LIVING SOILS

A Call to Action

Soil Association

Introduction

Soil is essential for life on earth. It is the earth's living skin we all rely on, but take for granted. One quarter of all known species live within soil. Just one teaspoon can hold more organisms than there are people on the planet. Soils hold more carbon than our atmosphere and vegetation combined. As Lady Eve Balfour, founder of the Soil Association said: 'The health of soil, plant, animal and man is one and indivisible'.

Healthy soils provide food, feed, fuel and even fibre for clothes. Healthy soils store and regulate water flow and mitigate climate change. 95% of our food comes from soil.

But soils are also fragile. Declining soil health spells trouble for everyone. When extreme weather hits, the scale of floods and droughts are made worse by unhealthy soils. Bare or damaged soils are more at risk of soil erosion. Soil washed away can clog up rivers and lakes, increasing the flood risk for people living downstream. Unhealthy soils also store less carbon, contributing to global warming. And of course, when soil degradation is severe, food production is drastically reduced.

Despite this, soil degradation is widespread across the world. A quarter of all soil is severely degraded and soil erosion occurs on a massive scale. Around 10 million hectares of land are abandoned every year, due to soil erosion alone. This is just as relevant to the UK as to other countries. With our imports of animal feed and food, UK farming and consumption also contributes to soil damage overseas.

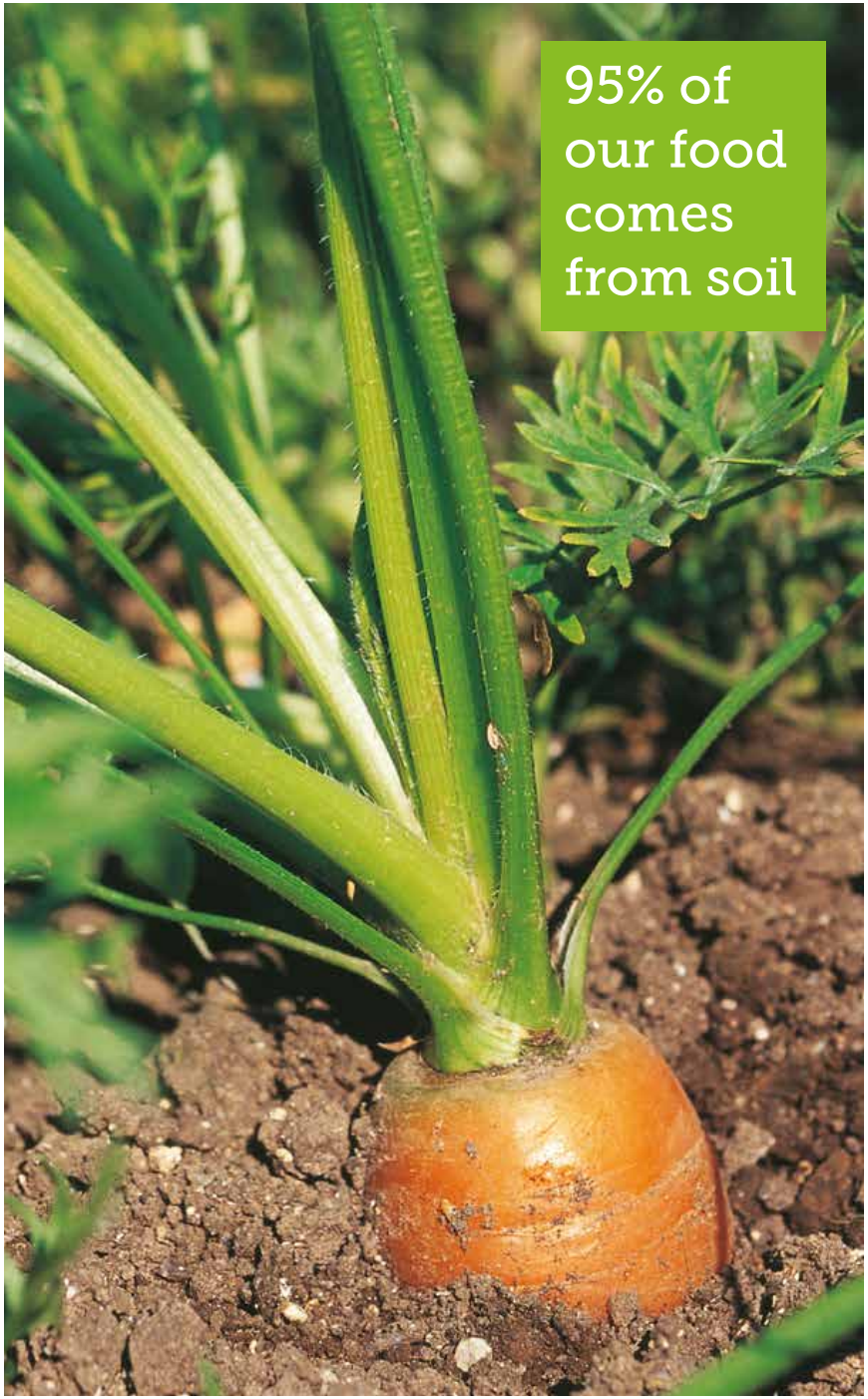
We are still learning about our soils. Notably about the variety of soil life, its role in sustaining soils and how we are damaging it.

Intensive farming, reliant on chemical inputs, is responsible for much of this soil degradation and more intensive farming certainly won't fix this global problem. Agroecology - a system of agriculture and land management that looks to natural ecosystems to inform its agricultural practice and feeds the soil to feed the plant - will remedy this situation. Organic farmers who use agroecological practices build and maintain healthy soil.

Around 10 million hectares of land are abandoned every year, due to soil erosion alone

The pressure on soil is great. It will only increase with climate change and population growth. We need to reconsider how we value and manage our soils, to change our path to a healthier future. The United Nations Food and Agriculture Organisation (FAO) has designated 2015 to be the International Year of Soils. This is the time to take notice and make steps towards changing practice.

