

How citizen science can support businesses to deliver on environmental targets

Introduction

Data has never been so important. With businesses and governments increasing their sustainability and climate ambitions, including setting science-based targets, the need for data is paramount to inform decision making and to monitor progress. In agriculture a range of different organisations and stakeholders need data; from agri-businesses and utility companies, to farmers who are increasingly being asked to demonstrate their contribution to positive environmental outcomes.

Citizen science, the collection of scientific data by non-scientists, provides unprecedented opportunities to collect reliable data¹ at scale. Such data is being collected across the world and can be used to guide local management decisions, inform policy and uncover novel sustainable land-use practices^{2,3}. When co-designed with key stakeholders from the beginning, citizen science can incorporate a variety of needs to enable collaborative long-term planning.

Overview of the Agriculture Bill: payments for public goods

The UK government's 25 Year Environment Plan sets out a broad ambition to protect and enhance the environment, including improvements to agricultural landscapes. To deliver on the Environment Plan, the Agriculture Bill was developed which will replace direct subsidies for farmers with a system of payments for public goods. This recognises the contribution that effective land management can have on a range of environmental and wellbeing benefits such as:

PROTECTION OF THE ENVIRONMENT, INCLUDING IMPROVED AIR AND WATER QUALITY

ADAPTATION AND MITIGATION TO CLIMATE CHANGE

IMPROVED SOIL HEALTH

PUBLIC ACCESS TO THE COUNTRYSIDE

HIGHER ANIMAL WELFARE

CONSERVATION OF PLANT AND ANIMAL GENETIC DIVERSITY

The value of citizen science in agriculture

In the UK, the Agriculture Bill sets a clear tone and direction for a future farming system that balances food production with the protection and enhancement of the environment. This focus at a policy level provides an ideal opportunity for businesses to work upstream in their supply chains supporting farmers to deliver on environmental outcomes. Citizen science provides unique opportunities for farmers and agri-businesses to gain greater insight into the environmental impacts of their agricultural practices and opportunities to improve them. This will enable farmers to access the financial support available under the Agriculture Bill and contributes to the business delivering on their own sustainability ambition/targets.

There is a clear need to adopt a science-based approach when planning and managing agricultural systems for three key reasons:

- 1 THERE IS A NEED TO FILL VITAL KNOWLEDGE GAPS** on the state of natural resources. This ties in with the Agriculture Bill where some public goods are not well understood yet are fundamental to building a resilient agricultural system. For example, we are facing a global soil crisis and, in the UK, it is reported that some of the most fertile fields may be unproductive within a generation⁴. Despite the importance of soils for production, carbon storage and wider environmental benefits, huge knowledge gaps remain, and only 0.41% of UK funding into environmental monitoring is being invested in UK soils⁵.
- 2 BUSINESSES NEED TO BETTER UNDERSTAND THE RISKS AND OPPORTUNITIES** associated with natural capital management across their supply chains. This is essential if they are to take informed and impactful decisions that build resilience and maintain healthy food production systems.
- 3 FARMERS WILL NEED TO PROVIDE METRICS** to evidence the health of their land and the interventions that preserve its services if they are to access the support provided by the Agriculture Bill.

Citizen science approaches have never been so relevant for businesses and farmers to begin building and developing baseline data on their farm and land management practices. Not only will this prepare farmers to respond to this new policy when it is approved by parliament, but it will also enable them to make more informed decisions in the present. In addition, citizen science has a key role to play in supporting businesses and farmers to work collaboratively to implement new ways of working to achieve their environmental targets. Key benefits and opportunities include:

THE COLLECTION OF RELIABLE, HIGH-QUALITY SCIENTIFIC DATA at scale to improve understanding of the health of natural capital from a local farm level up to larger landscapes, national and international scales.

VALUABLE INSIGHTS TO IDENTIFY TRENDS AND CONNECTIONS across farms and land uses to drive collaborative ways of working. The data collected and subsequent analysis enables stakeholders to work collaboratively and adopt new ways of working which support the health of natural resources across land boundaries.

COLLABORATION is further enabled through the participatory nature of citizen science where stakeholders are engaged and included in the research. This ensures that a range of issues are considered and addressed and that the insights gained support collaborative long-term planning across landscapes and supply chains.

