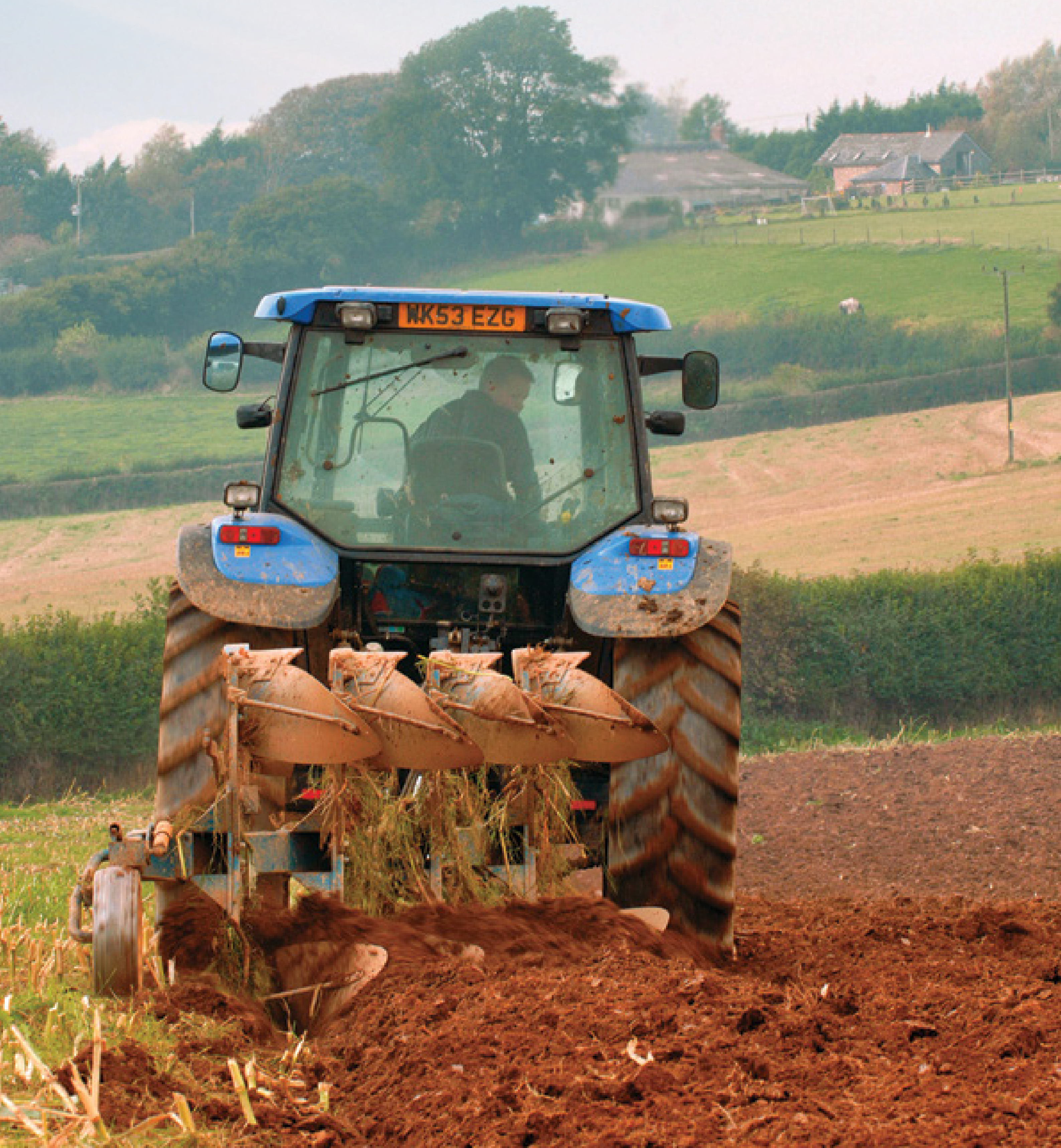
To plough or not to plough

Tillage and soil carbon sequestration



Policy Briefing, November 2018

Executive summary

Fertile, healthy soils are vital for our food security. Globally, they store an estimated 9.8 billion tonnes of carbon. If managed well, they can reduce greenhouse gas emissions; but if badly managed, soils turn from a store to a source of emissions. Soils can also help prevent floods and reduce the impact of droughts; but badly managed soils lose the ability to absorb and filter water, damaging water supplies and increasing flood risk.