In this document we examine what soils are made of including, crucially, the countless organisms that live in it and explain where we have been going wrong in how we manage soils. The good news is there is a solution. Science proves that organic farming methods and agroecology will repair soils. This is essential for all our futures.



Case study

The Fens

Is soil erosion something we should worry about in the UK? Yes! One of the most famous examples of soil erosion is occurring in The Fens. These peat soils were drained in the 17th century to create excellent soils, seemingly perfect for cultivation. Over time however, problems have occurred. Peat that is drained breaks down. It combines with oxygen (becoming oxidised) and shrinks as it dries up. Winds then literally blow the soil away. Heavier tractors and few hedges to provide protection from the wind have worsened the problem. Official estimates are that 28% of England's deep peat soils have been 'wasted' in this way[1].

Not only are we losing the soils in which we grow our food but we are also losing the ability of our soils to offer essential 'ecosystem services' such as supporting biodiversity, storing carbon and flood and drought protection. 380,000 tonnes of soil carbon is being lost, each year, from the peat soils in the East Anglian Fens. Once it has been lost from the soil most of this carbon is emitted to the atmosphere, contributing to climate change. Even though the Fens make only 0.12% of UK landmass, this loss of soil carbon equates to 9% of the total carbon loss from soils across England and Wales.

A Fens Blow. Unprotected soil is being blown from the Fens

Why do we need healthy soil?

We are dependent on the top few feet of the earth's surface for many things. Not only do healthy soils provide the basis for the vast majority of our food, they also regulate flooding, provide a home to a quarter of all known species and contain more carbon than the atmosphere and all vegetation combined. We should look after our soils.

Healthy Soils enable us to produce food and meet our basic needs

According to Maria-Helena Semedo, Deputy Director General of Natural Resources at the FAO[2], 95% of our food comes from soil. But we also need soil to grow animal feed, fuels (such as wood and biofuel) and fibre (such as cotton for our clothes). In the UK we use nearly all of our soils for this purpose. Unless that is we have already concreted over them.

But 'sealing' soils in concrete isn't the only way to stop soils supporting the production of food, feed and fibre. Worldwide, the 10 million hectares of cropland abandoned every year is the equivalent of 30 football pitches every minute[3].

Soils Control Water Flow

Healthy soils act as sponges – soaking up and holding water for plants and other organisms and controlling the rate at which excess water drains through and away. This is how healthy soils provide a buffer against flooding and drought.

Worldwide, 10 million hectares of cropland is abandoned every year

Soils Control Pollution

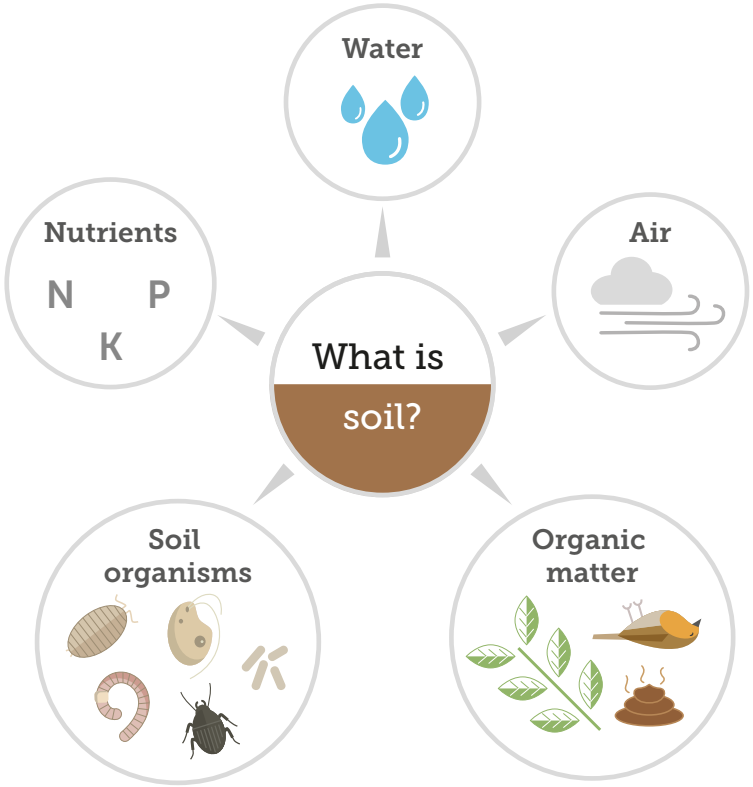
As water seeps through soil it interacts with soil particles and soil organisms. Soils rich in micro-organisms help break down harmful chemicals, reducing levels of contamination and thereby reducing pollution.

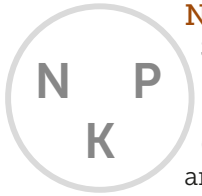
Soils Regulate Climate Change

Soils hold more carbon than the atmosphere and all vegetation (including all forests) combined. Many soils have the potential of storing far more carbon than they already do, which could significantly help fight climate change. Carbon is added to soil as organic matter. This can be from plants, capturing carbon from the atmosphere which then becomes incorporated into the soil when leaves fall or the plant dies. Another way for carbon to be added to soil is by land managers adding organic matter directly to soils, for example by using organic fertilisers such as farmyard manure or green waste composts. Transferring carbon from the atmosphere into the soil in this way can help countries meet their climate change mitigation targets.

What is soil?

Soil is a combination of minerals, organic matter, air, water and living organisms. It is this combination of materials that provides the essential components and services to sustain life.





Nutrient Supply

Soils provide plants with 17 nutrient elements essential for plant growth (including carbon, oxygen and hydrogen from the air). They are considered to be either macro elements (needed by the plant in large amounts) or micro elements (only needed in small amounts).

