FUTURE AGENDA
Open Foresight

THE WORLD IN 2030
Peak Soil

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Soil is fundamental, fragile and finite. It impacts everything from food and health to conflict and migration. Deeper understanding of its degradation raises the significance of soil to equal that of climate change and biodiversity loss.

Economic Impact of degraded soils on global GDP	**10%**
Carbon absorption potential of regenerative farming practises	**80 = 100 bn tonnes pa**

We know that the quality of our soil is the key to the food we grow, the clothes we wear and the water we drink. It recycles nutrients, sequesters carbon, is fundamental to biodiversity, helps keep our ecosystems in balance and is an essential part of our general wellbeing. But, although soil represents the difference between survival and extinction for most terrestrial life, human activities have caused it harm leading to compaction, loss of structure, nutrient degradation, increasing salinity and denuding landscapes. Furthermore, the urgent need to preserve soil receives relatively little attention from governments. An unsung hero of our planet, it is fragile, infinitely important and finite.[1] Why do we treat it with such disregard?

Perhaps we just don't notice the changes taking place under our feet. The formation of soil is a very slow process. Creating one millimetre of coverage can take anything from a few years to an entire millennium. Also, perhaps we don't know enough about soil to really understand its true role. It is incredibly complex. In a mere teaspoon, there are around a billion bacteria from several thousand different species, a million other single cell organisms, a million individual fungi and hundreds of "larger" animals such as microscopic worms and insects.[2] Analysing and identifying soil microbes is challenging. Currently less than 5% can be isolated and captured through conventional microbiology. Although we know that they influence crop growth, can potentially increase yields and that groups of microbes can do things that individual bugs cannot manage alone, we just haven't worked out quite how they do it yet.

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What we do know is that around 95% of the food we eat comes from the soil; around a quarter of all known species on Earth call soil their home and it is able to store one and a half Olympic swimming pools full of water per hectare so is key to the prevention of flooding and mitigation of drought. Soil, particularly peat, is also an active store for carbon.[3] Indeed, in the UK, peatlands represent the single most important terrestrial carbon store holding at least 3.2 billion tonnes. Some argue, to protect them from long-term damage, ongoing farming on peat soils such as fenlands, should stop completely.[4]

About 3.2 billion people worldwide are currently suffering from degraded soils. This represents an economic loss in the order of 10% of annual GDP.[5] The highest numbers of those affected are in South and East Asia, the Sahara region including North Africa, and the Middle East including the Arabian Peninsula. The reduction in crop yields due to poor soil is expected to range from 10% to15% in these regions. The soil in western nations is also under threat – and has been for quite some time. In the 1930s rapid mechanisation of farming practises combined with a series of droughts caused the Dust Bowl in the USA. This affected around 400,000km^2 of land in Texas, Oklahoma, New Mexico, Colorado and Kansas. Other areas such as the Piedmont Region, which stretches from Virginia to Alabama, has lost one third of its topsoil over the last 200 years. More recently, 1300 polluted or contaminated sites have been identified.[6] In Europe, the EU reckons the total annual societal loss from soil degradation is about $100 billion.[7]

But economic loss is only part of the story. In some areas soil degradation will increase the chance of conflict as more peoples seek access to fertile land. In others, more intensive farming practises will impact the air we breathe and the water we drink and accelerate the decline in biodiversity. The climate will also be affected; three times more carbon is stored in soil than in the atmosphere. Finally, all this will have significant social impact. Many of us visit the countryside for our physical or mental wellbeing.

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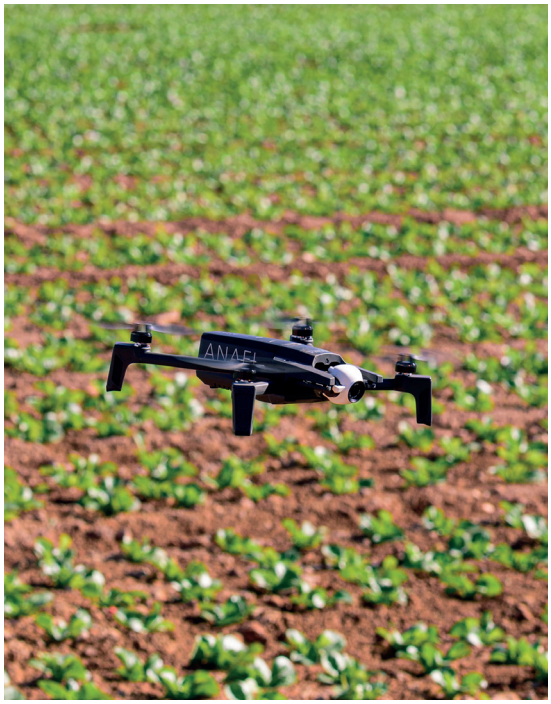
The Reasons

There are multiple reasons for this. They include poor farming practises, industrial pollution, increasing urbanisation (and the subsequent loss of land), inadequate governance and ill-conceived farming subsidies. Rising population demands for food and materials adds to the problem so in the years ahead we can expect continued deforestation, increasing emissions from rice and intensively farmed ruminant livestock and the misuse of nitrogen in fertilisers. As the planet warms, soil erosion on degraded lands is likely to accelerate as a result of more extreme weather events; wind and rain account for most of this but it is also affected by forest fires and changes in the distribution of invasive species, pests and pathogens.

