapters of the State of Natural Resources Report.

Chapter 1	Introduction to the State of Natural Resources Report (SoNaRR): An assessment of sustainable management of natural resources
Chapter 2	Understanding drivers of change in natural resource use
Chapter 3	Summary of extent, condition and trends of natural resources and ecosystems in Wales
Chapter 4	Resilient Ecosystems
Chapter 5	Well-being in Wales
Chapter 6	Identifying Unsustainable Management
Chapter 7	Towards sustainable management of natural resources
Chapter 8	Assessment of the sustainable management of natural resources
Annex	Technical Annex for Chapter 3
Annex	Technical Annex for Chapter 7 (Part 1)
Annex	Technical Annex for Chapter 7 (Part 2)
Annex	Record of confidence assessments
Annex	Method for assigning confidence to evidence presented
Annex	Acronyms and Glossary of terms

All of the SoNaRR documents can be downloaded from the NRW website:
www.naturalresources.wales/sonarr.

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8. Assessment of the sustainable management of natural resources

Introduction:

This chapter draws together the conclusions from the preceding chapters to set out our assessment of the extent to which sustainable management of natural resources (both on land and at sea) is being achieved in Wales. In doing this we consider:

- The overall state of natural resources and the resilience of ecosystems;
- A summary of the benefits we get from resilient ecosystems;
- A summary of the unsustainable use and management of ecosystems;
- Risks to benefits caused by poor ecosystem resilience, and/or unsustainable management of ecosystems;
- Opportunities to manage risks by maintaining and enhancing the resilience of ecosystems.

Each of these matters is considered in the first part of this chapter and should provide a clear evidence base to inform the development of the National Natural Resource Policy by Welsh Ministers and the first set of Area Statements by NRW.

The second part of the chapter sets out our assessment of biodiversity as required in the Environment (Wales) Act. This draws on the headline messages from Chapter 3.

The final part of the chapter considers the next steps for the preparation of the next SoNaRR in 2019 and beyond.

8.1. Overall state of natural resources and the resilience of ecosystems

The summary analysis from Chapter 3 shows that whilst there have been improvements in recent years, particularly in water quality and some elements of air quality, many of our natural resources and the resilience of Wales' ecosystems are continuing to decline (a separate assessment of biodiversity is in section 8.3 below).

Chapter 4 sets out a framework for the assessment of resilience looking at the four attributes of extent, diversity, condition and connectivity at the national and broad habitat scale. This is the first time such assessments have been completed for Wales.

The assessment of each of the attributes at a national and habitat scale shows that there are problems. It is unlikely that ecosystems across Wales have sufficient resilience and this will impact on their capacity to provide services and benefits into the future.

The national maps presented in Chapter 4 show broad regional variations that reflect historical land use and habitat loss, with diversity, extent and connectivity tending to be relatively high in upland and coastal regions, low in lowland regions and especially low along major river valleys. The condition of mountains, moorland and

heaths is a significant concern for their long term resilience. It is important to understand the root causes of problems affecting condition in areas which otherwise have good potential for resilience.

Analysis on a habitat by habitat basis provides more detail. Whilst we are not in a position to indicate an overall measure of resilience at this point in time, it is clear that **all** habitats have problems with all four attributes of resilience. Condition is the attribute most frequently cited as poor. Although this alone is sufficient cause for concern, our analysis goes even further: by considering the impacts of these problems on well-being, not only now but also in the future.

Summary of the benefits we get from resilient ecosystems

Chapter 5 sets out our analysis of the contribution that natural resources make across the seven well-being goals from the Well-being of Future Generations (Wales) Act. Our analysis shows how closely natural resources are linked with all aspects of life in Wales:

- **A Resilient Wales** – Biodiversity, mountains, moorlands and heaths, semi-natural grasslands, woodlands, urban greenspaces, rivers, streams, lakes and wetlands, coastline and marine ecosystems all contribute to supporting Wales' ability to adapt to climate change. They are fundamental in supporting all of the well-being goals.
- **A Prosperous Wales** – Natural resources provide significant opportunities for employment and economic activity in Wales. Many of our key industries, such as agriculture, fisheries, forestry, energy and tourism are dependent on natural resources.
- **A Healthier Wales** – Natural resources make a significant contribution to the physical health and mental well-being of people in Wales. For example: trees help to absorb pollutants and improve air quality; access to nature and greenspace has positive impacts on physical and mental health.
- **An Equal Wales** – Equal access to ecosystems that provide cultural services would contribute to equality in Wales. At present, access is not equally distributed. (For example, not everyone lives in close proximity to accessible greenspace.)
- **A Wales of Cohesive Communities** – Involving communities in the management of their local parks and woodlands has been shown to improve community cohesion and reduce antisocial behaviour.
- **A Wales of Vibrant Culture and Thriving Welsh Language** – Landscapes have played a significant role in the development of distinct cultural practices, such as local building techniques relying on local materials, or locally specific art and literature.
- **A Globally Responsible Wales** – The environment supplies all our material resources, so we must better understand the impacts of our activities globally in terms of both imports and exports.

