Soil Health in Agriculture

NFFN Cymru's response to the Senedd's Economy, Trade, and Rural Affairs Committee inquiry into soil health and agriculture.

Key Points

- Healthy soils provide **multiple benefits** for food production, the environment and wider economy, whilst poor soil health has a **negative impact.**
- Welsh soils face **numerous threats** and have witnessed recent **negative trends**.
- Soil health **monitoring** should include physical and biological properties alongside chemical analysis to ensure the long-term resilience of agricultural systems.
- The **Sustainable Farming Scheme (SFS)** must support and reward farmers to implement regenerative farming techniques and nature-based interventions to improve soil health.
- The importance of **advice and guidance** for farmers to improve soil health is paramount for the successful transition towards more sustainable and resilient agricultural systems.
- While standalone **soil health legislation** is a future possibility, strengthening existing environmental **regulations** and embedding soil health more firmly within agricultural **support** mechanisms are likely near-term pathways.
- There are strong arguments for **establishing targets** for agricultural soil health in Wales, however there are considerations and challenges that need addressing.

1. The role and state of soils in agricultural systems

Agricultural soils are of vital importance and provide a host of services and benefits.[1]

- **Foundation for Food Production:** Soils provide the essential medium for plant growth, supplying water, nutrients, and physical support for crops and grasslands which underpin livestock farming.
- **Nutrient Cycling:** Healthy soils are vital for the natural cycling of nutrients, making them available to plants and reducing the need for synthetic fertilizers.
- **Water Regulation:** Soils play a key role in storing and filtering water, influencing water availability for plants and helping to regulate water flow, reducing the risk of flooding and drought.
- **Carbon Storage:** Agricultural soils, particularly grasslands and peat-rich areas, are significant carbon sinks, playing a crucial role in climate change mitigation by storing atmospheric carbon.
- **Biodiversity Support**: Soils are a habitat for a vast array of organisms, from microbes to invertebrates, which contribute to soil health and ecosystem functioning.
- **Supporting Ecosystem Services:** Healthy agricultural soils contribute to broader ecosystem services such as clean water and air.

Whilst there are positive aspects to agricultural soil health in Wales, our soils face numerous threats and have witnessed recent negative trends.

Positive aspects:[2]

- **High Soil Organic Carbon (SOC):** Welsh agricultural soils, particularly under permanent grassland and peat, tend to have higher levels of SOC compared to the European average. This is beneficial for carbon storage and overall soil health.
- **Grassland Dominance:** Most of Wales' agricultural land is permanent grassland, which is generally considered to be at a lower risk of soil degradation compared to arable land.
- **Stable Soil Carbon in Improved Land:** Data suggests that soil carbon levels in improved grassland have remained stable over the past 30 years.

Negative aspects:

- **Soil quality:** Has deteriorated across all habitats apart from woodlands where there has been some improvement.[3]
- **Peatlands:** While important for carbon storage, drained or degraded peatlands can be a source of greenhouse gas emissions. 75% of peatlands have in some way been impacted, turning them from carbon sinks to carbon sources.[2]
- The latest ERAMMP National Trends and Glastir Scheme Evaluation Report highlights soil health concerns in Wales;[4]

    - A 2 to 4 fold increase in the number of improved soils with nutrient levels above recommended levels risking leaching to water courses. 8% in arable and 17% of improved soils now exceed the recommended levels.
    - 8% decrease in topsoil carbon concentration in arable soils
    - A 6-32% increase in soil compaction reducing resilience to drought, increasing risk of both rapid runoff and nitrous oxide emissions – the latter a potent greenhouse gas.
    - 72% of Improved Grassland sites fall below the minimum soil acidity levels when productivity may be reduced
    - The Glastir agri-environment had few positive benefits for soil with a couple of exceptions including an increase in topsoil carbon concentrations in 3 of the 19 habitats