The government is committed to placing soil at the heart of UK farming. The Secretary of State for Environment, Food and Rural Affairs (Defra), Michael Gove, has said that proposals to improve soil health will have 'as strong an evidence base as possible'. On that basis, he has expressed support for conservation tillage systems, also known as 'min-till' or 'no-till'. This Soil Association briefing aims to set out the extent of current knowledge.

Key points:

- Min or no-till has become popular in recent years. Min and no-till systems minimise soil disturbance and are claimed to sequester additional carbon over time, as organic matter increases and with it soil carbon levels.

- Min till also offers the potential for lower costs of machinery use (lower energy use), less damage to soil structure, less risk of soil erosion, less environmental damage from nitrogen leaching and pesticide run-off from bare (ploughed) land, and environmental benefits such as increased soil fauna and habitats for birds.

- However, scientific research on conservation tillage does not support the position that min or no-till be adopted as a guaranteed method of cutting farming's greenhouse gas emissions. For example, a study carried out by ADAS for Defra in 2006 concluded that "there is only limited scope for additional soil carbon storage/accumulation from zero/reduced tillage practices and organic material additions, over and above 'present day normal farm practice'", and that "there are questions over the implications of such practices for nitrous oxide emissions and the overall balance of greenhouse gas emissions (expressed on a carbon dioxide equivalent basis)". Other leading research concluded that the role of no-till in mitigating climate change "is widely overstated".

- Min or no-till systems generally rely on herbicides to kill crop residues and weeds. This may have a damaging impact on soil biodiversity and the surrounding environment—in particular, evidence is emerging of damage to earthworm populations.

- In the UK, non-organic arable farmers who use min or no-till systems have frequently suffered severe outbreaks of grass weeds such as blackgrass, leading to a resumption of ploughing. Min or no-till techniques are also used by some organic farmers who do not use herbicides to help manage their tillage systems.

- Min or no-till is certainly not the only way to increase soil carbon. There is clear scientific evidence that many farming practices—particularly those that are part of organic farming systems, such as winter cover-cropping, use of farm-yard manure and inclusion of grass leys in arable rotations—contribute to raising the levels of soil organic matter and soil carbon.

- As several studies have reported, the better performance of organic farming in sequestering soil carbon may be because organic systems have between 32% and 84% greater microbial biomass; and organic farming systems appear to have positive effects on soil microbial community size and activity. A long-term study published in 2007 concluded that "organic farming can build up soil organic matter better than conventional no-till farming can". A recent U.S. study found that organically managed soils store more carbon for longer periods and have on average 44% higher levels of humic acid—the component of soil that sequesters carbon over the long term—than soils not managed organically.

- Min and no-till bring other benefits to soils, including greater concentration of organic matter near the soil surface, better soil structure, enhanced seedling emergence and water infiltration and water retention, making them more resilient in the face of droughts or floods. However, other practices will bring similar benefits, including farming practices inherent in organic farming but available to all farmers, such as tree planting (including integrating trees with farmland – agroforestry), conversion of arable land to grassland, and inclusion of temporary grassland in arable cropping systems.

- Depending on the starting conditions and soil type, one study found that the rate of increase of soil carbon drops by 50% 10 years after converting from arable to semi-permanent grassland. After 50 years, some soil scientists suggest that the rate is virtually zero when a new soil equilibrium is reached, but new research suggests increases will continue for longer. This is good news in the fight against climate change because to meet internationally-agreed targets, cuts in greenhouse gas emissions are needed over the next 30 years. The French Government initiative, agreed by the UK, is that we should increase soil carbon levels by 0.4% annually to 2050.

