



**“The health of soil, plant, animal and man is one and indivisible”**

*Lady Eve Balfour, Soil Association founder*

*The Greenhouse Trust's Gallery seeks to engage artists and everyone who is interested in art with the 'Climate Change Challenge'. We are the only generation that can safeguard the future. Future generations will be unable to reduce the impacts of CO<sub>2</sub> emissions above 350ppm (pre-industrial human activity)*

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*Charity No. 1037992*

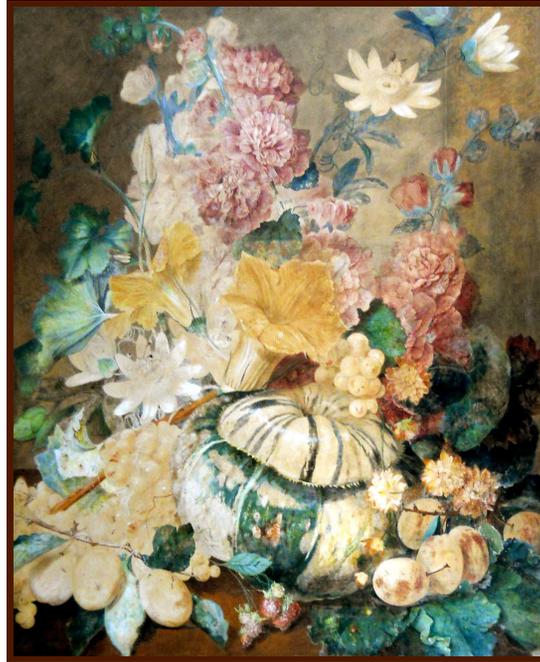


*Detail: Flower Piece - Painting - Oil on board - Bennett Oates*

## *eARTh*

### *Living Soils: A Call To Action*

**By increasing the quantity of carbon contained in soils by 0.4% a year, we can halt the annual increase in CO<sub>2</sub> in the atmosphere, which is the major contributor to the greenhouse effect and climate change.**



*James Sillet - An abundance of fruit and flowers  
Norwich School (1764-1840).*

**History reveals that civilizations rise and fall on how well they treat their soils. The earth's topsoil provides us with 95% of our food, animal feed, fuel and fibres for clothing.**

**Soil regulates flooding, provides a home for a quarter of all known species and contains more carbon than the Earth's atmosphere and vegetation combined.**

**Less than one sixth of the land on Earth is suitable for growing crops. Yet one third of the world's arable soils are now 'degraded' and three quarters of that third is now 'severely degraded'.**

**It can take a thousand years for just one centimetre of topsoil to form. Today, agricultural erosion is depleting soil faster than it can be replenished. Roughly one third of our arable land has been lost since 1960 as a result of soil degradation.**



# eARTH 0.4%

## **CARBON SEQUESTRATION IN SOILS FOR SECURITY AND THE CLIMATE**

The quantity of carbon contained in the atmosphere is currently increasing by 4.3 billion tons every year. The world's soils contain 1500 billion tons of carbon in the form of organic matter, The earth beneath our feet is not only fundamental to life itself, if we act now, we can improve our our quality of life and chances of survival.

If we humans deliver a 0.4% annual increase in the quantity of carbon contained in soils, we can halt the current increase in CO<sub>2</sub>, the major contributor to the greenhouse effect. The more fertile the soil is the more able it will cope with drought and flooding and the effects of climate change. The more soil is covered with plant life the richer it will be in organic material and therefore in carbon. This exhibition is one, in an ongoing series of shows and events that are inspired by the Soil Association's campaign to increase the organic matter in our soils (an important measure of soil health) by 20% over the next twenty years.

## eARTH : AGRO-ECOLOGY

is a system of agriculture and land management that looks to natural ecosystems to inform agricultural practice, feeding the soil, that in turn feeds plants and addresses the damage done by agribusiness and intensive farming.

Carbon farming is a term used to describe a suite of agricultural practices that sequester (capture and store) carbon in the soil and in above-ground perennial biomass. If widely implemented, these practices have the capacity to sequester hundreds of billions of metric tons of carbon from the atmosphere in the coming decades. In the UK, and particularly here in East Anglia, we have precious peaty soils with high carbon content that are crucial carbon stores and sinks when managed sustainably.

Greenhouse gas emissions to date have already committed us to a changed climate. However, if we combine carbon farming with a massive global reduction in fossil fuel emissions, we may still be able to step back from the brink of disaster. Unlike high-tech geo-engineering strategies, these practices also feed people, create more fertile soils, and contribute to the wider ecosystem health.

