

Cashing in on carbon



Jenni Dungait

FCCT The Soil Carbon Project Workshop

February 2019



**Farm
Carbon
Cutting
Toolkit**

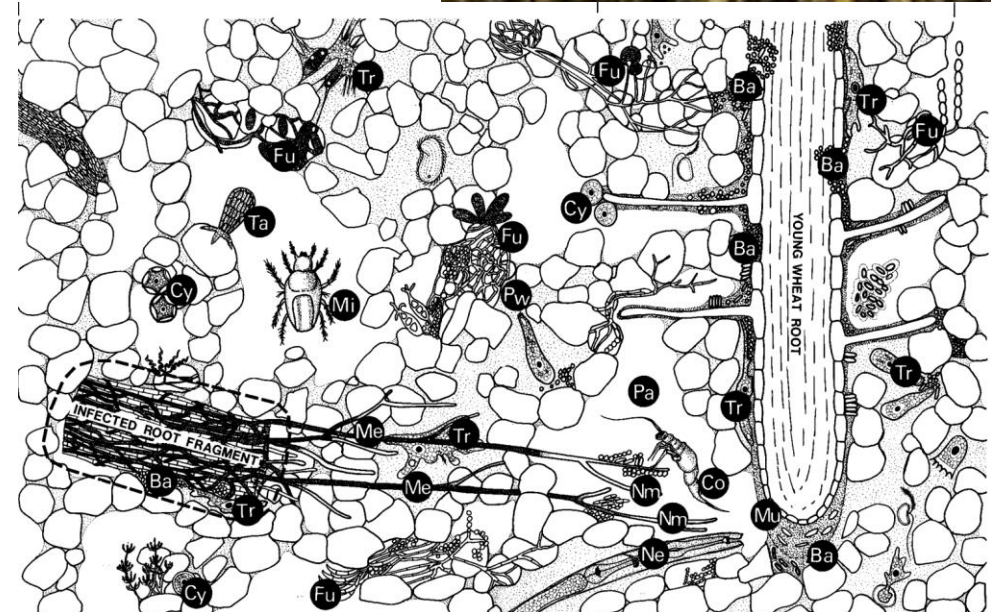
What is soil organic carbon?

Decomposing plants

‘the energy of the sun flowing through your soil’

60% of soil organic matter

- 5% of soil organic matter is alive (soil biology)
- Underground industry supporting the sustainability of your farm



Making money from soil organic carbon

- Payment for increasing soil organic carbon
- Increasing yields and quality by increasing soil organic carbon
- How to prove that soil organic carbon is increasing.



Dirt: where food begins

We rely on soils to grow most of the food we eat.

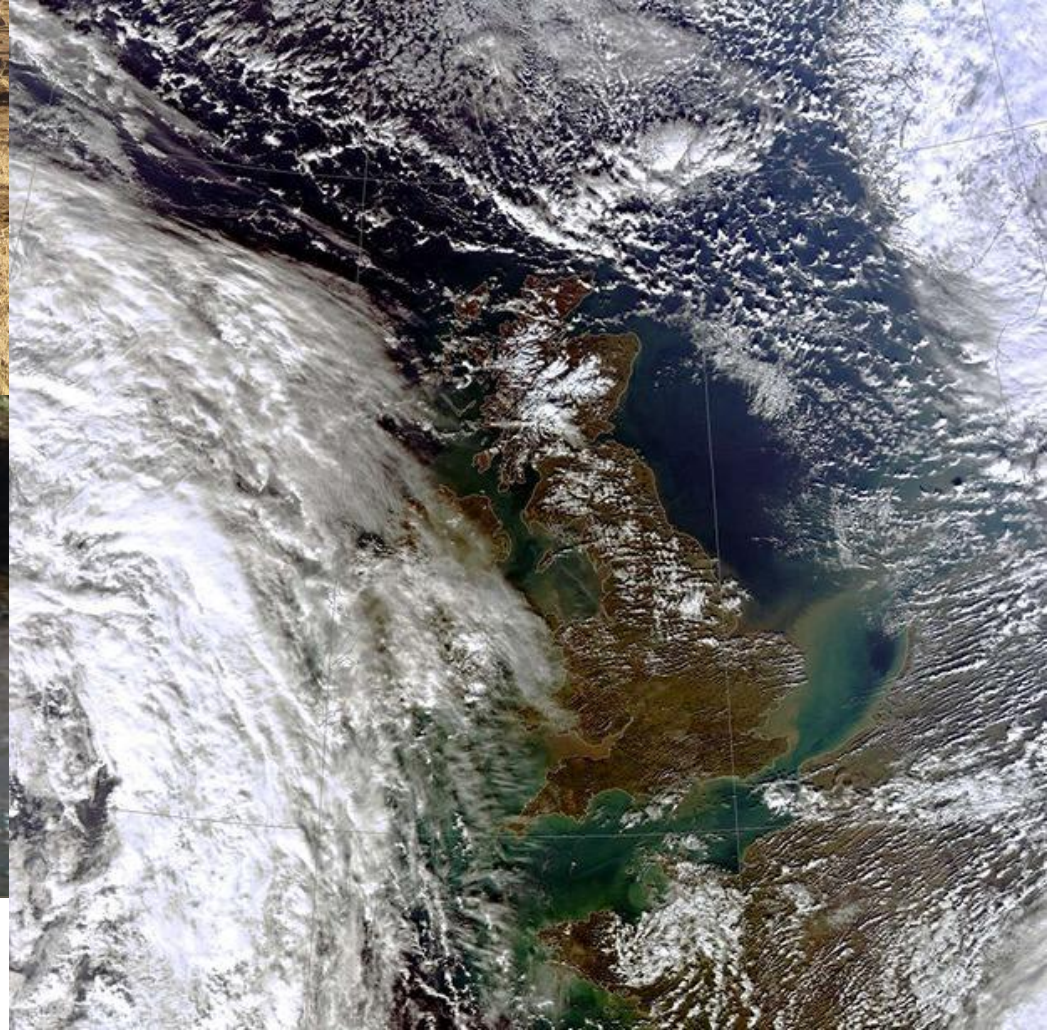
Soil is a non-renewable resource.