By making these inter-linkages and dependencies more explicit, it becomes clear that taking action to build the resilience of natural resources will provide significant other benefits across the well-being goals. Recognising these contributions is a crucial first step in helping the people of Wales and all parts of the public, private and

third sectors understand and optimise their contribution across the well-being goals. We go on to present the risks to these benefits in the Natural Resources and Well-being Risk Register in Chapter 7.

Summary of unsustainable use and management

Chapter 6 has identified a number of failings or gaps in the management or regulation of natural resources which suggest that natural resources are not being managed sustainably. We have looked at a broad range of management activities but recognise that this may not cover the full spectrum of activities that influence the management of natural resources in Wales. From this analysis, we have identified some 'systems failures' where management and human activity create negative impacts on ecosystems; these impacts present risks for future generations. The failings we identify are summarised in Table 6.1, and are grouped around four criteria :

- Natural resources are continuously declining or are being used faster than can be replenished;
- The health and resilience of our ecosystems is being compromised; this includes targets not being met or 'limits' in danger of being breached
- The benefits from ecosystem services are not being optimised;
- The contribution to well-being of ecosystem service provision is not meeting our basic needs, or is declining.

Many existing management approaches, particularly those that do not consider the wider benefits of ecosystems, are compromising the resilience of ecosystems. This is often exacerbated by market failure, resulting in an under-valuation of the benefits we get from ecosystems. This is putting the ability of ecosystems to deliver benefits for future generations at risk, or missing opportunities to optimise the benefits from natural resources. Even where regulations are put in place to correct this market failure, they are not sufficiently integrated and usually limited to a sectoral approach to issues. These management approaches need to change so that they become more integrated, and it is hoped the evidence presented in SoNaRR will help such change to happen by feeding into Welsh Government policy.

We have drawn on these issues in the compilation of the first Natural Resources and Well-being Risk Register for Wales (in Chapter 7).

Risks to benefits caused by poor ecosystem resilience, and / or unsustainable management.

We have developed the first Natural Resource and Well-being Risk Register for Wales. This identifies the key risks to the resilience of our natural resources and the benefits they provide. It draws on the evidence in Chapter 3 on the state of natural resources and on the resilience assessment in Chapter 4. It presents risks alongside a summary of the resilience assessment to help the reader quickly assess which attributes of the ecosystem are causing concern for well-being. It also draws on the evidence about the benefits that natural resources and ecosystems provide (set out in Chapter 5) and the identification of failings in our management of natural resources (in Chapter 6).

In summary, the risks relate to:

- The potential reduction in availability of current benefits for future generations
- The potential declining availability of natural resources
- The exacerbation of existing environmental, social or economic issues
- Climate change related risks and increased negative impacts (such as hazards)

We intend to: develop the Risk Register further through engagement and collaboration; develop ways of measuring and evaluating potential risk and inform the development of Area Statements.

8.2. Opportunities to manage risks through maintaining and enhancing the resilience of ecosystems.

At a Wales-wide scale, the evidence in the Risk Register highlights a number of risks to our well-being that need to inform the development of the National Natural Resources Policy (NNRP) and Area Statements. As Chapter 7 sets out, it is difficult to summarise or prioritise those risks without further dialogue with stakeholders about where the risks are arising and how severe the likely impacts could be.

One way of managing risks is by removing the pressure or negative impact altogether. Because of the complexity of drivers (as set out in Chapter 2), that is not normally a viable option. However, for every risk there is an opportunity.

Table 8.1 explores some of the opportunities to address risks by building more resilient ecosystems. The table draws on the key failings identified in Chapter 6, as summarised in Table 6.1. It combines these issues with the risks set out in the Risk Register alongside the ecosystems most likely to be affected. It then considers the ecosystems that provide potential opportunities for risks to be addressed. From this table we can therefore identify some of the key opportunities for Wales to manage natural resources more sustainably.

Table 8.1 Summary of the key issues relating to the sustainable management of natural resources in Wales (from Chapters 6 and 7), the impacts on natural resources and ecosystem resilience (from Chapters 3 and 4), and the opportunities for addressing them.
 * Which ecosystems is it impacting upon? (Risks): * some impacts, ** moderate impacts, *** most impacts. + Which ecosystems can be managed for benefits? (Opportunities): + Some opportunity, ++ Medium opportunity, +++ Most opportunity.

Issue	Ecosystem								
	Mountain moorland Heath	Enclosed Farmland	Semi natural grassland	Woodland	Freshwater	Urban	Coastal Margins	Marine	
1. Natural resources depleting or in continual decline: Where are the opportunities for action to maintain and enhance the resilience of ecosystems?									
Water availability and consumption management. (Risk of drought)	* ++	* +	* +	* ++	*** ++	** ++	*		
Declines likely in quality and quantity of soil resource through erosion, improvement, land take, and contamination	* ++	*** +++	* ++	+ +	*** +	* +++	*	*	
Maintaining the productive potential of our woodland resource	++	* ++	* +	*** +++	*	* +++			
Dependency of fossil fuels and transition to renewable energy	* ++	++	+ +	+++	++	** ++	+ +	+++	
2. Resilience of ecosystems being compromised: Where are the opportunities for action to maintain and enhance the resilience of ecosystems?									
Waste crime leading to damage to ecosystem (and impacts on well-being)		* +		*	*	*** +++	*	*	
Pollution incidents and risks to aquatic ecology from diffuse and point source pollution. Sediment in water courses.	*	* +++	* +	+ +	***	** +++		**	
Legacy minewaters and physical modifications.	*	* +	* +	+ +	*** +	** +++		**	
Building on floodplains.	++	+ +	+ +	++	** +++	*** +++	* ++		