- **Economic impacts:** The annual cost of soil degradation in England and Wales is an estimated £1.2 billion. This is mainly linked to loss of organic content of soils (47% of the total cost), compaction (39%) and erosion (12%).[5]

Identified threats and areas of concern:[6]

- **Compaction:** Around 40% of Welsh soils are considered potentially vulnerable to compaction. Damage from heavy machinery and livestock, on intensively managed grasslands or even in set-stocked extensive systems, and during wet conditions, is a significant threat. This can reduce water infiltration (contributing towards flooding), aeration, root growth and thus yield.
- **Erosion:** About 7% of Wales' land is susceptible to high erosion rates, and this risk is greatest during high intensity rainfall events. This leads to loss of topsoil and nutrients, and can negatively impact water quality. There is overall a low risk of soil erosion, however erosion is highly localised and intense resulting in hotspots where significant soil loss can occur.

- **Loss of Soil Organic Matter (SOM):** Levels are a key indicator of soil health. While generally stable in Wales according to recent data, maintaining and enhancing SOC is crucial for long-term soil health and carbon sequestration.
- **Land Use Change:** Conversion of permanent grassland to other uses can negatively affect soil properties.
- **Agricultural Intensification:** The main pressures and threats to soil biodiversity are the intensification or higher productivity systems using higher inputs (such as synthetic fertilisers, pesticides, sewage sludge and herbicides),[7] whilst carbon losses may be caused by intensification of the management of grassland.[8]
- **Climate Change:** Predicted to impact soil wetness, carbon, biology, compaction, erosion, and overall agricultural capability.

To conclude, while a significant portion of agricultural soils in Wales are currently in good condition, there are specific threats and areas where improvement is needed. Maintaining and enhancing soil health is crucial for the sustainability of Welsh agriculture, its contribution to environmental goals, and its resilience to climate change.

2. Monitoring of soil health

Traditional soil analysis packages measure;

- pH: measures the acidity or alkalinity of the soil
- Available Phosphorus (P)
- Available Potassium (K)
- Available Magnesium (Mg)

These elements are essential to optimize crop and pasture growth. This information is important for farmers to make informed decisions about fertilizer application, ensuring that crops receive the nutrients they need without over-fertilizing, which can be detrimental to the environment.

However, standard soil testing provides an incomplete picture of soil health as these tests measure the *plant-available* or *extractable* portion of nutrients, which is a small fraction of the total amount present in the soil. As such farmers are often advised to achieve optimum soil nutrient levels by applying synthetic inputs (N, P, K). This feeds the *plant*, rather than feeding the *soil*. However farmers can significantly improve their soil health without relying on external inputs by focusing on regenerative agriculture principles and nature-based solutions (this is explored further in section 4). Healthy soils, characterized by a diverse community of microorganisms, well-developed soil structure, and adequate organic matter content, create an environment where insoluble macronutrients like phosphorus and potassium can be effectively mobilized and taken up by plants.[10, 11, 12, 13] This highlights the importance of maintaining and improving soil health for sustainable plant nutrition and reducing the reliance on external inputs.

As our understanding of soil health evolves, there's a growing recognition that focusing solely on these soluble nutrient forms is insufficient. A more holistic assessment requires incorporating physical and biological assessments.

- *Visual Evaluation of Soil Structure (VESS)*: This relatively simple, on-farm assessment provides a rapid indication of soil structural quality, identifying issues like compaction, poor aggregation, and anaerobic conditions. Training and resources are needed to enable widespread farmer adoption.

- *Water Infiltration Test*: Simple field tests to measure how quickly water soaks into the soil can indicate structural issues and water-holding capacity.
- *Earthworm Counts and Diversity*: Earthworms are key indicators of soil biological health. Simple field counts can be conducted by farmers, and more detailed diversity assessments can be done in the lab.
- *Bulk Density and Porosity:* Measuring the weight of a known volume of soil (bulk density) and calculating the pore space provides insights into compaction and aeration. This could be incorporated into standard soil testing packages.
- *Soil Respiration*: Measuring the rate of carbon dioxide release from the soil indicates microbial activity and overall biological function. Lab-based methods exist, and simpler field kits are becoming available
- *Aggregate Stability:* This assesses how well soil aggregates hold together when subjected to water or physical stress, which is crucial for understanding erosion risk and water movement.