Globally, 40% of soil suitable for agriculture is degraded by unsustainable farming methods.

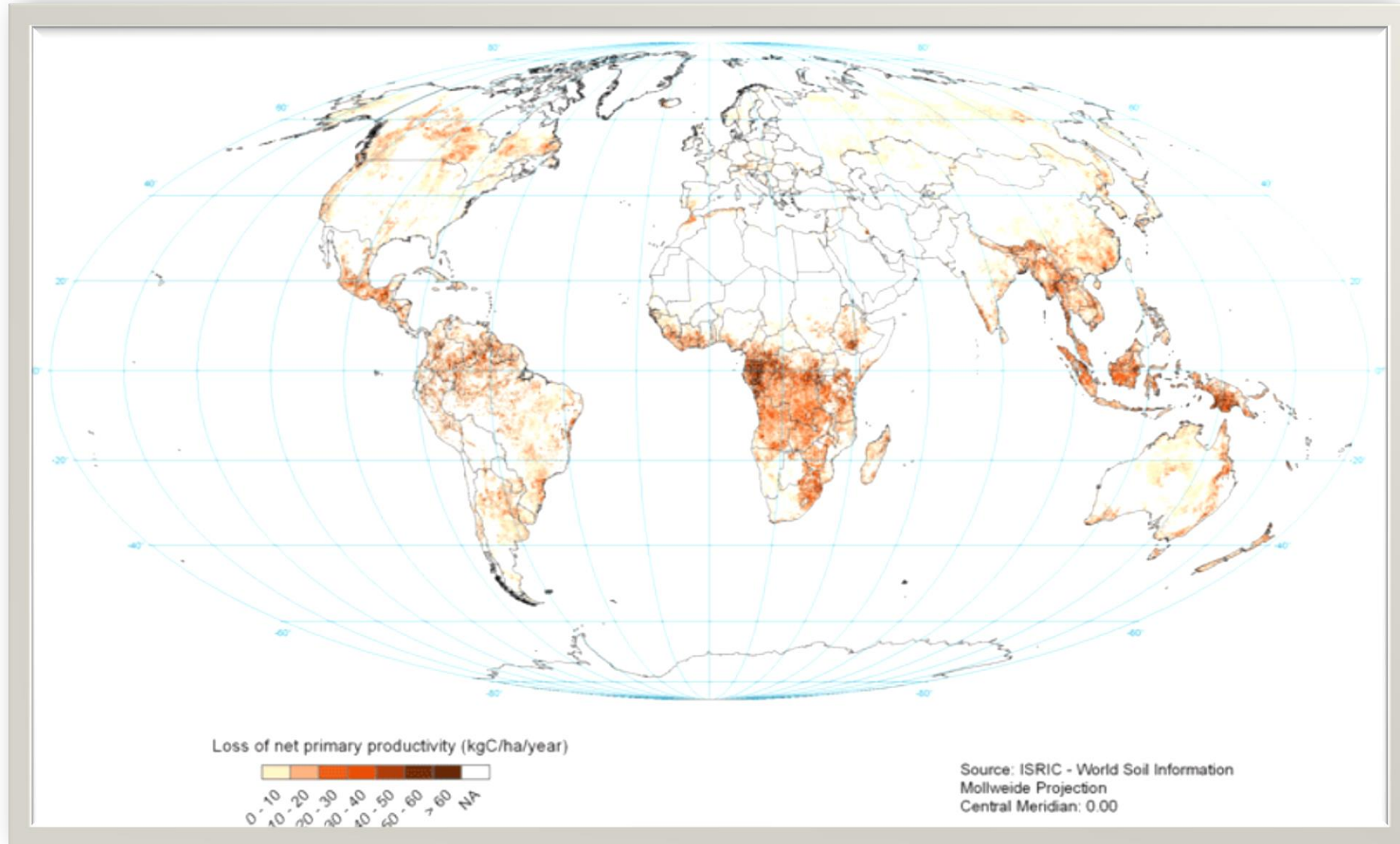
Competition for land – energy production, urbanisation, mining.



