



Soil Erosion: A Global Challenge

Soil erosion occurs naturally through climatic conditions, such as heavy rainfall and wind. Heavy rainfall can cause erosion by water hitting the surface of the soil, breaking down and dispersing soil particles within it. Wind can cause soil erosion by whipping up loosened soil particles and carrying larger soil particles along the surface, affecting the topsoil.

Although soil erosion occurs naturally, it is worsened by human activity, such as agriculture and deforestation. For example, the removal of vegetation (plants and trees), which acts as a cover for soil, can increase the extent of surface erosion on soil. Additionally, overgrazing by animals on pastured land can lead to higher rates of erosion, as it can also reduce ground cover.

There are many effects of soil erosion. These include: land degradation; threats to global food security; and increased carbon emissions. Land degradation refers to the reduction or loss of biological or economic productivity on land. This can impact several functions of the ecosystem, including food production and water retention. At present, soil erosion is exacerbating land degradation, with erosion rates higher than formation rates. Soil is unrecoverable in a human lifespan, as it can take up to 1,000 years to produce just 2 to 3 centimetres of soil. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, at least 3.2 billion people are at risk of being negatively affected by land degradation, such as malnutrition and forced migration.

Land degradation as a result of soil erosion also threatens global food security, leading to up to 50 percent losses of crop yields. A 2019 study by the EU's joint research centre into the estimated cost of soil erosion by water found that worldwide food production was reduced by 33.7 million tonnes, of which 22.5 million tonnes are crops.

Soil erosion also leads to an increase in carbon emissions in the atmosphere. This is because soil erosion leads to the displacement of soil and the organic carbon within it. Erosion allows more carbon dioxide to be released into the atmosphere, increasing the effect of climate change.

Measures have been introduced globally to prevent soil erosion. Governments and UN representatives have signalled their commitment to achieving land neutrality and improving planning to minimise soil erosion. Land neutrality is achieved when an area of productive land remains stable or increases in size. In the United Kingdom, the Government has allocated a minimum of £200,000 towards creating metrics on soil, which would allow the Department for Environment, Food and Rural Affairs to monitor soil health at farm and national level. The Government also stated that it would be seeking ways to work with farmers to achieve good soil management practices, such as identifying choices for land under cultivation.

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What is Soil Erosion?

According to the Food and Agriculture Organisation of the United Nations (FAO), soil erosion is defined as “the accelerated removal of topsoil from the land surface through water, wind and tillage”.¹ Although soil erosion occurs naturally under climatic conditions, the FAO argues that it is “significantly increased and accelerated” due to “unsustainable” human activities. This includes intensive agriculture and deforestation.²

What is the Impact of Soil Erosion?

In the FAO’s status of the world’s soil resources report 2015, soil erosion was judged to be the number one threat to soil functions in five out of seven regions (Africa, Asia, Latin America, Near East and North Africa, and North America). This is despite the trend deteriorating in Africa, Asia, Latin America and Near East Africa.³

Soil erosion can: cause land degradation; threaten global food security; and increase carbon emissions.

Land Degradation

Land degradation can take many forms, but is often considered to be the “serious disruption of a healthy balance between five key ecosystem functions”. These are: food production; fibre provision; microclimate regulation; water retention; and carbon storage.⁴

At present, soil erosion rates are higher than formation rates. This means its loss and degradation is unrecoverable in a human lifespan, as it can take up to 1,000 years to produce just 2 to 3 centimetres of soil. According to the FAO, 33 percent of the Earth’s soils are already degraded, with the threat of over 90 percent becoming degraded by 2050.⁵

It is estimated that soil erosion is affecting the wellbeing of billions of people. In a 2018 assessment report for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), more than 100 experts argued that land degradation posed a “serious danger to human well-being”.⁶ Their findings revealed that at least 3.2 billion people were at risk of being negatively affected by land degradation, such as malnutrition and forced migration. This is due to 43 percent of the world’s population living in regions affected by land degradation. IPBES also estimated that 4 billion people will be living in drylands by 2050, with land degradation and climate change having forced 50-700 million people to migrate.⁷

¹ Food and Agriculture Organisation of the United Nations, ‘[Global Symposium on Soil Erosion: Key Messages](#)’, accessed 5 December 2019.

² *ibid.*

³ Food and Agriculture Organisation of the United Nations, [Soil Erosion: The Greatest Challenge for Sustainable Soil Management](#), May 2019.