- Despite the use of ploughing on most organic farms, organically-farmed soils have been found to have on average 21% higher levels of soil organic matter than non-organic soils. Recent research found that shallow non-inversion tillage resulted in no significant reductions in yield relative to deep ploughing, with significantly higher earthworm populations and better weed control. The most recent research, published in 2018, concluded that soil organic carbon can be over-estimated if deeper soils are ignored, and that their results "support the message advocated in former studies that the no-till sequestration potential with respect to mitigating climate change is likely to be over-optimistic".

- Organic farming practices perform significantly better against a range of other soil health indicators, such as abundance of soil microbes. While soils cannot prevent droughts and floods, they can be more resilient in the face of flooding and drought. A 2017 U.S. study found that soils from organic farms had 13% more soil organic matter and 26% more potential for long-term carbon storage than soils from non-organic farms.

This document was the final Soil Association briefing that Soil Association Policy Director Peter Melchett worked on before his death in 2018.

Introduction

The government has repeatedly committed to placing soil at the heart of UK farming and the government's consultation document, Health and Harmony: the future for food, farming and the environment in a Green Brexit, recognised that "we have an opportunity to improve the health of our soils".[1] The recently published Agriculture Bill confirms that public money will be aimed at providing public goods, and we welcome the focus on soils that this entails. However, from what we have seen, it is not the radical rethink that we so desperately need if the government is serious about restoring soil health, amongst other key issues.

Secretary of State for Environment, Food and Rural Affairs (Defra), Michael Gove, has assured farmers that the future proposals will have "as strong an evidence base as possible" when proposing what techniques farmers should adopt to improve their soil health. On that basis, he has expressed support for conservation tillage (also known as 'min-till' or 'no-till') systems.

However, the scientific research on conservation tillage does not support the position that min or no-till be adopted as a guaranteed method of cutting farming's net greenhouse gas emissions. This briefing aims to set out the extent of current knowledge on this topic.

An estimated 9.8 billion tonnes of carbon are stored in the UK's soils, making them an essential resource to reduce greenhouse gas emissions and tackle climate change.

Valuing soil

UK's soils are in crisis due to erosion and loss of organic carbon. Fertile, healthy soils are vital for the nation's food security and provide us with more than food.

An estimated 9.8 billion tonnes of carbon are stored in the UK's soils, making them an essential resource to reduce greenhouse gas (GHG) emissions and tackle climate change.[2] However, when badly managed, soils can turn from a store to a source of GHG emissions.

Soils perform a vital function in the prevention of floods and droughts. Healthy soils, rich in organic matter, can store excess water—providing resilience against water stress in periods of drought, and protecting against flooding. In contrast, eroded and compacted soils lose the ability to absorb and filter water, damaging water supplies and increasing flood risk.

Improving soil health is a critical way to tackle climate change.[3]

Healthy soils act as a carbon sink by drawing carbon down into the soil to store it.[4] Cropland soils are ideal for use as a carbon sink, since they have been depleted of carbon in most areas. Globally, an estimated 70 to 133 billion metric tonnes of carbon that was trapped in the soil has been released since measurements began.[5] Recognising the ability of soil to sequester carbon and its contribution to climate mitigation, the UK signed up to the French government's 4 per 1000 soil carbon initiative at the UN Climate Change Convention in Paris. This initiative aims to increase soil organic carbon by 0.4% each year to help meet the Paris targets for net GHG emissions by 2050.

Why is tillage a problem?

The extent of any damage to soils from mechanical operations will depend on the time of year, depth of cultivation and frequency of such actions, how wet the soil is, and the soil type.

Inversion ploughing will turn the soil upside down, but the degree of disturbance will depend in part on the depth of ploughing. Repeated mechanical operations can reduce soil organic matter (SOM), as soil microorganisms become more compromised, but inversion can help oxygenate soil, making methane and nitrous oxide emissions from anaerobic soils less likely.