Issue	Ecosystem							
	Mountain moorland Heath	Enclosed Farmland	Semi natural grassland	Woodland	Freshwater	Urban	Coastal Margins	Marine
Nitrogen deposition affecting soils, biodiversity and water.	**	*	*	++	***	* +++	***	*
Soil sealing and compaction. Impacts on hydrology and water quality.	* ++	** ++	++	++	**	*** +++	*	
Tree health and structural diversity of woodlands				*** +++	**	* ++		
Contribution to greenhouse gases and climate change	* ++	* ++	** ++	* +++	*	** +++	**	***
Coastal flood defence.						** +++	*** +++	**
3. Benefits from ecosystem services not being optimised or contribution to well-being declining: Where are the opportunities for action to maintain and enhance the resilience of ecosystems and the benefits they provide?								
Reuse of waste stream (e.g. Anaerobic digestion)		* +++	+ +	+ +		** +++		**
Lack of catchment management and sustainable drainage for multiple benefits	* ++	* ++	* ++	* +++	** +++	* +++	* ++	+ +
Soil carbon management. Water regulation.	+++	* +	++	+++		** ++	+ +	
Lack of appropriate woodland management preventing wider benefits from woodland. Supply of wood- fuel.		* ++		* +++		* ++		

Issue	Ecosystem							
	Mountain moorland Heath	Enclosed Farmland	Semi natural grassland	Woodland	Freshwater	Urban	Coastal Margins	Marine
Under-utilised flow resources	+	++	++	++	++	++	++	++
Integrated management of public and private urban spaces. Water sensitive urban design.					**	*** +++		
Opportunities for tourism, recreation, aquaculture and renewable energy.	++	+	+	++	++	++	++	+++
Litter, fly-tipping and local environmental quality	*	*		*	*	*** +++		
Poor water quality affecting recreation / fisheries / health. Costs to business and customers from increased water treatment.	+++	** ++	+	+	+++ +	*** +++		* ++
Poor air quality and noise affecting human health	*			++		*** +++		
Productive potential of agricultural land.	+	** +++	+			+		
Population and climate change related risks, e.g. Air quality, noise, urban temperatures and flood events.	++	++	+	+++	++	*** +++	+++	

It is important to consider the ways these opportunities can be taken forward in order to optimise their contribution to the well-being goals. Many of the issues will need joined-up thinking to achieve this, and will require solutions that integrate across sectors – such as managing our water. Some of the issues will be associated with deeply ingrained challenges linked to market forces or cultural and behavioural issues (for example, dealing with waste and energy efficiency). Some will require a completely different approach to management, others may just require a tweak in the way that we currently manage our natural resources.

Considering the potential contribution natural resources could make to well-being, a number of key priorities emerge from Table 8.1. These do not prescribe, but rather capture a series of potential actions that, if taken forward, would maintain and enhance the resilience of ecosystems and optimise the benefits for well-being. These are:

- Increased green infrastructure in and around urban areas, (including urban trees and sustainable drainage)
- Increased woodland cover and more existing woodlands brought into appropriate management to deliver multiple benefits
- Coastal zone management and managed realignment
- Working within whole catchments to manage nutrients, and maintain, enhance and restore floodplains and hydrological systems
- Better soil management for carbon storage, water quality and continued productivity
- Better utilisation of our uplands (mountains, moorlands and heaths) to deliver multiple benefits
- Integrated management of marine ecosystems through a plan-led system that facilitates better understanding of the benefits of marine natural resources and optimises their use

In addition, global climate change poses risks to the whole range of Wales' natural resources and ecosystems¹. Adapting to climate change is, therefore, a key priority if current levels of ecosystem services are to be maintained or enhanced. All of the above actions provide opportunities for adaptation.

Also evident from Table 8.1 is that many of the opportunities for better management of ecosystems occur in locations distant from where the problems originate. This highlights the need to take a targeted approach to management and to integrate delivery at the appropriate scale (a key principle of sustainable management).

These emerging opportunities chime with the results of a recent UK study² and underline the need for intervention by Government and others to secure the sustainable management of natural resources in Wales.