In conclusion, while traditional soil testing and monitoring in Wales is useful, it doesn't provide a complete picture. By integrating physical and biological assessments alongside traditional chemical analyses, leveraging technology, empowering farmers with knowledge and tools, and creating supportive policy frameworks, we can gain a much richer understanding of our soil resources and work towards more sustainable and resilient farming systems.

3. Classification of soils for land use

The Agricultural Land Classification (ALC) system, which Wales shares with England, is the main framework for classifying agricultural land quality. Its primary function is to assess the long-term limitations of land for agricultural use based on physical and chemical characteristics. [14] Land is classified into five grades, with Grade 1 being the best quality and Grade 5 the poorest:

Grade 1: Excellent quality agricultural land with very few limitations.
Grade 2: Good quality agricultural land with slight limitations.
Grade 3a: Good to moderate quality agricultural land.
Grade 3b: Moderate quality agricultural land.
Grade 4: Poor quality agricultural land with moderate limitations.
Grade 5: Very poor quality agricultural land with severe limitations, often suitable only for permanent pasture or rough grazing.

There are many positives to this approach, particularly for its role in strategic land use planning and protecting higher quality agricultural land from development. It is also a well-established and understood system within the planning and agricultural sectors.

However, there are limitations to this approach.[15]

- **Outdated Climate Data:** A significant criticism is that the climate data used in the ALC dates back to 1941-1980 and doesn't account for recent climate change impacts, potentially overestimating the quality of some land.

- **Limited Scope:** The ALC primarily focuses on the inherent physical limitations for agricultural production and doesn't fully integrate aspects like soil health (biological and physical properties beyond structure and texture), carbon sequestration potential, or other ecosystem services beyond food production.
- **Generalised Maps:** Predictive ALC maps provide a strategic overview but aren't accurate enough for site-specific assessments, requiring detailed surveys for planning applications.

For modern agricultural needs with increasing focus on sustainable agriculture, climate resilience, and soil health, the ALC's limitations in these areas become more apparent. There's a growing need for a more integrated approach to soil assessment that considers a wider range of soil functions. To be more fit for purpose in the context of modern agricultural and environmental challenges, there's a need to complement the ALC with enhanced monitoring and assessment of physical and biological soil health indicators. Integrating these aspects into future policy and potentially refining the ALC system itself would provide a more holistic understanding of Wales' soil resources and support more sustainable land management decisions.

4. The policy and legislative mechanisms to protect soils and productive land

While Wales currently lacks specific, standalone legislation solely dedicated to soil health, soil is protected through a combination of environmental regulations and the framework of agricultural support schemes.

1. **The Agriculture (Wales) Act 2023** is a significant piece of legislation that lays the groundwork for protecting soils in Wales, although it doesn't contain specific, direct regulations solely focused on soil health in the same way as air or water. The effectiveness of this protection will depend on the detailed implementation of the SFS and the ambition of the indicators and targets set by the Welsh Government

2. **The Sustainable Farming Scheme (SFS):** While not strictly a regulatory framework, it aims to incentivize farmers to adopt practices that deliver environmental benefits, including soil health.

3. **The Water Resources (Control of Agricultural Pollution) (Wales) Regulations 2021:** This piece of legislation is aimed at preventing water pollution from agricultural sources. While the primary focus is water quality, it has implications for soil health.

4. **Environment (Wales) Act 2016:** This Act promotes the sustainable management of natural resources, which includes soil. It places a duty on public bodies to maintain and enhance biodiversity and promote the resilience of ecosystems, which are intrinsically linked to healthy soils.

