

Sustainable development, Climate crisis, and Pandemic: UK science response to a changing world

by

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As we emerge from the Covid pandemic, the world is different. Model simulations and common sense suggest that this change will continue, at a faster rate, as we move into a warmer and uncertain future. The challenges associated with tackling the “climate crisis” while finding and implementing the path towards sustainable development for the sake of humanity and natural ecosystems on our unique blue planet are enormous. We are aware that there is no simple answer to address this intractable global challenge, but the nature and urgency of the tasks ahead has sparked a new quality and depth of ‘science without borders’.

The UK has traditionally been, and will continue to be, a global player in science and innovation. This article looks at aspects of a rapidly changing landscape and analyses the transition of the science sector into a new quality of cross-disciplinary and cross-sectoral research aiming to mitigate the impacts of climate change through innovative strategies to achieve the [UN Sustainable Development Goals](https://sdgs.un.org/goals) (SDGs) (**Figure 1**).



Figure 1: The 17 goals of the UN Sustainable Development Goals (SDGs), <https://sdgs.un.org/goals>.

The quality and impact of this new ‘science without borders’ is breath-taking and exciting and opens unprecedented opportunities for researchers at any phase of their career, students, and stakeholders partnering with universities. This study explores information from the UK, with a focus on Scotland and Heriot-Watt University, the home of the author.

Roots of a changing research landscape

The issue of global climate change and the urgency for co-ordinated global action is not new. The [Intergovernmental Panel on Climate Change](https://www.ipcc.ch/) (IPCC) was established in 1988.

Since then, IPCC has become the global authority to analyse and update on the status of Earth's climate and outline possible projections under diverse business and societal scenarios. IPCC is underpinned by the best climate science teams from across the world. The implementation of climate science into politics and society poses however a different and highly complex task.

One critical milestone towards such a global political and social agenda has been the ratification of the United Nations (UN) Millennium Declaration in 2000, committing world leaders to combat poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women, defined in [eight Millennium Development Goals](#) (MDGs).

The MDG agenda experienced a major push at two outstanding events at the end of 2015. On 12 December 2015, at the Conference of Parties ([COP 21 in Paris](#)), a landmark agreement was reached to combat climate change and to accelerate and intensify actions and investments for a sustainable low carbon future. The 'Paris Agreement' for the first time brings all nations into a common basis to undertake ambitious efforts to combat climate change and adapt, with enhanced support for developing countries. With this scope it entered a new course in the global climate effort. This landmark decision was complemented by the UN Sustainable Development Goals (SDGs), which officially came into force on 1 January 2016. The SDGs are nationally-owned and country-led, wherein each country is given the freedom to establish a national framework in achieving the SDGs.

UK Science and Innovation response to the SDGs

The UK is a world leader in research, with only China and the USA ahead in research output ([Universities UK, 2020](#); [Wastl et al., 2020](#)). This outstanding performance in the UK does not happen just because of brilliant researchers working in universities and other research centres. Remarkably, over 57% of UK publications are the result of international collaboration (Universities UK, 2020). These figures emphasise that universities in the UK not only employ some of the best talents from across the globe but that the national research community heavily relies on and works with international partnerships to create a combined outcome that secures a world-leading position.

The UK government response to address the global challenges of the SDGs has been strong. From 2016 until 2021 allocations for Official Development Assistance (ODA) research have massively increased to support of four major funds (Department of International Development, DFID, Department for Business, Energy & Industry Strategy, BEIS GCRF, BEIS Newton Fund, and National Institute for Health research, NIHR Global Health Research). Jointly these programs invested above a staggering one billion pounds between 2020-2021, doubling the resources from 2016-2017 ([GCRF, 2019](#)), and have resulted in upscaling of science engagement, creating greater impact, and fostering new partnerships, between UK universities and globally.



