Agri-TechE

Agri-Tech and ELMs

– the Innovation Enablers

INTRODUCTION

Should the agri-tech industry take the lead and develop a set of environmental standards to support the transition to net zero agriculture?

Such standards would create an evidence-base of good practice for retailers and consumers and underpin a movement towards food production with lower environmental impacts.

The challenge of creating an evidence-base was discussed at the Agri-TechE event *Agri-Tech and ELMs – the Innovation Enablers*.

The delegates – drawn from a range of disciplines including farmers, technologists, researchers and advisors – discussed some of the requirements, the technologies that are currently available, the gaps that need to be filled and gave examples of on-farm developments that show environmental land management in action.

Some of the outputs are summarised in this document.

This will become increasingly important with the introduction of the UK government's new 'Environment and Land Management' (ELM) scheme, which will see a see a shift towards incentivising farmers to deliver "public goods" in exchange for public money.

We thank the presenters at this event, who included:

- **Andrew Blenkiron**, Farm Director at Euston Estates
- **Jake Freestone**, Farm Manager at Overbury Enterprise
- **Lizzie Emmett**, Adviser for Upper Wensum Cluster Farm Group
- **Chris Brown**, Head of Sustainability at ASDA
- **Susie Stannard**, Senior Consumer Insight Analyst at AHDB
- **Dr Jacqueline Hannam**, Senior Research Fellow in Pedology at the University of Cranfield
- **Greg Beeton**, Divisional Partner at Brown & Co
- **Jenny Phelps**, Senior Farm Environment Advisor for FWAG South West
- **Dr Alasdair Sykes**, Managing Director for Sustainability at Trinity Agtech
- **Thomas Gent**, UK Country Manager & Head of Certificates at Agreena

The event also included short pitches from:

- Hummingbird Technologies
- Soil Moisture Sense
- Timac Agro
- Howseman Agriculture
- Soilwater
- MycoNourish
- METOS UK
- Natural Aptitude
- University of Reading
- Delta-T Devices

Agri-Tech and ELMs – the Innovation Enablers was kindly hosted and catered by **Rothamsted Research** on Tuesday 22nd March 2022.

COMMENT: **Jake Freestone, Farm Manager of Overbury Enterprises**

We need more resilient soils in order to cope with climate change and to grow crops with less and less artificial inputs.

Over the last 7 years our organic matter has risen by an average of 0.2% a year, which is significant. On our farms we've stopped using insecticides on our combinable crops– our fertiliser is down over a quarter on most crops – our spring barley fertilizer is down 35% - our fungicide use has halved in the last 2 seasons– so we're having a much better time, and we've completely eliminated soil erosion.

But if we were to go back to tillage, we would quickly reverse that. Introducing more air into the soil would oxidise the carbon back into CO_2, the structure of the soil would be lost and we'd go back to having soil erosion.

There are lots of different ways to measure soil carbon, most of which are quite expensive, and require taking a large soil core and sending it to a lab. The requirements are onerous, in terms of how many samples are needed over time, and from different parts of each field. And the variability and inaccuracy of the actual analysis is worrying.

What I'm excited about is the potential to use satellite imagery for remote sensing of carbon in the soil, backed up by ground truth testing.

We're in discussion with a company doing this – and they're managing to achieve somewhere close to 90% accurate carbon-content readings from their satellite imagery, compared to soil core measurements – and that will be great. And the benefit is you can make a carbon map of the farm – not just looking at one 20mm-wide core but scanning the whole farm to understand the soil health down to the field level and more.

If ELMs encourages more farmers to transition into minimum till farming that would be a great outcome. But for ourselves, while there is always room for improvement, the low hanging fruit has already been picked. I certainly feel that we need to be rewarded for continuing to do what we are doing, once the basic payments system has been removed.

COMMENT: **Lizzie Emmett, Adviser for Upper Wensum Cluster Farm Group**

Measuring water quality should be a priority for ELMs as it provides an objective and rapid metric for environmental health.

Tests by the Wensum Farmers have shown that our run-off is infinitely smaller than is assumed by the government using its existing models. The results have also demonstrated how use of cultivation techniques such as cover crops can reduce this loss still further, saving the farmer money on inputs. This is a clear indication of the benefits to the farmer of best practice; the change is measurable and the benefits to the environment clear.

This data is really ground-breaking. It provides a tool in the toolbox to inform policy but also to demonstrate to the farmer the value of a given practice.

However, it also shows that farmers are just one piece of the jigsaw. The measures show that the majority of the effluent is coming from the sewage treatment works – so improvements by farmers alone are not going to improve water quality.

