Sustainability lies in the soil

An experimental system developed in partnership by vegetable growers Produce World Ltd's **Mr Jonathan Tole** and Cranfield University's Senior Lecturer in Sustainable Soil Management, **Dr Robert Simmons**, is poised to revolutionise the way farmers manage their soils. Together, the researchers are unlocking the potential of soils through the new science of agri-informatics and their innovative, collaborative Soil-for-Life® management system.

In a time of growing human population and increasing impacts of global climate change, food security is of increasing concern. Producers and policymakers agree that there is an urgent need to increase agricultural production in the short term, while maintaining environmental sustainability for the long term. But can these two, often competing factors be achieved in tandem?

Dr Robert Simmons, an expert in sustainable soil management, believes that much of today's inefficiency – and unsustainability – in crop production has its roots in inappropriate soil management. In fact, soil provides the foundation for over ninety percent of all agricultural production worldwide so it is no surprise that degraded soils can result in sub-optimal yields of poor quality crops with higher levels of wastage. The state of the soil not only impacts directly upon crop yields, but also has implications for the timing and effectiveness of agricultural operations, resulting in land not being used to its full capacity. Furthermore, a build-up of diseases in soils may make them unsuitable for growing many crop species – in total, it is estimated that over ten trillion US dollars is lost each year due to declining soil quality.

SUSTAINING THE SOIL

It is becoming more widely accepted that our soil – the basis of food production, a store of water and carbon, a key climate regulator, and home to a uniquely diverse community of organisms – needs a health check. In fact, Jonathan Tole, who was Dr Simmons' key partner at UK vegetable producers Produce World, says: "Enhanced soil management practices will drive growth in farm profits and sustainable improvements to farming that reduce the impact of agriculture on the environment."

However, soil is a complex entity which differs from farm to farm and field to field. To harness the scientific and technical expertise of Cranfield University, and the farming and business knowledge of Produce World, Dr Simmons and Mr Tole built a team of soil and environmental scientists, database designers, agri-business experts, and web developers. Together they developed an innovative, high-tech and user-friendly solution to support farmers and agri-businesses to manage their soil sustainably, despite its complexity. The solution, called Soil-for-life®, aims to reverse soil degradation, improve soil quality, and maintain soil health in the long term, providing users with the information they need to balance environmental sustainability with economic viability.

As one of the largest fresh produce businesses in the UK, Produce World was uniquely placed to provide data across a ▶

wide range of sites and crops, which laid the foundations for Soil-for-life®. Combining this with Cranfield University's expertise in both soil science and database design, Dr Simmons' and Mr Tole's team was able to develop a web-based system for soil information management, which which will be able to be used to identify patterns between physical, chemical, and biological soil health, farm management practices, and crop performance.

EXPANDING THE CONCEPT

In 2015, Soil-for-life®, which began life as a Knowledge Transfer Partnership between Cranfield University and Produce World, won a prestigious Research Councils UK Research Base Impact Award. Since then, the programme has moved up a whole new level with 'Soil-for-life Beta,' – a three-year, half-a-million-pound project, aimed at expanding from Produce World's own fields and farms to support the entire UK agricultural industry through a fully functional and commercially viable, cloud-based soil information management system.

Using robust statistical algorithms, Soil-for-Life® will be able to 'mine' the big data now available from the emerging new field of 'agri-informatics', to predict the most suitable management techniques for any crop growing in any field in any given year. Using a web-based interface, farmers will soon be able to view information about previous agricultural practices at their own site, and sites with similar soil and environmental characteristics.Note only that, it is envisaged that they will also be able to predict best practices for the coming season and optimise crop rotations to make optimal sustainable use of their soil.

The continuing aims of Soil-for-life®, say Dr Simmons and Mr Tole, are multiple, with the overarching goal being to drive improvements in crop production, reducing wastage and increasing efficiency, while at the same time benefitting soil and environmental health. This will be achieved by identifying site- and crop-specific best practices, improving current computer models of crop performance, designing soil management practices to mitigate the impact of climate variability, and optimising inputs of chemical fertilisers and pesticides.