INSIGHT FOR FARMERS on the current health of their land and the environmental impacts of their day-to-day management decisions. Farmers can use this insight, alongside their unique knowledge of the local landscape and farming system, to modify their operations and improve the sustainability of their practices to support natural resources. This data would also enable farmers to evidence the impact of their interventions to inform best practice which can contribute to further policy development.

Citizen science in action

Evenlode Catchment, Oxfordshire, UK

Earthwatch is supporting two research projects led by citizen scientists within the Evenlode catchment. They aim to provide insight into the impacts of agricultural runoff and water pollution on the quality of local river water, and potential methods to reduce these inputs. In the first project citizen scientists map sources of water pollution and abundance of aquatic macroinvertebrates across the catchment area, including pollution from agricultural runoff and sewage treatment works.

In the second project farmers at five sites in the catchment area take part in a novel field trial. This is to understand whether installing waste wood products (coppice bundles) on vulnerable agricultural soils can reduce soil loss through erosion and reduce nutrient run off into water courses. The measurements being recorded include: the build-up of soil upslope of the bundles and testing the concentration of nitrates and phosphates in this soil, as well as testing nitrate and phosphate levels upstream and downstream of the site (for farms which are adjacent to the river). These results are being analysed and compared with control areas next to the experimental site to test effectiveness.

Through sampling the data themselves, the citizen scientists are engaged with and understand the connections between local resources and land uses. They have developed a collective understanding that this project needs to involve key stakeholders and respond to changes and inputs from across the catchment area. So far, this project has led to collaborations between the utility company Thames Water, farmers, and public bodies such as the Environment Agency who are working together to improve water quality.

Ciliwung River, Indonesia

In Indonesia the Ciliwung River flows 199km from the volcanic ranges of West Java through the Indonesian capital Jakarta and out into the Jakarta Bay. As part of Earthwatch's [FreshWater Watch](#) programme, citizen scientists collected data along the river using simple testing kits. Their measurements showed that nitrate and phosphate concentrations in the river were caused by agricultural practices and rainwater intensity. This led to the implementation of water improvement projects along the Ciliwung River course including working with farmers upstream. Farmers started modifying their use of fertilisers for their agricultural needs to reduce nutrient run off into the river. Improvements are being recorded in Jakarta, where thousands of people live in stilted houses above the river and rely on its water for daily use.

The business case for citizen science

As more agri-businesses commit to science-based targets across their supply chains and explore new opportunities to improve the sustainability of their operations, access to data is vital. Citizen science enables businesses to engage with key stakeholders across their supply chains, benefit from invaluable local knowledge and collect data quickly and at scale. It provides the foundation to create informed and collaborative partnerships to test and develop new ideas to drive sustainable agricultural practices forward.

As experts in citizen science, Earthwatch supports businesses to design and implement citizen science research programmes that work towards corporate sustainability goals and science-based targets. We have established practices to monitor water quality, carbon sequestration, pollinators and soil biodiversity and are expanding our work in soil health. We have extensive experience in creating and co-designing projects led by citizen science including:

APPLIED RESEARCH aimed at understanding the impact of certain systems or agricultural practices on the environment and how such impacts can be reduced or even modified for environmental gains.

REGIONAL PARTNERSHIPS that bring stakeholders together across landscapes, generate collective monitoring of environmental quality and enable collaborative planning and long-term impact.

ENGAGEMENT OF STAKEHOLDERS across supply-chains using data obtained through citizen science to support shared learning that enables collaboration and a re-imagining of agricultural practices.

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Appendix

1. "Innovation for Agriculture" connects farmers with farming research, to help make modern farming more sustainable, resilient, and productive. Practical and interactive workshops, farm walks, and on-farm demonstrations to help farmers to put knowledge into practice: <https://www.innovationforagriculture.org.uk/>
2. The accuracy of farmer-generated data in an agricultural citizen science methodology: <https://www.biodiversityinternational.org/e-library/publications/detail/the-accuracy-of-farmer-generated-data-in-an-agricultural-citizen-science-methodology/>
3. The role of citizen science in addressing grand challenges in food and agriculture research: <https://royalsocietypublishing.org/doi/full/10.1098/rspb.2018.1977>
4. Commons Environment Audit Committee, 2016
5. Huge knowledge gap over health of soil: <https://www.bbc.co.uk/news/science-environment-51861539>