2015. YEAR OF SOILS.
SOIL. SUSTAINS LIFE.

Working together for the benefit of soils.

Solid arguments
for better stewardship
of a finite resource.

Contents

Soil is finite ...

Soil is the uppermost layer of planet Earth's crust, varying from a few centimetres to several metres in depth. Soil formation takes a very long time: soils in Central Europe, for example, took several thousand years to develop. Soil fertility determines whether plants can grow. Consequently, severe damage to soils – such as from erosion – can not be mitigated by natural processes in the short or medium term. Therefore, on a human scale soils are a finite resource.

... and soil is vanishing.

Almost a quarter of Earth's land area has been degrading over the last 25 years.[1] Globally we are losing more than 10 million hectares of fertile soil per year as a result of unsustainable agricultural land use, soil pollution, urbanisation and infrastructure development.[2] While the majority of countries is already facing some measure of degradation, large areas of Africa and South America are particularly affected. Especially in the dryland areas, which occupy 40% of Earth's land area, natural ecosystem provisioning services are under threat.[3] The sealing up of surfaces, erosion, and loss of soil organic matter are contributing to the decline of fertile soils in Germany as elsewhere.

For example, 73 hectares of land are sealed up in Germany every day for transport infrastructure and settlements – that is one hectare every 20 minutes.[4] This sealing up of surfaces has many negative repercussions: valuable (arable) soils are lost along with habitats for flora and fauna. The soils' impact on climate is also lost. The unsealing of surfaces is onerous and extremely expensive

01

Soil is valuable ...

... for food production.

More than 90% of our food production is directly dependent on soils. Their quality and fertility directly determine yields of fruit, vegetables and grains. But the high demand for meat products in industrial nations as well as the rising demand for such products in newly industrialising countries impact on soils and increasingly threaten as yet healthy soils and forests.

Huge amounts of land are used for the production of livestock feed, with land management often being non-sustainable. For example, 90% of the global soya crop is used directly for intensive livestock farming.[5] In countries such as Argentina or Brazil, more and more forests and pasturelands are converted to cropland as a result.

According to the Food and Agriculture Organization of the United Nations (FAO), modern intensive agriculture has enabled world grain harvests to double from 1.2 to 2.5 billion tonnes per year between 1970 and 2010.[6]

However, over vast areas, soils have been damaged severely by cropping. One of the impacts is compaction

caused by heavy agricultural machinery. This in turn compromises the soils' capacity to infiltrate and store water. It also increases erosion, i.e. the removal of soil: if rainwater does not infiltrate the soil but runs off the surface it takes soil with it. The remaining soil dries out more easily, making it susceptible to wind erosion. Moreover, in many areas reductions in available soil nutrients result from highly-efficient harvesting, the removal of crop residue, and insufficient recycling of organic matter back to the soils. Over time, the precious humus layer is being lost.

… for many of the good things in life.

Soils not only offer us food but also many of the other good things in life. Soils are, for example, the source of all textiles, be they plant-based, animal-based, or synthetic.

The connection is obvious for plant fibres such as cotton or linen. Animal fibres mostly come in the form of hair from animals which need soil-based pastureland. Synthetic fibres are manufactured either from cellulose, i.e. wood or other plant fibres, or from petroleum which formed over millions of years from plants.[7] Timber for furniture or toys is another one of those good things that would not exist without soils. The same is true for coffee, tea, tobacco or chocolate without which our daily lives wouldn't be half as enjoyable. Moreover, plants valued for their medicinal or cosmetic properties, such as argan oil, Aloe vera or Stevia would not be able to grow in the absence of healthy soil.

… for water quality.

Soil and water greatly influence each other. Not only does soil filter water and allow it to infiltrate, but soil can hold many multiples of its own weight in water. The water-holding capacity of the soil and deeper horizons thus lower the risk of both flooding and drought.

If rainwater does not infiltrate but runs off at the surface, soil erodes. As a result, nutrients such as phosphates and nitrates derived from fertiliser usage are washed into watercourses. The waters' unnaturally high nutrient concentration enhances algal growth which makes the water greenish and turbid. When the algae die, the oxygen dissolved in the water is used up for their decomposition, which results in oxygen-deficient zones that are more or less incapable of sustaining life. In addition to this eutrophication, the nitrogen compounds dissolved in water pose yet another problem: if high concentrations of dissolved nitrates reach the groundwater, the water is no longer fit for drinking. The soil's filter function as well as more prudent fertiliser usage can prevent such a situation. The EU Nitrates Directive therefore aims at protecting water quality in Europe.

… for energy provision.

Approximately 2.4 billion people – in particular in Africa's and Asia's rural areas – are dependent on biomass (fuelwood, charcoal and dung) for their energy needs. This biomass could not be produced without soil.[8]

Due to this dependence, trees and shrubs are often cut down for charcoal production. But their removal leaves the soil unprotected. Soils then degrade all the more rapidly, resulting in diminished growth, and in turn lower fuelwood availability. Fuelwood plantations are more sustainable: fast-growing tree species, that can also thrive on marginal soils, can yield a significant amount of wood as early as four to five years after planting. Proper management can ensure a constant energy supply while also providing for long-term soil protection.