Soil sickness



Unhealthy soil causes reduced yields



Future-proofing your soils

- Building soil resilience is at the heart of emerging UK policy
- Soils (with air, water and biodiversity) are considered as part of the UK's asset base, i.e. Natural Capital
- Reduced emissions from soils are key
 - CO₂ - paying farmers to increase organic matter in soils
 - N₂O, NH₄ and NO₃ - reducing N pollution from livestock and N fertiliser applications
 - CH₄ – reducing emissions from livestock by reducing stocks, genetic selection and diet
- Nutritional quality of food
 - focus on 'hidden hunger' from micronutrient deficiencies





Farm soil subsidies

Sir, There has been considerable discussion of the opportunity to improve agri-environment schemes after Brexit. One attractive idea is payment for outcomes that have public benefit, rather than subsidies based on land area. Soil protection is one area where such monies can be wisely spent. In addition to food production, soils provide many environmental benefits, including flood protection, recycling of nutrients, water purification and climate regulation. These benefits are hampered by the continuing loss of soil carbon as described in the parliamentary soil health inquiry in 2016.

If such a payment is accepted, the issue then becomes what indicator we use to determine soil improvement. During the soil health inquiry, soil organic carbon content was identified as the indicator of soil quality that the scientists agreed on. We also concur that soil organic carbon content should be the measure of choice, and that maintaining or increasing this vital driver of soil health should be financially rewarded.

This would benefit farmers' productivity and enhance the environmental benefits provided by soils to the wider community. PROFESSOR LIZ BAGGS; PROFESSOR STEVE BANWART; PROFESSOR RICHARD BARDGETT; PROFESSOR GARY BENDING; PROFESSOR COLIN CAMPBELL; PROFESSOR CHRIS COLLINS; PROFESSOR TIM DANIELL; PROFESSOR LORNA DAWSON; PROFESSOR JENNIFER DUNGAIT; PROFESSOR BRIDGET EMMETT; PROFESSOR KEITH GOULDING; PROFESSOR PETER GREGORY; Plus a further 20 professors of soil science at thetimes.co.uk/letters

Paying farmers for soil organic carbon



Jennifer Dungait @soilhealthexp · Jan 3

Michael Gove says 'Farmers should be rewarded for organic content of soils.' Hurray! #ORFC19 #soilhealth @MikeGreenSustAg @Luppod61 @sectormentor @ADB0806 @

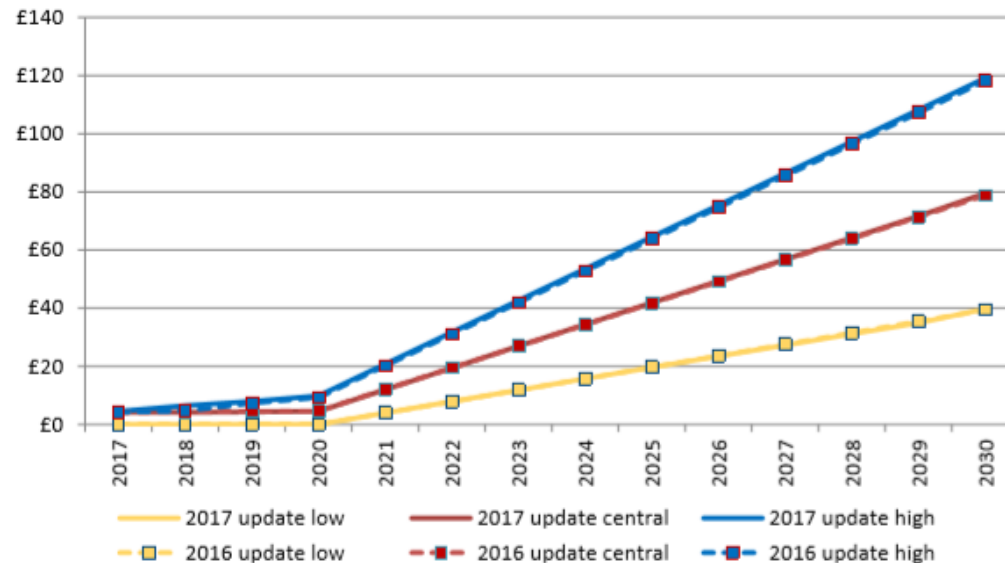
10

14

36



BEIS appraisal carbon values 2017 update (real 2017 GBP/tCO₂)



Who will pay?

- Polluters/off-setters
- Governments
- Insurance companies
- Consumers

Soil organic carbon increases yields

CROP YIELD INCREASES ACROSS CHINA

Straw residue incorporation at a rate of 3 t C / ha / yr with mineral fertilizer application at 200–400 kg N ha⁻¹ yr⁻¹ was demonstrated to be the best farming practice