Figure 2. The UK Global Challenges Research Fund,
<https://www.ukri.org/our-work/collaborating-internationally/global-challenges-research-fund/>

Flagship programs such as the Global Challenges Research Fund ([GCRF](#)) (Figure 2) have received £1.5 billion between 2016 and 2021 to support cutting-edge research and innovation that addresses the challenges faced by the developing countries. There are major success stories to report from all ODA research programs, but here we keep the focus on GCRF and the exciting changes this program has enabled.

Since its start in 2016, GCRF has been delivered by 17 UK organisations, including UK Research and Innovation (UKRI), and the UK Research Councils, to support over 800 projects in 126 low-and middle Income project partner Countries (LMIC) and over 1,700 organisations with strategic partnerships. Three of the largest programmes supported nearly 2000 researchers in more than 1000 partner organisations in over 100 countries, but none of these numbers can convey the human impact of this investment. At the project level, global health leads the portfolio, with around 240 projects, followed by Cities and Sustainable Infrastructure, Food Security, and Resilience to Environmental Shocks and Change, each at around 100 projects, followed by Security and Forces Displacement, around 80 projects, and education with around 20 projects.

It is difficult to directly assess how the recent changes in global challenge funding in the UK has changed research intensity and output, and research mentality. Some clues come from the analyses of UK academic contributions to the SDGs recorded by national assessment submissions ([Digital Science, 2021](#)). Data from the 2014 Research Excellence Framework (REF) reflect on the state of research for the period 2008-2014 serves as a baseline. Assigning the REF 2014 SDG-related outputs to the SGD goals detects the breadth of integrated research before GCRF and other ODA research funding was introduced, with SDG 16 Peace and Justice, Health and Wellbeing, 13 Climate Action, and 7 Energy leading the field. A different approach ([Fraisl et al., 2019](#)) concludes that citizen science contributes to 5 SDG indicators and has potential to contribute to another 76 indicators, in total covering around 33% of all SDGs. The largest contribution is with SDG 15 Life on Land, SDG 11 Sustainable Cities and Communities, SDG 3 Health and Wellbeing, and SDG 6 Clean Water and Sanitation.

How will the performance of the UK with regards to SDG related research look like in the current 2015-2021 REF cycle? Scientific publication is one aspect of demonstrating output and impact; other important assets and values are; however, not capture by this variable. Focussing on UK publications from 2020 only, the data suggests that the 2014 REF outcome may be dwarfed compared with REF 2021. If correct, this would further

demonstrate the ongoing massive and hopefully irreversible change towards integrated and solution-based research in the UK.

The Covid pandemic

The Covid pandemic has paralysed the world and put most SDG activities to slow progress or even to a halt. The consequences of this standstill are disastrous for the most vulnerable countries in many cases reversing the achievements made in the five years these countries adopted the SDGs. For example, the number of people at risk of starvation have doubled to 270 million, compared to figures before the pandemic. An editorial from Nature from January 2021 therefore asks how science can put SDGs back on track and to conclude some concrete recommendations ([Editorial, Nature 2021](#)).

GCRF research in Scotland

GCRF was distributed through a number of 'delivery partners', including UK Research and Innovation (UKRI), the learned societies, such as the Royal Academy of Engineering, and university funders, such as the Scottish Funding Council (SFC). In the five years since 2016, SFC has distributed nearly £42M in GCRF support (sfc.ac.uk) to Scotland's 18 Higher Education Institutions. This national funding from SFC is part of the GCRF funding secured from the central UK program.

Scotland's performance in SDG science has been excellent. During the first three years more than 800 projects were funded out of Scottish universities in 80 developing countries. Human health and well-being have remained the most significant research themes from the start of the programme, reflecting the countries' well-established heritage of tropical medicine research. However there has also been a steady growth in projects addressing displacement and conflict, clean energy, and communities.