The UK study found there was good evidence, in terms of both costs of risks and benefits of action, for the following options²:

- Woodland planting – strong evidence on the benefits of increased woodland cover, especially close to urban areas where it will have most value for recreation and health;

- Upland Peatland Restoration – strong evidence on the benefits of restoring peatland and managing them for carbon, water and recreational benefits;
- Wetland creation – strong evidence on the benefits of increasing the area of wetlands, particularly upstream of urban areas;
- Protecting and expanding areas of intertidal habitat – good evidence of the benefits of stopping losses and creating more habitat in order to help manage the rising costs of coastal defence;
- Improving and expanding urban greenspace – growing evidence supports the health benefits of good quality greenspace close to people’s homes;
- Improving air quality – good evidence, particularly in urban areas, of the benefits of less pollution;
- Improving the environmental performance of farming – good evidence of the benefits of agri-environment actions, but continuing case for additional interventions to reduce environmental impacts further (more analysis needed);
- Managing catchments – good evidence available on the benefits at a project level but difficult to generalise results to other places without detailed analysis to take account of specific contexts.

It is no surprise that agriculture, occupying over three quarters of Wales, makes a big impact in terms of benefits, risks and opportunities. Even when considering such an extensive land use, however, taking a ‘systems approach’ and bringing in the wider connections to society is important.

Looking at the ‘food production system’ gives us a more strategic vantage point to consider issues such as diffuse pollution or habitat loss. Such a perspective is essential if we are to get to the root causes of problems and design interventions which optimise the benefits. Doing this in collaboration with the people managing the land from the outset provides significant opportunities for the sustainable management of natural resources.

8.3. Assessment of biodiversity

SoNaRR must set out NRW’s assessment of biodiversity (including the living organisms and types of habitat included in any list published under section 7). Biodiversity is defined in the Environment (Wales) Act as “*the diversity of living organisms, whether at the genetic, species or ecosystem level*”. Biodiversity is a fundamental component of ecosystems and as such it underpins our assessment of the state of natural resources in Wales. If biodiversity continues to decline, it is a strong indication that we are not achieving sustainable management of our natural resources.

Chapter 3 and the supporting Technical Annex set out our assessment of the extent, condition and trends of habitats and species within the marine, terrestrial and freshwater environments, based on available data. These data provide information across a spectrum of biodiversity, but they do not cover all species or aspects of biodiversity of relevance to us. For instance, we do not yet have the information

needed to properly address or assess some important species groups, such as fungi and micro-organisms, or aspects such as genetics and structure. This underlines the need to take a systems approach, where we work around gaps in evidence.

For species (animals, plants and other organisms) our assessment shows that:

- The condition of Special Areas of Conservation (SAC) and Special Protection Area (SPA) species features on sites in Wales, as reported in 2013, remains mostly unfavourable (55%). There are some exceptions with birds and mammals being 86% and 68% in favourable condition, respectively³
- Between 2002 and 2008, fewer than half of the species on the interim Section 7 list were considered to be stable or increasing³
- Wales (along with the UK as a whole) did not meet the 2010 international and national biodiversity targets⁴
- Trends of extent and population for terrestrial, freshwater and marine species vary enormously within taxonomic groups, with some species increasing and some decreasing (e.g. both increases and decreases can be seen in many pollinator species (e.g. bees, birds and bats), whilst for many we do not have sufficient data on which to base any conclusions^{5, 6, 7, 8}
- All species are directly affected by changes in habitat quantity and quality. These changes relate to increased or reduced management regimes and intensity of management. Fragmentation and eutrophication are particularly challenging for many species (see sections 3.6-3.13⁹).

For habitats of principal importance our assessment shows that:

- Some key habitats of conservation importance are scarce, small in extent and highly vulnerable, e.g. lowland semi-natural grasslands;
- The majority of Special Areas of Conservation (SAC) and Special Protection Area (SPA) habitats in Wales are in unfavourable condition (75%);
- More than 50% of Biodiversity Action Plan (BAP) habitats are in decline in Wales.

What does this mean overall for biodiversity?

In line with other published sources (e.g. State of Nature^{3, 10}), the evidence presented in Chapter 3 and the supporting Annex demonstrates the continuing decline in biodiversity across Wales.

It is not a simple picture: as species depend on such a diverse range of conditions and niches, requirements vary with seasons and stages of life-cycles, and so they are unlikely to all respond in the same way or over the same time-scales. For example some bird and mammal species are showing general improvements. It's also possible that some monitoring methods may have changed over time, blurring the identification of trends. Overall, however, the evidence strongly suggests an ongoing decline.

There is no single or simple reason for the ongoing decline in biodiversity. It has been caused by a wide range of factors operating at different temporal and spatial scales and in different combinations. These factors have been described in this report and include, for example, habitat loss and fragmentation, over-exploitation,

inappropriate management, and competition from INNS. Biodiversity is linked through complex ecological webs: declines in one species or habitat may have knock-on effects to others that might be quite unexpected. Biodiversity decline may also be a very long process, and impacts may take years, decades or even centuries to become fully apparent. For these reasons we cannot necessarily expect simple solutions or quick fixes to biodiversity decline. The failure of past biodiversity targets is perhaps not surprising if delays in system responses were not taken into account. Reversing the decline in biodiversity is an essential investment for well-being in Wales, but will require systemic change across many interlinked social, economic and environmental systems. These systems are all complex, adaptive and dynamic and therefore capable of transformation, given the right conditions. The Welsh Government National Natural Resource Policy which SoNaRR will inform, is the starting point for this change.