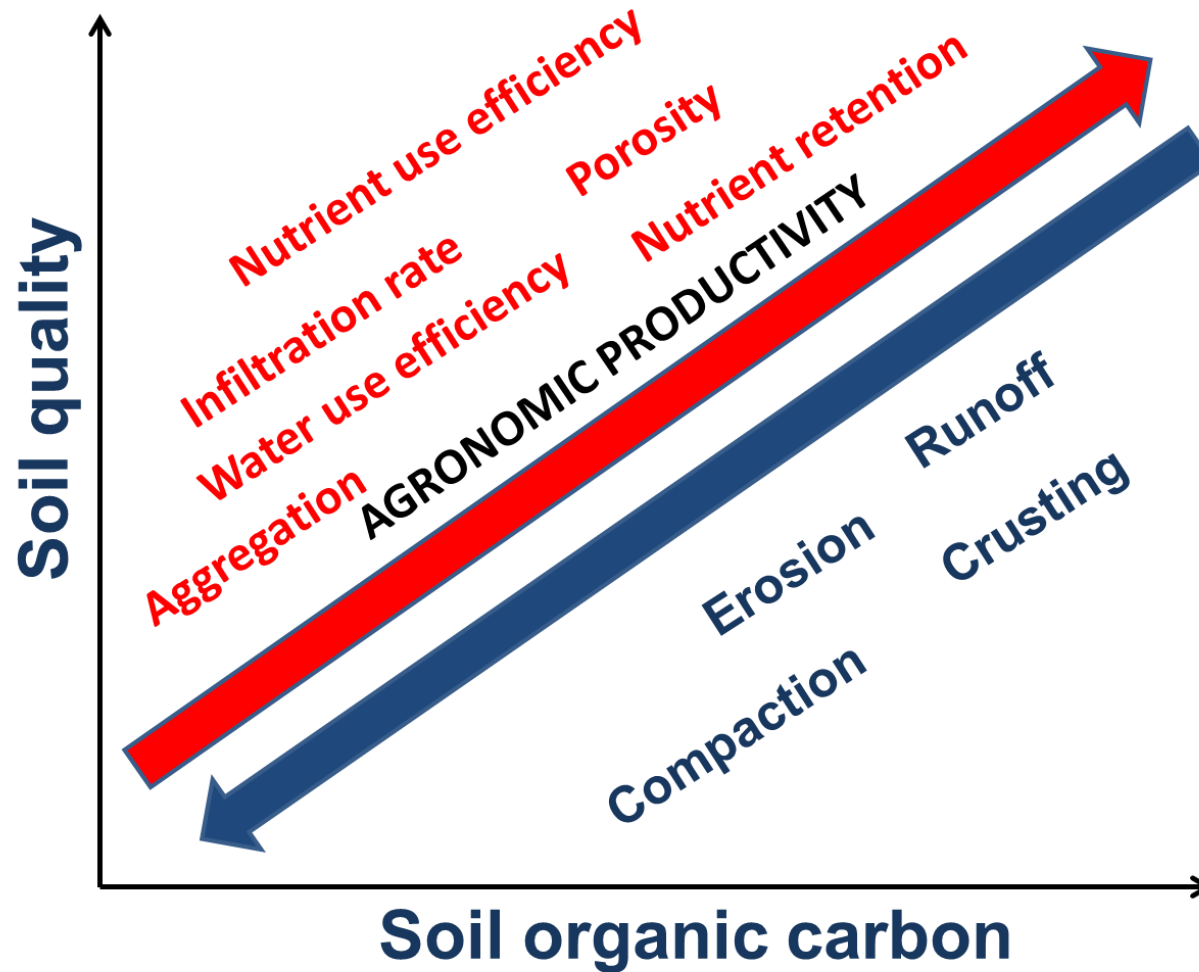
- crop yield increased by average **33 %** (range 18 – 56%)
- soil organic carbon stocks increased at the average rate of **0.85 t C / ha / yr**

INCREASE IN LIVELWEIGHT GAIN OF CATTLE AND SHEEP IN THE UK

Increased soil organic carbon is associated with a better animal performance and less nutrient losses into watercourses,