5. **Well-being of Future Generations (Wales) Act 2015:** This Act sets out seven well-being goals for Wales, including a "Resilient Wales" which emphasizes maintaining and enhancing a biodiverse natural environment with healthy functioning ecosystems. Soil health is a fundamental component of this goal. The Act also includes a national indicator on the "*concentration of carbon and organic matter in soil*," highlighting its importance.

The Welsh Government has undertaken evidence reviews on soil and is developing a draft soil policy statement, [16, 17] which could pave the way for more targeted legislation or regulations in the future. However, while standalone soil health legislation is a future possibility, strengthening existing environmental regulations and embedding soil health more firmly within agricultural support mechanisms are likely near-term pathways. The ongoing development and implementation of the SFS in Wales will play a key role in shaping the future management and state of agricultural soils in the country. Ensuring that the SFS provides sufficient incentives and support for farmers to adopt comprehensive soil health management practices will be crucial.

Nature Based Solutions for Soil Health

The SFS must support and appropriately fund farmers to implement nature-based interventions and management techniques to improve soil health.[18]

- **Planting cover crops**: Cover crops enhance soil health by increasing organic matter, improving soil structure, promoting nutrient cycling, and reducing erosion.[19, 20]
- **Pasture species diversity:** Higher plant diversity in grasslands is associated with improved soil measures, including soil moisture, carbon, nutrient recycling and uptake, and biodiversity.[21, 22, 23, 24]
- **Regenerative grazing:** Strategically managing grazing and rest periods, often referred to as rotational or mob grazing means that plant roots grow deeper, increasing soil organic matter, improving soil structure, and enhancing water infiltration.[25, 26, 27]
- **Agroforestry:** By integrating trees into agricultural systems, farmers can enhance soil structure, fertility, and water infiltration, while also reducing soil erosion.[28, 29, 30]
- **Organic fertilizers and Composting:** This significantly benefits soil health by increasing soil organic matter, improving structure, and enhancing biological activity. This leads to better nutrient availability, water retention, and overall soil resilience.[31, 32 , 33]

Importantly, these nature-based solutions can help farmers reduce reliance on bought in inputs such as feed and synthetic fertilizers, reducing costs and reducing environmental impacts.

Soil Health Planning and Monitoring

While soil testing requirements under the SFS Universal Layer proposes to focus on potassium (K), Phosphorous (P), Magnesium (Mg), pH and soil organic matter; higher-tier actions could incentivize farmers to undertake more comprehensive soil health assessments that include physical and biological indicators, as discussed in the previous answer. As the SFS evolves, specific Optional or Collaborative actions that demonstrate significant soil health benefits could, over time, become prerequisites to entering the SFS Universal Layer, particularly if their uptake is insufficient to meet national goals.

Farmers will need training and accessible resources (field guides, online tools, workshops) to confidently conduct visual assessments and simple biological tests, as well as interpreting the results. The data collected from careful observation of soil structure, water infiltration, and plant health through enhanced monitoring are essential for making informed management decisions and tracking the impact of different practices on overall soil health.

Advice and Guidance

Many of the sustainable farming practices promoted by the SFS (e.g., soil health management, agroforestry, precision nutrient management, biodiversity enhancement) require specific knowledge and skills. Access to expert advice will be vital for farmers to implement these practices correctly and achieve the desired outcomes for soil health. Furthermore, it often takes time for soil health to improve significantly, and farmers may need support and patience during the transition. Soil health is a multifaceted concept encompassing biological, chemical, and physical properties, and many farmers may not have a comprehensive understanding of these interactions and how their management practices impact them. Advice can demystify these complexities and highlight the importance of a holistic approach.

- **Best Practice Guidance:** Advice services can provide up-to-date information on the most effective and efficient ways to implement sustainable soil health practices, drawing on research and practical experience.