The majority of soil breaking actions are carried out to produce a seedbed and establish a crop. Weed suppression with hoes and other mechanical weeding machinery also break the soil surface. As we learn more about the impacts of breaking and turning over the soil, the need for such cultivations is increasingly being questioned. Some farmers are seeking ways of minimising their cultivations to limit possible damage, and to save on the costs of mechanical operations. A similar move happened around 30 years ago in the UK, but 'direct drilling' as it was called (without ploughing) fell out of fashion, partly because of increasing weed problems and possibly less powerful machinery than is now in use.[6]

Organic farmers use nitrogen-fixing legumes, cover-crops, livestock grazing and rotations in place of fertilisers and pesticides

What are min and no-till systems?

Conservation tillage is a group of practices that generally reduce the amount of tillage needed. Reduced tillage intensity is one of the key components of conservation agriculture systems promoted by the UN's Food and Agriculture Organisation (FAO) to conserve, improve, and make more efficient use of natural resources.

It relies on three key practices:

- Minimal soil disturbance by direct planting through the soil surface
- Maintenance of a permanent vegetative soil cover or mulch to protect the soil surface
- Diversified crop rotations of annual crops with the inclusion of winter cover-crops.

The six tillage classes, defined by France's National Institute for Agricultural Research (INRA) in order of decreasing intensity, are as follows: deep inversion (greater than or equal to 25 cm depth); double-layer ploughing (inversion of the soil to a depth of ~15 cm and loosening to ~30 cm); shallow inversion (less than 25 cm depth); non-inversion (10–25 cm depth); min-till (less than 10 cm depth); and no-till.[7]

Direct drilling is a key aspect of a no-till system. Seed is inserted in a field where the surface has not been inverted, although it may have been disturbed, and any crop residues from the previous crop are partially incorporated or left on the surface. Seeds are delivered in a narrow slot created by discs, coulters or chisels. Direct drilling offers the potential for savings over traditional plough-based crop establishment systems due to possible lower costs associated with machinery use (lower energy use), less damage to the soil's structure, less risk of soil erosion, and less environmental damage from nitrogen leaching and pesticide run-off from bare (ploughed) land. Direct drilling can also provide environmental benefits, such as increased soil fauna and habitats for birds.

Farmers who practice no-till have generally relied on herbicides to kill crop residues and weeds. This can lead to higher inputs of agrichemicals that may have a damaging impact on soil biodiversity and the surrounding environment. Agrochemical companies tend to be strong supporters of no-till practices.[8]

No-till or min-till techniques are also used by some organic farmers who do not use herbicides to help manage their tillage systems. Organic farmers use nitrogen-fixing legumes, cover-crops, livestock grazing and rotations in place of fertilisers and pesticides, and mechanical means if needed to destroy previous crops prior to direct drilling. Some find that min or no-till systems work well for them.

What is the impact of conservation tillage on soil health?

Tillage leaves soil exposed to wind and water, increasing erosion. By using minimal tillage and direct drilling, farmers minimise soil disturbance and therefore reduce erosion. A possible added benefit is that carbon is sequestered, as, over time, organic matter increases and with it soil carbon levels.

However, min or no-till is certainly not the only way to increase soil carbon. Many farming practices—in particular, those that form part of organic farming systems, such as winter cover-cropping, use of composted farm-yard manure and inclusion of grass leys in arable rotations—contribute to raising the levels of SOM. Despite the disruption caused by ploughing, organically-farmed soils have an average of 21% more SOM than non-organic soils.[9] This is because of the panoply of techniques that are inherent in organic farming systems which build soil health.

There is also a significant question over the negative soil (and environmental) impact of the spraying of pesticides commonly employed in min or no-till systems. There is well-documented evidence that pesticides damage biodiversity above and below the surface of the soil.[10]

Evidence that glyphosate-based herbicides can harm non-target organisms—particularly amphibians [11], symbiotic mycorrhizal fungi [12] and earthworms [13]—continues to mount. A recent study found that the activity of vertically-burrowing earthworms almost ceased three weeks after an application of glyphosate, and the reproduction of the same worms was reduced by 56% within three months after herbicide application.[14] There is a growing body of evidence suggesting that the environmental damage caused by high agrochemical usage might well offset any possible carbon benefit of reduced tillage.

