MICROBIOLOGY SOCIETY

75 YEARS

A Sustainable Future

Project Statement

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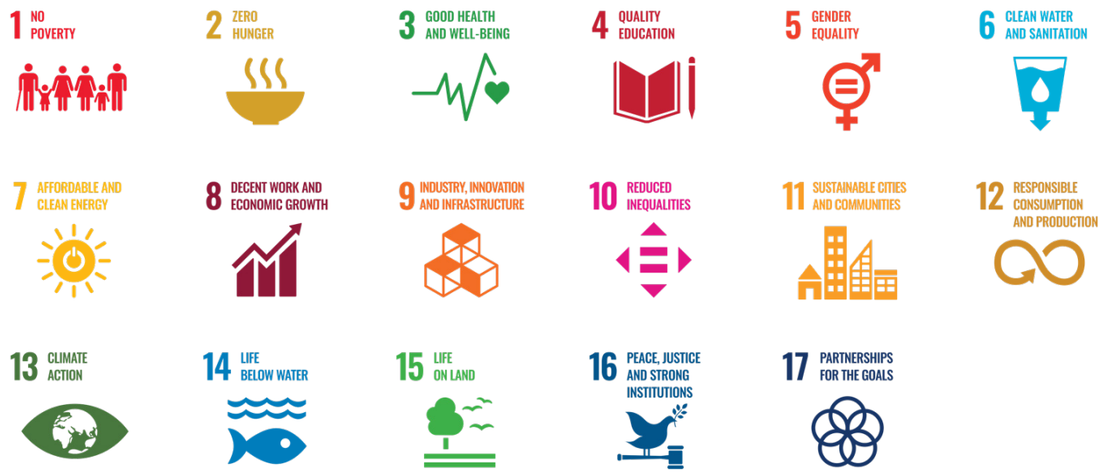
Microbiology has made our present better than our past, and can make our future better still. Policy decisions based on knowledge of underlying microbiological processes will be the basis of future progress, well-being and, ultimately, sustainability"
Emeritus Professor Judith Armitage, President of the Microbiology Society.

The United Nations 17 Sustainable Development Goals (SDGs), including "good health and well-being", "gender equality" and "affordable and clean energy", build on the success of the Millennium Development Goals to cement hundreds of years of incremental human progress with the support of a strong international community. The global goals are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. Many of the steps that will be taken on the long road towards achieving the SDGs will involve outputs from microbiological research. The major policy decisions needed to set us on this journey require knowledge of relevant microbial activities and how these can be channelled for the greater benefit.

To mark the 75th anniversary of the Microbiology Society, we embarked on an ambitious project that demonstrates the value and raises the profile of microbiology in addressing the world's biggest challenges. While the broader role of microbiology was taken into consideration, the 'A Sustainable Future' project focused on three areas where the discipline's contribution is particularly significant. These include **antimicrobial resistance** (AMR), which has been described as one of the biggest threats to humanity; the **circular economy**, a system which aims to maximise the efficient use of the world's finite resources; and **soil health** which is essential for feeding the world's growing population.

This year, the Covid-19 pandemic has posed unprecedented risks and challenges for governments and citizens alike. However, it has also provided humanity with an opportunity to effect profound social and environmental change, and highlighted the importance of having a world class research and innovation base able to rise to future challenges. Bringing together Microbiology Society members and other stakeholders, this project reflects on the greatest threats facing future generations. These threats range from the emergence and spread of drug-resistant pathogens to the impacts of global waste production and the effects of climate change on the ecosystem. Importantly, this project also showcases the positive effects that microbes have on mankind directly, as well as on human and natural environments.

The need for **sustained microbiology research and innovation** in AMR, circular economy and soil health is imperative to help deliver the SDGs, particularly those related to poverty and hunger (SDGs 1 and 2), economic growth (SDGs 7 and 8), production and consumption (SDGs 2, 9, 11 and 12), good health and wellbeing (SDG 3) and the environment (SDGs 6, 13, 14 and 15). Better **collaborative efforts** between academia and industry, as well as governmental, regulatory and societal organisations will be essential in the creation and adoption of **evidence-based policies** that will be needed to ensure a sustainable future for the generations to come.