- **Tailored Advice:** Farms in Wales are diverse in terms of size, type, and environmental context. Generic advice may not always be sufficient. What works on a lowland dairy farm may not be suitable for an upland sheep farm. Tailored guidance, considering individual farm circumstances, will be crucial for successful implementation

- **Learning from Experience:** Guidance can facilitate knowledge exchange and peer-to-peer learning, allowing farmers to benefit from the experiences of others who have successfully improved their soil health

- **Problem Solving:** As farmers adopt new practices, they may encounter challenges. Access to advice can provide solutions and support to overcome these hurdles.

- **Regenerative and nature-based interventions:** As mentioned previously, soil health advice often recommends applying synthetic fertilizers to reach target nutrient levels for specific crops or grassland. Advice should shift towards a more integrated approach that considers soil health more broadly, incorporating aforementioned regenerative farming techniques and nature-based interventions.

The importance of advice and guidance for farmers to improve soil health in Wales is paramount for the successful transition towards more sustainable and resilient agricultural systems. Without this crucial support, the widespread adoption of soil health-enhancing practices and the achievement of national environmental goals will be significantly hindered.

5. The potential for legal frameworks and targets for soils.

While explicit, legally binding targets for agricultural soils across Wales are not yet fully defined, the framework is in place for their potential development in the future. The Agriculture (Wales) Act 2023 provides a strong legal foundation for prioritizing sustainable land management, including soil health. The five-yearly Sustainable Land Management reports mandated by the Act could set out broader targets for soil health across Wales based on collected data and progress towards the SLM objectives.

There are strong arguments for establishing targets for agricultural soil health in Wales:

- **Measures Progress:** Quantifiable targets allow for the monitoring of soil health improvements or declines over time, enabling the assessment of policy effectiveness and the identification of areas needing more attention.
- **Informs Policy and Funding:** Targets can help justify and direct funding for soil health initiatives within the SFS and other relevant policies.
- **Drives Farmer Engagement:** Well-defined and achievable targets, coupled with appropriate advice and support, can motivate farmers to adopt soil-friendly practices. The proposed SFS with its universal soil testing requirement could provide a baseline for future target setting.

However there are considerations and challenges in setting soil health targets.

- **Complexity of Soil Health:** Soil health is influenced by numerous interacting factors (physical, chemical, and biological), making it challenging to define and measure with single, simple targets. A suite of indicators may be necessary.
- **Spatial Variability:** Soil types, climate, and land management practices vary significantly across Wales, meaning that uniform national targets may not be appropriate. Regional or soil-type specific targets might be needed.
- **Data Availability and Monitoring:** Robust and consistent data on soil health across Wales is crucial for setting meaningful targets and tracking progress. While ERAMMP provides valuable data, more comprehensive and farm-level data collection may be required. The SFS's soil testing could contribute to this.
- **Farmer Acceptance and Practicality:** Targets need to be realistic, achievable, and developed in consultation with farmers to ensure buy-in and practical implementation.

If targets were to be implemented, they could focus on various aspects of soil health, such as:

- **Soil Organic Matter (SOM):** Increasing SOM levels across different agricultural land types. Indicator 13 of the Well-being of Future Generations (Wales) Act 2015 already monitors the concentration of carbon and organic matter in soil, providing a foundation for more specific targets.
- **Soil Structure:** Improving indicators of soil structure, such as aggregate stability and visual evaluation scores (VESS).
- **Soil Biodiversity:** Monitoring earthworm populations or other indicators of soil biological activity.
- **Nutrient Management:** Reducing nutrient surpluses and improving nutrient use efficiency.
- **Soil Erosion:** Reducing the rate of soil loss from agricultural land.
- **Soil Compaction:** Decreasing the area of agricultural land affected by compaction.

The ongoing development of the SFS provides a key opportunity to integrate soil health considerations and potentially lay the groundwork for future target setting, building upon existing monitoring efforts and the knowledge gained through the scheme's implementation.

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