The CCRA17 Evidence Report¹ shows the dynamism of ecosystems and the increased risks to species and habitats from climate change. This dynamism means that there may also be opportunities from new species colonisations, which in some cases may be beneficial, as species extend their ranges. Conversely, native wildlife may be increasingly at risk from pests, pathogens and invasive species. There are also risks from change in the frequency and/or magnitude of extreme weather and wildfire events. Climate change is influencing the expansion or contraction of some species' ranges and populations, and the increasing frequency of extreme climatic events, predicted in many climate change scenarios, may have serious implications¹¹.

As Chapter 4 on resilience has shown, we quite often know the sorts of intervention required to improve biodiversity. They are often quite simple in principle and based on maintaining, restoring and creating habitat, and getting the right management in the right place. However, one of the problems in the past has been the piecemeal approach to managing biodiversity. To be most effective, interventions need to be carried out in a joined-up way, with careful thought given to their location. Larger scale and more joined-up action is needed if we are to realise the full potential of ecosystems and natural resources. This approach, coupled with recognition of the crucial links to well-being set out elsewhere in this report, will be the key to successfully reversing declines in biodiversity and maximising their contribution across the well-being goals. We need to work in tandem with other social and economic systems, adapting these systems so that managing for the resilience of ecosystems becomes the 'easy' option – the natural solution.

8.4. SoNaRR next steps

This is the first assessment of the extent to which sustainable management of natural resources is being achieved in Wales. Many of the data we have drawn on in this first assessment support more traditional approaches to nature conservation and environmental monitoring. Often these data are not well-suited to broader assessments of ecosystems, their resilience and contribution to well-being. We have made best use of what we have got and shown how the data could be used in a new approach to assessing resilience, managing risk and quantifying benefits. As part of NRW's transformation, which intends to embed the new purpose and principles of sustainable management of natural resources across all our functions, we expect to

align environmental monitoring and data collection more closely to the framework set out in this first SoNaRR.

We have drawn on methods and tools that are at the leading edge of academic and policy development. We intend to build on the risk-based approach set out in this report. In doing this, we will continue to focus on ecosystem resilience and well-being as set out in the Welsh legislative framework.

The Risk Register provides the basis of our assessment of sustainable management. We will develop this approach further for SoNaRR 2019 and develop indicators more closely aligned to the risks flagged in the register. This will provide a clear line of sight to natural resources, ecosystems and well-being benefits. We will draw on the interdisciplinary models, methods and tools currently under development to inform future assessments of sustainable management of natural resources. We will also:

- Look to develop a framework for **resilience** that supports natural resource management at different scales;
- Continue to improve our understanding of the links between natural resources, ecosystem resilience, and **well-being**. (In particular we need to consider the options for looking at the unsustainable use of non-renewable resources. As many of the natural resources used in Wales originate overseas, we also need to consider better ways of delivering the 'Global responsibility' well-being goal; for example, through raw material footprinting);
- Work with other bodies to test and refine the use of the **Risk Register**, augmented by **spatial and economic modelling**, as a support tool for integrated planning, in particular, well-being plans and Area Statements. We are keen to work with others to discuss how these methodologies can help to evaluate the likelihood and impact of these risks;
- Look to develop more sophisticated ways of analysing and measuring the resilience of **urban ecosystems**, which will help land-use planners, policy makers and the public to understand the complex relationships between and within people and place, and actions needed to optimise the contribution natural resources and ecosystems make to well-being.

As decisions around the use of natural resources often affect a range of different interests, a deliberative approach will be required that can enable NRW's evidence and analysis to be built on by partners for informing their decisions. There is no technological silver bullet for the complex issues society faces around the use of natural resources. Building on a range of evidence from different partners and using an adaptive management approach for testing out solutions is the best route forward.

8.5. New evidence to inform future SoNaRRs

SoNaRR is required to report on evidence gaps on any aspects which NRW consider important for the assessment of sustainable management of natural resources. Throughout the report we have identified gaps in our evidence and considered the level of confidence in our conclusions. This will form the basis of our engagement with Welsh Government, partners in the wider public sector, academics, the third sector and the private sector to consider the best way of addressing these gaps with limited resources. We also recognise that there are opportunities to streamline data

collection and evidence gathering by using innovative means of data capture; however, all parties need to be clear about what is needed.

New data

Understanding ecosystems as ‘complex systems’ requires modelling of various kinds to examine the many and varied sets of interactions and feedback mechanisms. An identification of new data requirements is best considered in relation to the data that can support modelling needs. We have demonstrated (in Chapter 7) how spatial analysis tools provide new scope for looking at old problems. We want to build on this work and help to support future assessments of ecosystem resilience and opportunities for optimising ecosystems’ contribution to well-being, by combining spatial approaches with economic modelling of natural resources. We discuss possible models below.

Integrated management requires us to use data in a much more interdisciplinary fashion, including the need both to integrate measures of well-being with natural resource datasets and to work effectively across different scales. The risk register approach points to the need to look at natural resources at a scale relevant to assessing their benefits; something which is often not possible with current ecological data. Even while adopting new tools, many of the fundamental elements needed to enable this style of management are still underdeveloped and key data are missing. An example is soil data – overlooked in the past but central to modelling natural resources and ecosystems.