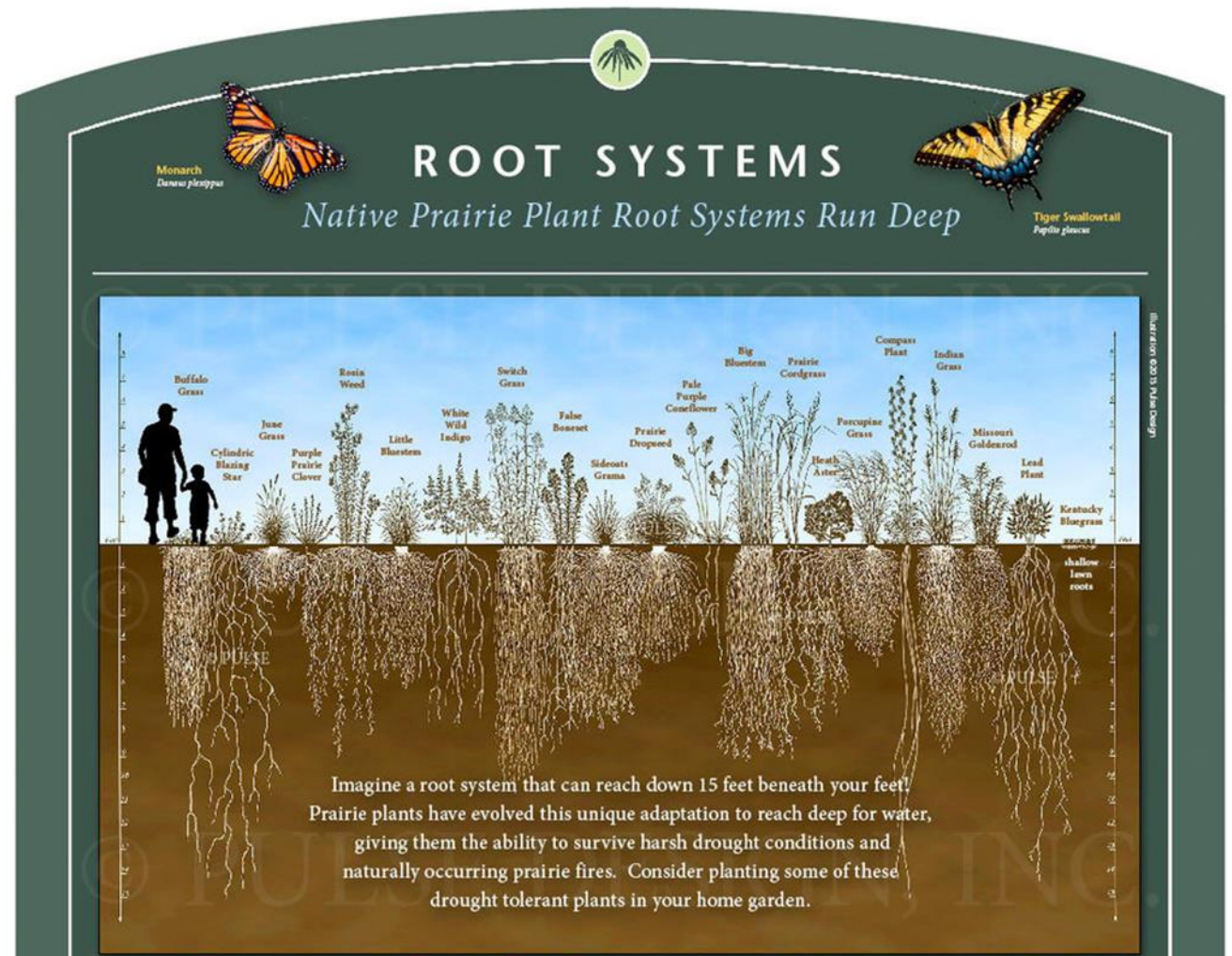
Increased stocking densities if greater botanical diversity and elevated soil organic carbon

How soil organic carbon increases yields



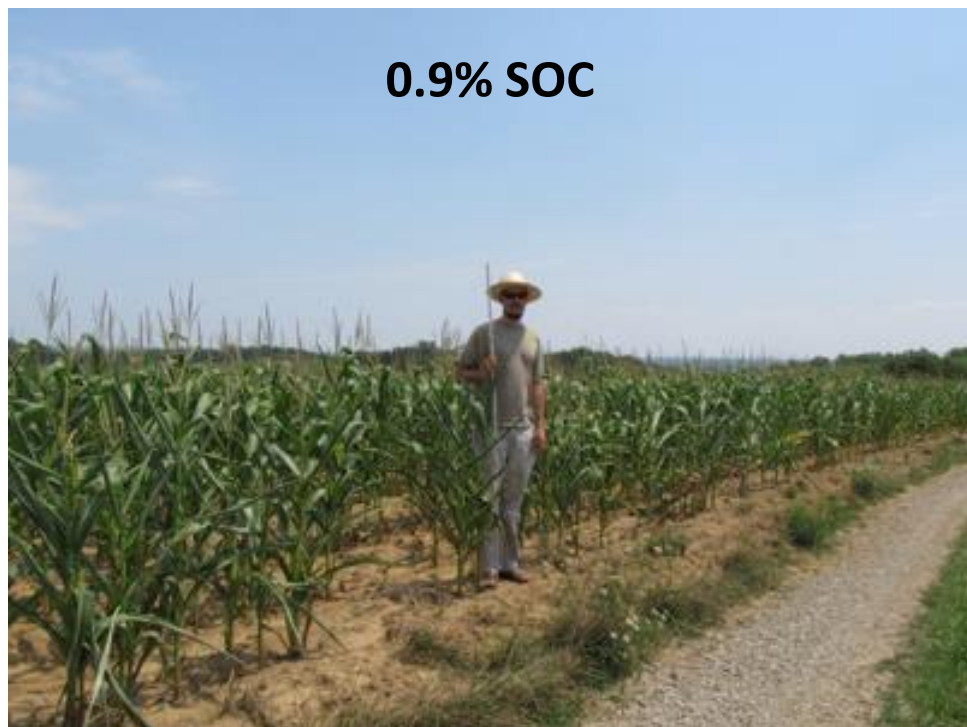
Methods to increase soil organic carbon

- Reduce tillage
- Return all residues and manures to soil
- Cover crops
- Prevent losses by erosion and run-off
- Encourage deeper rooting