Tackling antimicrobial resistance

AMR is a slow-moving pandemic, which already causes at least 70,000 deaths a year globally. Unchecked, the impact of AMR will continue to grow and has the potential to become the greatest future threat to human health and well-being.

Tackling the issue of AMR aligns with many of the SDGs; specifically, those related to poverty (SDG 1), human health (SDG 3), food security and agriculture (SDG 2), clean sanitation (SDG 6) and economic growth (SDG 8). Microbiology is at the forefront of developing novel antimicrobial compounds, vaccine research, providing sustainable solutions for treating livestock and crop diseases, unravelling disease transmission patterns across ecosystems and informing which antimicrobials should be prescribed when. Therefore, the microbiology community is pivotal for AMR research and can have a major influence in this area, which can contribute to delivering the SDGs.

The current landscape of AMR research in the UK and Ireland is highly active and expansive. However, the challenge is significant and some aspects of the research must be augmented in order to provide new solutions to infections caused by antimicrobial-resistant organisms. Whilst basic research is fundamental to understanding the how and why, the field also needs to be more applied, aiming to translate findings into new interventions through enhanced interactions with other disciplines and industrial partners.

Recommendations

Microbiology research in the field of antimicrobial resistance

1. Sustained microbiology research and innovation in the field of AMR is imperative to help deliver the UN SDGs, particularly goals related to poverty (SDG 1), food production (SDG 2), good health and wellbeing (SDG 3) and the environment (SDGs 6 and 15).

Improving antimicrobial resistance surveillance networks

2. In order to optimise current surveillance systems, microbiologists should seek to progress the implementation of innovative solutions such as rapid point-of-care genomics and should advocate to be included at the heart of both national and international surveillance efforts.

Enabling antimicrobial resistance research

3. To enable sustainable AMR research, longer-term and more ambitious funding of basic microbiology, challenge-led research and interdisciplinary projects is required.

Facilitating a knowledge exchange ecosystem

4. Funders and the AMR community need to support the creation of an AMR innovation and knowledge centre that pulls together capabilities from different disciplines to accelerate the AMR research agenda.

5. The AMR community should advocate for a forum that brings people together from different fields and serves to communicate the value of AMR work to those who set the scientific agenda and to a wider audience.

Antimicrobial resistance and society

6. The microbiology community should commit to educating stakeholders, including the public, policymakers and the media, around the topic of AMR and microbiology more generally, and use the current momentum around infectious diseases to raise awareness of the issue of AMR.

Transitioning to a circular economy

Exploitation of material resources and increased pressure on natural ecosystems have raised concerns over potential future resource risk and supply failures worldwide. In recent years, interest in a circular model that looks beyond the current linear 'take-make-dispose' industrial model has surged among scientists, policy makers and business actors. The circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems.

Microbiology is essential for the development of the circular economy, including in the areas of plastic and food waste. It allows the use of renewable bio-based resources (e.g. agricultural side streams and food processing side streams) and their conversion into products of value using microbial enzymes and whole-cell processes such as anaerobic digestion, thereby addressing SDG 7 (affordable and clean energy), SDG 9 (industry, innovation and infrastructure) and SDG 12 (responsible consumption and production). Microbes in soil can contribute to soil health and regenerative agriculture (SDG 15: life on land). Microbiologists and chemical engineers can collaborate to make wastewater treatment less energy-intensive and help achieve SDG 6 (clean water and sanitation).

Open and broad collaboration is essential to realising the transition of our society from a linear to a circular economy, which is interlinked with the challenge of achieving climate neutrality. Microbiologists must engage the wider public, policymakers and industry to inform the debate on addressing grand challenges and showcase the positive impacts of microbiology for society as a whole.

Recommendations

Microbiology research in the circular economy

1. Sustained microbiology research and innovation in the field of the circular economy is imperative to help deliver the SDGs, particularly goals related to the environment (SDGs 6, 14 and 15), sustainable production and consumption (SDGs 9, 11 and 12) and economic growth (SDGs 7 and 8).