In addition to rivers, there are 20,000 ponds in Norfolk, and the biodiversity levels are monitored before and after restoration. Plant diversity can increase four-fold after pond restoration.

Sometimes it's as simple as having some fruit-bearing hedges and wildlife strips to provide food and shelter. We have seen farms where a flock of linnets have turned up for the first time in 20 years.

Every farmer in the group has winter and summer bird data, and I can use the data to suggest habitat improvements. To start a discussion, I might ask something like 'have you seen linnets on your farm recently?' or 'do you want to know how your yellowhammer numbers compare with others in the group?'. This often means they are keen to take action, and measures such as reducing hedge cutting and planting food sources can increase bird populations and create little villages of birds. The following year, if I take a farmer out with some binoculars, they can see the results for themselves.

This is something tangible – you can see the difference – and it motivates the farmer to do more. But if this involves a commitment of time and resources there also needs to be a proportional financial reward as well from the government, to show that improving habitats is also valued by the wider community.

BIODIVERSITY AND POLLINATORS

The challenge: ***How can non-specialists accurately identify plant and insect species and report the outcomes in a meaningful way?***

Current technologies

- eDNA sampling for rivers and air, which provides an estimate of diversity based on the genomes present.
- Rothamsted Insect Survey (insectsurvey.com) provides a resource for measuring trends and benchmarking.
- The Defra MAGIC website (magic.defra.gov.uk) provides authoritative geographic information about the natural environment from across government.
- Automated monitoring of insects using sound e.g. with AgriSound.

Opportunity gap

- Frameworks and guidance for biodiversity reporting, particularly ways to capture the multiple interactions between species.
- Better funding for biodiversity reporting.
- More assessment of the benefit of targeted insecticides e.g. RNAi biopesticides or PheroSyn.

Example of on-farm innovation

- IPM (Integrated Pest Management) approaches use multiple ways to reduce pest load while minimising environmental impacts.

WATER

The challenge: ***How can the source of water pollution be identified and a whole watershed approach be adopted to improve water quality?***

Current technologies

- Open source models are available for measuring water quality, including SWAT (Soil & Water Assessment Tool, a well-established academic model; swat.tamu.edu) and WaSIM (Water Flow and Balance Simulation Model; wasim.ch).
- Water pollution analytical kits, as used by Wensum Farmers.
- DOC (dissolved carbon) measurement which gives an indication of nutrients leached from soil.

Opportunity gap

- Automated monitoring, which requires better infrastructure including network connection.
- Help with developing 'joined-up' testing at a catchment scale, at the correct sites, which could trace pollutants back to the source.

Examples of on-farm innovation

- Smart irrigation delivers water when needed by the crop e.g. drip tape from Drip UK and Howseman Agriculture is being piloted on Norfolk farms.
- Wensum Farmers have pioneered an approach that uses cover crops and water monitoring to manage water pollution.

CROPS

The challenge: ***How can we make crops less reliant on inorganic inputs?***

Current technologies

- Yield mapping using aerial and satellite imagery, which has the potential to inform variable rate application of seed and fertiliser.
- Use of mixed variety plantings, e.g. mixed cropping to avoid monoculture.
- Precision farming and satellite data, which enables targeting of inputs
- Advanced plant breeding technologies, which have potential to increase plant resilience.

Opportunity gap

- New pesticide 'modes of action', including biopesticides, with appropriate IPM support.
- Support with mixed cropping, companion cropping and cover cropping.
- Automated mechanical pest management, including detection using 'e-noses' and robotics for per-plant treatments.
- Better understanding of how bio-stimulants work and their efficacy.

Example of on-farm innovation

- Greater use of legumes in rotation is creating a natural source of bioavailable nitrogen.
- Improvements in breeding of sugar beet has created a longer growing season, boosting productivity without the use of inorganic chemicals.

MACHINERY

The challenge: ***How can machinery become more fuel-efficient, lessen soil damage and require less labour?***

Current technologies

- GPS tracking and precision spraying.
- Knowledge of soil compaction models, and how to mitigate it.
- Use of machine vision and laser technology, which provides automated weeding.

Opportunity gap

- To solve interoperability – the ISOBUS challenge (ISOBUS asks that all machinery use the same standardised communications and connectors).
- Machinery suitable for radical approaches, e.g. no-till or agroforestry.
- Alternative fuels, e.g. biogas, hydrogen and methane.
- Autonomous vehicles and robotics.

