**Soil Health Metrics for Environmental Land Management Schemes (ELMS) Discussion Workshop Report**

**Objectives**

By the end of the workshop we will have:

1. Had the opportunity to hear about the experience gained to date from soil monitoring on the Wimpole Estate (the National Trust’s largest in hand lowland farm);
2. Developed a consensus as to the most practical and reliable on farm measurements for soil health;
3. Recommended a soil sample methodology for Defra to include in the new Environmental Land Management Scheme (ELMS) development.

For a list of attendees please see Appendix 1.

**Day 1 – Monday 20 May 2019 14:30 – 17:30**

Home Farm, Wimpole Estate, Arrington, Royston, Cambridgeshire, SG8 0BW

The afternoon provided an opportunity for the group to hear about the work being carried out at Home Farm on the National Trust Wimpole Estate to improve soil health across the farm.

The group were introduced to the Veristech soil monitoring equipment [https://www.veristech.com](https://www.veristech.com), saw how the Sectormentor app [https://soils.sectormentor.com/](https://soils.sectormentor.com/) could be used to carry out soil health tests and discussed a range of issues relating to soil health on arable and upland farms.
Rob Macklin began the day by reminding the group of the desire to draw out consensus around what farmers could measure on farm in order to develop a greater understanding of their soil health. This information would then inform which actions they should take to maintain or improve their soil health. It was important that discussions remained grounded in the reality of on farm tests which were meaningful and manageable.

**Reflecting on day 1**

The workshop began with participants each sharing something they enjoyed, and something they learnt from the Home Farm tour the previous afternoon. The content generated was as follows:

**Something I enjoyed…**

<table>
<thead>
<tr>
<th>Discussions in field and at dinner.</th>
<th>The discussions in the field.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group discussion with practitioners, seeing the Veris system. Mix of perspectives.</td>
<td>Looking at Hanslope soils.</td>
</tr>
<tr>
<td>Being in the field talking soils and listening to skylarks.</td>
<td>The challenging discussion about the fact that we aren’t at the end of our journey.</td>
</tr>
<tr>
<td>Engaging with farmers. Thinking through solutions to problems.</td>
<td>Meeting a wide range of soil health experts.</td>
</tr>
<tr>
<td>Discussion and debate over improving condition of soils.</td>
<td>Learning the secrets of a new land/farm/people interaction.</td>
</tr>
<tr>
<td>Discussing soils with a diverse group.</td>
<td>Exchanging ideas.</td>
</tr>
<tr>
<td>The discussions initiated by the soil pits – in particular the difficulty of changing soil condition in the context of production requirements i.e. the constraints both ways.</td>
<td>Hearing about many different techniques Callum is trialling to reduce weeds and build soil health on farm and hearing the history of the soils at Wimpole.</td>
</tr>
<tr>
<td>Getting out in the field with stimulating colleagues, seeing old friends and making new ones.</td>
<td>Meeting the many scientists who were carrying out many different experiments in order to further understand exactly how soils work.</td>
</tr>
<tr>
<td>Enjoyed = everyone arriving as planned.</td>
<td>Hearing about the problems associated with organic farming from Callum.</td>
</tr>
</tbody>
</table>
Something I learnt...

<table>
<thead>
<tr>
<th>Improving soil health/quality doesn’t happen rapidly.</th>
<th>Soils are red for many different reasons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil structure improving but still poorer – unexpected!</td>
<td>The longevity of charlock seeds.</td>
</tr>
<tr>
<td>The success of participatory approaches in the Yorkshire Dales.</td>
<td>I learnt about charlock.</td>
</tr>
<tr>
<td>Veris capable of pH recording.</td>
<td>Real on farm problems. Difference of opinions.</td>
</tr>
<tr>
<td>Bad soil management can take a long time to recover.</td>
<td>AHDB have produced some important soil work.</td>
</tr>
<tr>
<td>Time needed to turn soils into healthier ecosystems and challenges faced by organic arable farmers.</td>
<td>Interesting new technology applications as part of supporting information to help farmers think. Agrovista.</td>
</tr>
<tr>
<td>The Slake Test. Where (apart from heavy clays) you can gain an understanding of aggregate stability which is related to microbial activity (or lack of it).</td>
<td>Wimpole soils still need work to improve even after 10 years. To find a balance between academic and practical farming activity.</td>
</tr>
<tr>
<td>Soil monitoring using Veristech is more calibrated with tests than I had appreciated.</td>
<td>It can’t just be about soil it must be about how that links to productivity, margin, biodiversity, water etc.</td>
</tr>
</tbody>
</table>

On farm soil assessments – the options

The following tests were agreed by the whole group as being key to measuring soil health (in mineral soils):

- Soil organic matter (SOM);
- Soil structure (VESS);
- pH;
- Routine nutrient availability (P, K, Mg & trace elements);
- Earthworms (total counts and/or by functional group);
- Drainage (duration at field capacity);
- Penetration resistance (compaction).

