

Science, Innovation and Technology Committee Call for Evidence: Innovation and global food security

[Call for Evidence - Committees - UK Parliament](#)

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BGS Summary of organisation / expertise

The British Geological Survey (BGS) is a public sector organisation and the UK's principal provider of objective and authoritative geoscientific information and knowledge for wealth creation, sustainable use of natural resources, reducing risk and living with the impacts of environmental change. Our responsibilities include advising the UK government on all aspects of geosciences, as well as providing impartial geological advice to industry, academia and the public. Our knowledge is based on decades of corporate experience in the collection, collation, databasing, statistical evaluation, mapping and interpretation of geological and environmental data.

BGS works globally to help stakeholders make better decisions about geology and the role of geological processes in underpinning the economy, environment and society. We are the UK's premier provider of geological data, information and knowledge to help address major global challenges. Our work helps to support UK foreign and trade policies and demonstrates how the UK is tackling global challenges.

1. How scientific and technological innovations can be combined with low-technology practices to support global food security:

How emerging technologies developed outside agriculture, such as AI, can support this aim.

The role of biotechnology (e.g. genetic engineering and gene editing techniques such as CRISPR) in increasing crop yields and resistance to climate change.

The ethical concerns associated with high-tech solutions in agriculture.

The use of low-tech solutions that can be easily diffused.

From a geoscience perspective, global food security is impacted by 1) soil quality and nutrient content; 2) soil erosion; 3) management of water resources and 4) agricultural practices. Scientific advances in these areas provide the data and information needed to understand how to sustainably manage those natural resources, often through the use of relatively low-technology practices.

Soil quality and nutrient content

Scientific knowledge - *Soil modelling based on near-infrared (NIR) and mid-infrared (MIR) spectroscopic scans allow to determine soil properties and can also be used to help determine fertility requirements, particularly potassium (K) and phosphorus (P).*

Potassium is a key macronutrient to increase disease resistance and water stress tolerance. It is also needed to increase the ability of maize (a staple carbohydrate) to efficiently uptake other nutrients, especially micronutrients essential for human health. Making data on soil quality and nutrient content widely available through tools such as the Micronutrient Action Policy Support (MAPS) [Tool](#), allows users to identify, analyse, model and project specific dietary micronutrient deficiency risks and interventions. Global scan archives can be used along with those newer modelling approaches, which are cheap and have been shown to be effective in Africa through the [African Soil Information Service](#) (AFSIS).

Low-technology practice - Where the data indicate challenges around soil nutrients, there is the potential to make use of low-tech solutions. One example is the *spreading of locally sourced crushed rock on fields*. Those crushed rocks will release nutrients as a fertiliser and can potentially sequester CO₂ through Enhanced Rock Weathering.

Example - The British Geological Survey has collaborated on this topic with partners from Malawi, where maize is the staple carbohydrate, and potassium (K) depleted soils are under pressure from sustained subsistence farming. Farmers are dependent on government-subsidised fertilisers, which 1) are an expensive imported good, 2) with a high embodied carbon footprint and 3) often lacking in K which is expensive on the international market. However, K-rich minerals derived by the crushing of local rocks have been successfully tested as a slow-release K fertiliser in pilot trials. The K-rich minerals could be produced as a by-product of local mining for critical minerals, thereby reducing potential mine waste volume and providing a revenue stream to the mine.

Soil Erosion

Scientific knowledge - *Soil erosion leading to the loss and degradation of the soil resource (e.g. through over grazing) is potentially a major factor in disrupting global food security and is an area that climate change is likely to impact through increasing intensity of precipitation events.*

Innovation - BGS has undertaken the use of remote sensing and high-resolution aerial photography for the Welsh government to identify areas of soil degradation and erosion. This is a relatively straightforward GIS based exercise which could be used for monitoring of soil degradation in any part of the world, if up to date high resolution imagery is available. (Tye, A.M. & Robinson, D.A. (2020). ERAMMP Report-45: Soil Degradation: Erosion & Compaction Phase-1. Report to Welsh Government (Contract C210/2016/2017) (UKCEH 06297/06810), Tye, A., Robinson, D.A. (2019) Environment and Rural Affairs Monitoring & Modelling Programme – ERAMMP Year 1 Report 18: Technologies to Capture Evidence of Soil Erosion. Report to Welsh Government (Contract C210/2016/2017). Centre for Ecology & Hydrology Project NEC06297).