There are also significant research gaps in relation to the understanding of climate risks that potentially undermine our ability to enhance the resilience of natural resources and ecosystems. The CCRA17 Evidence report¹ has identified a range of research challenges, including: understanding potential future land use change and opportunities for new cropping regimes; assessing the risk to freshwater species of higher water temperatures; understanding the costs and benefits of adaptation options for coastal areas vulnerable to sea level rise and, in particular, the impacts and thresholds for viability in coastal communities and how they can be managed. Addressing these issues will be crucial for enhancing ecosystem resilience and improving community adaptive capacity.

Developing new tools and approaches

Existing approaches will only take us so far. If we are to achieve the ambition to have sustainable management of natural resources, we will need to draw on other tools and techniques to explore and value fully the contribution that resilient ecosystems make to well-being. In particular, it is proposed to focus on:

- Natural resource accounting
- New ways of using spatial information
- Integration of environmental economic models with spatial information

Natural Resource Accounting

Accounting tools could help to inform natural resources policy if measurements can be undertaken at a Wales level. Natural resource accounting is emerging as a key area of statistical development, similar to the development of national income accounting after World War Two. The United Nations published a document outlining

experimental ecosystem accounts which covered both flows of benefits and the stocks of resources:

While ecosystem accounting does consider ecosystems and the economy to be different systems, they are analysed jointly reflecting the fundamental connections between them. The use of an accounting framework enables the stock of ecosystems – ecosystem assets – and the flows from ecosystems – ecosystem services – to be defined in relation to each other and also in relation to a range of other environmental, economic and social information. ¹²

The Office for National Statistics (ONS) is working towards using a fully tested ecosystem approach to provide official statistics by 2020. By 2017 the ONS intend to have robust cross-cutting accounts for recreation services and carbon.

Arriving at one agreed set of figures will be difficult, however. The values will always be subjective and will not account for all the values in place. There are currently at least five key methodologies for evaluating ecosystem services, none of which arrive at the same figures¹³.

The development of natural resource accounting as an adjunct to integrated reporting by private, public and third sector bodies is also progressing. Organisations such as Tarmac, the Crown Estate and the National Trust have already experimented with such an approach. Natural resource accounting, mediated through official statistics and integrated reporting, helps to prevent the state and resilience of non-market natural assets being ignored. NRW are seeking to use corporate natural resource accounting for the woodland estate. It is hoped that such corporate accounts could feed in to a set of national natural resource accounts for Wales.

Spatial Information

To fully understand the opportunities for sustainable management, a better understanding of the range of ecosystem benefits provided in a given area is necessary. A spatial planning approach is required in order to provide a framework to examine relevant natural resources in an integrated way. An example of what is possible has been given in Chapter 7. There are many different methods being developed with very different focuses, which can also be very specific; for example, water, forestry, urban areas. A range of such tools can be found on the Ecosystems Knowledge Network website¹⁴.

Wales is unusual in that it has invested heavily in developing high resolution spatial datasets (LIDAR and Phase 1 datasets in particular). This gives us much greater detail on both the nature and location of keystone features within the Welsh landscape. New sources of information can be added to the models from which outputs can then be fed into SoNaRR and the Area Statements.

Integration of environmental economics with spatial information

As well as using spatial planning inputs, we also need to model the economic value of natural resources better so that a fuller appreciation of their value is embedded in decision making. The Integrated Land Use Model (TIM), outlined in the UK National Ecosystem Assessment Follow On¹⁵ (Figure 8.1), uses modelling to produce

economic outputs. These outputs quantify benefits in physical units, such as runoff, yield etc. so that they can be valued economically and used in comparison with existing economic information in decision making processes.

TIM seeks to enhance decision making by giving values for benefits which do not have a market price, such as recreation and greenhouse gas emissions. It also deals with things with a value which goes beyond their use to us, and it quantifies the value of biodiversity without trying to cost this in terms of money:

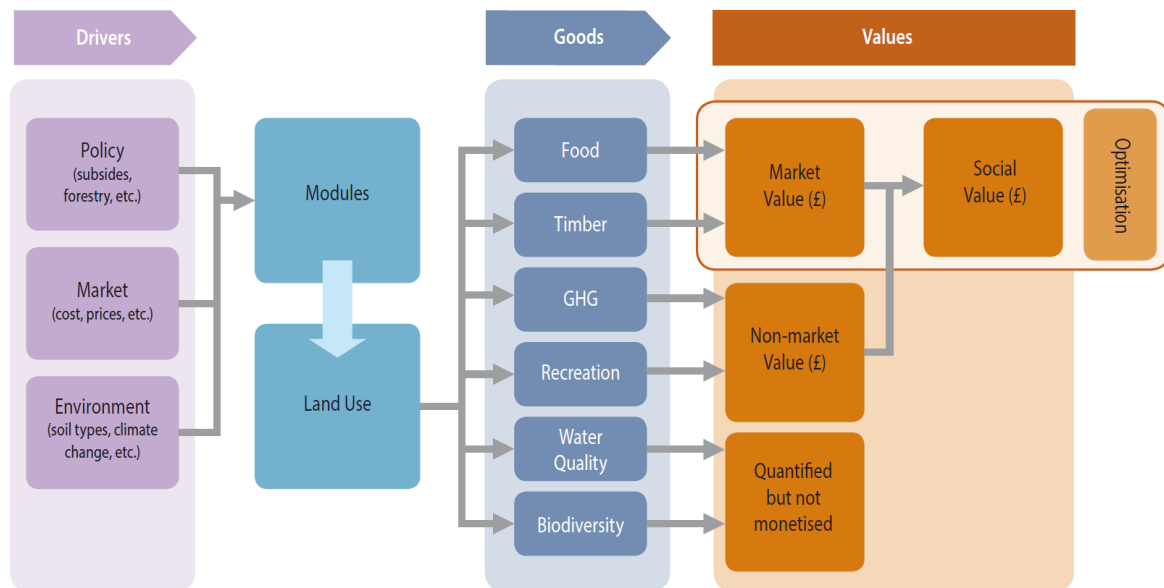


Figure 8.1 The Integrated Land Use Model (TIM): A schematic overview showing the main drivers, goods and values. TIM incorporates both market and non-financial value¹⁵.

We also want to make the underpinning data, evidence and assessment much more accessible to users, and we will explore the opportunities for developing a web-based portal so that our assessment can be continually updated and refined. To do this, we need to understand the needs of the end user better. One of our next steps will be to develop a process of engagement on our evidence, particularly with those stakeholders for whom Area Statements will be an important evidence base. NRW see Area Statements as the next opportunity to refine and improve our evidence on sustainable management through a deliberative process.

New software packages being developed externally are on the horizon, and they could be used by partnerships of stakeholders to examine the links in regional socio-environmental systems. An example is the 'Resilience.io' platform¹⁶ (Figure 8.2) which seeks to take the kind of information gathered in SoNaRR to benchmark a regional economy against others worldwide.

resilience.io platform

Open source, human - ecological - economic, systems integration

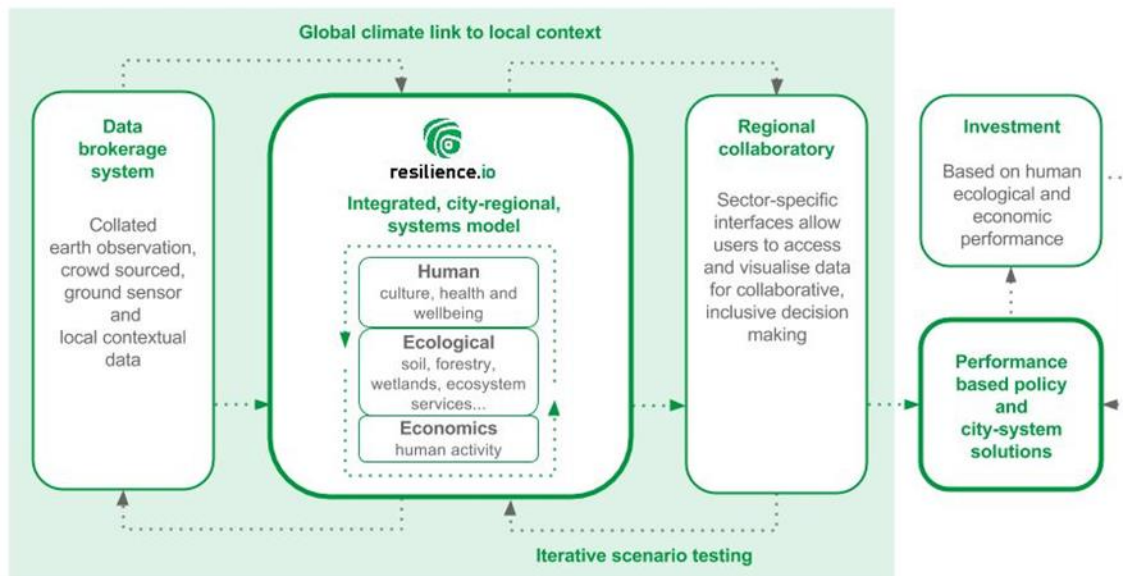


Figure 8.2 Resilience.io diagram¹⁶.

We will be looking for opportunities to share our information in ways that best contribute to partners' decision-making requirements, building on Lle - Wales' data sharing hub, for example.

8.6. Ways to get involved

The evidence presented in this first SoNaRR provides the baseline and platform from which we will develop future SoNaR reports. It is the evidence base that will inform the priorities for action set out by Welsh Ministers in the first National Natural Resource Policy (NNRP) due for publication in March 2017. The evidence will also inform the first set of Area Statements that NRW will start preparing from March 2017 following publication of the NNRP.

Since this is an assessment of the extent to which Wales is achieving the sustainable management of natural resources, we are committed to working with the wider public sector, the third sector and the private sector to build on this first SoNaRR. As the implementation of the new Welsh legislation continues, this report will have a crucial role in steering policy in the direction best suited to achieving the national well-being goals. As such a key resource, we hope that SoNaRR will continue to develop and be used by many different stakeholders for a range of activities.