Our demand for ever cheaper food is increasing soil degradation. Food producers have become reliant on artificial fertilizers, herbicides and pesticides. These are undermining our health and damaging the vital ecosystems on which life depends. Whether we are motivated by personal health concerns or the wider state of the environment, there we need to protect and recreate healthy soils.

Over the last 50 years the levels of key minerals within fruits and vegetables in the UK alone have declined by up to 70%. Governments and policy makers are not doing enough to turn the tide on our modern, unhealthy, de-natured diet and lifestyle choices.

## ***SOIL DEGRADATION***

is caused by inappropriate or ill-timed agricultural, industrial or urban practices. These produce erosion, loss of organic matter, decreased fertility, damaged soil structure, salinization, pH changes, toxicity, flooding and drought.

We are now discovering how such problems affect both the organisms which live in soil and the vital ecological processes they perform. Soil organisms need to flourish for it to be healthy. Industrial agricultural practices such as continuous cultivation, mono-cultures, hedge removal, reliance on inorganic fertilizers, over-grazing and repeated use of heavy machinery, have produced degraded land, reduced plant and animal species diversity, increased susceptibility to disease and lost livelihoods. These activities have also dramatically reduced the nutrient content of food. For example, levels of essential minerals in UK fruits and vegetables fell by up to 76% between 1940 and 1991.

Failing to return organic material to the soil depletes its quality, reduces its water-holding capacity and damages its structure. Intensive livestock farming often results in over-grazing, removing the protective layer of vegetation from soil and increasing its compaction. Repeated use of inorganic fertilisers makes soils more acidic.

Salinization caused by climate change is a new threat to soil in the UK. All soils contain salts but salinization represents a significant increase, usually due to human activity. More common in arid and semi-arid regions, it can result from mismanaged irrigation systems or from the use of salty water.

Although deforestation may not seem relevant to the UK, the demand for livestock feed, particularly soya and maize grown in countries like Argentina and Brazil, is causing deforestation and so increasing climate change.

## ***THE PRESSURE ON SOIL: WORLDWIDE***

is great and this can only increase as the population of planet Earth is uprooted by famine, flood and wars fought for scarce food and resources. The UK also contributes to soil damage overseas, by virtue of its farming and consumption practices, importing both animal feed and some of our food.

When soil degradation is severe, food yields are often drastically reduced. Bare or damaged soils are more at risk of erosion and the soil that is washed away clogs up rivers and lakes, increasing flood risk. Unhealthy soils also store less carbon, contributing to global warming; the resulting extreme weather increases the scale of floods and droughts.

In our towns and cities we have concreted over large areas of land. 'Sealing' soil in this way reduces its quality and that of our air and living environment.

## ***SOIL LIFE AND BIODIVERSITY OF ORGANIC MATTER***

We now know the physical and chemical consequences of industrial farming. The latest area of concern however is its adverse effect on soil biodiversity. Biological soil degradation can be defined as a decline in the amount and diversity of organisms and organic matter in soils. Agricultural intensification reduces the abundance of soil organisms and changes the way that soil ecosystems function. The reasons for this include:

- *Reliance on inorganic fertilizers, which reduces levels of organic matter and habitat quality for soil organisms.*
- *Repeated cultivations, which physically disrupt soil organism habitats.*

- *Increased monoculture use, which fails to provide the diverse conditions needed for soil organisms to thrive.*
- *Pesticide use, which kills not only the intended target but also beneficial organisms.*

Several pesticides are known to persist in soils long after cropping. For example, the three neonicotinoids, currently under an EU moratorium, which are known to affect bees and other pollinators (clothianidin, imidacloprid and thiamethoxam) also reduce soil biodiversity and produce poorer soils.

Non-organic farms in the UK use around 31,000 tonnes of chemicals every year to kill weeds and insects and control disease. In contrast, organic farming methods actively maintain soil health and nutrients. Previous UK Governments have said that organic farming is better for wildlife, causes less pollution from spraying and produces less CO<sub>2</sub> and fewer dangerous wastes.

Intensive land use adversely affects soil organism ecosystems. The more inorganic fertilizer applied, the more dependent on it the soil becomes. Reducing the number of organisms in soils also reduces its natural ability to provide nitrogen to crops.

### **SAVE OUR SOILS - IMPERATIVE FOR AGRICULTURE**

To save our soils, we need to combat physical, chemical and biological degradation. We need to improve soil processes, nutrient sourcing and water management and protect soil biodiversity.

Water scarcity is one of the main limitations to crop growth. UK climate change projections indicate longer periods of scarcity so it is vital that we improve the soil's capacity to absorb and retain water. This can be done by increasing levels of organic matter and is the reason that organic farming improves drought tolerance in soils.

Agro-ecology feeds the soil, so that the soil can feed the plant.