The BGS labs have developed a soil erosion assessment technique using ²³⁹⁺²⁴⁰Pu, based on the same principles as the 30-40 year old technique using ¹³⁷Cs. The ²³⁹⁺²⁴⁰Pu technique has many advantages including a much longer half-life than ¹³⁷Cs (which is reaching the end date of its usefulness), stronger binding to particles and less plant uptake issues (K⁺ and Cs⁺ are similar in terms of behaviour so plants can uptake Cs making the analysis less robust).

Examples - The extraction method was used to assess soil erosion and deposition rates in the Gulf of Winham, Kenya. Additional work has been undertaken in this area using the 'Revised Universal Soil Loss Equation' in the Gulf of Winham to estimate potential susceptibility to soil

erosion on a spatial scale. Degradation of soils in Kenya through overgrazing is being examined in a joint BGS-University of Lancaster PhD. The use of plant species, particularly legumes, selected to help improve degraded soils through improvements in soil structure is a potentially cheap route to improve soil condition (Isaboke, J. *et al.* Plutonium isotopes can be used to model soil erosion in Kenya. *Environ Geochem Health* **46**, 338 (2024). <https://doi.org/10.1007/s10653-024-02084-2>. Humphrey, O.S., Osano, O., Aura, C.M., Marriott, A.L., Dowell, S.M., Blake, W.H., Watts, M.J. 2022. Evaluating spatio-temporal soil erosion dynamics in the Winam Gulf catchment, Kenya for enhanced decision making in the land-lake interface, *Science of The Total Environment*, 815, 51975.)

Management of water resources

Scientific knowledge - *Scientific advances on mapping aquifers, monitoring groundwater levels and quality, and modelling and forecasting groundwater recharge have great benefits for planning and implementing sustainable irrigation schemes.*

Innovations on developing and managing sustainable water supplies are fundamentally linked to global food production: irrigation is one of the major pathways to intensify agriculture on existing croplands, with irrigated areas accounting for 24% of croplands but 40% of global food production. Groundwater stored in subsurface aquifers accounts for nearly half of all irrigation water; aquifers are nature's reservoirs, storing several orders of magnitude more water than surface reservoirs, and therefore often simpler and cheaper to access.

Low-technology practice - Technological advances such as the use of solar pumps show benefits for helping to decarbonise pumping, and drip irrigation and managed aquifer recharge show promise for reducing demands on aquifers.

In practice - New understanding of African geology is helping local hydrogeologists predict which areas have the most potential for solar pumps and new, easy-to-use technology is being developed to help better assess the quality of groundwater, unleashing the ability to address both water and food insecurity without the need for fossil fuels.

Conservation Agriculture

Scientific knowledge – *Conservation Agriculture (as system that aims to prevent the loss of arable land while regenerating degraded soils) influences soil physical properties and the broader water cycle and can have considerable impacts on food security by improving climate and yield resilience.*

Low-technology practice - Research has evidence that low-tech conservation agriculture practices, such as reduced tillage and residue retention, improve water capture and drought resilience while also stabilising maize yields by enhancing crop water-use efficiency through simple measures smallholders can implement with basic tools and residue management.

Example - BGS has collaborated with the University of Nottingham, and partners in Malawi, Zambia, and Zimbabwe on the [CEPHaS project \(Capacity for Conservation Agriculture Research\)](#) to enhance knowledge of conservation agriculture and strengthen local research capacity. Trials in Zimbabwe and Zambia found ~45–49% higher infiltration rates under conservation agriculture with residue retention compared to conventional ploughing. In

addition, reduced tillage and mulching was found to help stabilise maize yields by improving crop water-use efficiency. Field work tracking soil moisture down to 1 m shows that these methods are accessible to smallholders, requiring only hand tools and residue management rather than expensive technologies.

2.The effects of these innovations on the global agricultural system:

Their effects on farmers and other agricultural workers, and on availability of land and other resources.

Whether technological dependence in agriculture could create new vulnerabilities.