Macro Elements	Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg) and Sulphur (S), Carbon (C), Oxygen (O) and Hydrogen (H).
Micro Elements	Manganese (Mn), Iron (Fe), Boron (B), Zinc (Zn), Copper (Cu), Molybdenum (Mo), Chlorine (Cl), Cobalt (Co).

Water

To enable these nutrients to be taken up by plants, soils must also contain water to dissolve the nutrients so that plant roots can absorb them. Sufficient water is also essential for it to travel through the plant, transferring the nutrients into the stem, leaves, fruits and flowers; as well as to provide rigidity for the plant to stand upright.

Organic Matter

Organic matter originates from plants (e.g. crop residues and roots) and animals (e.g. manures) and helps to hold nutrients and water in the soil. It also aids in reducing soil compaction and increasing the amount of rainwater that the soil can soak up. In the UK, the amount of organic matter in our arable and horticultural soils is in long term decline.

Air

Typically, about 50% of the volume of any soil is made up of spaces ('pores'), through which either water or air can flow[4]. The air held within these soil pores, diffuses into root cells, allowing roots to grow. Most soil organisms need air to carry out their crucial roles of breaking down soil organic matter into nutrients that plants can absorb.

Living organisms

Soils are full of life. One quarter of all species on Earth live in soils, providing the basis for all food production for the other three-quarters - including us! Like all habitats, soils must provide the full range of conditions necessary for these species to survive and thrive. However, farming practices inevitably tend to simplify the complex food webs that naturally exist in soils

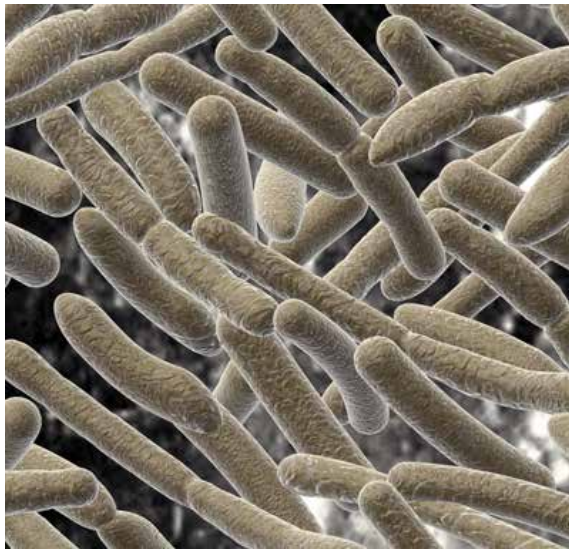
Until now we have not managed soils with their biology in mind. Yet, this soil life is as important to us as the life above ground. As the FAO[5] recognises, the life in soils 'requires the same attention as above-ground biodiversity'. Species living in soils form part of the same food web as life above ground. They are essential to the supply of nutrients to the crops on which we all depend. When campaigning to protect valuable habitats such as rainforests, environmentalists point out that these ecosystems may contain species that could provide medicinal benefits to humans. Now we are waking up to the potential benefits of soil biodiversity: Recently we have seen the discovery of new forms of antibiotics[6] and even anti-depressants[7] in soil.

However, as scientists have recently acknowledged *'Soil biodiversity is under threat by a range of pressures but remains severely understudied'*[8].

Life Under Earth

The variety of life in our soils is amazing. Just one teaspoon of soil contains around 10,000 different species[9]. This variety of life is essential to life on Earth and human prosperity. Whilst plants are essential in capturing the energy from the sun, it is the soil life which ensures the burial and breakdown of plant litter (old leaves and dead plants), releasing that energy for root uptake and transfer back to the plant. In this way, life in soil is an essential part of the web of life.

The major groups of soil organisms include bacteria, fungi, protozoa, nematodes, arthropods and earthworms, though there are many more.



Bacteria

Bacteria are tiny single-celled organisms. That same teaspoon of productive soil generally contains between 100 million and 1 billion bacteria. Bacteria perform several important functions. Some convert organic matter into forms useful for plants; others break down pollutants. Some form mutually beneficial partnerships with plants, supplying nitrogen to plants which in turn provide sugar for the bacteria.

Fungi

Fungi are important for nutrient cycling, water dynamics, disease suppression and just physically binding soil particles together. Forming long thread like structures called hyphae, they convert hard-to-digest organic material into forms that other organisms can use.

Protozoa

Protozoa are aquatic single-celled animals that live in the water filled pores, and the film of water that surrounds soil particles. Living in the top 6 inches of soil they consume bacteria, releasing excess nitrogen in a form available to the plant roots that surround them.

Nematodes

Nematodes are microscopic organisms, most of which are beneficial for agriculture. Living in the thin film of moisture that surrounds the soil particles, beneficial nematodes play an important role in decomposing organic matter and therefore the recycling of nutrients.

Earthworms

The feeding and burrowing activity of earthworms incorporates organic matter into the soil promoting decomposition, humus formation and nutrient cycling. The tunnels they leave behind them as they burrow through the soil provide channels for root growth, water infiltration and gas exchange. A review of nearly 60 different global studies has demonstrated that earthworms can increase yields in the absence of nitrogen fertiliser – by on average 25%[10].

However, earthworms do not only create good soils, they need good soils to live in. Worms breathe through their skin and so need a moist environment. Even slightly degraded soils can affect worm populations.

