

Response from the Society for General Microbiology to *Call for evidence: Shaping NERC's Priorities*

The Natural Environment Research Council (NERC) put out a [call for evidence](#) in March 2015 to help inform its' strategic investment priorities for the next Comprehensive Spending Review period.

The Society for General Microbiology, through consultation with NERC-funded Members, highlighted a number of potential research and innovation priorities. The Society also identified issues concerning how funding priorities are decided upon and implemented by NERC.

Q1. What emerging research and innovation opportunities promise to make the biggest impact on societal challenges?

The Society for General Microbiology recently consulted members working across the breadth of microbiology to identify the grand societal challenges where microbiology plays an important role as either a cause and/or solution. **Infectious diseases** and **food security** were identified as important challenges, alongside the cross-cutting challenges and opportunities posed by **climate change** and **biotechnology**.

It is clear that **microbes are a fundamental component of our natural capital**. They underpin key ecosystem processes in natural and urban environments (e.g. biogeochemical cycles, degradation of pollutants, waste treatment processes) and both contribute to, and offer solutions to, threats to UK and global security associated with health, food and climate change (e.g. infectious diseases in humans, animals and plants, soil degradation, production and consumption of green house gases, sustainable energy sources).

The following suggestions are specific research needs and innovation opportunities identified by our NERC-funded members, which relate to the aforementioned grand challenges, and fall under the remit NERC:

Soil biodiversity and security

Soil science, of which microbiology is a key component, is essential for the continued delivery of vital ecosystem services and to ensure food security in the face of global population growth and climate change. Current strategic programmes and research partnerships, including *Biodiversity & Ecosystem Service Sustainability* (BESS) and *Global Food Security*, are helping to address these issues, particularly from an agricultural and ecosystem function perspective. It is vital that NERC and its partners maintain strategic funding streams and knowledge exchange for soil science beyond the end of current funding programmes.

An innovation opportunity that is perhaps overlooked is that UK soils present a national resource where useful novel compounds, such as antimicrobials and enzymes, could be discovered in the future. A priority therefore would be to understand the distribution and abundance of UK soil microbiota, particularly in lesser studied natural environments by looking at their genomes, function and environmental tolerances.

Health security from an environmental perspective

Climate change and globalisation are resulting in increased societal and economic threats to the UK and other countries from animal, human and plant pathogens. It is vital that NERC, working with its

partners, prioritises investments in understanding and tracking the impact of environmental changes on disease threats. For instance, environmental change may increase the prevalence of endemic and exotic insect vectors of viral and bacterial diseases in the UK, with huge implications for agricultural productivity, biodiversity and human health. Changing climate conditions in the UK could also positively enhance the life cycles of fungal diseases, such as maize and wheat rusts, to the detriment of agricultural productivity and food security.

Antimicrobial resistance (AMR) is another global health security threat, which environmental research has an essential role in tackling; NERC's current lead on the *AMR in the Environment* component of the cross-council AMR funding initiative illustrates this. However, it is important that AMR remains a long-term strategic priority of NERC beyond the initial five years of the Government's AMR action plan. This is required due to the scale of this issue and the fact that the evolution of AMR is a dynamic problem, which will require on-going environmental surveillance and basic evolutionary microbiology, which fall directly within NERC's remit.

These threats also present potential innovation opportunities from NERC-funded research. For example, research may be used to develop biotechnologies to manage and monitor disease threats, characterise and exploit disease-related genes, and to discover new antimicrobials.

Impact of environmental change on microbes

As highlighted in the above-mentioned themes, given the importance of micro-organisms for ecosystem services and health security, a better understanding of environmental change on microbial diversity and ecology should feature among NERC's future priorities.

More research is needed to provide mechanistic understanding and quantitative prediction of the influence of environmental change on microbial communities, and in turn, how this affects ecosystem services. Better understanding the resilience and resistance of microbes to environmental change may lead to new innovation opportunities that provide societal and economic benefits. Such research requires an increased focus on the development and application of theoretical and modelling approaches, in addition to genomics approaches, which are perhaps more of a focal point for funding at present.

Q2. How should NERC ensure that our research and innovation investments deliver the most impact?

Funding and supporting multidisciplinary research, both directly and through cross-council collaboration, is vital for maximising impact. However, an issue identified by our members is that the processes and range of expertise used to judge grant applications are not always optimal for getting such research funded.

Expanding opportunities for knowledge exchange is also important for maximising impact. This needs to be facilitated among different research disciplines and between scientists and potential end users, including policy makers, industry and the public.

NERC's investments could also have a longer-term positive impact through strengthening the UK research base. For example, funding could target fields identified in the recent BBSRC/MRC consultation on vulnerable bioscience skills. Assurance of sustained funding is also vital to encourage recruitment and retention of researchers in priority fields, such as AMR.

While priority-driven applied funding is important for addressing societal grand challenges and innovation opportunities, maintaining a good proportion of funding for fundamental curiosity-driven

research is also important for achieving impact and addressing grand challenges from new perspectives.

NERC should also look to inform debate concerning regulatory frameworks that affect the research community it funds. For example, the impending implementation of EU regulations relating to the Nagoya Protocol will affect many NERC-funded researchers and may impede translational research.

Q3. Given the priorities identified in your answer to questions 1 and 2, who are key partners NERC should be working with?

It is clear that addressing the aforementioned grand challenges requires a coordinated approach across research councils, government departments, non-government organisations (NGOs) and industry, both within the UK and internationally. Partnerships, such as *Living with Environmental Change* and the *AMR Funders Forum*, illustrate the value of this approach. However, as highlighted in our suggested priorities, there are key research issues specific to NERC's remit that it must lead on promoting and funding.

Rolling engagement with the research community about strategic priorities and grand challenges is also important. Strategic priorities and funding solely guided by perceived policy needs may lead to research and innovation opportunities being overlooked, particularly if funding is increasingly diverted from curiosity-driven research to strategic programmes.

We would also encourage NERC to work more closely with learned societies, academies and professional bodies, which can act as a link to researchers, industry and the public. The Society for General Microbiology, for instance, has a diverse membership covering basic and applied microbiology across academic, industrial and clinical settings. The Society engages in broad range of activities that can contribute to achieving impact and knowledge exchange from NERC-funded research, including academic publishing, supporting researchers with grants and conferences, and engaging with the public, schools and policy makers.

Q4. How could NERC's research and innovation investments best support innovation and growth at a regional/local scale?

One way to support regional innovation and growth is to ensure that funding is not overly concentrated on a small number of institutions. Centres of excellence have great value, but it is also important to ensure that the entire UK research base is also supported by NERC investments in infrastructure and research projects.

Supporting and facilitating local/regional knowledge exchange between research institutions and businesses, government bodies and NGOs is another important way NERC can contribute to local innovation and growth. Funding CASE studentships and doctoral training partnerships is one way to facilitate the creation of these links.