... for our climate.

Soils store an estimated 3 trillion tonnes of carbon today, making them the world's second largest carbon reservoir after the oceans.[9]

In the form of different types of molecules, soils store much more carbon than the world's forests (roughly ten times as much) and the atmosphere (roughly five times as much). While the amount of CO_2 stored in soils varies depending on the type of soil, all of them have an enormous potential for greater storage of this damaging greenhouse gas. The global potential of soils for carbon storage is estimated to be between one and three billion additional tonnes of CO_2 per year. Up to 800 million tonnes could be stored as a result of sustainable land use practices on agricultural lands alone.[10] Healthy soils thus contribute directly to climate change mitigation.

… for our very existence.

Land degradation adversely affects the livelihoods of at least 1.5 billion people globally.[11] In the most strongly affected regions a particularly high proportion of people is directly dependent on agriculture.

Agriculture is their main source of revenue as well as meeting immediate food security. Farmers' yields drop in tandem with declining soil quality. If less food is produced, local food prices rise. In the long term, this is one factor amongst others contributing to food price rises at the global level, which in turn give rise to poverty and hunger while also adversely affecting development in the countries concerned.

… for life.

Not only is soil the basis of life, it is full of life itself, hosting a huge range of species. Countless plants, animals, fungi and microorganisms purify the water and air in the soil.

They thus contribute to a healthy, productive ecosystem.[12] One cubic metre of healthy soil, i.e. a cube with edges one metre in length, may contain more than 5 billion organisms.[13] In comparison, there are 'only' 7.3 billion people on Earth.[14] This means that roughly 1.5 kg of soil contains as many organisms as there are human beings on this planet.

02

Soil degradation and loss ...

... entail high costs.

The loss of fertile soil carries a high cost. Measured at a global scale, the decline in productivity and yields resulting from the global annual loss of fertile soil costs roughly 400 billion US dollar per year, or about 70 US dollar per person on Earth.[15] It costs the countries dearly: in Niger for example the cost of soil degradation equates to eight per cent of the country's Gross Domestic Product.[16]

... increase food insecurity.

It is expected that by the middle of this century the global human population will have risen to more than nine billion. By 2050, approximately 60% more food will be needed to feed them all.[17]

At the same time, per capita available cropland area is decreasing as a result of population growth and soil degradation.[18] The global agricultural land area has decreased by approximately 53 million hectares since 2000 due to degradation.[19] At the same time, one-third of food produced for human consumption is lost, e.g. due to improper storage or transport, or wasted, amounting to some billion tonnes per year worldwide.[20]

… exacerbate conflicts and result in migration.

Almost 3 billion people worldwide are subsistence farmers and therefore directly dependent on the soil beneath their feet.[21]

Soil degradation is one of the factors forcing an increasing number of people to leave their home region. There are no solid figures on the number of people fleeing areas solely as a result of climate impacts or loss of soil fertility. There were roughly 25 million environmental refugees in 1995. The United Nations (UN) estimate that by 2045 some 135 million people will be at risk of losing their livelihood due to soil degradation in dryland regions, forcing them to migrate.[22]

… intensify climate change.

The global repercussions of soil degradation are severe. Given that soils store immense amounts of carbon, damage to soils exacerbates climate change.

Soil degradation impairs the soils' carbon storage function, with the result that formerly sequestered carbon is released into the atmosphere. It has been estimated that degradation in dryland soils alone (desertification) has caused 20–30 Gt (billion tonnes) of carbon emissions. This is roughly equivalent to the global emissions due to the burning of fossil fuels for energy generation over the past two to three years.[23]

03

Soil can be protected ...

... by consumers.

- The purchasing and consumption of regionally produced foods does not 'occupy' soils in other parts of the world.
- Be they foods, clothing, furniture or cosmetics: buying environmentally or socially certified products means contributing to soil-protecting production and fostering farmers' rights. There is no absolute certainty that certified products do indeed meet all the criteria of sustainable production. The likelihood of their production being socially and environmentally compatible is however much greater than it is for their conventionally produced counterparts.
- Foods and clothing can be re-used or swapped instead of being discarded. Upcycling is a further variant of recycling where obsolete items of daily life are recycled to become new products, e.g. handbags made from skirts or purses made from truck tarpaulin.

- By avoiding the use of herbicides in the garden, a healthy soil flora can be maintained. The prudent use of road salt in winter also protects soils and watercourses; sand for example is a suitable alternative.
- Soil is delightful: relaxing in the garden or creative urban gardening bring us back in contact with the soil.
- Citizens can also get together to advocate more green-spaces in their neighbourhood. Existing vacant lots or disused transport infrastructure offer good opportunities for renaturalisation, unsealing of surfaces, or urban gardening projects.

... by the farming sector.