Arthropods

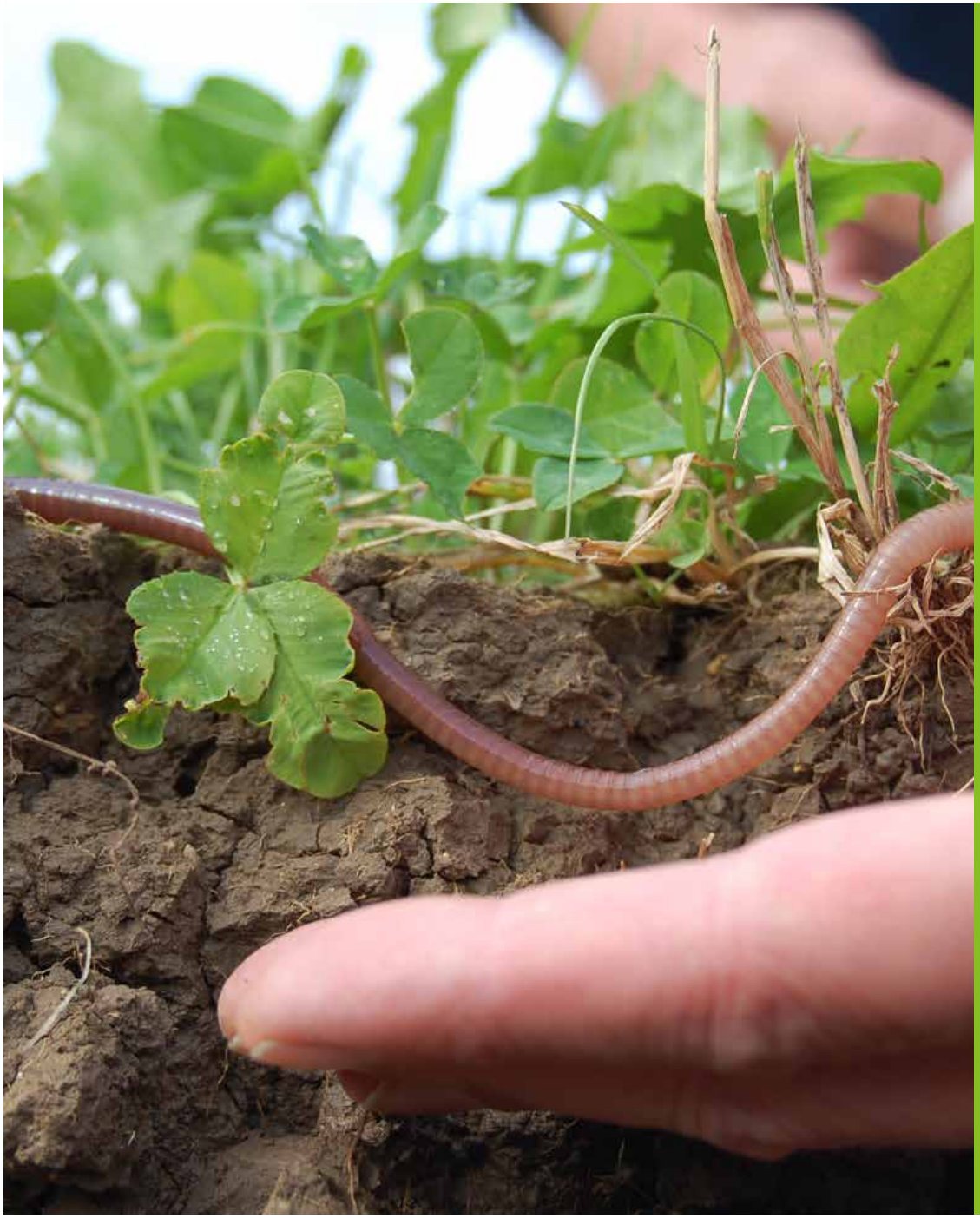
Arthropods are invertebrates and include centipedes, springtails, beetles and other insects. They can be grouped as shredders, predators, herbivores, and fungal-feeders, based on their functions in soil. Most soil-dwelling arthropods eat fungi, worms, or other arthropods. Rootfeeders and dead-plant shredders are less abundant. As they go about their business, arthropods mix and introduce air into the soil, shred organic material and prevent the population size of other soil organisms from becoming too large.

Molluscs

This is an important and diverse group of invertebrates which include snails and slugs. Many can have an adverse impact on crop production but some also play an important role in the decomposition of dead plant material.

Plants

Plants influence soils by exuding chemical secretions into the soil from their roots. For example, buckwheat produces a chemical that increases the availability of phosphorus, an important nutrient. Other plants produce chemicals that stifle the growth of competitors. For example, rye and mustard both produce a chemical that suppresses weeds, reducing the need for weeding in the next crop.



One quarter of all known species live within soil. Just one teaspoon can hold more organisms than there are people on the planet

The Soil Crisis

Although we depend on soils, across the world soils are being damaged by human activity. It has been estimated that

- Around one-third of the world's arable land has been lost since 1960 as a result of soil degradation[11].

- Approximately 25% of the world's soils are severely degraded[12].

- We lose the equivalent of 30 football fields of soil every minute to degradation[13].

This degradation has been going on for decades and there is no doubt that it is still occurring. The most recent comprehensive analysis of soil health by the FAO[14] identifies severely damaging processes occurring in all continents, including most of North West Europe, and damaging processes widespread across the globe.

This environmental carelessness is also expensive: globally the annual loss of 75 billion tons of soil costs the world about US$400 [£260] billion per year[15], whilst in the UK, topsoil losses per annum amount to 2.2 million tonnes, costing the farmer around £9 million per year in lost production[16].

A major new review of soil health, conducted by a group of leading scientists found that 'human activities, including agricultural soil erosion, are rapidly degrading soil faster than it is naturally replenished'. They concluded: 'At this rate, human security over the next century will be severely threatened by unsustainable soil management practices'[17]. It is time we realised, in this International Year of Soils, that not only do we have a moral responsibility to manage soils better as the habitat for many species with which we share the planet, but that it is in our own self-interest to do so, both on environmental and economic grounds.

What are Degraded Soils?

Soil degradation is a decline in soil quality. It is caused by inappropriate or ill-timed practices usually resulting from agricultural, industrial or urban use. It can include; erosion, loss of organic matter, decreased fertility, damaged soil structure, salinization (accumulation of salt), changes in pH, toxicity, flooding and drought.