UK arable farmers who currently use min or no-till systems frequently suffer severe outbreaks of grass weeds such as blackgrass. The UK's temperate climate and soils differ from the continental climate in countries like the USA and much of Europe and Russia, making weeds more prevalent. The UK generally has heavier soils, a smaller temperature range and more consistent year-round rainfall. This increases the difficulty in utilising min-till techniques, since UK grass weeds will germinate over a longer period, and min or no-till cultivation that might be viable in more continental climates does not work so well in the UK due to these significant climatic and soil differences.

Min or no till systems work best with combinable crops, and use can be limited after root crops like sugar beet or potatoes, where crop residues need to be buried by ploughing.

Other factors that will affect the amount of carbon that soils can sequester will include the type of soil and the depth of soil. For example, sandy soils will not hold the same level of carbon compared to a heavier soil, and the depth of soil above the bedrock can differ considerably. and this will impact the amount of carbon that can be sequestered in the soil.

Does min or no-till actually increase soil carbon levels?

Although many claim that min and no-till increase soil carbon levels, the scientific evidence suggests that this is not always the case.

ADAS conducted a study for Defra in 2006 that stated that there is only limited scope for additional soil carbon storage/accumulation from zero/reduced tillage practices and organic material additions.[15] There are further questions over the implications of tillage on nitrous oxide emissions and the overall balance of GHG emissions (expressed on a carbon dioxide (CO_2-C) equivalent basis). Defra's expert view has remained much the same since, despite enthusiasm from government ministers, farming organisations, and pesticides companies.

The science remains controversial today with academic studies reaching different conclusions. A 2016 Environmental Evidence review noted: "No tillage or reduced intensity tillage are frequently proposed mitigation measures for preservation of soil organic carbon (SOC) and improvement of soil quality, for example for reducing erosion. Whilst several reviews have demonstrated benefits to carbon conservation of no-till agriculture over intensive tillage, the general picture for reduced tillage intensity is unclear".[16] After accounting for methane and nitrous oxide emissions, as well as carbon sequestered, a 2014 Nature study indicated that zero tillage could play a significant role in minimising GHG emissions from soils and contribute to efforts to mitigate climate change.[17] On the other hand, a 2015 global meta-analysis found "no-till reduced yields, on average, by 5.1% across 50 crops and 6005 paired observations".[18]

A 2007 review in Environmental Pollution found that the extra nitrous oxide emissions from min or no-till soils could offset sequestration of 0.3 tonnes of carbon per hectare per year.[19] A comprehensive 2010 review for Food and Climate Research Network (FCRN) concluded that while there is no consistent pattern, nitrous oxide emissions usually increase under min-till.[20] On the overall benefits of min and no-till, the FCRN review concluded that there are possibly small SOC accumulations, which is in agreement with the Stern Report that estimates 0.14 tonnes of carbon per hectare per year sequestered under no-till.[21]

Researchers concluded that "no-till is beneficial for soil quality and adaptation of agriculture to climate change, but its role in mitigation is widely overstated."

Research in 2014 concluded that claims that min or no-till increase soil carbon "ignore a large body of experimental evidence showing that the quantity of additional organic carbon in soil under no-till is relatively small: in large part apparent increases result from an altered depth distribution.[22] The larger concentration near the surface in no-till is generally beneficial for soil properties that often, though not always, translate into improved crop growth. In many regions where no-till is practised it is common for soil to be cultivated conventionally every few years for a range of agronomic reasons, so any soil carbon benefit is then lost". The researchers concluded that "no-till is beneficial for soil quality and adaptation of agriculture to climate change, but its role in mitigation is widely overstated".

