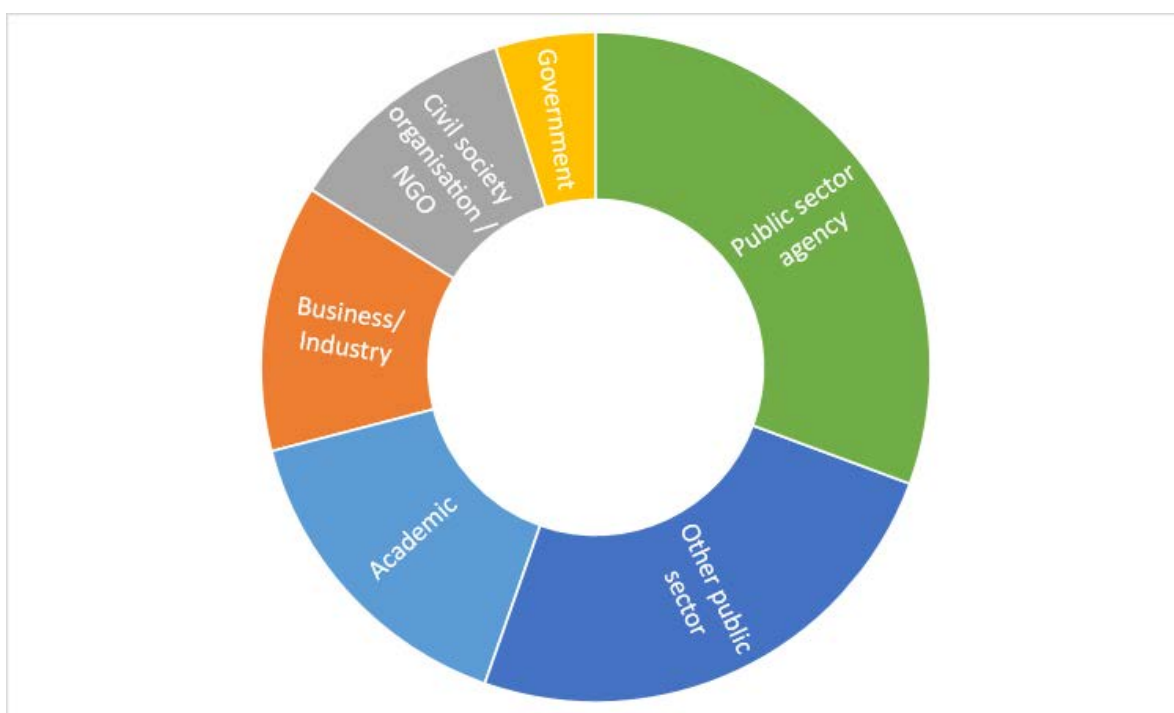


## Environmental Evidence for the Future Initiative

### Summary Report of Call for Evidence 2018

1. This report presents the results produced by an open call issued as part of NERC's 'Environmental Evidence for the Future' (EEF) initiative. The aim of the call was to gather, from a wide range of stakeholders, views on key knowledge gaps and evidence needs that should be addressed in order to underpin and enable the development of robust, effective UK environmental policy in the future. The [full report](#) of the results obtained, including details of the analysis undertaken, is available.
2. The call followed a series of four regional workshops that (i) prioritised the 'drivers of change' set out in the UK National Ecosystem Assessment (NEA) Technical Report and (ii) used these drivers to produce [65 '100-word challenges'](#) relevant to the environmental field and arising from the UK's decision to leave the EU.
3. A bespoke web-based tool allowed those responding to the call to highlight the knowledge gaps and evidence needs that, in their opinion, should be addressed in order to allow the 100-word challenges to be tackled successfully. In addition, Government Departments submitted written responses directly to NERC.
4. All sectors provided responses to the call. As the following graphic shows, public sector agencies provided most input (31% of all responses), which is not surprising as this initiative focused on the evidence needs of policy-makers. The 'Government' sector was under-represented (5% of all responses) while the response from the 'Civil society organisation/NGO' and 'Business/Industry' sectors was also low (~10% of all responses).