We are increasingly learning how the problems associated with soils affect soil organisms and, in turn the vital ecological processes they carry out. Soil life must flourish for soil to be healthy.

At this rate, human security over the next century will be severely threatened by unsustainable soil management practices

What is causing the problem?

Industrial agriculture, defined by high inputs of agrochemicals and fossil fuels, monoculture production, mechanisation and intensive livestock production is responsible for much of this degradation[18].

Practices such as continuous cultivation, the cultivation of steeper slopes, monocultures, removal of hedges, reliance on inorganic fertilisers, over-grazing and repeated passes with heavy machinery, have resulted in degraded land, loss of plant and animal species diversity, increased susceptibility to disease and loss of peoples' livelihoods (FAO, 1997; Conway, 2001; UNEP, 2012). They have also contributed to a dramatic decline in the nutrient content of food. For example, levels of essential minerals in fruits and vegetables in the UK fell by up to 76% between 1940 and 1991[19].

Soil life must flourish for soil to be healthy

Physical and Chemical Soil Degradation

The physical and chemical degradation of soil caused by industrial farming are well understood. Continuous cultivations fail to let soils rest and rejuvenate. A reliance on heavy machinery for seedbed preparation, repeated applications of fertilisers and pesticides and then harvesting, damages and compacts the soil. A failure to return enough organic material to the soil depletes the soil of organic matter, reduces water holding capacity and visibly damages soil structure. In the livestock sector intensive stock farming brings a risk of over-grazing, removing the protective layer of vegetation and increasing the likelihood of soil compaction. The repeated use of inorganic fertilisers has been shown to make soils more acidic.


Compacted soil

Intensive farming

Two additional threats to soils more commonly associated with soil overseas but increasingly of relevance to the UK are salinisation (increased levels of salt) and deforestation.

All soils contain salts, but where there is a significant increase, usually due to human activities, salinisation results. More common in arid and semi-arid regions, it can result from the mismanagement of irrigation systems or the use of salty water. With climate change there is an increasing risk of salinisation in some UK soils.

We may think we are not responsible for deforestation because we are not felling forests to create new farmland in the UK. Yet our demand for livestock feed, particularly soya and maize, grown in countries like Argentina and Brazil is increasing the demand for land and causing deforestation there.

These physical and chemical consequences of industrial farming are well understood. The relatively new area of concern however is how it damages soil biodiversity – and the negative impact this will have for our soils in the future.

Biological Soil Degradation and its Causes

Biological soil degradation is the decline in the amount and diversity of soil organisms and organic matter in soils. We know that agricultural intensification reduces the abundance of soil organisms and changes the way that ecosystems in soils function[20]. The reasons for this are likely to include:

- A reliance on inorganic fertilisers, which has reduced organic matter levels, reducing the habitat quality for soil organisms.

- Repeated cultivations, physically disrupting the habitat for soil organisms.

- The rise of monocultures, which fail to provide the variety of conditions necessary for the diverse range of soil organisms to thrive.

- Pesticides that can kill not only the intended target, but also other beneficial organisms. Several pesticides are known to persist in soils, long after their intended use. For example the three neonicotinoids temporarily restricted for agricultural use by the EU in 2013[21]. This chemical contamination leads to a decrease in soil biodiversity and therefore poorer soils. Non-organic farms in the UK use around 31,000 tonnes of chemicals each year to kill weeds, insects and control diseases.

In contrast organic farming uses methods designed to maintain soil health and nutrients, so that the soil can support healthy crops. Previous UK Governments have said that organic farming is better for wildlife, causes lower pollution from sprays, produces less carbon dioxide and fewer dangerous wastes[22].

We are now beginning to understand how this loss of soil organisms and organic matter affects the soil processes on which we all depend. A recent Europe-wide study confirmed that intensive land use does impact the ecosystem services that soil organisms provide. Notably the researchers suggested that the 'reduction in bacterial channel biomass might increase the dependency on mineral fertilizer'. In other words, the more we use inorganic fertilisers, the more we become dependent on them, because by reducing soil life we have lost the soils' natural ability to provide nitrogen to crops[23].

However, despite this growing awareness of the importance of soil biology to maintaining the ecosystem services on which we depend, our knowledge of soil life – and the impact that we are having on it – is limited[24].

Clearly, we still have much to learn about the species that live in soils and their role in supporting the ecosystem services on which we depend. But we do know that the interactions between these species are essential to our well-being – and also quite amazing.

For instance, arbuscular mycorrhizal fungi develop a mutually beneficial (symbiotic) relationship with plants. The hair-like fungi act like root extensions, helping plants

Pesticide spraying

reach further into the soil than they would otherwise. This helps plants take up more nutrients, such as phosphorus, sulphur, nitrogen and other micronutrients than they could do without the fungi. The body structure of some fungi can be crucial in physically holding soil together and therefore improving soil structure. These soil dwelling fungi make a direct contribution to supporting our crops.

We know that healthy soils are essential to our ability to produce food, to control flooding and droughts and to limit the impacts of climate change. If we are to safeguard our soils – and hence ourselves - we must urgently address these multiple aspects of soil degradation.

How do we save our soils? Imperatives for agriculture

The reality of soil degradation is already grave but climate change is making the situation worse. The projections for hotter, drier summers in the UK and more intense rainfall events will bring increased soil drying then saturation. This will increase the soil's vulnerability to wind and water erosion.

In order to save our soils, we need to combat degradation on all (physical, chemical and biological) levels. We need to improve soil processes and nutrient sourcing, management of water in soils and better understand and protect soil biodiversity.

Adopting agroecological approaches such as organic farming provides us with the means of doing so. Agroecology applies ecological concepts and principles to the design and management of sustainable agricultural ecosystems[25]. It is a way of learning from ecology to inform what we should be growing, where we should be growing it and how we should be growing it within the natural support framework provided by the soil and local climate. Agroecology seeks to feed the soil, so that the soil can feed the plant.