It is important to note that the size of funding does not necessarily translates proportionally into positive impact on the ground in the countries of the global south. In LMICs, the impact of relatively small amounts of funding has been significant and sometimes a game changer. Scottish universities are aware of this situation, and therefore most projects supported through SFC-GCRF were for less than £30,000 and commonly only lasting for a year or less, but the impact on communities and conceptual new ideas has been far-reaching, as is illustrated in the final section, based on project examples from HWU.

GCRF research at HWU

In Heriot-Watt University, GCRF funding was used to preferentially support researchers at the start of their careers to build up international networks and to run small research programmes on topics that they cared deeply about. Out of the 48 projects funded by SFC-GCRF at HWU ([HWU-GCRF](#)) half were for 'seed' awards (<£20,000), but they 'jump-started' new and highly productive relationships with international partners (Figure x).



Figure x: GCRF project team from Malaysia and Indonesia inspecting aquaculture farm in mangrove forests of Matang in Malaysia.

The GCRF ‘seed’ and alike ODA research projects have also been a strong catalyst for professional development for academic staff (see Pereira, this volume). The SDG priority areas of the 48 SFC and 18 directly supported projects at HWU up to summer 2021 show a broad spectrum addressing all SDGs (Figure x), with preferences for SDG 3 Good Health and Wellbeing and SDG 4 Equality and Education, followed by SDG 11 Sustainable Cities and Communities, SDG 1 No Poverty and SDG 5 Gender Equality.

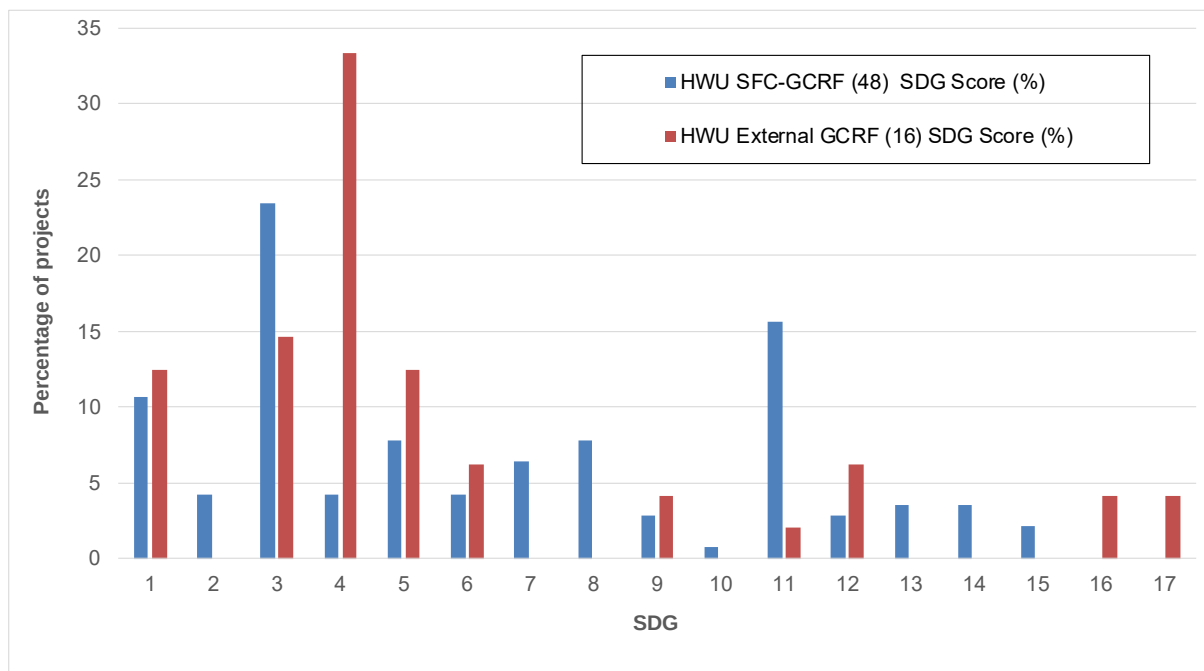


Figure x: Assignment of UN SDGs to all GCRF funded project sat HWU. Projects are split between SFC-GCRF projects (48) and GCRF directed projects (18), presented as percentage of both funding sources. Primary and secondary SDG assignments were used for each project, double-weighting the primary SDG compared to the secondary SDG to highlight the core focus of the respective project. Further SDGs, addressed by the projects, are not included in this analysis.