This was confirmed in a recent meta-analysis completed in 2017 and published in 2018. In a major study, researchers looked at the results of 101 long-term field trials against a background of "a number of meta-analyses revealing either a positive or non-significant effect" of changing from ploughing to min or no-till.[23] This study looked at both SOC levels and soil density, and the researchers also found that the "no-till sequestration potential is overvalued when neglecting deeper depths, since the SOC storage capacity was reduced when soils were studied to a depth of 60cm".

The meta-analysis highlighted that both intermediate min and no-till practices increase soil carbon stocks in the first 30cm compared to high-intensity tillage in temperate climates. However, these positive effects decreased with soil depth, and the researchers say "these results support the message advocated in former studies that the no-till sequestration potential with respect to mitigating climate change is likely to be overoptimistic". The scientists say that further studies are needed, particularly of soils at deeper depths.

Recent estimates from UK experiments suggest that 0.31(+/-0.18) tonnes carbon per hectare per year is sequestered under no-till and approximately half this amount for min-till.[24] That said, UK min-tilled land is often ploughed every few years to control grass weeds, which may negate any carbon storage. What is clear is that min and no-till bring other benefits to soils, including greater concentration of organic matter near the soil surface, better soil structure, enhanced seedling emergence, water infiltration and water retention.

Does soil reach a maximum carbon holding capacity?

All soils will have a limit to the amount of carbon they can store. However, on most soils these limits are generally high enough—and increases in carbon sequestration can continue for long enough—to have a positive impact on net GHG emissions.

The inherent physical and chemical characteristics of the soil may determine the maximum quantity of SOM which can be stabilised.[25] Studies have observed that over time the ability of soil continually to sequester carbon decreases.

Depending heavily on the starting conditions and soil type, 10 years after converting an arable cropping system into semi-permanent grassland, some research found that the rate of carbon drawdown drops by 50% after 50 years, and the rate is virtually zero when a new soil equilibrium is reached. However, this is good news in the fight to combat climate change because to meet internationally agreed targets, we need to achieve net cuts in GHG emissions over the next 30 years. French government estimates suggest that by increasing soil carbon levels by 0.4% annually, we would be able to offset up to 75% of global anthropogenic GHG emissions. This figure is questioned by some soil scientists, but the significant potential for soil carbon sequestration remains.

Recent research suggests soil carbon sequestration may continue for much longer: in a long term study published in 2017, UK researchers showed increases well beyond the 20-year limit usually accepted.[26] They concluded that with "43 years of data from a permanent grassland experiment we show that soils not only act as significant carbon (C) sinks but have not yet reached C saturation. Even unfertilized-control soils showed [increased] C sequestration rates .... between 1970 and 2013".

In the UK, agricultural soils are severely degraded and it is thought that SOM has been declining for decades.[27] The immediate need is to restore agricultural land to as close to its original soil carbon level as we can; as well as offsetting a significant portion of our GHG emissions, this will improve crop yields, increase farmland wildlife and, by improving the water holding capacity of soils, will reduce flooding and farming's vulnerability to droughts.

Does nitrogen become a limiting factor?

There is a fine balance of nitrogen to carbon in the soil. To stay alive, microbes need a carbon:nitrogen ratio near 24:1.[28]

When the carbon level is raised, additional nitrogen needs to be added to balance out the ratio. Researchers have questioned the feasibility of significantly increasing soil carbon levels without relying on artificial nitrogen fertiliser to recalibrate the carbon:nitrogen ratio. Having to add manufactured nitrogen, with consequent energy use and emissions of nitrous oxide (a powerful GHG) would counteract any reduction of GHG emissions.

Organic farmers do not rely on artificial fertiliser to increase the nitrogen levels of their soils. Instead, they use legumes as cover-crops that naturally fix nitrogen into the soils through their root system due to a symbiotic relationship with bacteria such as *Rhizobium spp*.

This nitrogen can be released for use by subsequent crops. Through these natural processes, organic farmers can raise the nitrogen levels in their soils to facilitate higher soil carbon levels without relying on artificial fertilisers.