Soil Organic Matter

Action to improve soils must include work to improve soil structure and soil organic matter. Increasing soil organic matter improves water infiltration and retention. Water availability is one of the greatest limitations to crop growth[26]. Organic farming practices have been shown to improve drought tolerance in soils. UK climate change projections suggest longer periods of reduced water availability, so improving the water holding capacity of our soils by increasing soil organic matter, is more important than ever. Where data is available, it indicates a clear trend of declining organic matter in UK arable and horticultural soils. We must stop this trend and set a path towards increasing organic matter. We think that an average increase by 20% within 20 years is achievable. In the UK, a new study compared soil quality on a sample of allotments and farmland and found much better soils on the allotments[27]. We must have the ambition of making farmed soils as healthy as allotment soils.

A Green manure is a crop that is grown solely for the purpose of soil fertility. Some are legumes, such as clover, which can fix nitrogen from the air through their relationship with Rhizobia, (beneficial bacterial that live in nodules on the root of the plant). Once the green manure crop is incorporated into the soils, this nitrogen is then available for the next crop.

For soil organic matter, an average increase by 20% within 20 years is achievable. We must have the ambition of making farmed soils as healthy as allotment soils

Green manures and cover crops can also reduce run-off and soil erosion by maintaining permanent soil cover. Deep rooted green manure crops open up the soil as they grow, thus improving water infiltration. The addition of these green manure crops as organic matter further improves water penetration into the soil and builds soil organic matter levels. With an improving soil structure, green manures can reduce the leaching of nutrients, improve soil fertility and reduce nutrient additions to ground water and streams.

Green manures and cover crops also help to repair soils by providing food sources for microbes, vertebrates and invertebrates, all of which can contribute to the control of pathogens and pests. Green manure crops can also outcompete and suppress weeds (again limiting the requirements for pesticides and other chemicals).

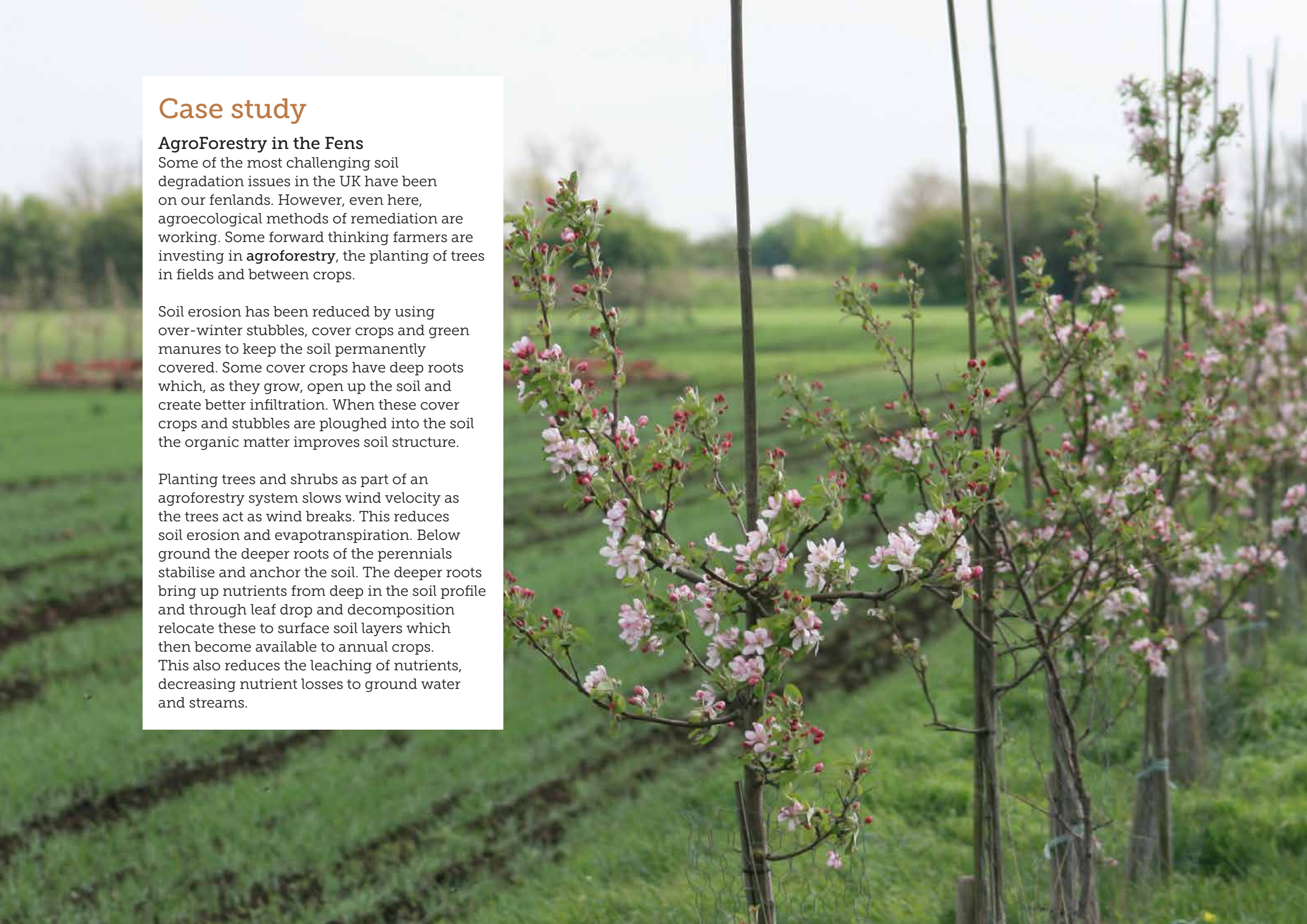
Green manure

Compost can be made on farm from waste biomass generated by crop production, e.g. the straw left over from barley or the inedible roots and shoots of other crops. Nutrient losses through run off or leaching are much lower when compost is used compared with equivalent applications of fresh manure or slurry. Composts have also been shown to contain beneficial microorganisms that help to protect crops from disease causing organisms[28].