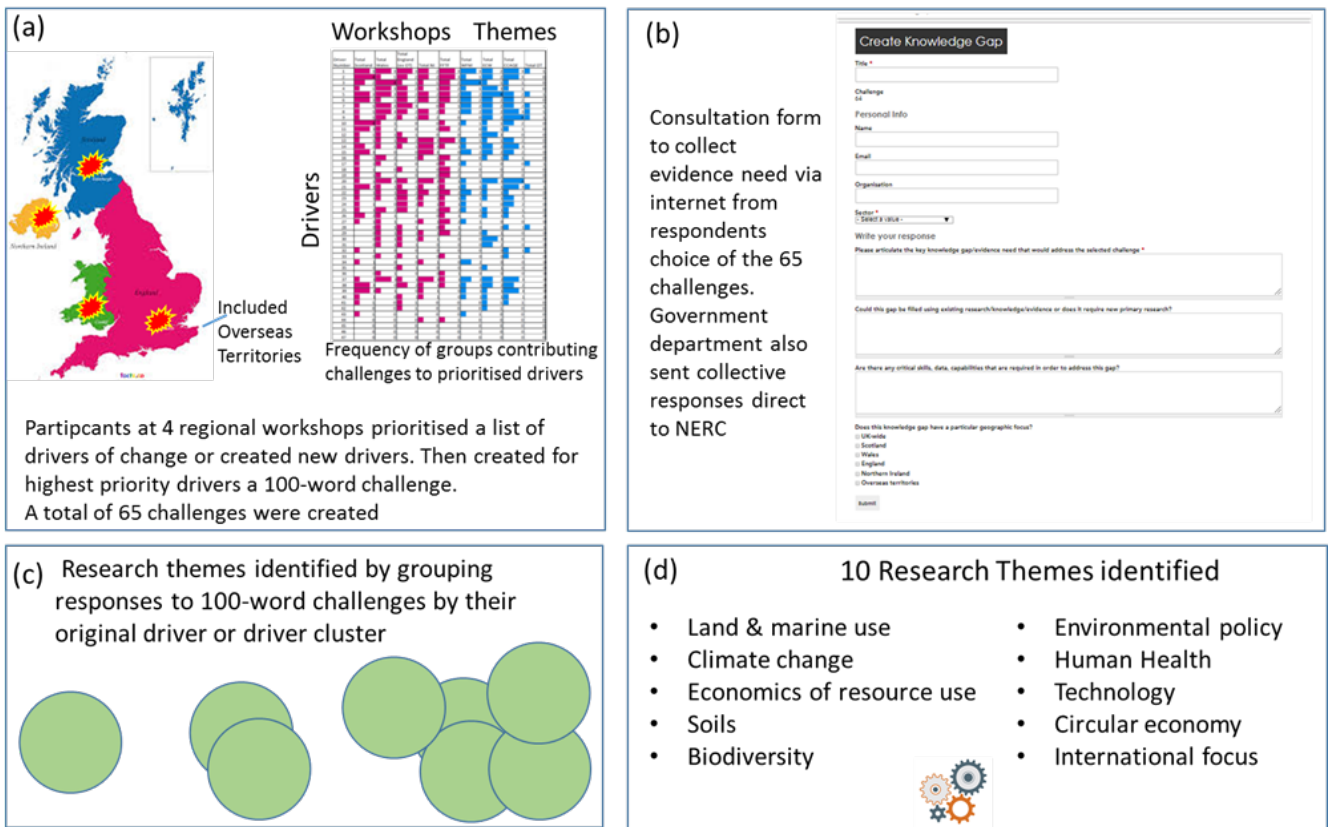


5. A total of 30 individuals and organisations submitted responses, while a further 34 respondents provided input anonymously, via the web-based tool. The anonymous responses were all considered to be genuine and legitimate (i.e. they included no inflammatory, extraneous or off-topic responses) and so were included in the subsequent analysis by the EEF team; the majority of these responses were from the 'Business/Industry' and 'Government' sectors (accounting for 35% and 26% respectively).
6. All of the 186 separate responses received were grouped according to the drivers of change (or clusters of similar drivers) they related to. (Note: The majority of respondents considered that the evidence needs they highlighted were UK-wide, or UK-wide including the UK's Overseas Territories.) This process also provided the basis for the identification of 10 interlinked 'research themes'. These 10 research themes are outlined in the following graphic:



7. Overwhelmingly, respondents to the call indicated the need for new research in all of these research areas. Many statements also indicated that there was a need to undertake a synthesis of existing knowledge and to combine data from different disciplines, especially in terms of integrating social science and natural science datasets so that the full socio-ecological system could be considered. Only three statements indicated that no new primary research was needed and that only implementation of existing knowledge was required.
8. The following graphic summarises the overall process that was implemented, and which is described above. It outlines: (a) the prioritisation of drivers of change, which resulted in the generation of the 65 100-word challenges; (b) the wide consultation that was undertaken, involving both the use of the bespoke web-based tool and the collection of

direct responses; (c) the grouping of the responses received and their use to identify 10 research themes; and (d) the research themes.



9. The results of the process, in terms of the knowledge gaps and evidence needs identified by respondents for each of the 10 research themes, are summarised below:

### Land and Marine Use

Just under a quarter of all responses analysed (23%) were relevant to this research theme. The relevant drivers and the resulting 100-word challenges focused on the production and use of natural resources from the terrestrial and marine environments. 43% of responses in this research theme related to drivers which focused on the holistic need to consider the use of land and marine resources in terms of competing demands, environmental policy and food security. 22% of responses categorised in this theme answered challenges centred on the concepts of natural capital and ecosystem services as a framework to provide knowledge on management options, regional planning and policy formation relating to land and marine use. All sectors responded to this research theme.

All responses relevant to this research theme considered that either new research or synthesis work combining knowledge and data from diverse sources was required. 89% of responses were coded by the analysis team as requesting new research and 51% were coded as requesting knowledge synthesis.

Just under half of the responses (49%) called for interdisciplinary research, echoing the idea of combining data and synthesising knowledge from diverse sources. A fifth of responses explicitly called for transdisciplinary research.

The majority of responses relevant to this theme called for a holistic understanding of the full socio-ecological system. Knowledge gaps relating to natural capital, integrated modelling and policy analysis were identified in many of the responses. Many responses considered that the natural capital approach was a means to sustain robust human-nature linked systems and called for research to develop durable methods to inform policy. 40% of statements considered that single-focus process models were not sufficient and that there was a need for (often spatially explicit) integrated models in order to deliver a more rigorous approach.

In conclusion, respondents recommended research to further the use of the natural capital and ecosystem service frameworks and to integrate these studies with analysis of existing and future policies. The use of integrated spatially explicit models was recommended by respondents as a means to assimilate knowledge across diverse disciplines, in order to enable the full socio-ecological-coupled system to be considered when creating policy.

### Climate Change

This research theme focused on global climate change, considering many aspects ranging from extreme events (e.g. flooding, invasions by alien species and pests) to adaption and mitigation measures and the need for better forecasting. Public sector agencies and research organisations were the primary respondents for this research theme (84%). It is notable that no academic response was relevant to this theme.

Evidence needs relating to the quantity and quality of data on temporal change were the most articulated requirement (cited by 60% of respondents). 40% of respondents emphasised the need for long-term data covering a range of abiotic and biotic aspects. The need to consider all elements of the ecosystem was stressed as a key research gap by almost half of the responses relevant to this research theme. Statements highlighted the need for donors to fund programmes of sufficient depth to consider both the effect of ecosystem processes on the climate and the effect of climate change on ecosystems and their ability to enhance human wellbeing. Many respondents also recognised as a key research gap a holistic understanding of the role of humans in climate change. Respondents articulated the need for research in terms of both actions and policies which encourage or discourage activities related to climate change. The need for research relating to adaption to and mitigation of climate change, particularly associated with extreme events, was also identified.