Example of on-farm innovation

- Minimum-till agriculture reduces the use of ploughing and soil disturbance.
- Controlled Traffic Farming reduces soil compaction.

WOODLAND

The challenge: ***How can we increase woodland in the landscape and measure its value for carbon capture whilst still maintaining productivity?***

Current technologies

- Woodland carbon code, which enables projects to make a soil carbon assessment prior to tree planting with repeat assessments as the project progresses (woodlandcarboncode.org.uk).
- UAVs (drones), which enable woodland health monitoring.

Opportunity gap

- Remote, automatic disease and pest detection.
- Woodland rewilding standards.
- Better understanding of carbon sequestration.

Example of on-farm innovation

- Agroforestry is showing benefits, e.g. underplanting of fruit trees and planting trees as windbreaks in cereals.

LIVESTOCK

The challenge: ***How can we increase the efficiency of livestock production so higher quality meat is produced with lower environmental impacts?***

Current technologies

- 'Virtual fencing', which allows easy grazing management without physical fences.
- Feed supplements that can reduce methane production.
- EID tagging and livestock sensors; electronic ear tags have been in use for decades, but smart use is required.

Opportunity gap

- Availability of emissions scores based on rearing conditions, feed type, breed, genetics and individual animal.
- Alternative, low-emission feeds and methane-reduction feed additives.
- Optimisation of anaerobic digestion.
- Implementation of tech for breeding lower emissions / improved performance, including gene editing.

Example of on-farm innovation

- Precision livestock platforms, such as Breedr, are increasing efficiency of the value chain.
- Integrated systems benefit livestock, soils and provide weed control, such as at Overbury Enterprises, where sheep graze on cover crops over winter.

AIR

The challenge: ***How can we reduce greenhouse gas emissions, improve air quality and monitor the improvements?***

Current technologies

- Carbon footprint decision tools, which provide estimates of greenhouse gas emissions based on farm practices.
- Satellite-based Earth observation, artificial intelligence and environmental modelling tools, which are being used to monitor field-level management practices and quantify the outcomes they deliver, e.g. Hummingbird Technologies.

Opportunity gap

- Methods to trap greenhouse gases and extract the nutrients.
- Better management of slurry.
- Affordable and portable greenhouse gas emission measuring devices.

Example of on-farm innovation

- New platforms, such as Trinity AgTech, are emerging that allow farmers to measure, optimise and report all aspects of natural capital across their farming enterprises, including carbon, biodiversity and water protection.
- Agreena uses farm practices as a proxy to measure carbon capture and provides a platform for carbon trading.

SOIL

The challenge: ***How do we adopt an approach that puts soil health first and measure quality improvements?***

Current technologies

- RothC model (rothamsted.ac.uk/rothamsted-carbon-model-rothc), which measures carbon turnover resulting from changes in topsoil.
- Soil enhancements like Rescaype, which increase nutritional retention in the soil.
- Soil moisture sensors, as water retention increases with soil health e.g. Soil Moisture Sense.
- AHDB Nutrient Management Guide (RB209) (ahdb.org.uk/nutrient-management-guide-rb209), which offers best practice guidance on the application of mineral fertilisers, manures and slurries to crops

Opportunity gap

- More detailed and ground-truthed soil maps.
- Better understanding of soil science and microbial interactions.
- Commercial soil biology to enable assessment at scale.
- More consistent methods for measuring and monitoring soil carbon.

Example of on-farm innovation

- Strip-till cultivation – tilling is restricted to narrow 25cm-wide strips that will be planted with the seed row.
- Beneficial mycorrhizal fungi, such as provided by MycoNourish, offer alternative seed treatments.

COMMENT: **Matthew Guinness, VP of Sustainability at Hummingbird Technologies**

We use a range of technologies including satellite-based Earth observation, artificial intelligence and environmental modelling tools to monitor field-level management practices and quantify the outcomes they deliver. Whether through carbon credit programmes, other ecosystem service markets or agri-food supply chain initiatives, these monitoring and verification tools enable systems that reward farmers for practices that improve outcomes for biodiversity, water and climate change.

COMMENT: **Tim Blythe, Director of Soil Moisture Sense**

Cover crops and application of manure can both help increase the amount of organic matter in the soil, so continuous moisture monitoring over multiple seasons can show changes in water holding capacity and water infiltration.

Understanding what is happening below the surface is critical to smart water management. We have developed a sophisticated monitoring system that can provide a detailed view of water infiltration, drainage and soil temperatures, as well as root development.

Soil monitoring combined with weather sensors would provide a more complete picture of what is happening in the growing environment.