Protection from drought: Ohio, USA, 2012

Conventional tillage



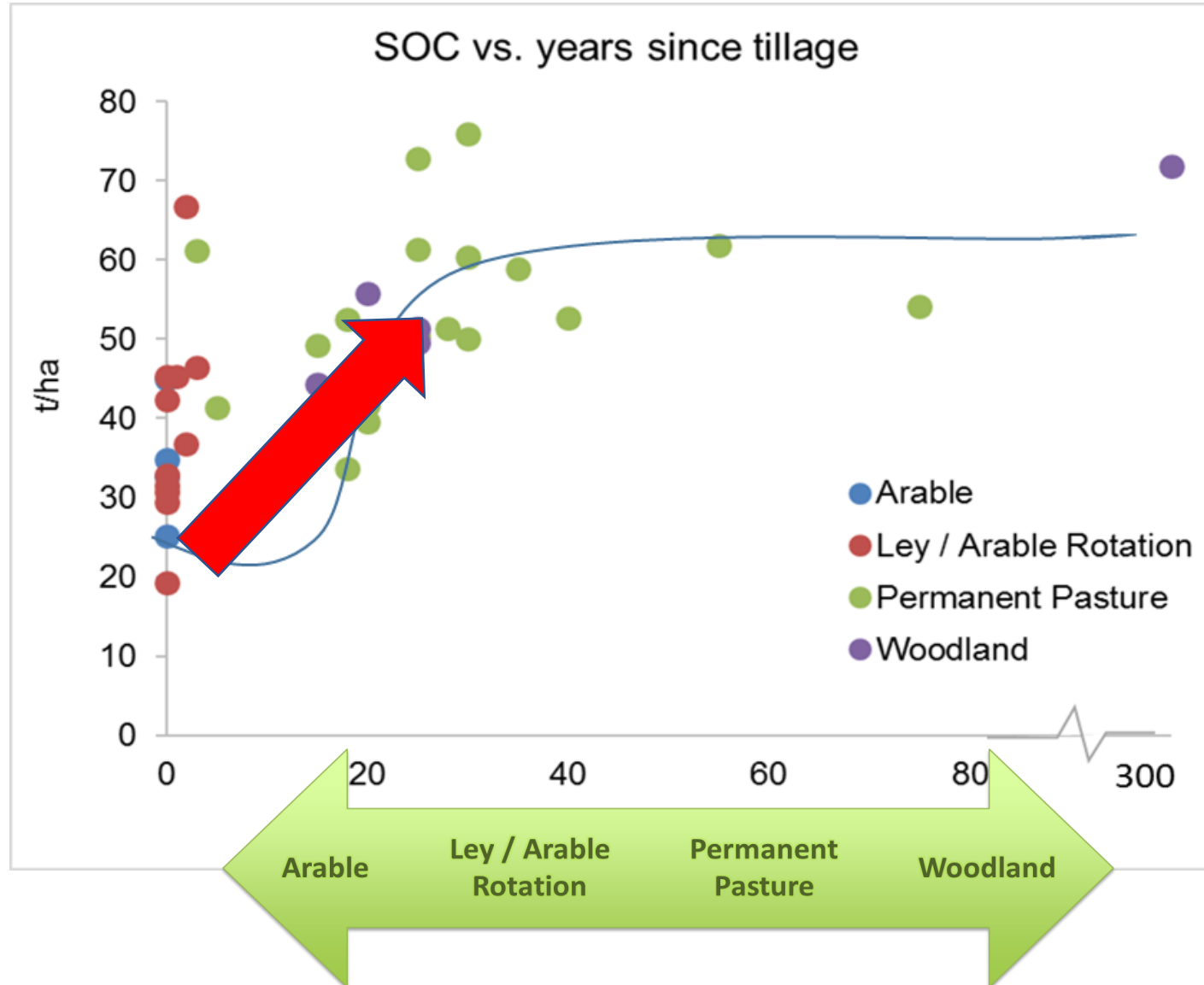
Conservation tillage



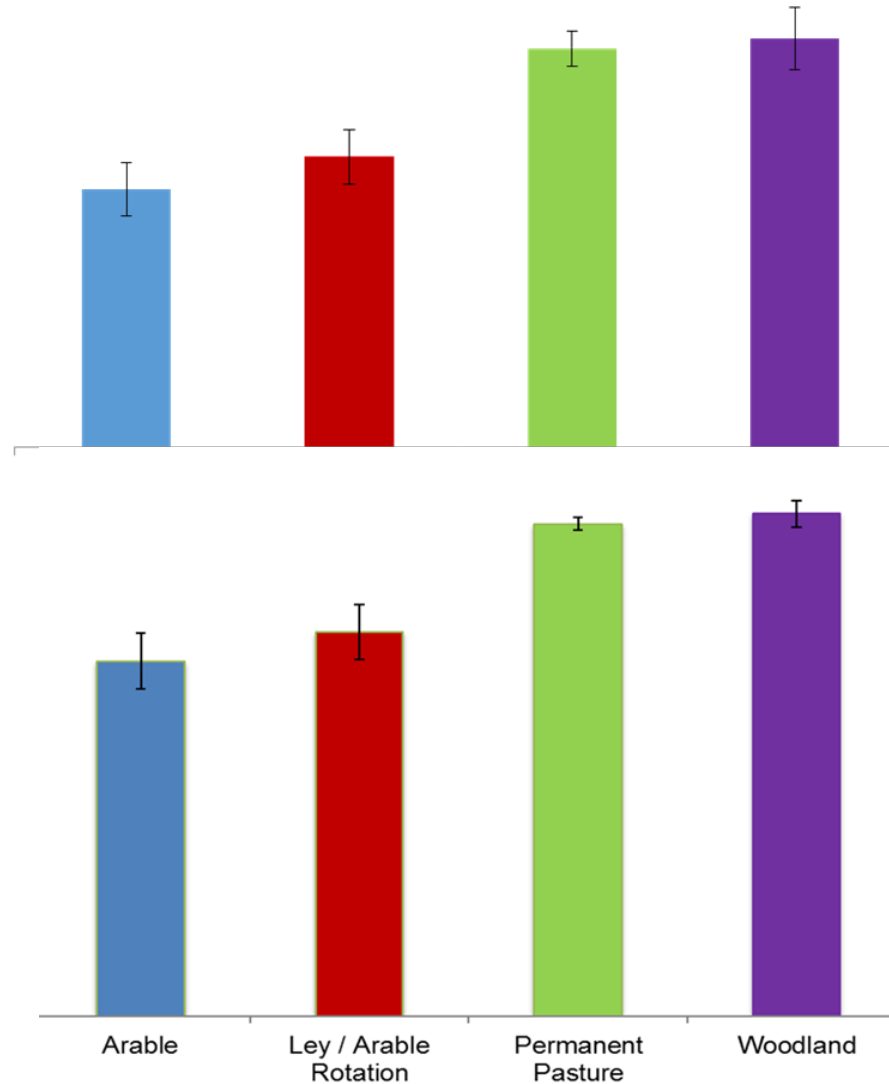
Can you measure soil organic carbon on-farm?