Scaling up microbiology research and innovation

2. Microbiologists working in the circular economy field should seek collaboration outside of their core research expertise and realise how it applies to big global challenges. By collaborating with industry and funders, microbiologists should also advocate for flexible funding schemes, which would allow researchers to achieve longer-term research aims and to bring new expertise in to manage evolving challenges and work towards impact.

Enabling a collaborative community

3. A physical or virtual space fostering non-competitive communication and showcasing the practical benefits and economic outcomes of successful circular economy projects is needed to encourage more research and industry collaboration.

Developing a sustainable policy framework

4. While progress is being made, with governments adopting new policies, innovators developing new technologies and industry committing to transform their business models, large-scale action and impact is still lacking. Further effort to shape policy that meets societal, environmental and economic needs will be essential in ensuring the transition to a circular economy.

Facilitating greater multi-sector engagement

5. Greater societal engagement could be gained by creating a coalition-building initiative to bring together representatives of the population to hear balanced evidence on the choices the UK and Ireland face and make recommendations about what should be done in order to transition to a circular economy.

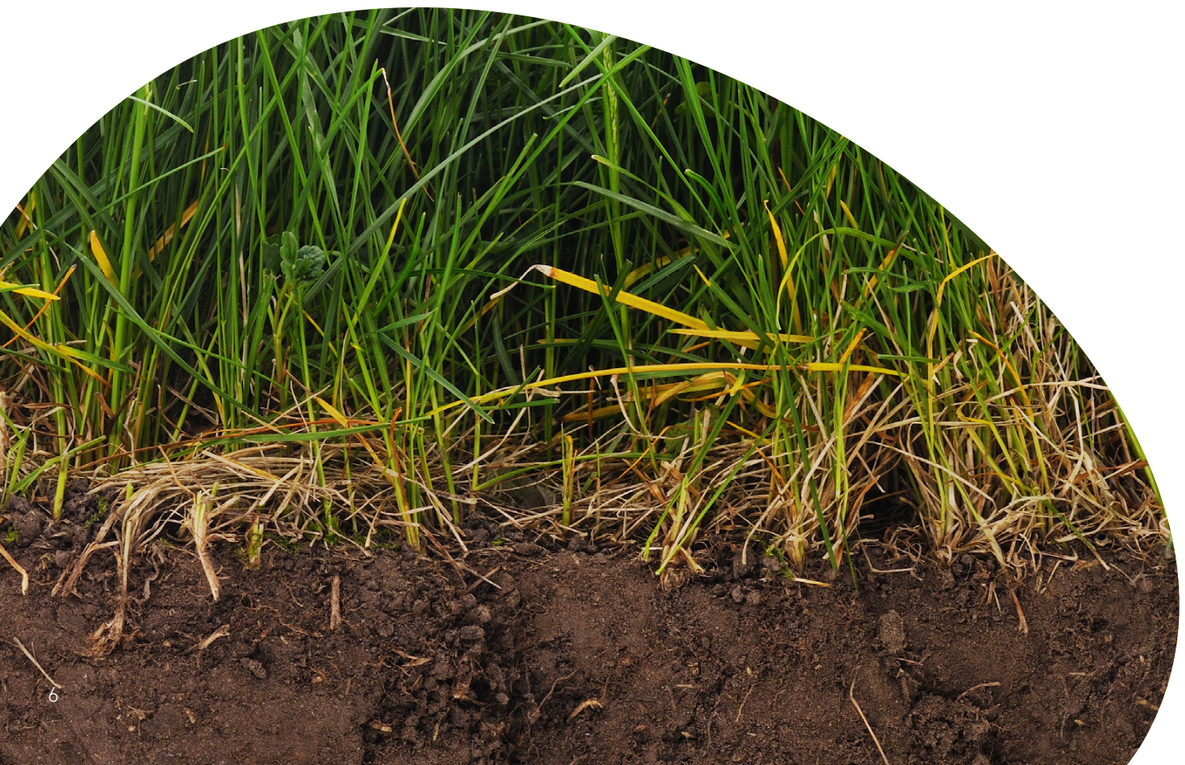
6. Without a significant shift in human behaviour, technological solutions will be ineffective at transitioning to a truly circular economy. The use of sustainably managed bio-based resources proposed by expert scientists is only one part of the culture change we must undergo as a, technological society.