This first SoNaRR marks an important landmark. It is the first statutory report to have been prepared by NRW under the Environment (Wales) Act. We recognise that it's the first opportunity people will have to see the difference in the way that we set out the risks, priorities and opportunities for the sustainable management of natural resources in Wales. Even though this is still work in progress, Wales now has the opportunity to use the new legislative framework and emerging research on natural resources to deliver a robust and innovative approach. Our aim is to build on this first

report by continuing to gather the information we need to improve our contribution to the complex decisions being made on the use of natural resources.

We would like to hear from you if you hold any other evidence on the state of natural resources in Wales, on the resilience of ecosystems or on their contribution to well-being which could assist us to build the evidence base on sustainable management.

Please contact.... Sonarr@cyfoethnaturiolcymru.gov.uk

References for Chapter 8

(“Accessed” refers to the date the link was last accessed)

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- ¹ Committee on Climate Change. 2016. *UK Climate Change Risk Assessment 2017 Evidence Report, Summary for Wales* [online]. Available from: <https://documents.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Wales-National-Summary.pdf>. [Accessed 29th July 2016].
- ² Natural Capital Committee. 2015. Third Report to the Economic Affairs Committee: The state of Natural Capital: Protecting and Improving Natural Capital for Prosperity and Wellbeing.
- ³ Burns F, Eaton MA, Gregory RD, ed. 2013. *The State of Nature Report*. The State of Nature partnership. Available from: <http://www.rspb.org.uk/forprofessionals/science/research/details.aspx?id=363867> [Accessed 14th July 2016].
- ⁴ National Assembly for Wales. 2011. *Sustainability Committee: Inquiry into Biodiversity in Wales, January 2011* [online]. Available from: <http://www.assembly.wales/Laid%20Documents/CR-LD8384%20-%20Sustainability%20Committee%20Inquiry%20into%20biodiversity%20in%20Wales-31012011-208859/cr-ld8384-e-English.pdf#search=inquiry%20into%20biodiversity%20in%20wales> [Accessed 14th July 2016]
- ⁵ Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA, Gregory RD. 2015. Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. *British Birds* 108, 708–746.
- ⁶ Fox R, Brereton TM, Asher J, August TA, Botham MS, Bourn NAD, Cruickshanks KL, Bulman CR, Ellis S, Harrower CA, Middlebrook I, Noble DG, Powney GD, Randle Z, Warren MS, Roy DB. 2015. *The State of the UK's Butterflies 2015*. Wareham: Butterfly Conservation and the Centre for Ecology & Hydrology
- ⁷ Bat Conservation Trust. 2016. *The National Bat Monitoring Programme. Annual Report 2015* [online]. London: Bat Conservation Trust. Available from: http://www.bats.org.uk/pages/nbmp_annual_report.html. [Accessed 14th July 2016]
- ⁸ GMEP. 2016. *Glastir Monitoring and Evaluation Programme (GMEP) portal* [online]. Available from: <https://gmep.wales> [Accessed 14th July 2016]
- ⁹ Great Britain Parliament. House of Commons. Department of Environment. 1994. *Biodiversity: The UK action Plan*. London: The Stationery Office HC 1994.
- ¹⁰ Hayhow DB, Burns F, Eaton MA, Bacon L, Al-Fulaij N, Bladwell S, Brookman E, Byrne J, Cheesman C, Davies D, DeMassimi S, Elding C, Hobson R, Jones J, Lucas SR, Lynch S, Morgan L, Rowe A, Sharp R, Smith RG, Stevenson K, Stretton TA, Taylor R, Gregory RD. 2016. *State of Nature 2016: Wales*. The State of Nature Partnership.
- ¹¹ Living with Environment Change (LWEC). 2015. Biodiversity Climate Change Impacts, Report Card 2015. Available from: <http://www.nerc.ac.uk/research/partnerships/lwec/products/report-cards/biodiversity/>. [Accessed 9th August 2016]
- ¹² UN. 2014. System of Environmental-Economic Accounting (SEEA) Central Framework. Available at: http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf. [Accessed 1st August 2016]
- ¹³ Spangenberg JH & Settle J. 2010. Precisely incorrect? Monetising the value of ecosystem services: *Ecological Complexity* 7, 327-337 . Available at: https://www.researchgate.net/publication/223454920_Precisely_incorrect_Monetising_the_value_of_ecosystem_services. [Accessed 1st August 2016]
- ¹⁴ Ecosystems Knowledge Network. 2016. Welcome to Tool Assessor [online]. Available from: <http://ecosystemsknowledge.net/resources/tools/tool-assessor>. [Accessed 24th August 2016]
- ¹⁵ UK NEA. 2013. UK National Ecosystem Assessment follow-on. Work Package 3: Economic value of ecosystem services. follow on Work package 3. Cambridge, UNEP-WCMC.
- ¹⁶ Resilience.io. 2016. Enabling transformational change [Online]. Available at: <http://resilience.io/> [Accessed 1st August 2016]