An increase of organic matter in soil of 20% within 20 years is thought to be achievable. Our national and regional ambition should be to make farmed soils as healthy as allotment soils. Improvements in farm, park, garden and allotment soils can be used to promote, educate and celebrate organic food production and the global benefits of agro-ecology.

### **COVER THE EARTH - GROW GREEN MANURE**

Green manures are crops that are grown to improve soil fertility. Some are legumes, such as clover, which fix nitrogen from the air using Rhizobia (beneficial bacterial which live in nodules on plant roots). Once incorporated into soil, the nitrogen becomes available to the next crop. Deep rooted green manure crops open up the soil as they grow, improving water penetration. Adding them to soil increases levels of organic matter and improves water absorption. Green manures and cover crops can also out-compete and suppress weeds (reducing the need for pesticides and other chemicals). Below ground, the deeper roots of perennial plants stabilise and anchor the soil. They bring up nutrients from deep in the soil profile and relocate them to the surface, where they become available to annual crops. This also reduces the amount of nutrients lost by leaching into groundwater and streams.

Soil organisms also benefit from the use of crop barriers, inter-cropping and crop rotation which are all natural (non-chemical) methods of pest control.

## ***The time to act is now!***

In September 2016 a UK parliamentary committee scrutinised soil quality and agricultural strategy. The evidence presented revealed that:

- ◆ *30% of climate emissions will come from farming by 2050.*
- ◆ *40% of food will be lost without pollinators*
- ◆ *95% of neonicotinoids go into the soil with no research on the impacts on the soil or ourselves. These pesticides have been shown to harm bees and other pollinators.*

***Soils control pollution.*** Soils rich in microorganisms can interact with, & break down, harmful chemicals, reducing levels of contamination & reducing pollution.

***Soils regulate climate change.*** By acting as a reservoir for more carbon than the atmosphere and vegetation combined. Many soils have the potential to store even more carbon, which could significantly help fight climate change. Carbon is added to soil as organic matter, either naturally from plants or applied directly as organic fertilizers, such as farmyard manure or green waste composts.

***The variety of life in our soils is amazing.*** Just one teaspoon of soil contains around 10,000 different species and more organisms than there are people on the planet. This variety is essential to life on Earth and human prosperity. Plants are essential for capturing energy from the sun but it is soil life which breaks down plant litter, releasing nutrients for root uptake and transfer back to plants. Life in soil is an essential part of the web of life.

***Support soil-friendly organic farming with your shopping choices.*** Your money will then support farmers and growers who do not use pesticides and who put soil health and care for the environment at the core of their business.

***We must reconsider how we value and manage our soils as part of our path to a healthier future.*** Whether we have a window-box, a garden, an allotment, a smallholding or a farm, we can all protect the soils that we rely on.

***Look after the soil in your garden and community spaces.*** The most environmentally-friendly and soil-friendly way to feed yourself is to grow your own food in an allotment or garden, recycling as much nutrient and water as possible.

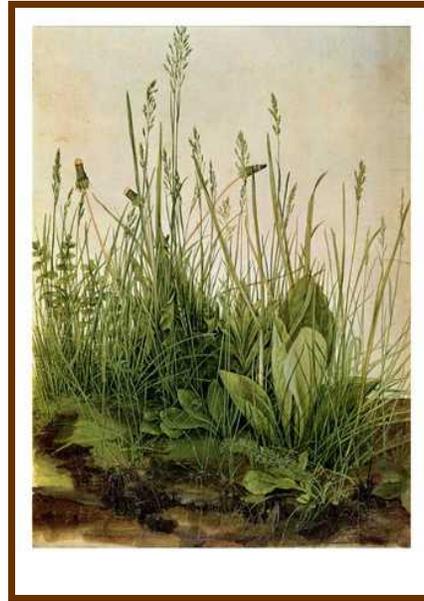
***Raise awareness and discuss the issue of soil degradation with friends and family.*** It is a sobering thought, but many local allotments have better soil quality than Norfolk's agricultural farmland. Whether or not we manage soils personally, their quality affects us all, and everyone has a role to play. Industrial farming practices destroy the complex food webs that naturally exist in soils. We need to manage soils with their natural biology in mind. Soil biodiversity is as important as that above ground, its benefits are severely understudied. However, we are beginning to grasp its potential benefits. Recently, new forms of antibiotics and anti-depressants have been discovered in soil.

***Support the call to invest in research*** into understanding soil organisms, their role in supplying our food, how they are affected by industrial farming and how we can protect them. Productivity and sustainability studies should include non-commodity benefits, such as protecting the carbon stored in peat soils and valuing a soil's ability to soak up excess rainwater. In the UK, and particularly here in East Anglia, we have precious peaty soils with a high carbon content. These are crucial carbon sinks when managed sustainably.

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