It was noted that there is a difference between unstructured metrics that are suitable at the farm scale to help farmers better understand their soil health, and metrics that are suitable for national surveys and need to be conducted with scientific rigour.

The how – thinking about the methodology

Working in four small groups each was given a different perspective to adopt when considering points around the methodology and process of testing for soil health. The following contributions were written down by the groups, then shared in a plenary discussion.
Group A – perspective: Dartmoor Farmer

- Key that soil survey methodology is low-cost, simple and relatively quick and appropriate to land / soil type.
- Need to quantify ‘good’ soil health indicators for specific land and soil types to enable realistic benchmarking comparisons.
- Need standardised information/protocols.
- Soil health should be assessed in spring/autumn [at optimum moisture for monitoring compaction and earthworms].
- Visual Evaluation of Soil Structure (VESS) is simple and should be universally applied.
- Surface compaction recording should be included e.g. Penetration resistance.
- Identify high-risk locations e.g. gateways, field feed troughs.
- Ensure standardised soil sampling for pH and nutrients plus Soil Organic Matter.
- Assess and record vegetation type and % soil cover - linked to soil erosion / exposure risk / soil health.
- Provide advice for result interpretation to inform behaviour and management, business resilience and long-term planning.
- Farmer cooperation – make soil health measurements a ‘facilitated’ group activity, like Countryside Stewardship facilitation funds.
- Note: Effective broadband connectivity should not be a barrier for accessing / collecting information in field.

Group B – perspective: Dartmoor ELMS Group

- Important to establish a starting point e.g. via a mapping exercise
- Farm surveys should identify:
  - vegetation cover and type
  - sites at risk of compaction / erosion e.g. gullies, supplementary feed sites
  - water table / drainage / earthworks
  - sampling locations – [GPS located]
- General soil surface visual assessment to include signs of erosion etc.
- Need a scorecard for each environment for measuring soil health for different land/soil types – e.g. uplands, slopes, in bye.
- Use a Peat VESS on peat soils, see Wales and Scotland versions.
- Use standardised lab samples pH, P, K, Mg, SOM.
- Scorecard measurements – could be GPS located and repeated over time with results interpreted with advisor.
- Sampling should ground-truth published information.
- Soil/ELMS management plans could be linked to government [soil and water quality] target areas.
- Advisor input – should be part of ELMs Soil Management Plan to identify key information and management decision/actions.
• Compliance check? Vegetation cover/ bare soil assessment may require aerial imagery – drones?
• Appropriate stocking rates, stock density and timing for soil condition / types.
• Support managed grazing approaches e.g. use of plate-meters, sward gauges.

**Group C – perspective: East of England Farmer**

• Before assessing soil health, check field variation / extent of different soil types to select sample points. Could also use crop yield data integrated with new soil sampling technology e.g. Veristech.
• Sampling needs to be appropriate to land cover / soil type.
• Tests best done in early spring i.e. – not frozen, not completely waterlogged, at field capacity before drying out.
• Selected sampling point locations can host multiple tests.
• Aim to cover whole farm over 5-year period – every field.
• Laboratory soil sampling = longer sampling cycle: 3-5 years.
  o Use the same accredited laboratory to avoid discrepancies.
  o RB209 standard protocol for whole/part field sampling to provide average plus a number of specific sample sites per soil type within field* (GPS recorded).
  o Pool localised sub-samples to reduce variation, e.g. create a sample from n subsamples within x metres of GPS point.
  o Sampling to 20cm Mg + P + K + pH + Soil Organic Matter.
  o Texture – once for each soil type to cross-check judgement – lab tested.
• Physical sampling = shorter sampling cycle, annual
  o GPS recording of n sample sites for each soil type within field (as above*).  
  o Photos of field sampling points aids recording and review.
  o Data recording linked to GPS by phone app is simple.
  o Visual Evaluation of Soil Structure.
  o Check and record soil texture in field
  o Worm sampling methodology – e.g. as per Great Soils / Jackie Stroud.
  o Penetrometer resistance – annual sampling.
  o All tests together in same block of soil.
  o Targeted sampling to address issues.
  o Peat soils, e.g. Fens (organic black lands) require different strategies.
• Be good to give farmer a sampling pack to support/incentivise data collection.
• Key value of farmers seeing data is to understand difference over time.
• Need to develop and use a standardised methodology to include frequency of replication of tests.
Group D – perspective: East of England ELMS Group