AN EXCITING FUTURE

One of the most exciting features of the Soil-for-life® project is that, the longer it continues, the more information it will generate, and the greater improvements it will make as a result. As businesses and farms join up to the project, they both use *and generate* data relevant to their own fields, contributing to the formation of an agri-dataset which will enable statistically significant relationships between cause and effect to be recognised. In practice, this means real-world recommendations can be made capable of implementing changes in soil and crop management that will actually improve productivity and environmental sustainability. As Dr Simmons says: "As our customer base grows, so will the functionality and predictive power of the platform."





The longer Soil-for-life® continues, the more information is generated and the greater improvements can be made

Q&A

The general view of agriculture might be that increased production and environmental sustainability conflict with one another. Do you really think that they can go hand in hand?

At Soil-for-life® we strongly believe that increased production **must** go hand in hand with environmental sustainability. Optimising the use of whole farm datasets and working with farmers and businesses will provide the fundamental basis for sustainable intensification.

The success of Soil-for-life® depends upon farmers and businesses providing data about their soils, farming practices and yields. What makes you think they will be willing to do this?

Soil-for-life® is a secure platform in which individual farmers' and businesses' data is anonymised. Going forwards we envisage that by demonstrating that Soil-for-life® can drive improvements in soil health, operational efficiencies and profits, we will create a growing community of data providers.

What have been the advantages of a university and a business working together on this?

From a university perspective working in collaboration with Produce World and their participating growers has provided us with a greater understanding of UK horticulture production systems, key soil management challenges and commercial considerations of soil management within a range of crop production systems. Working together means that we have been able to effectively share key knowledge and expertise to really make substantive progress in developing Soil-for-life®.

Additionally, it brings the practical commercial approach of business with the academic rigour of a university.

What do you see as the advantages of running Soil-for-life® as a spin-off business?

Firstly, independence from Produce World to provide assurance to farmers and businesses in the same sector that their data and the insight they gain back is for their benefit and not that of Produce World. It also sharpens the mind: as a small start-up company, we can be agile and responsive to customer needs.

What are your long-term hopes for Soil-for-life® and what are the next steps you will be taking towards them?

Our long term hope for Soil-for-life is that it becomes an invaluable tool for farmers around the globe to support their decision making on the farm. Our short-term hope now is investor funding to accelerate system development. We are in dialogue with a number of farm data platforms and hope to build on these collaborations.

Now established as a spin-out social enterprise, Dr Simmons and Mr Tole see Soil-for-life® as far more than a website. Rather, it is the means to a paradigm shift in global agricultural practices. Together they are building a community motivated to unlock the potential of soils through the new science of agri-informatics. Whilst receiving a toolkit to support their own improvements in soil health, crop yield and sustainability, farmers will in turn provide their own data into the combined data pool which will be analysed in depth by Soil-for-life's algorithms. This will provide robust predictions that underpin agricultural and environmental improvements at the field, farm and business scale and beyond.

Detail

RESEARCH OBJECTIVES

Dr Simmons' research focuses on sustainable soil management. One aspect of his work is looking at ways to improve soil health, minimise wastage and field losses as underpinned by sustainable soil management. He has worked in collaboration with Produce World Ltd over the last six years to develop soil management systems.

FUNDING

- Biotechnology and Biological Sciences Research Council (BBSRC)
- Innovate UK

COLLABORATORS

- Dr Steve Hallett, Dr Ron Corstanje, Dr Joao Barradas, Jason Carvalho (Cranfield University)
- Jonathan Tole, Andrew Burgess (Produce World Ltd)



BIO

Dr Rob Simmons is a senior lecturer in sustainable soil management, specialising in soil erosion processes, the design and implementation of appropriate soil conservation options, and the optimisation of whole farm datasets. His portfolio includes projects funded by Innovate UK, UK Commercial Growers, Levy Boards, WRAP, NE, EA, BBSRC, NERC and DEFRA.

Jonathan Tole is CEO of Soils-for-life, having recently left Produce World to develop the new business. He has a lifetime of exposure to farming and fresh produce industries. He has operated at senior levels across multiple functions and sites.

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