⁴ Abbas El-Zein, ‘[On Dangerous Ground: Land Degradation is Turning Soils into Deserts](#)’, *Conversation*, accessed 5 December 2019.

⁵ Food and Agriculture Organisation of the United Nations, ‘[Global Symposium on Soil Erosion: Key Messages](#)’, accessed 5 December 2019.

⁶ Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, ‘[Worsening Worldwide Land Degradation Now ‘Critical’, Undermining Well-being of 3.2 Billion People](#)’, 23 March 2018.

⁷ *ibid.*

Soil erosion is also causing land degradation in the United Kingdom. In June 2019, the Environment Agency warned that over 2 million hectares of soil were at risk of erosion in England and Wales, with water being the most prevalent form of erosion. It also reported that 17% of arable soils in England and Wales showed signs of erosion and 40% of arable soil was considered at risk.⁸ In 2010, the Environment Agency calculated that soil degradation cost England and Wales £1.2 billion every year.⁹

Threats to Global Food Security

Land degradation as a result of soil erosion threatens global food security. According to the FAO, soil erosion can lead to up to 50 percent loss in crop yields.¹⁰

A 2019 study by the EU's joint research centre into the estimated cost of soil erosion by water found that US\$8 billion is lost annually from global gross domestic product. It was also found that worldwide food production was reduced by 33.7 million tonnes, of which 22.5 million tonnes were crops. This was attributed to reducing crop yields and increasing water usage for agriculture, which had increased by an average 1.6 percent worldwide.¹¹ For example, in Southeast Asia, more water was required because of the "intense" irrigation practices in rice production.¹² The study noted that due to the lower amount of agri-food products, such as wheat, available in the international markets and the consequent price increases, the total value of these goods had increased by US\$24.9 billion.¹³

Increased Carbon Emissions

A key function of soil is the storing of organic carbon, consequently removing carbon dioxide from the atmosphere. The Earth's soil contains approximately 2,500 gigatons of carbon, which is three times the amount of carbon in the atmosphere and four times the amount stored in plants and animals.¹⁴

Soil erosion leads to the displacement of soil and the organic carbon within it. According to Dr Joanna Clark, a lecturer in soil carbon at Reading University, if all the carbon in soil was released it would lead to "runaway climate change".¹⁵ In the United Kingdom, soil currently stores approximately 10 billion tonnes of carbon, equivalent to 80 years of annual UK greenhouse gas emissions.¹⁶

In a study published by the EU joint research centre in 2018, scientists estimated that accelerated soil erosion in EU agricultural land would lead to a 35 percent increase in eroded carbon in the

⁸ Environment Agency, [The State of the Environment: Soil](#), June 2019, p 3.

⁹ *ibid.*

¹⁰ Food and Agriculture Organisation of the United Nations, '[Global Symposium on Soil Erosion: Key Messages](#)', accessed 5 December 2019.

¹¹ Pasquale Borelli et al, '[A Linkage Between the Biophysical and the Economic: Assessing the Global Market Impacts of Soil Erosion](#)', *Land Use Policy*, July 2019, vol 86, pp 299–312.

¹² Linh Anh Cat, '[Soil Erosion Washes Away \\$8 Billion Annually](#)', *Forbes*, 21 May 2019.

¹³ Pasquale Borelli et al, '[A Linkage Between the Biophysical and the Economic: Assessing the Global Market Impacts of Soil Erosion](#)', *Land Use Policy*, July 2019, vol 86, pp 299–312.

¹⁴ Renee Cho, '[Can Soil Help Combat Climate Change?](#)', Earth Institute at Columbia University, 21 February 2018.

¹⁵ Roger Harrabin, '[Climate Change Being Fuelled By Soil Damage—Report](#)', BBC News, 29 April 2019.

¹⁶ Environment Agency, [The State of the Environment: Soil](#), June 2019, p 3.

atmosphere from 2016 to 2100. It believed this would be likely to “exacerbate” carbon losses from agricultural land to the atmosphere.¹⁷

What are the Causes of Soil Erosion?