- Need a clear method. Farm approach led and soil laboratory analysis.
- Standardised methodology and spec for analysis for all lab-based tests.
- Farmer-led sampling should span best and most difficulty soil locations.
- Clear standard methods for farmers have to be very clear. Packaged into 2 approaches:
  - 1. Farmer led field tests including:
     - VESS
     - Earthworms
     - Aggregate stability (Slaking test)
     - Penetrometry
     - Drainage – indicated by keeping record of Field Capacity throughout year.
     - Frequency at least every other year to monitor change.
  - 2. Soil laboratory analysis
    - pH / Mg / P / K / SOM

- Timing: spring – easier to see issues and plan a response in the cropping year. Descriptive parameters are needed to further define [spring] sampling period, possibly using soil wetness as an indicator of optimum timing.
- Choose a point in crop rotation to replicate the test.
- Frequency: Soil lab analysis: year 0 and year 5 and year 10 (regulatory).
- Data produced could indicate trends to inform and support selection of remedial options / management decisions. Soft data – recognise that on farm soil heath metrics inherently variable and therefore should not be accepted as empirical evidence in isolation.
- Soil health results [principally] to indicate outcome of active soil heath monitoring – to be used to help inform / educate and guide management decisions. Soil health results themselves e.g. % Soil Organic Matter or number of earthworms are not suited to direct linkage to payments.

Potential work flow for ELMS

- Farmer conducts a basic assessment using mapping of farm with respect to potential options in scheme.
- Farmer meets with contract manager and agrees options plan.
- Farmer implements measurements at start of options.
- Farmer implements options.
- Farmer implements measurements at end of assessment period.
Sectormentor demonstration

Abby Rose gave a short demonstration on the functionality of the Sectormentor app - designed to help farmers monitor and assess the soil health on their farm. Methodologies are freely available on the web. The app allows in field recording of optional soil test. Abby shared some of the results from the tests conducted the previous afternoon at Home Farm.

Key messages to Defra

The content raised during the morning discussions were then distilled. Groups moved round each prompt heading sharing their suggested recommendations. These were then shared and refined in the final plenary discussion.

The SSP Group came to a consensus on a universal suite of recommended metrics, tests and methodology that could promote soil health in the context of the new ELMS. The group agreed that the sampling and recording of soil health linked to improved soil management should be rewarded as a public good.

The content generated was as follows:

The Tests

A suite of straightforward metrics should be included in ELMS, these should focus on established tests that can be done by farmers in the field. We recommend the following soil health indicators tests:

**Universal**

- Mineral soil condition/structure (VESS) / Peat condition assessment
- Earthworm counts in early autumn/late spring
- Lab samples pH, P, K, Mg, SOM (loss on ignition), soil texture

**Optional**

- Slaking test – to measure aggregate stability
- Penetration resistance

**Additional supporting information might include:**

- Recording excessive surface wetness from observations – to indicate drainage problems.
- Photographic record of soil surface condition to identify risks of erosion.

**Development required:**

The metrics listed above have well developed sampling procedures and interpretation guides. However, some work to develop, standardise and prescribe these metrics will be needed before they can be used in ELMS. For example, the VESS for mineral soils developed by AHDB Healthy Grassland Soils will need to be extended to cover upland soils and arable. Peat and peaty soils will need a different type of VESS metric [probably based around vegetation cover and type, depth, wetness and degree of oxidation] to indicate if the soils are declining, stable or building.
**Methodology**

We recommend the use of technology such as smart phones and GPS to make soil monitoring simple, replicable and uniform across industries and land types.

This could be easily done by using GPS fixed sampling points to allow comparisons and replicability over time, and external monitoring. The licencing of existing soil monitoring apps, such as Sectormentor, would be a cost-effective way to roll out this sort of technology.

Defra will need to create clear guidance on:

- The number of GPS fixed sampling points required per farm.
- The number of soil samples/ measurements to be taken at each GPS point and frequency of sampling.
- Protocol for bulk sampling of soil for lab analyses around a GPS location.
- Standard sample depth for laboratory soil analyses.
- Approved apps for in field assessments and recording data. Timing – soil in correct condition to sample.

We agree that context measures are essential for interpretation

- Texture – Soil types.
- Soil depth.
- Subsoil characteristics.
- Landscape position / topography.

**Comments:**

- Payments could be based on a combination of soil health measurements and positive land management options.
- We do not recommend that payment rates (for outcomes) should be based solely on the numerical results from soil tests due to inherent variability.
- Soil health results and trends over time should support the land management decisions / options to improve soil health.
- Farmers should lead and direct the monitoring plan (and implement large parts themselves).
- We believe that additional information and support is needed to help interpret tests and recommend practical on-farm options for improvements. E.g. Guidance from expert advisers to assist data interpretation and self-reporting – to inform options to improve field operations.
- We consider that additional engagement in soil health can be derived from facilitated peer-peer benchmarking and discussion.
- Promote cross-industry support for agreed soil monitoring guide information – what tests, why, how.
• A simple coded dashboard (conscious of colour blindness interpretation) scheme to present results helps interpretation and application of the results by farmers.