What levels of fluctuation should be expected?

An increase in ambient temperature will, among other things, stimulate microbial activity, which is expected to decrease the amount of SOM.

Global temperatures are rising due to climate change, and climate change will also cause more extreme weather events, including changes to precipitation levels and frequency. Increased heavy rainfall will have a negative impact on soil health since there will be increased run-off and higher levels of erosion, but these will be reduced by increasing levels of SOM and ensuring that soils are not left bare, especially in winter.[29]

Can new technologies help?

Many no-till conventional farmers are looking to reduce their glyphosate usage.

Innovative Farmers, a farmer-led research network supported by the Soil Association, is considering the issue in their trial of a range of mechanisms to terminate cover-crops. With such new technologies organic farmers are also looking to min and no-till practices to minimise tillage, where possible. Within the Innovative Farmers network, scientists work with groups of farmers to facilitate practical 'field labs' on farms across the UK. The current cover-crop management trial will test how different practices can reduce the need for glyphosate to kill off cover-crops.[30]

Does organic farming require tillage?

A 2007 long-term study found that "organic farming can build up SOM better than conventional no-till farming can".[31]

Organic farming, despite its emphasis on building organic matter, had been thought to endanger soil because it relies on tillage and cultivation—instead of herbicides—to kill weeds. But the study showed that organic farming's addition of organic matter in manure and cover-crops more than offset losses from tillage. 89% of surveyed organic farmers practicing conservation agriculture used some form of reduced tillage (defined as any tillage shallower than the standard conventional ploughing practice) and/or a non-inversion method, and as many as 27% of the organic farmers practicing conservation agriculture used no-till.

Although organic farming controls weeds without herbicides, there are challenges when combining organic practices with reductions in tillage intensity, and crop yields may be compromised. Reducing tillage intensity in organic systems reduced crop yields by an average of 7.6 % relative to deep inversion tillage with no significant reduction in yield relative to shallow inversion tillage. Among the different classes of reduced tillage practice, shallow non-inversion tillage resulted in non-significant reductions in yield relative to deep inversion; whereas deep non-inversion tillage resulted in the largest yield reduction, of 11.6 %. Using inversion tillage to only a shallow depth resulted in minimal reductions in yield, of 5.5 %, but significantly higher populations of some earthworms and better weed control.[32]

What methods are integral to organic farming that build soil organic matter and soil carbon?

There are a number of practices including mixed (livestock and crops) farming that are integral to most organic farming systems and that build SOM and soil carbon.

For example:

Shallow inversion ploughing

It has long been the practice of organic farmers to limit the depth to which they plough, aiming for minimal disturbance of the upper layers of their soil. This was primarily to avoid turning up new weed seeds buried deeper in the soil. However, recent research suggests that the depth to which either inversion ploughing, non-inversion ploughing or cultivations are carried out may have a greater impact on SOM and soil carbon sequestration than the nature of the tillage system employed.[33] Of the different cultivation systems studied, shallow inversion tillage performed best, with higher soil carbon sequestration and better weed control.

Composted animal manures

Organic farmers generally need to add animal waste from chickens, pigs, cattle or sheep to their crop land to supply phosphate and potash (the third and most crucial input needed by growing crops, nitrogen, is supplied by growing nitrogen-fixing legumes like red clover). All animal wastes added to soil will add to soil carbon, but there is a hierarchy, with compost best, followed by composted farm yard manure, and liquid slurry having least impact. Organic farms are more likely to use straw-based (rather than liquid slurry) systems, and organic rules require manures to be composted for at least 6 months.

Grass leys in arable rotations

Organic farms require around 2-3 years of grass/clover leys (usually red clover or Lucerne) in a typical 6-year rotation, to provide the nitrogen needed to grow crops. In countries where two or three crops can be grown each year, at least one will be a deep-rooted, nitrogen-fixing crop. Grass/clover leys add to SOM and carbon sequestration.