Manure can provide a valuable source of nutrients, but its application does need to be well managed in light of a good understanding of the needs of the land, structure of the soil, requirements of the crop and the nutrient availability within the manure. For instance, slurry can be improved by treating it in advance with a bacterial slurry additive to enhance soil biology.

In the UK there are some good initiatives encouraging farmers to use manures as a source of nutrients rather than as a waste to be disposed[29]. This must continue, matching the supply of nutrients to the needs of the soil and the crop.

On farms that are either all arable or all livestock, closing resource loops by turning wastes – such as manures and crop residues – into nutrients, may be more complicated, but it is achievable. For example, recovering nutrients from consumer wastes, biochar (a form of charcoal) and treated sewage sludge are all developing technologies that have the potential to improve the way we manage our soils. These innovative technologies need to be researched and advocated to move our farming systems in the right direction.



Case study

AgroForestry in the Fens

Some of the most challenging soil degradation issues in the UK have been on our fenlands. However, even here, agroecological methods of remediation are working. Some forward thinking farmers are investing in **agroforestry**, the planting of trees in fields and between crops.

Soil erosion has been reduced by using over-winter stubbles, cover crops and green manures to keep the soil permanently covered. Some cover crops have deep roots which, as they grow, open up the soil and create better infiltration. When these cover crops and stubbles are ploughed into the soil the organic matter improves soil structure.

Planting trees and shrubs as part of an agroforestry system slows wind velocity as the trees act as wind breaks. This reduces soil erosion and evapotranspiration. Below ground the deeper roots of the perennials stabilise and anchor the soil. The deeper roots bring up nutrients from deep in the soil profile and through leaf drop and decomposition relocate these to surface soil layers which then become available to annual crops. This also reduces the leaching of nutrients, decreasing nutrient losses to ground water and streams.

Soil organisms benefit from other agroecological practices such as using **crop barriers, inter-cropping** with different crops and **crop rotation**, which ensures that pests that might attack one crop don't have that same food source the following season, so they die out naturally.

Organic farming and Agroecological principles provide systems that put soil health at the core of farming operations. They should be supported and promoted more strongly

There is a wide range of techniques available to help repair soils. Farmers must choose which best suit their particular soils, but this wide range of measures means that it should be possible for all farmers to find ways of protecting their soils. Natural England has highlighted some of the barriers that farmers face in adopting these practices[30]. Policymakers and farm advisers now need to work with farmers to overcome these barriers and adopt these new techniques. Organic farming and Agroecological principles provide systems that put soil health at the core of farming operations. They should be supported and promoted more strongly.

How do we save our soils? Imperatives for the policy makers

In order to save our soils landowners need a supportive policy framework that allows for and actively encourages a long-term sustainable approach to the management of soils. Such policies would need to include:

1. Support for agricultural production that is closely tied to natural ecosystem functions. For example, farmers should be supported to establish agroforestry systems that protect soil.

2. Promoting management that improves soil condition. We believe it is possible to stop the decline in soil organic matter in UK arable and horticultural soils and to increase it by 20% over 20 years. New policies are required to support this change of direction. Policies should discourage damaging practices such as harvesting maize late in the year when soils are wetter and more vulnerable to damage.

3. A research programme that develops agroecological and sustainable technologies. Recent studies have shown that whilst soil biology is important it is poorly understood and that the 'yield gap' between organic and non-organic systems has been over-estimated in the past[31]. Hence, we have an urgent need to invest in research to improve our understanding of soil life, its impact on supplying the food we eat and how it is damaged by industrial farming operations.

4. The promotion of innovation and knowledge exchange between agroecological and industrial agriculture. Both systems have useful insights and techniques. We particularly need to share emerging learning about soil life and how to protect it.

5. Measurements of productivity and sustainability must include non-commodity benefits, such as protecting the carbon stored in peat soils and valuing soils for their ability to soak up excess rainwater.


The pressure on soil is great. It will only increase with climate change and population growth. We need to reconsider how we value and manage our soils, to change our path to a healthier future

How do we save our soils? What we can all do

Whether we have a farm, a garden or window box, we can all do something to help protect soils. Here are four suggestions.

1. Look after the soil in your garden and community spaces. The most environmentally and soil friendly way to obtain your food is to grow your own in your allotment or garden, recycling as much of your own nutrients and water as possible. The techniques discussed above, such as green manures and composting will work just as well in the garden or on the allotment as they will on farmland.

2. Support soil-friendly organic farming through your shopping choices. Your money will be paying for the health benefits of not consuming pesticides whilst supporting farmers and growers who put soil health and care for the environment at the core of their business. If you buy direct from the grower you can ask them about how they look after their soils.

3. Support our campaigning work to get the Government to take soil seriously. Tell your MP that this issue is important to you. Ask them to support policies and initiatives that take a longer term, environmentally healthy approach to soil preservation and farming.

4. Raise awareness. Share this report with people you know and discuss the issue of soil degradation with them.


Species living in soils form part of the same food web as life above ground

Conclusions

Healthy soils are essential to our prosperity. We are still learning about the untold variety of life in our soils. This includes learning about the benefits that we gain from soil life and how our actions are damaging soils.

Soil loss through biological, chemical and physical degradation has severe and world-wide consequences. We cannot go on as we are. The application of short term approaches to soil and crop management have caused much of the problem and certainly cannot be the answer to re-building our soils.

We need to continue researching and learning about soils and soil biology. Crucially, we must start to apply that knowledge.

Organic farming and agroecology provide a set of tools that work with all the natural components of soils and what the local ecosystem can naturally provide. They consider the long-term rehabilitation of soils and advocate the growing of crops that are suitable to that area and its environmental constraints.

Knowledge of the tools however is not enough: there has to be an underpinning of a supporting policy framework and the political will to change our approach to soils and ensure their future.