Weather Conditions

Water Erosion

Heavy rainfall can cause soil erosion; when rainwater hits the surface of the soil, it breaks down and disperses particles within it. Often, this occurs in regions where vegetation is sparse, such as East Africa. There are four main types of water erosion:¹⁸

- **Splash erosion:** This represents the first stage of the erosion process. It occurs when rainwater hits the soil surface, resulting in the displacement of soil particles.
- **Sheet erosion:** This form of erosion leads to the removal of soil in thin layers by rain or by flows of water on the surface of the soil. This results in the loss of topsoil, which contains the most nutrients. Sheet erosion mostly affects sloping land that has been farmed, which has resulted in little vegetation to protect it.
- **Rill erosion:** Rills are shallow drainage lines less than 30 centimetres deep. Therefore, rill erosion occurs when surface water flows within these lines, consequently eroding the soil. Erosion can be reduced by decreasing both the volume and speed of surface water using grassed waterways and drains.
- **Gully erosion:** Gullies are deep channels that are larger than rills (more than 30 centimetres) and cannot be removed by farming. Gully erosion tends to occur where surface water has been allowed to concentrate.

There are several measures that can be implemented to prevent soil erosion by water. These include using vegetation, mulch and retaining walls:¹⁹

- **Vegetation:** By planting vegetation, soil is protected from direct contact with rainwater. In addition, vegetation (plants and trees) also create root systems, stabilising soil by making it harder to separate, subsequently preventing erosion.
- **Mulch:** Mulches are loose coverings or sheets of material placed on the surface of cultivated soil in order to retain moisture.²⁰ Therefore, the application of mulch to the topsoil allows soil to soak up water, protecting it against rainfall.
- **Retaining walls:** These walls can be built around an area of erosion to prevent surface runoff, which is the movement of water across the surface of soil.

¹⁷ Cristiano Ballabio et al, '[Soil Erosion is Unlikely to Drive a Future Carbon Sink in Europe](#)', *Science Advances*, 2 November 2018, vol 4 no 11.

¹⁸ New South Wales Government, '[Soil Erosion Solutions](#)', 19 November 2008.

¹⁹ *ibid.*

²⁰ Royal Horticultural Society, '[Mulches and Mulching](#)', accessed 5 December 2019.

Wind Erosion

Wind can also cause soil erosion. This is most prevalent in regions where there are drier climates or seasons. Similar to water, wind can whip up loosened soil particles, affecting the topsoil. This occurs through three processes: suspension; saltation; and surface creep:²¹

- **Suspension:** This occurs when wind lifts finer particles (less than 0.1 millimetres in diameter) in the air over long distances. This can often lead to dust storms.
- **Saltation:** In this process, the wind lifts middle-sized particles (0.05 to 0.5 millimetres in diameter) off the ground. However, these particles are too large to be carried through the air, instead moving by bouncing over the soil surface. This can cause larger particles to break into smaller ones, resulting in the soil surface wearing.
- **Surface Creep:** Creeping occurs when large soil particles (0.5mm to 2 millimetres in diameter) are dragged over the surface of the land, as they are too heavy to be carried by the wind. This causes the larger particles to collide and dislodge other particles in the soil surface, resulting in erosion.

Wind erosion can be minimised by retaining or increasing vegetative (eg plant and tree) cover to reduce wind speed at ground level and by introducing windbreaks. Windbreaks can range from trees and shrubs to fences and walls.

Agriculture and Deforestation

Agriculture and deforestation, including the removal of vegetative land cover for soil, also impacts the increase of surface erosion on soil. This is because vegetation shelters soil from high winds. In addition, the roots of plants and trees bind soil together, helping to form a more solid mass which is less susceptible to erosion.²²

Overgrazing by animals on pastured land can also lead to high rates of erosion as it can reduce ground cover, enabling erosion by wind and rain. This reduces the ability for plants to grow.²³

What is Being Done to Prevent Soil Erosion?

Globally

The FAO has established several bodies, such as the Global Soil Partnership and the Global Symposium on Soil Erosion, to find global solutions to tackle soil erosion.

Global Soil Partnership and the Global Symposium on Soil Erosion

In 2012, the Global Soil Partnership (GSP) was established by the FAO as a mechanism to promote the sustainable management of soils. Its priorities for action include: promoting the establishment of

²¹ Queensland Government's Department of Environment and Resource Management, [Wind Erosion](#), February 2011.

²² World Wildlife Fund, '[Soil Erosion and Degradation: Overview](#)', accessed 2 December 2019.

²³ *ibid.*

inclusive policies and soil governance; and improving knowledge of soil conditions through the establishment or strengthening of soil information systems.²⁴

In May 2019, more than 500 participants attended the Global Symposium on Soil Erosion, which was co-organised by the FAO and GSP, amongst others. Participants included representatives from: FAO member states, such as the United Kingdom; non-governmental organisations; civil society; farmers' associations; and land users.