In conclusion, responses relevant to this research theme stressed the need for long-term data not only to identify temporal trends in environmental change but also to capture extreme events and allow mechanistic understanding, and thus improve models for forecasting and for policy scenario studies. Respondents also called for research with sufficient depth and longevity to allow a holistic understanding of ecosystem processes and human drivers.

### Economics of Resource Use

This research theme focused on the influence of economic driving forces on environmental issues – for example, the influence of market forces (relating to supply chains and public subsidiaries) on products from the terrestrial and marine environments; or the economic influence of recreation and tourism on the environment with a particular focus on the UK's Overseas Territories. A third of the relevant responses were provided by the 'Business/Industry' sector, with the farming and forestry industries notable contributors; however, all sectors identified key research gaps.

As might be expected, the majority (90%) of the respondents considered it necessary to consider evidence for the full socio-ecological system. The role of markets and the flow of goods and materials (including people) was highlighted by 65% of respondents, while the natural capital approach to valuing the environment was emphasised by 45%. 30% of respondents reported that they considered that new research should focus on the creation of integrated spatially explicit models; 25% said that it should focus on the monitoring and evaluation of existing policy in order to learn from the past. A quarter of respondents also thought that there was a need for evidence on all aspects of the ecosystem when considering policy instruments and measures designed to influence the economic use of resources. A fifth of respondents highlighted the need to understand human behaviours relating to the use of natural resources.

In conclusion, the need to understand the multifaceted influence of natural resource use on the environment in the UK, its Overseas Territories and globally was considered a high-priority area for future research. The natural capital accounting approach was viewed by many to be a practical and useful one, but respondents noted that it required more research to ensure robust evidence that can inform policy.

### Soils

This research theme addressed several key unknowns relating to soils, including soil diversity, quality and health. A third of the responses relevant to this theme were supplied by academics and a third by public sector agency staff, with the final third supplied by representatives from other sectors.

The most important evidence need identified was a holistic understanding of ecosystems (cited by 53% of all responses relevant to this research theme). Soils were recognised as critical to many aspects of the ecosystem, such as soil health, the impact of soils on human wellbeing, the role of soil in contributing to climate change, the unknown influence of climate change on soil health and the subsequent consequences for food production.

In conclusion, respondents recognised soil's role in the environment as fundamentally important because it affected many aspects related to environmental policy. They recommended a diverse range of research topics that collectively would enhance policy-makers' knowledge. In the responses, there was consensus that research should consider soils more explicitly within research programmes (e.g. in programmes focused on climate change or land use) and that the influence of policy on soil form and function should be explicitly considered.

### Biodiversity

This research theme combines challenges focused on invasive alien species, pests and diseases and the decline of species. Relevant responses also highlighted the need to consider holistically the linked human-nature system and all the interactions within the ecosystem. 44% of respondents recognised a lack of knowledge relating to ecological networks as a key research gap, while 61% considered it important to integrate knowledge from a range of disciplines.

In conclusion, the key research gaps relating to the spread of pests and alien species centred on understanding ecological networks and the role of humans in dispersal processes. Similarly, another key research gap related to the role of humans in degrading

ecosystems and the subsequent effects on biodiversity survival. Respondents reported that the knowledge obtained from research projects which utilised tools and models in the field of ecological networks would provide policy-makers with more robust evidence with which to create policy to protect humans from pests and diseases and to enable biodiversity to survive in an increasingly human-dominated landscape.

### Environmental Policy

This research theme focused on the knowledge required so that UK administrations can deliver new environmental regulations post-Brexit. 73% of responses relevant to this theme highlighted the need to consider the full socio-ecological system and consequently to involve a wide range of stakeholders when evaluating new policy options.