Finding Solutions

Addressing soil health is now firmly on the global agenda. Much work has already been achieved by international bodies such as the United Nations Convention to Combat Desertification (UNCCD), the International Soil Reference and Information Centre (ISRIC), the Global Soil Partnership, the Intergovernmental Technical Panel on Soils (ITPS) and with regional initiatives with centres such as the European Soil Data Centre (ESDAC) acting as the single reference point for soil data at a European level.8,[9,10,11,12] In addition, the Global Soil Laboratory Network (GLOSOLAN) is a result of a unique, international collaboration led by the Food and Agriculture Organisation's (FAO) Global Soil Partnership. For the first time, more than 400 labs in 127 countries are working together to harmonise data and methods for soil analysis so that soil data and information is comparable and interpretable across laboratories, countries and regions. The biggest international effort is perhaps a French-led initiative called "Four per 1,000"; launched at the COP21 Paris Climate Summit, it aims to boost carbon storage in agricultural soils by 0.4% each year.[13] There are also industry led initiatives such as in Austria, Healthy Soils for Healthy Food, a producer-retailer-consumer programme led by supermarket chain SPAR with support from WWF. This focusses on GHG sequestration through soil carbon on agricultural land.



That said, there is much still to be done. This is tricky because policy design and formulation is often strongly sectoral, particularly at local level. In the past this has resulted in ineffectual or worse, damaging, regulation. For example, in Europe an over-emphasis on cheap food has been an ongoing issue; in the US government policy encouraged farmers to specialise, but the resulting monocultures require an increasing amount of water, fertilizer and pesticides. In China the reliance on land transfers to generate revenues has meant local governments have had little motivation to manage pollution.

Taking Action

As awareness of the issues grows, some long-established land management and restoration practices are being questioned. These include ploughing, monocropping and the over dependence on pesticides or artificial fertilisers. Many are now testing alternative practises and regenerative agriculture. For example, in the mountainous region of Mexico, where intensive farming practises have caused soil erosion and decay, farmers from the Mixte community are returning to a polyculture system called milpa, where soil fertility is preserved by planting black beans and pumpkin between corn.[14]

Making better use of local resources, returning organic matter to soils, and implementing more diverse crop rotations that include legumes to reduce the reliance on synthetic fertilisers, can significantly benefit soil health, slow erosion and reduce dependence on environmentally damaging pesticides and fertilisers.[15] Cover crops, no-till methods and allowing animals to graze in a way that mimics their natural behaviour can help to build soil, crowd out weeds and retain moisture. Agroforestry, which differs from traditional forestry by its focus on the interactions between components rather than just on the individual components themselves, is also having an impact. In Northern Thailand an initiative to plant perennial trees, fruit trees, vegetables and herbs in a mixed agriculture system, and reduce the use of pesticides, herbicides and fertilizers, has halted soil erosion and restored ecosystem services across 500 hectares of what was previously maize monoculture owned by approximately 700 smallholders.[16]

Farmers need greater support from policy makers to drive meaningful change. Some are already using incentives to gradually integrate new approaches into mainstream agriculture. In Costa Rica the removal of cattle subsidies in the mid-1980s, the banning of deforestation in 1996 and the provision of incentives to promote reforestation and biodiversity has done much to stimulate soil improvements. Forest cover is now up at 52% from an all-time low of around 25%.[17] Subsidies are also being applied to good effect in the US. Over the last 20 years, local governments in Maryland and Virginia, have used them to encourage farmers to plant cover crops.

More significantly regulators around the world are looking with interest at what impact the UK's move to a new Environmental Land Management (ELMs) scheme will have. Due to be piloted from late 2021, it is designed to shift the focus from food production to that of providing "public goods". Instead of being paid for owning land, subsidies will be allocated based on "environmental land management" and cover pest control, hedge and tree planting, the creation of habitats and general landscape improvement. It's an ambitious programme that needs careful management. Farmers operate on tight margins and some experts predict the upheaval could force many out of business.