Whether as individuals we directly manage soils or not, this is for the benefit of us all and we all have a role to play.

About the Centre of Agroecology, Water and Resilience

In 2010, the Centre of Agroecology, Water and Resilience (CAWR) (formerly the Centre for Agroecology and Food Security (CAFS)) was established to undertake applied research and education on agroecology as the underlying paradigm of sustainable agriculture. This approach is required not only to ensure that all the peoples of the world are fed, but also for humanity to avoid destroying the life support system and renewable resources upon which it depends.

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Coventry University

About the Soil Association

The Soil Association was formed in 1946 to pioneer a better world – one where we can live in health and in harmony with nature. Today we're just as dedicated to making positive change happen. We're farming and growing, buying, cooking and eating. We're campaigning and researching. Together we're transforming the way we eat, farm and care for the natural world.

We believe in a world where people and planet thrive – but more importantly we're pioneering practical solutions to make it happen.

www.soilassociation.org

Endnotes

[1] Natural England (2010) England's peatlands: carbon storage and greenhouse gases. NE257

[2] World Soil Day address: *http://www.scientificamerican.com/article/only-60-years-of-farming-left-if-soil-degradation-continues/*

[3] *http://www.saveoursoils.com/userfiles/downloads/1423729537-Save%20our%20Soils%20Toolkit%20-%20ENG.pdf*

[4] *http://www.agriinfo.in/default.aspx?page=topic&superid=4&topicid=271*

[5] FAO (2015) *http://www.fao.org/globalsoilpartnership/world-soil-day/en/*

[6] *http://www.nature.com/nature/journal/v517/n7535/full/nature14098.html*

[7] *http://discovermagazine.com/2007/jul/raw-data-is-dirt-the-new-prozac*

[8] De Vries et al (2013) 'Soil food web properties explain ecosystem services across European land use systems', in PNAS; 110, 35, 14296-14301 *www.pnas.org/cgi/doi/10.1073/pnas.1305198110*

[9] *http://www.ceh.ac.uk/products/publications/documents/soil-microbes-august-2013.pdf*

[10] Willem van Groenigen et al (2014) 'Earthworms increase plant production: a meta-analysis' Scientific Reports

[11] WRI (1994) – World Resources Institute, New York, Oxford University Press

[12] FAO (2011) State of the world's land and water resources for food and agriculture

[13] *http://www.ifoam.bio/en/news/2015/04/21/press-release-ifoam-organics-international-calls-stop-soil-destroying-international*

[14] *http://www.fao.org/nr/lada/gladis/gladis/*

[15] Land Degradation: An overview H. Eswaran1, R. Lal2 and P. F. Reich3 Published in: Eswaran, H., R. Lal and P.F. Reich. 2001. Land degradation: an overview. In: Bridges, E.M., I.D. Hannam, L.R. Oldeman, F.W.T. Pening de Vries, S.J. Scherr, and S. Sompatpanit (eds.). Responses to Land Degradation. Proc. 2nd. International Conference on Land Degradation and Desertification, Khon Kaen, Thailand. Oxford Press, New Delhi, India.

[16] Defra 2009 Soil Strategy for England

[17] *http://www.sciencemag.org/content/348/6235/1261071.abstract*

[18] Wibbelmann, M., Schmutz, U., Wright, J., Udall, D., Rayns, F., Kneafsey, M., Trenchard, L., Bennett, J. and Lennartsson, M. (2013) Mainstreaming Agroecology: Implications for Global Food and Farming Systems. Centre of Agroecology and Food Security Discussion Paper. Coventry: Centre for Agroecology and Food Security

[19] McCance, R.A. and Widdowson, E.M. (1940-1991). The Composition of Foods. 1st to 5th edns. London: Ministry of Agriculture, Fisheries and food and the Royal Society of Chemistry

[20] Postma-Blaauw et al Soil biota community structure and abundance under agricultural intensification and extensification'; in Ecology 91 (2), 2010, pp460-473

[21] Professor D Goulson interviewed on Farming Today. BBC Radio 4 (20 February 2015)

[22] For example see Shepherd et al (2003) An Assessment of the Environmental Impacts of Organic Farming: Defra funded project OF0405 and the Organic Entry Level Scheme Handbooks at https://www.gov.uk/environmental-stewardship

[23] De Vries et al (2013) 'Soil food web properties explain ecosystem services across European land use systems', in PNAS; 110, 35, 14296-14301

[24] Gardi et al (2013) 'An estimate of potential threats levels to soil biodiversity in EU', in Global Change Biology, 19, 1538-1548

[25] Alteri, M.A. (1987) Agroecology: the Scientific Basis of Alternative Agriculture. Boulder. Westview Press
Altieri, M. A. (1995) Agroecology: the Science of Sustainable Agriculture. Boulder. Westview Press

Wibbelmann, M., Schmutz, U., Wright, J., Udall, D., Rayns, F., Kneafsey, M., Trenchard, L., Bennett, J. and Lennartsson, M. (2013) Mainstreaming Agroecology: Implications for Global Food and Farming Systems. Centre of Agroecology and Food Security Discussion Paper. Coventry: Centre for Agroecology and Food Security

[26] Tivy, J. (1990) Agricultural Ecology. Singapore: Longman Singapore Publishers Ltd.

[27] Edmondson et al (2014) Journal of Applied Ecology, 51, 880-889

[28] Soil Association (2003). Soil Association Technical Guides; Soil Management on Organic Farms. Bristol.

[29] For example *http://www.nutrientmanagement.org/home/*

[30] Stockdale E.A. & Watson, C.A. 2012. Managing soil biota to deliver ecosystem services. Natural England Commissioned Reports, Number 100.

[31] Ponisio et al (2014) Proc. R. Soc. B 2015 282 20141396; DOI: 10.1098/rspb.2014.1396. Published 10 December 2014

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