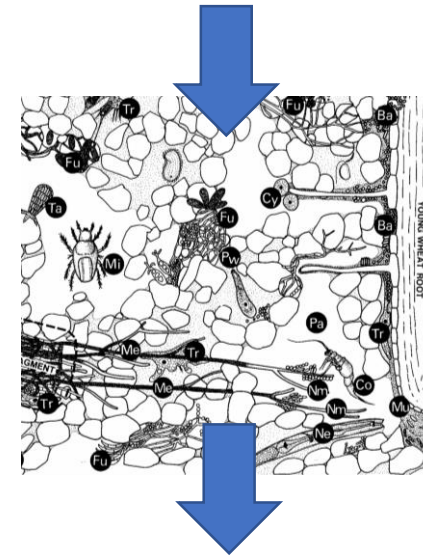
Tamar Valley
Organic
Group
(Biology)



Reduced tillage increases soil health



Soil organic matter



Aggregate stability in water

Soil aggregate stability is best test for soil organic carbon

Soils with good physical structure are generally associated with larger soil organic carbon contents.

A constant supply of soil organic carbon is needed for aggregate formation and stability.

Stable aggregates indicate the level of soil organic carbon in farm soils

Farmers rated the slake test and earthworm counts as the top 2 methods at the PFLA AGM in 2017.

Full report available on-line



Grassland soil (high %SOC)

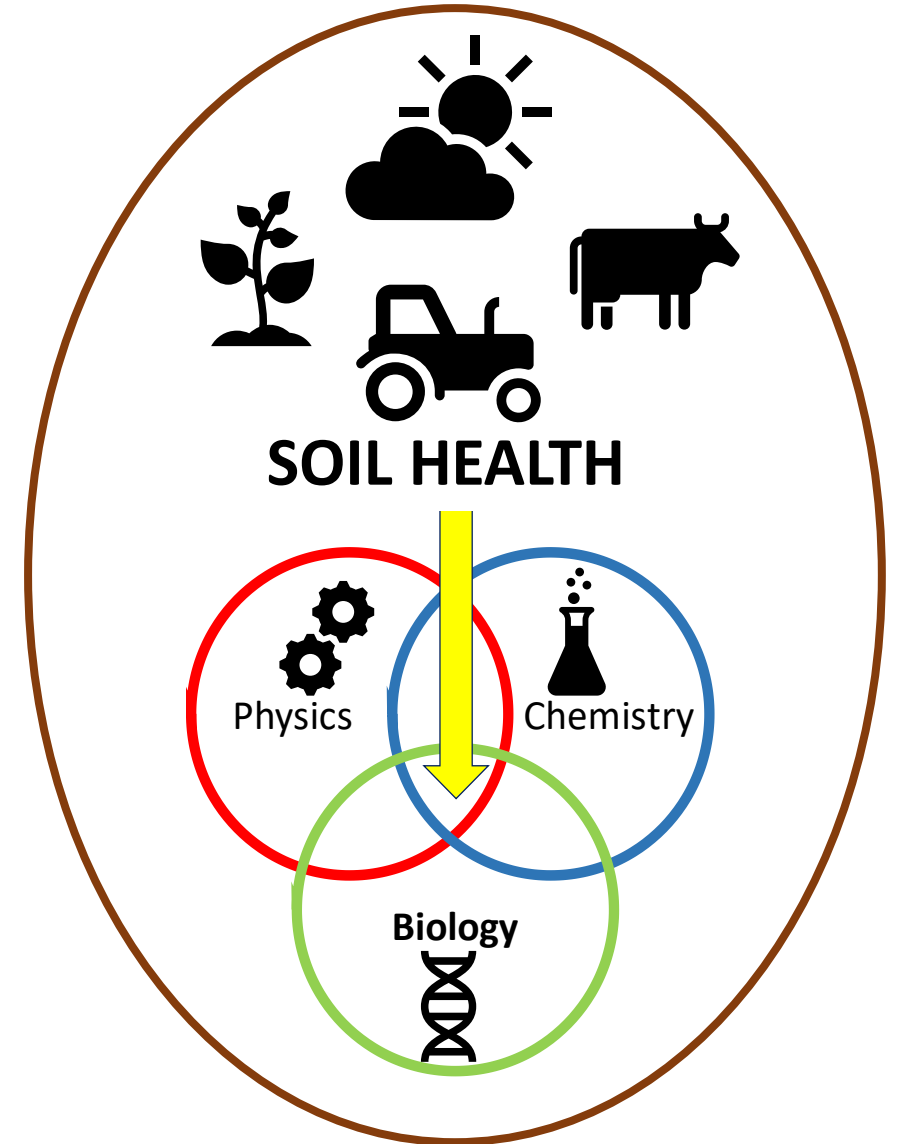


Arable soil (low %SOC)