Achieving soil health

Soils are critically important to the functioning and sustainability of the planet. They provide a range of essential functions, including producing the vast majority of our food, filtering our water and regulating climate. Most of these functions are underpinned by micro-organisms, making the knowledge of how they work of vital importance. In spite of this, soils are being degraded at an alarming rate. Twenty-four billion tons of fertile soil are annually lost from agricultural systems worldwide and it is estimated that 60-70% of EU soils are unhealthy.

Micro-organisms improve crop productivity and sustainable agriculture (SDG 2: no hunger). They play a role in pollution bioremediation, promotion of soil formation, prevention of soil erosion (SDG 6: clean water and sanitisation; SDG 15: life on land) and in carbon sequestration and reduction of greenhouse gas emissions (SDG 13: climate action). Microbes can also be used for improved control of pollutants, pathogens and nutrients (SDG 2: good health and well-being). Achieving soil health is not only relevant to agriculture, but rural and urban societies alike will benefit as better-quality land becomes available for use, while natural environments will benefit from improvements in microbial biodiversity.

The EU has raised soil health as one its top 5 priorities and many global initiatives are emerging in the area of soil protection. The UK should take advantage of this increased profile to consolidate active communities working together to improve the uptake and development of new sustainable land management practices.



Recommendations

Microbiology research in the circular economy

1. Sustained microbiology research and innovation in the field of soil health is imperative to help deliver the SDGs, particularly goals related to hunger (SDG 2), good health and well-being (SDG 3), clean water and sanitation (SDG 6), climate action (SDG 13) and life on land (SDG 15).

Framing soil health

2. The soil health community should evolve the concept of soil health towards a universal definition that is understood and adopted by all stakeholders, with metrics that encapsulate a soil's physical, chemical and biological features, but also takes the soil's specific ecosystem into consideration.

3. The soil health community should ensure that research is accessible to non-academics by raising awareness amongst stakeholders and society, which should include activities such as showcasing work in non-academic outlets and improving outreach in schools and (agricultural) colleges.

Enabling a collaborative community

4. Funders and the soil health community should work together to develop a coherent long-term funding strategy with interdisciplinary collaboration at its heart to ensure the continuity of research and monitoring over larger (time) scales that are relevant to soils.

5. Funders and the soil health community should support the creation of a soil health innovation and knowledge centre that pulls together capabilities from different disciplines and sector organisations to foster collaboration and should provide opportunities for (re)training and development of skills and competencies for a next-generation sector workforce that can confidently and rapidly accelerate the soil health agenda.

Collaborating with industry

6. The soil health academic community should increase engagement and collaboration with agriculture and industry in order to improve knowledge exchange for effective translation of research outputs into farm-ready affordable innovations, while also developing policy and quality control mechanisms to incentivise sustainable soil management.

Transferring knowledge and skills

7. Funders and the soil health community should support increased education and (re)training of soil health researchers, advisors and sector employees to address a lack in capacity, and tshould ensure that sector-wide knowledge, skills and competencies are available for successful participation in interdisciplinary projects. The Microbiology Society should align with other societies to help facilitate progress in this area.

A Sustainable Future Reports

The complete reports are available at the following links :

- Tackling antimicrobial resistance: opportunities and challenges for microbiology research and innovation
- Transitioning to a circular economy: opportunities and challenges for microbiology research and innovation
- Achieving soil health: opportunities and challenges for microbiology research and innovation

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The Microbiology Society is a membership charity for scientists interested in microbes, their effects and their practical uses. It is one of the largest microbiology societies in Europe with a worldwide membership based in universities, industry, hospitals, research institutes and schools.

Our members have a unique depth and breadth of knowledge about the discipline. The Society's role is to help unlock and harness the potential of that knowledge.