In conclusion, the key research gaps suggested by respondents focused on a need for greater analysis of the effects of current policy and for scenario planning. In particular, inter-sectoral effects were highlighted as a neglected area. As noted above, respondents also called for more consultation with a broader range of stakeholders to consider the likely impacts of policy change.

### Human Health

The focus of this research theme was on two drivers of change. One centred on the use of antibiotics and the risk of chemical contamination of the environment; the other centred on the opportunities that the natural environment presents for human health.

The evidence needs highlighted for this research theme focused on the need to understand the linkages between human health and the environment (cited by 100% of responses relevant to this research theme), and specifically to understand the coupled socio-ecological system (60%) and the interlinkages between components of the ecosystem (40%). A fifth of respondents considered that there was a lack of knowledge with regard to understanding human motivation and behaviour, while 53% called for studies that are more interdisciplinary to identify key evidence needs for this research area. Environmental monitoring (especially of the aquatic and marine environments) was stressed in relation to the environmental risk of chemical contamination from human medicines.

In conclusion, the evidence needs reported by responses relevant to this theme centred on consideration of generating a holistic view of human health and the environment through interdisciplinary studies; but surprisingly few respondents (7%) considered that it was important to combine social and natural scientists in a single project – despite a call to consider human motivations. This may have been because they considered that this was inherent when they highlighted the need for interdisciplinary studies.

The concept of ecosystem services was highlighted as a means to provide evidence to encourage integration of knowledge and to inform policy-makers. More research on nature-based solutions was called for, as respondents considered that more knowledge of such an approach could inform policy-makers on measures and instruments to mitigate the effects of chemical pollution (especially in the aquatic environment) and could directly benefit human health in the urban environment.

### Technology

This research theme considered new technology designed to monitor the environment, boost production and digitally gather information and link it together (i.e. via the Internet of Things). The need for research into sensor technology to enhance long-term monitoring was highlighted in many fields, such as predicting extreme events, driving innovations in regulation and methods of compliance assessment, informing land design and planning, and natural resource management (e.g. air and water quality). Several responses also highlighted the need for research to improve data management. Some respondents raised the need to research the ethical use of technologies such as geoengineering, nanotechnology and synthetic biology.

In conclusion, respondents urged donors to fund research into technological developments, particularly sensors and the linking of sensors (i.e. the Internet of Things) in order to provide long-term monitoring of the environment and so enhance policy-makers' and public sector agencies' ability to build cheap, effective compliance monitoring as well as provide an evidence base for new policy.

### Circular Economy

This research theme focused on care for the environment in fields such as waste disposal and recycling. 64% of responses relevant to this theme suggested that research gaps should be addressed by considering the full socio-ecological system, while 36% suggested full evaluation and monitoring of current policy. 27% identified as key research gaps the links between the circular economy and human health; 27% also identified the concept of natural capital as such a gap. 27% of respondents also stated that there was a need for transdisciplinary research.

In conclusion, the majority of responses relevant to this research theme highlighted a need for evidence centred on the production, utilisation and recycling of waste which would involve all sectors of society.

### International Focus

This research theme articulated issues relating to the need to consider international collaboration, transboundary relationships and the role of UK scientists in solving global environmental problems.

All responses relevant to this area stated that it was necessary to consider the full socio-ecological system when conducting research to fill evidence gaps. Integrated and spatial modelling was considered to be an important tool by 71% of respondents and the need to understand markets and the flow of material was highlighted by 57%. 43% of the respondents mentioned a need to understand human motivation and the temporal rate of change.

In conclusion, responses relevant to this research theme focused on the need to consider transboundary issues, particularly food security and air pollution, in a global context. This supported the view that global consensus is the most effective route to environmental protection.

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Overall, there was a strong call for interdisciplinary research – with respondents often explicitly calling on donors to fund transdisciplinary research (i.e. to involve non-science actors in project design). Funding streams to encourage the collation and analysis of

datasets from diverse disciplines (i.e. re-purposing datasets) were recommended in order to address knowledge gaps in the environmental science evidence base and to inform policy and practice in the future.