Winter cover-crops

In the UK, organic farmers favour spring-planted crops, as they take up naturally-fixed nitrogen more efficiently than the autumn-planted crops favoured by non-organic farmers. This generally requires organic farmers to plant a green winter cover-crop to conserve soil and hold nitrogen overwinter. When these crops are incorporated into the soil they add to SOM and carbon sequestration.

Deeper and denser rooted crops

On organic farms, without the addition of manufactured nitrogen, mined phosphates and potash, crops have to scavenge the soil more aggressively to find the nutrients they need to grow. This gives organic crops deeper and denser roots, and organic farmers often look to plant deep rooting crops, like clovers and lucerne, to encourage better uptake of nutrients. These deeper and denser roots are incorporated into the soil, adding to SOM and soil carbon.

Can organic methods deliver improvements to soil health?

Recent research published in Advances in Agronomy found that organic farming can build SOM better than conventional no-till farming.[34]

Organic farming, despite its emphasis on building organic matter, was thought by some to endanger soil carbon stocks because it generally relies on tillage and cultivation—instead of herbicides—to kill weeds. Studies showed that the organic farming system's addition of organic matter through composted manures and plant residues more than offset any possible losses from tillage.

Organic soil cultivation has the potential to sequester high levels of carbon. Researchers in Europe have reported that the progressive conversion to 50% of EU land under organic farming by 2030 would offer a mitigation potential of 23% of agricultural GHG emissions through increased soil carbon sequestration and reduced application of mineral fertilisers.[35]

One explanation for the better performance of organic farming in sequestering soil carbon may be because, as several studies have reported, organic systems have 32% to 84% greater microbial biomass carbon, and organic farming systems appear to have positive effects on soil microbial community size and activity.[36]

A recent study from the U.S. found that organically managed soils store more carbon for longer periods and have on average 44% higher levels of humic acid—the component of soil that sequesters carbon over the long term—than soils not managed organically.[37] This research found that soils from organic farms had 13% more SOM and 26% more potential for long-term carbon storage than soils from conventional farms. There is now also a significant body of evidence to show that organic farming practices perform significantly better against a range of other soil health indicators, such as abundance of soil microbes and resilience against flooding and drought.[38]

Conclusion

Sweeping generalisations about soil health are hard to make. There is no 'silver bullet solution' for soil health and there is no short cut for building soil carbon.

The government should look to support further research into soil health and associated practices. However, organic farming has been proven to be the most effective way of building soil carbon, and it does not require the high level of agrochemical inputs that can further damage soil and farm wildlife. If the government wants to achieve greater soil health across the UK, it should encourage the wider adoption of organic farming practices and provide support for farmers to encourage a higher level of conversion; and whether using inversion tillage, min or no-till systems, all farmers should take special care to disturb as little of the top layer of their soils as possible.

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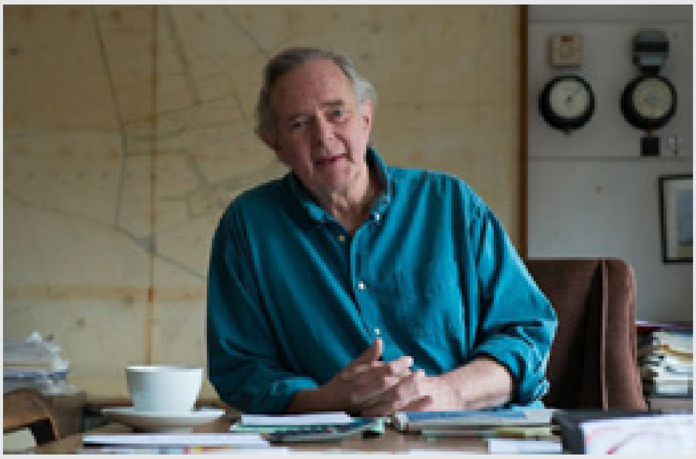
In memory of

Peter Melchett

1948-2018

Life-long champion of the environment and
Soil Association Policy Director, 2001-2018



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