At the event, participants identified three measures to “accelerate” efforts to tackle soil erosion globally.²⁵ The measures were:

- Developing a global map of soil erosion hotspots.
- Finalising a political plan of action to be presented at the Conference of the Parties of the UN Convention to Combat Desertification (UNCCD) taking place in September 2019.
- Undertaking a global study on the costs and benefits of both soil erosion and erosion control.²⁶

In September 2019, nearly 6,000 delegates (including government ministers and heads of UN bodies) participated in the 14th Conference of the Parties of the UNCCD in New Delhi, India.²⁷ Following the conference, parties to the UNCCD (including the United Kingdom) reaffirmed their commitment to achieving land neutrality, in an accord known as the New Delhi Declaration.²⁸ The accord also welcomed initiatives by India to reduce degradation, such as restoring an additional 5 million hectares of degraded land by 2030.²⁹

World Soil Day

In addition to organising the Global Symposium on Soil Erosion, the FAO also raises awareness of soil health and erosion by marking World Soil Day annually.

World Soil Day takes place on 5 December every year. The FAO states that the day seeks to focus attention on the “importance of healthy soil” and to “advocate for the sustainable management of soil resources”.³⁰ Since 2012, the FAO and the GSP have organised events to commemorate World Soil Day. This includes conferences and events, such as talks in schools to highlight soil science.³¹

In 2019, the campaign for World Soil Day 2019 was “Stop Soil Erosion, Save Our Future” and was designed to raise awareness of the “importance of sustaining healthy ecosystems and human well-

²⁴ Food and Agriculture Organisation of the United Nations, ‘[Global Soil Partnership](#)’, accessed 5 December 2019.

²⁵ International Institute for Sustainable Development, ‘[Global Symposium Calls for Action Plan to Tackle Governance of Soil Erosion](#)’, 4 June 2019.

²⁶ *ibid.*

²⁷ United Nations Convention to Combat Desertification, ‘[COP14: 2–13 September New Delhi, India](#)’, accessed 5 December 2019.

²⁸ United Nations, ‘[Delhi Declaration: Countries Agree to Make ‘Land Degradation Neutrality’ By 2030, A National Target For Action](#)’, 13 September 2019.

²⁹ United Nations Convention to Combat Desertification, ‘[The New Delhi Declaration: Investing in Land and Unlocking Opportunities](#)’, accessed 5 December 2019.

³⁰ United Nations, ‘[World Soil Day](#)’, accessed 5 December 2019.

³¹ British Society of Soil Science, ‘[World Soil Day 5th December Call For Help](#)’, accessed 5 December 2019.

being”. The United Nations hopes it will do this by addressing the “increasing challenges in soil management”, raising the profile of “healthy soil” and by encouraging governments, organisations, communities, and individuals to engage in proactively improving soil health.³²

According to Professor Sir Robert Watson, who is the current chair of IPBES, countries are not doing enough to tackle soil erosion. He argues that governments have focused on climate change “far more” than they have focussed on the loss of biodiversity or land degradation. This is despite all three being “equally important” to human wellbeing.³³

United Kingdom

The previous Conservative Government introduced measures to improve soil health and prevent soil erosion. This included: the publication of an environment plan; the introduction of new farming rules; and legislation on agriculture.

25 Year Environment Plan

In January 2018, the Department for Environment, Food and Rural Affairs (Defra) published its 25 year environment plan, setting out government action to “help the natural world regain and retain good health”.³⁴ As part of this, the Government’s policy to “use and manage land sustainably” included improving soil health and restoring and protecting peatlands.³⁵

Describing the data on soil health as being “held piecemeal” by different institutions and organisations, Defra announced in the environment plan that it would be investing at least £200,000 to create better metrics. This would allow the department to assess improvements to soil and “cost-effective and innovative” ways to monitor soil at farm and national level.³⁶ In addition, Defra reported that it would be seeking ways to work with farmers to achieve good soil management practices, such as “appropriate” choices for land under cultivation.³⁷

In response to the plan, the Soil Association, a charity campaigning for humane and sustainable farming, food, and land use, described it as a positive start. However, it said it ignored what action must be taken to “effectively” monitor soil health. The Soil Association called on the Government to fully recognise the contribution that increased organic farming would make to restoring UK soils; for example, by including the use of soil organic matter in the mandatory soil testing rules for farmers.³⁸

Similarly, the Campaign to Protect Rural England (CPRE), a non-profit organisation focusing on the countryside, called on farmers to turn to conservation agriculture to improve soil health and reduce erosion. This included minimal or no tillage of soil and maintaining organic soil cover with vegetation.³⁹

³² United Nations, [‘World Soil Day’](#), accessed 5 December 2019.