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Greater action is needed to reduce nitrogen run-offs from fertiliser. Research by academics David Kanter and Timothy Searchinger suggest that the most effective way to achieve this is not to regulate the farmers, but to focus instead on persuading producers to look for alternative solutions.[18] They argue that most nitrogen management policies already offer farmers incentives to change farming practises by, for example, developing nutrient management plans or using more environmentally friendly fertilizers but, because of the sheer number of farmers, these policies are difficult to regulate and have had limited impact. A different approach is to focus on the small number of actors which control a majority of the fertiliser market and encourage them to come up with alternative products. In North America for example this boils down to five companies which currently control over 80% of the production capacity for urea, an inexpensive form of nitrogen fertilizer, and ammonia, the main ingredient for all types of nitrogen fertilizers.[19] Four of these already offer a more environmentally friendly product and provide a service to help farmers use nitrogen more efficiently. If policy makers support these initiatives, they could also create important economic opportunities for the industry, stimulating the new technologies better suited to specific crops and climates.

A major problem is that as yet the impact of better soil practise on carbon storage cannot be accurately measured, reported and verified (MRV), so it is difficult for farmers to access the funds currently pouring into carbon offsetting and 'natural solutions'. This notwithstanding, Australia already has a market for carbon credits, and another has recently been established in the US. The aim is to persuade greenhouse-gas producers to offset their emissions by paying farmers to sequester carbon for them. Rather than reduce emissions themselves companies and consumers aiming to reduce their carbon footprint can pay farmers to do it for them. A group of ten Canadian utilities companies have created such an exchange and, in 2019, a group of Iowan farmers were paid up to $3 an acre to sequester carbon dioxide, methane and nitrous oxide. However, initiatives such as this will only get significant traction when there is greater clarity around MRV.

Corporate investment is driving change in other ways too. Earlier this year, a group of agricultural traders and food companies, including Indigo, Cargill, General Mills, McDonald's USA and Mars, launched the Ecosystem Services Market Consortium that encourages farmers to adopt conservation management practices. Elsewhere new technologies are already helping large scale farmers address issues such as soil compaction due to the use of heavy weight tractors and machinery. This can reduce yields by over 15-20%. Expect autonomous driving technologies to be developed that produce smaller lightweight machines. As well as being good for the soil, a Goldman Sachs report suggested innovations such as this will deliver a $45bn addressable market based on a 13% yield improvement. The companies that stand to benefit in this value chain include Intel, Bosch, Delphi, Conti, TRW, Quanergy and Case.[20]

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Monitoring Soil Quality

Looking forward, increasingly available digital technologies such as sensors, geospatial imagery, mobile financial services and data analytics can be leveraged to make soil healthier and agriculture more precise, productive, resilient, and profitable. It also lays the groundwork necessary to monitor soil quality and composition in real time. If that were cracked, then it would make it easier for governments to increase incentives for the likes of carbon sequestration. Current initiatives include the development of deep-soil sensing technology (with potential backing from the USDA and big-data focused technology companies). Although this is in the early stages of development, companies such as CropX already offer sensors to help farmers adjust irrigation to the needs of their soil.[21]

As new molecular fingerprinting, using genetic sequencing technology, becomes more widely available, it is hoped it will be easier for scientists to measure and understand how combinations of species interact and therefore determine which chemicals will encourage some microbe species and discourage others. More government support is needed here. In the UK, only 0.41 per cent, or a mere £284,000, of the cash invested in environmental monitoring goes on auditing the soil. This compares with £60.5m tomonitor water quality, and £7.65m to check on air.[22]

More investment to enable greater understanding of how soil works and how to map its progress would help in other ways too. It would provide clarity around how soil can be used to store CO2. This is seen as a huge opportunity for mitigating climate change. Soil that has been ploughed and artificially fertilised has depleted soil carbon levels. Figures vary but Rattan Lal, Professor of Soil Science at Ohio State University estimates that since people began farming around 50 – 70% of soil's natural carbon has been lost. Globally, he suggests that, if regenerative farming practises are adopted even depleted soils could reabsorb 80 billion to 100 billion metric tons of carbon, reducing atmospheric, more widely carbon dioxide by 38 to 50 ppm.[23]

Wider understanding of agricultural practises would also help. Alongside financial support, small-holders, who make up the majority of farmers across the world, would benefit from access to better education around regenerative farming practises in order to drive change.[24]

The responsibility does not lie with food producers alone. The public needs to be persuaded to change its purchasing habits. Urbanisation and the long tail of supply chains means that our collective understanding about how food is produced and where it comes from has diminished. In the UK a 2018 a survey showed that 42% of 18-24-year-olds described their knowledge of the countryside as either "poor" or "very poor".[25] Education initiatives need to be strengthened so that people understand the impact that their behaviour has on land – not just the climate. In turn this could reduce the pressure on farming and potentially allow more land to be left for nature.