Summary

SOIL ORGANIC CARBON

- The sun's energy driving the health of the soil system
- Get ready for carbon credits
- Increasing soil organic carbon improves crop and livestock yields
- Soil organic can be measured directly and indirectly on-farm



Soil organic carbon toolkit

- Download the British Geological Society 'MySoil' app
- Get your spade out!
- Do some soil health tests
- Record change over time – input data in FCCT

THE BEATING HEART OF SUSTAINABLE FARMING

What is soil health—and how can you improve it on your farm? Jennifer Dungait offers some practical advice

The idea of soil health is a relatively new scientific concept in modern farming. It differs from the concept of soil quality, because it recognizes the key role of managing soil biology, as well as soil chemistry both as an input and indicator of soil health. The impact of tillage, to achieve more sustainable farming systems, is a key factor in soil health. Soil biology, chemistry and physics can be used to assess soil organic matter in agricultural systems. I work side-by-side with farmers to improve soil organic matter and soil health by developing natural understanding of how various soil biology, chemistry and physics can be used to improve the sustainability of farming. I work with farmers and scientists across the world to find out how popular indicators of soil health work at the operational level, and to use this science-based knowledge to develop these tools for all farmers to use to see and understand whether changes in management are improving the health of their soils or harming it.

A farmer's most useful tool?

The answer is the soil. Over the last generation, the widespread adoption of big farm machinery and harvest technology has increased the distance between many farmers in the West and their most precious resource and ally—the soil. Contact this with the intensity of farming in the developing world who are literally born to farm with their own hands. Of course, I am not advocating moving away from technology. But farmers across the planet need to use that legacy of knowledge and skills in partnership with new technologies so they can produce a sufficient, safe and nutritious food that meets the dietary needs and food preferences for

an active and healthy life for all, while at the same time nurturing Mother Nature. This must start with understanding and respecting the foundation of all agricultural production—the soil.

Get to know your soil! The best place to start understanding and improving your soil health is to develop a direct relationship with your soil. Take some time to go out into your fields and dig a soil pit to get to know the soils across your farm intimately.

Plot dig down as far as you can to the bedrock, if that is possible, and then tidy up one side so that it is vertical, straight edge. As you dig, think about the following points:

- Is it difficult to dig?
- Is it sandy, sticky, or crumbly, sticky?
- Can you see different soil layers? What color are they? How deep are they? Are the boundaries between layers sharp or do they fade into each other?
- Does the soil stick together or fall apart? What does the soil feel like? Is it very sticky when moist? Does it break apart easily? Is it crumbly, gritty, sticky or sticky?
- How far do you need to go down? Are there obvious layers of compacted soil that roots cannot get through?
- Are there any signs of life? What kind of bugs and other life forms do you see? Are there earthworms, beetles and other bugs, as well as fungal growth?

So, when thinking about how to improve the health and management of your soil, remember that bugs need a constant supply of soil organic matter to feed on. Keep producing the nutrients, energy and grit that feed the soil particles together



Soil profile for the pit you can see the structure, if possible, and tidy up one side to a vertical straight edge.



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SIMPLE TESTS TO ASSESS THE HEALTH OF YOUR SOIL
Digging soil pits on your farm is the first step in learning about your soils and finding out what you can do to improve soil health, while comparing soils in different fields across your farm will give you an even better picture. You may find that fields you thought were similar are very different when you dig below the surface. But there are a number of simple tests you can do to get to know your soil even better. Before you start any of these tests, note the weather and make sure you are comparing soils with the same soil layer from sandy loam through to clay. If you are not sure of your soil type, a number of online guides are available. I see the way to follow soil type guide is to use a soil type guide available. Try to choose sites that are flat and well away from boundaries and trees that could affect the general character of your soil. Finally, I would also advise taking the soil of the soil using a sample off the surface or a separate sample, so the soil can affect the other soil.

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This test is based on the evidence that soil with good soil organic matter content holds more water, which the ground soil structure allows water to move down into the soil profile. This means the right conditions for growing good crops, your soils a store of water when the weather is dry. The water moves through the soil through pores that exist between soil particles and through larger earthworm burrows and soil channels. Take a short section of 10 cm pipe and push it a couple of inches into the ground, using a measuring cup to hold, pour a known amount of water onto the soil and use a stopwatch to time how long it takes the water to disappear. Again, compare results with fields in different soils across your farm, and also record the same site after a change in management to see if there is a difference. Make sure you use the same pipe, measured to the same depth and the same amount of water each time you do this test.

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