³³ Roger Harrabin, [‘Climate Change Being Fuelled By Soil Damage—Report’](#), 29 April 2019.

³⁴ HM Government, [A Green Future: Our 25 Year Plan to Improve the Environment](#), 22 March 2018, p 9.

³⁵ *ibid.*

³⁶ *ibid.*, p 43.

³⁷ *ibid.*

³⁸ Soil Association, [‘The 25 Year Environment Plan’](#), 15 January 2018.

³⁹ Campaign to Protect Rural England, [Back to the Land: Rethinking Our Approach to Soil](#), 3 December 2018, p 20.

New Farming Rules

In November 2017, the Government announced that it would be introducing new farming rules in England from April 2018.

The new rules included measures to prevent soil erosion from water. As part of this, farmers are now required to take “reasonable” precautions when carrying out agricultural activities. This includes creating grass buffer strips in valleys to prevent water runoff and placing livestock feeders at least ten metres away from inland freshwater or coastal waters, to prevent soil compaction from trampling. The Environment Agency has been tasked with enforcing these rules through its current inspection work of farms. Should a farmer be found in breach of the new rules, the Environment Agency will identify the changes needed to be made and agree a timeframe for them to do so.⁴⁰

Announcing the new measures, the then Parliamentary Under Secretary of State for the Environment, Thérèse Coffey, stated that it was a “win-win” for both farmers and the environment.⁴¹ The National Farmers Union, a member organisation for farmers in England and Wales, stated that it was “encouraged” that the rules would provide farmers with an “advice-led” approach to demonstrate best practice. However, it remained concerned over how the rules would be interpreted by farmers.⁴²

Agriculture Bill 2017–19

On 12 September 2018, the Government introduced the Agriculture Bill. The bill would have provided the legal framework for the United Kingdom to leave the common agricultural policy when the UK leaves the EU. It would also allow the Secretary of State for Environment, Food and Rural Affairs to provide financial assistance to support farming businesses in undertaking activities or measures to prevent or reduce environmental hazards. This could include financial assistance to reduce flood risk by “incentivising” good soil management.⁴³

The bill had its second reading in the House of Commons on 10 October 2018 and completed its committee stages on 20 November 2018. However, the bill did not receive a date for report stage and fell due to the prorogation of the 2017–19 parliamentary session.

Agriculture Bill 2019–20

In September 2019, Theresa Villiers, the Secretary of State for Environment, Food and Rural Affairs stated that the Government would be enthusiastic about reintroducing the bill.⁴⁴ The bill was subsequently included in the Queen’s Speech ahead of the 2019 parliamentary session.⁴⁵ However, the Government did not introduce it prior to the session ending on 5 November 2019, due to the calling of the general election. Following the general election, the bill was included in the Queen’s Speech for

⁴⁰ Department for Environment, Food and Rural Affairs, [‘Rules for Farmers and Land Managers to Prevent Water Pollution’](#), 2 April 2018.

⁴¹ Department for Environment, Food and Rural Affairs, [‘New Farming Rules for Water’](#), 30 November 2017.

⁴² National Farmers Union, [‘How Will the Farming Rules for Water Impact Your Farm?’](#), 14 March 2018.

⁴³ [Explanatory Notes to the Agriculture Bill 2017–19](#), p 12.

⁴⁴ House of Commons Environment, Food and Rural Affairs Committee, [Oral Evidence: Is DEFRA Ready for Brexit?](#), 9 September 2019, Q299.

⁴⁵ Cabinet Office, [‘Queen’s Speech 2019’](#), 14 October 2019.

the 2019–20 parliamentary session.⁴⁶ The bill was introduced in the House of Commons on 16 January 2020.⁴⁷ The bill enables the Secretary of State for Environment, Food and Rural Affairs to provide financial assistance for protecting or improving the quality of soil. This includes measures which support farmers with decision-making and soil management to improve soil health. For example, funding for soil health research to provide farmers with a site-specific understanding of their soil’s properties. In addition, the power could be used to “incentivise” farmers to invest in practices which both protect and enhance soil health.⁴⁸

⁴⁶ Prime Minister’s Office, [The Queen’s Speech 2019](#), 19 December 2019, pp 17–8.

⁴⁷ UK Parliament website, [‘Agriculture Bill 2019–20’](#), accessed 20 January 2020.

⁴⁸ [Explanatory Notes to the Agriculture Bill 2019–20](#), p 9.