Soil quality and nutrient content

When soil properties have been assessed and low-cost technologies such as using crushed rocks as a fertiliser are used, there is a potential to create some vulnerabilities such as:

- introduction of contaminants or
- overly high contents of the fertilising elements.

However, through effective management and dissemination of relevant data and information about these natural resources, we can develop appropriate regulation, guidelines and monitoring to help successfully manage the situation.

Management of water resources

Increased reliance on irrigation creates critical dependencies on the continued availability of good quality water. There is a potential risk of overuse and the possibility of overexploiting and depleting groundwater resources. There are examples in parts of the world, notably Northern India, Pakistan, parts of the US and China, where groundwater levels have fallen and reduced the water availability to some users (often the poorest and more marginalised) and other examples where increased irrigation has led to salinisation of the soil and water.

When it comes to solar powered pumping, a limiting factor is the underlying geology, not the availability of sunshine: about 30% of Africa's rural population for example live on ancient rocks that may not be able to support the higher pumping rates demanded by large solar pumps.

Increased reliance on irrigation must therefore be accompanied by good water management, including monitoring of water availability and quality, as well as adoption of agricultural practices that increase water retention and drought resilience of soils (e.g. conservation agriculture).

3. The UK's role in achieving global food security:

How the UK can contribute to advancing agricultural innovation and promoting global food security, including through policy, partnerships, trade, and overseas development assistance.

How UK universities and research institutions can contribute to global solutions.

The implications of global food production on the UK, including around climate, health, migration, and security.

With its international influence, scientific expertise and development programmes, the UK is well-positioned to meaningfully contribute to achieving global food security, one of the defining challenges of the 21st century exacerbated by population growth, climate change, and geopolitical instabilities.

International leadership and impact of large scale research programmes

The UK can develop innovative agri-tech and climate-smart farming through domestic strategies and international leadership at forums such as the G7 and COP. By providing funding to collaborate with the FAO, World Food Programme, and CGIAR (Consultative Group on International Agricultural Research), private sector and NGO partners, the UK could develop multi-scale, multi-phased research from micro- to macro-scale with significant impact on global food security. Supporting collaborative projects tackling food security challenges such as conservation agriculture, water scarcity, and nutrition security across the globe is a key role for the UK in achieving global food security. Through the FCDO, the UK supports programmes like the Global Agriculture and Food Security Program (GAFSP), invests in climate-resilient farming, and integrates food security into wider goals such as gender equality and health.

Harnessing the power of UK-funded research

UK universities and research institutes are central to advancing global food security as global leaders in water science, crop science, soil health, and plant breeding, nutrition and health. A key aspect to ensure sustainability in agriculture practices is through the development and dissemination of good practice and increased focus on capacity strengthening, an area that the British Geological Survey is highly involved in. By partnering with universities and NGOs in low- and middle-income countries to co-develop climate-smart agriculture, improve crop diversity, and strengthen local food systems, UK institutions are at the forefront of tackling global food security through innovative science, policy, and international collaboration. Peer-to-peer partnerships between UK public sector institutions and in developing countries support capacity development in individual partner countries.

Example – water and soil science. UK researchers are seen as a global leaders in water and soil science, with several research centres and universities leading international research on water, climate, and aquifers. UK research programmes led by FCDO and UKRI have helped position UK science at the forefront of global water research (e.g. UPGRO, REACH, CEPHaS) and built partnerships across the world with other researchers and practitioners. The strength and reputation of UK water science has given the UK unparalleled access to key institutions, including universities, government, UN agencies and donors. The UK can capitalise on these strong relationships to help influence climate and water smart agriculture to increase sustainable food production. Continued investment in the UK water research capability and in particular long-term programmes will help achieve these goals.

Implications for global food production on the UK

Global food production trends have direct consequences for the UK. Specifically, the COVID-19 pandemic and the war in Ukraine have demonstrated the vulnerability of global supply chains, driving up costs of wheat, fertiliser, and energy in the UK and abroad. Climate change impacts abroad – such as drought - can similarly disrupt imports and push up domestic food prices. Additionally, food security abroad is also linked to migration and stability, with potential humanitarian and security risks. Fostering resilient and sustainable global food systems thus enhances the UK's own security, economy, health, and climate goals.