One project uses a novel multi-disciplinary, multi-dimensional approach to socio-ecological system modelling. Focusing on the Colombian Amazon region the team used big data analysis together with economic techniques to merge existing environmental, socioeconomic, and agroforestry monitoring datasets from the Amazonian Scientific Research Institute – SINCHI into a new and integrated dataset to facilitate policy evaluation of land use alternatives (Figure x). Marco Ehrlich, Deputy Director for Science and Technology, SINCHI concluded that this project was a unique opportunity to generate innovative solutions and creative models capable of addressing the many problems and challenges confronting the largest and most biodiverse forest on Earth'. The new socioeconomic model has direct applications to other forest regions, including the coastal Choco region in Colombia. For the full story see [Socio-economic forest model, Colombia](#).



Figure x: HWU Colombia GCRF team welcomes SINCHI research visitor (right) in the Lyell Centre.

In another example, one early career researcher with expertise in the use of games for communication, applied her skills to communicating Covid-19 transmission risks with indigenous communities in Colombia. Working with Colombian partners they have helped the community to understand how the pandemic is affecting their lives and to take protective action. Although this was not a large-scale grant, the communities reached out in gratitude for the commitment to support them through these difficult times. For the full story see [Gamification in Colombia](#)



Figure x: Indigenous women from the Choco region in Colombia studying sample under scientific microscope.

The impacts of research often take time to be realised, but occasionally timing is perfect. A Heriot-Watt geologist investigated potential tsunami risks from sub-sea landslides in the Makassar Strait off Indonesia in 2019. As his results were emerging, the Government of Indonesia announced plans to shift their capital from Jakarta to Kalimantan, an area indicated to be potentially susceptible to inundation, should such a landslip occur. He and his partners in Indonesia Figure x), are now working with the government geological services to better understand the risks and make suitable accommodation for this in the planning of the new city. Full story see [Tsunami risk Indonesia](#).



Figure x: *Project introduction and concept meeting at our GCRF partner hosts in Indonesia.*

Maintaining these impactful research collaborations through a pandemic has been a major challenge that no-one was well prepared for. Nevertheless, adapting plans, working online across time zones, and responding to constantly changing travel conditions, these partnerships have been strengthened through adversity. Professional friendships are deepened as teams have become more understanding of what is and is not possible. While we know more about the scope for collaborating remotely, we have also come to value the benefits of direct human contact and realise our responsibility to drive these close partnerships further.



Figure x: Online project meeting with colleagues from HWU-Malaysia and GCRF project partners in Indonesia.

Summary and outlook

This is an exciting time for a new breed of sustainability scientists which take a holistic view at global challenges and use research and innovation to develop and deliver solutions on the ground, shared with and to the benefit of local communities. The UN SDGs provide a broad and highly relevant framework, giving science a new place in society and more direct responsibility to actively lead the agenda. The pandemic has demonstrated the central importance of up-to-date scientific facts driving political and our individual decisions. Delivering the SDG builds on the same foundation, just much greater orders of magnitude.

The research community across the UK and internationally has invested talent and energy into building global partnerships, which are essential for the multiple challenges that we face. That commitment will continue beyond the life of the UK GCRF programme and we will see its fruits for many years ahead.

Although the UK government has temporarily reduced its commitment to ODA funded research, in 2021-22, the UK science community very much hopes that the continuing benefits of such support will be recognised again and earlier commitments on ODA will be restored as soon as possible.

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