Misc. points relating to soil health

• Guiding principle: This is all about monitoring for soil to steer on-farm practice to improve soil health and maintain optimum condition.
• Need to determine indicators that support decisions concerning beneficial soil management options.
• Need flexibility in any scheme for location, farm type, soil type etc.
• Soft data e.g. Veris geophysics information can be very helpful as an indicator but less useful for empirical monitoring.
• Soil reporting could Integrate with RPA mapping system (overlaying soil classification).
• Would need soil surveys data for England (and Wales and Northern Ireland) publicly available [at low/no cost] to see which soil to manage by classification.
• Need to roll out and support high level, detailed education around soil to existing and new/incoming advisers.
• Historical (farmer) knowledge of land management helps to inform understanding of soil condition.
• Look at and consider top and subsoil.
• Representative sampling to avoid excessive bias recognising range of conditions due to inherent factors not just averages.
• Measures of Soil Organic Carbon can be estimated from soil colorimetry. James Hutton Institute have developed the SOCit app that can indicate SOM content instantly using smart phones. It is currently only calibrated to Scottish soils so it would be helpful if Defra could support development of the app for England and Wales.

Wrap up

The following points from the ‘Car Park’ were noted.

• Don't forget sub soils!
• There is still (lots of) work to do around agreeing methodology. There are lots of slightly different versions out there which have a large degree of commonality. [There could be merit in developing a British Standard for soil health metrics]
• It would have been good to explore the issue of removing soil organic matter off farms.

The workshop drew to a close with thanks from Rob Macklin and Andy Whitmore for the sustained contributions from the group throughout the two days.

The verbatim notes from the workshop would be circulated along with a summary of the recommendations to send to Defra once comments had been received from those in attendance.
## Appendix 1 – Attendees

<table>
<thead>
<tr>
<th>First name</th>
<th>Surname</th>
<th>Title / Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stephen</td>
<td>Briggs</td>
<td>Soil &amp; Water Manager, Innovation for Agriculture</td>
</tr>
<tr>
<td>Chris</td>
<td>Collins</td>
<td>Coordinator NERC Soil Security Programme, SSA</td>
</tr>
<tr>
<td>Dave</td>
<td>Freeman</td>
<td>Policy Manager, Agricultural Industries Confederation</td>
</tr>
<tr>
<td>Helen</td>
<td>Keep</td>
<td>Senior Farm Conservation Officer, Yorkshire Dales National Park</td>
</tr>
<tr>
<td>Alastair</td>
<td>Leake</td>
<td>Director of Policy, Allerton Project &amp; GWCT</td>
</tr>
<tr>
<td>Rob</td>
<td>Macklin</td>
<td>Head of Soils and Farming, National Trust</td>
</tr>
<tr>
<td>Lauren</td>
<td>McIntyre</td>
<td>Senior Scientific Officer, Environmental Land Management, Defra</td>
</tr>
<tr>
<td>Mark</td>
<td>Pawlett</td>
<td>Senior Research Fellow, Cranfield University</td>
</tr>
<tr>
<td>Jessica</td>
<td>Ponting</td>
<td>Knowledge Transfer Manager, SSP</td>
</tr>
<tr>
<td>David</td>
<td>Robinson</td>
<td>Soils, Land &amp; Ecohydrology, Centre for Ecology &amp; Hydrology</td>
</tr>
<tr>
<td>Felicity</td>
<td>Roos</td>
<td>Soils and Farming Researcher, National Trust</td>
</tr>
<tr>
<td>Abby</td>
<td>Rose</td>
<td>Sectormentor</td>
</tr>
<tr>
<td>Richard</td>
<td>Smith</td>
<td>Technical Specialist, Environment Agency, SSA</td>
</tr>
<tr>
<td>Elizabeth</td>
<td>Stockdale</td>
<td>Great Soils, AHDB, NIAB</td>
</tr>
<tr>
<td>Paul</td>
<td>Tallowin</td>
<td>National Trust Tenant Farmer, East Maldon, Essex</td>
</tr>
<tr>
<td>Callum</td>
<td>Weir</td>
<td>Farm Manager, Wimpole, National Trust</td>
</tr>
<tr>
<td>Andy</td>
<td>Whitmore</td>
<td>Principal Research Scientist, Rothamsted</td>
</tr>
</tbody>
</table>