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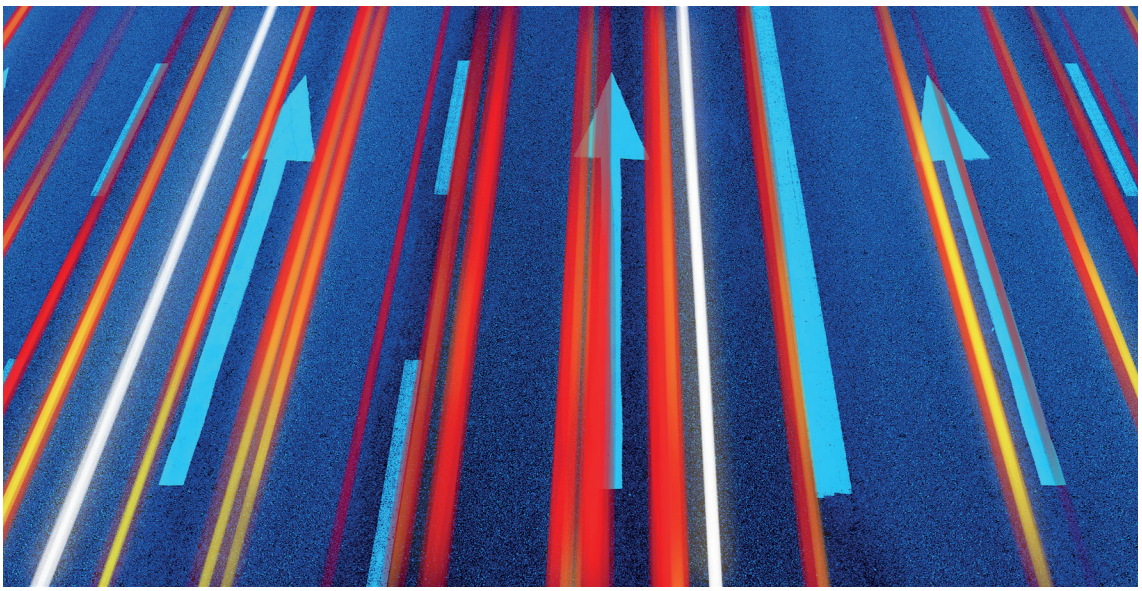
Leading in 2030

The “green revolution” that has produced a fourfold increase in global food production since the middle of the 20th century relied on pesticides, fertilisers, machinery, and monocultures.[26] This cannot continue. Soil is at the heart of three significant and interconnected global needs: feeding a growing global population, helping to mitigate against climate change and reversing dramatic biodiversity losses that threaten the ecosystems we depend upon. In 2020 this seems like a well-kept secret.

Throughout millennia we have been dependent on soil to feed the world and in return we have denied it sustenance. By 2030 the impact of not doing enough may well mean, like climate change and biodiversity before it, the consequence of unhealthy soil will, by necessity, be on everybody’s radar.



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Open Foresight

The World in 2030

This is one of 50 global foresights from Future Agenda's World in 2030 Open Foresight programme, an initiative which gains and shares views on some of the major issues facing society over the next decade. It is based on multiple expert discussions across all continents and covers a wide range of topics. We do not presume to cover every change that will take place over the next decade however we hope to have identified the key areas of significance. Each foresight provides a comprehensive 10-year view drawn from in-depth expert discussions. All foresights are on https://www.futureagenda.org/the-world-in-2030/

Previous Global Programmes

The World in 2020 was published in 2010 and based on conversations from 50 workshops with experts from 1500 organisations undertaken in 25 countries as part of the first Future Agenda Open Foresight programme. This ground-breaking project has proven to be highly accurate in anticipating future change and the results have been used by multiple companies, universities, NGOs and governments globally. Rising obesity, access not ownership, self-driving cars, drone wars, low cost solar energy, more powerful cities and growing concerns over trust were just some of the 50 foresights generated. For more details: https://www.futureagenda.org/the-world-in-2020/

Five years on, the World in 2025 programme explored 25 topics in 120 workshops hosted by 50 different organisations across 45 locations globally. Engaging the views of over 5000 informed people, the resulting foresights have again proven to be very reliable. Declining air quality, the growing impact of Africa, the changing nature of privacy, the increasing value of data and the consequence of plastics in our oceans are some of the foresights that have already grown in prominence. For more details: https://www.futureagenda.org/the-world-in-2025/

About Future Agenda

Future Agenda is an open source think tank and advisory firm. It runs the world's leading Open Foresight programme, helping organisations to identify emerging opportunities, and make more informed decisions. Future Agenda also supports leading organisations on strategy, growth and innovation.

Please contact us via:
douglas.jones@futureagenda.org

Future Agenda
84 Brook Street
London W1K 5EH
www.futureagenda.org
@futureagenda