- Locally adapted fertiliser applications and soil-protecting cultivation methods lead to a reduction in fertiliser usage and prevent eutrophication.
- Erosion control and organic fertilisers maintain the humus content appropriate to the various soil types, or, under appropriate management, may even increase it.
- The cultivation of site-appropriate crop species and cultivars minimises susceptibility to deficiencies, pests and diseases, resulting in an overall reduction in fertiliser use, irrigation, and pesticide usage.
- Year-round ground cover and conservation tillage. (i.e. no-till or reduced till on arable land) provide lasting protection against erosion. Reforestation similarly stabilises soils on sites susceptible to erosion.
- Integrated farming which establishes nutrient and energy cycles within the farm or at the regional level can also maintain soil fertility. The combination of arable cropping and livestock farming, or an increase in the diversity of crop types grown, provides for the long-term maintenance of yields.

- Regionally adapted structural landscape elements such as field margins, small woodlands, vegetated embankments along watercourses, linear copses or xeric grasslands provide for good erosion control, reduce eutrophication, and maintain biodiversity.
- In drylands, low-evaporation irrigation methods should be employed, e.g. drip-irrigation, in order to avoid soil salinisation.
- The role of fossil energy resources should be as small as possible in the energy balance of agricultural production processes, e.g. for running machinery (direct energy inputs) and for the usage of mineral fertilisers and pesticides (indirect energy inputs).

... by policy.

- In the early stages of planning a measure, expected impacts on soils should already be given consideration. This concerns strategic landscape planning as well as investment decisions, e.g. decisions on construction projects or planned industrial activities. The precautionary principle is essential in this context: impacts on soil resources must always be taken into consideration. Support for unsealing or site rehabilitation creates incentives for investments into healthy landscapes.
- The establishment and enforcement of sustainability standards for soil management – in industry, agriculture and spatial planning – provides for the protection of existing natural sites or land suited to agricultural use. This can help to avoid industrial pollutant deposition, damaging agricultural practices, and excessive sealing of soil surfaces.

- Compaction of existing building stock can be a soil-protecting alternative to the designation of greenfield settlements and transport infrastructure. The focus should be on the utilisation of inner-city vacant lots and on the modernisation of vacant housing stock.
- In public procurement and tenders, putting a high emphasis on suppliers' compliance with environmental and social standards constitutes a valuable contribution to soil protection.
- Producers as well as consumers should have access to information and advice (offered, for example, by state agricultural offices) on sustainable soil management.
- German policy could demand of domestic private investors that in countries without legal certainty around standards (e.g. human rights, land rights), they ensure compliance with such standards. Especially in developing countries, legal certainty for land owners not only promotes equity in society and helps to reduce poverty; it also motivates landowners to take good care of their land base.
- Global co-responsibility may also be exercised, and sometimes quite prominently so, at the municipal level. Strong networks of local authorities, local businesses and citizens are in a position to highlight local dimensions of global issues, expand knowledge about soil, and stimulate discussion on its sustainable utilisation.

04

Soil: Facts and Figures

77 ha of soil

This equates to:

Vatican City

lose some or all of their function in Germany every day as a result of:

Surface sealing ***Erosion*** ***Pollution***

This area is no longer available for food production.[24]

17%

of agricultural land in the EU

is already degraded.[25]

This equates to:

Ireland

2 billion ha

worldwide are affected by human-induced ***soil degradation****.*[26]

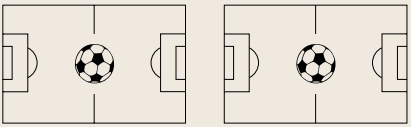
putting at risk the livelihoods[27]

of at least

1.5 billion people

1.3 ha

corresponds to:



which is the area needed by the average European

per year to produce the products consumed by that person

=

6×

more than a person in Bangladesh

can make use of.

Almost

60%

of the land utilised to meet Europe's consumption

is located outside of the EU.[28]

Statistically there are

2.000 m²

of arable land available per person.[29]

In 1970

> 3.200 m²

were available.

It is estimated that by 2050 it will be as little as

1.500 m²

This means that:

global agricultural production would need to be approximately

60% ↗

higher by 2050 than it was in 2007[30] *in order to feed*

> 9 billion people[31]

1/3

of the world's cropland

=

used for the production of

livestock feed

In the EU = 60%[32]

can be well fed with the meat produced using livestock feed grown on

1 ha

In comparison:

can be well nourished with the potatoes grown on

1 ha[33]

Of the

949 million people

living in sub-Saharan Africa[34]

approximately

640 million people

live in rural areas.

=

72%

are directly dependent on subsistence agriculture (self-sufficiency farming).

240 million people

in Africa are considered ***undernourished****.*[35]

This means that their daily diet contains fewer nutrients than their bodies require.

EU target:

10% 

Biofuel

on the market. Up to **7%** *may be obtained from foods such as cereals or oilseeds.* [36, 37]

Its production would require up to

20 million ha of land

This is roughly equivalent to :

120%

of the agricultural land used in Germany in 2015. [38]

The bulk of Germany's land area is under agricultural use. But the share of agricultural land in the total area has been continuously declining.

2000 = 53.5%

↓

2011 = 52.3%

of the total area,
especially in proximity to urban agglomerations. [39]

In Germany,

73 hectares

of land per day are covered with impervious surfaces.

13.5%

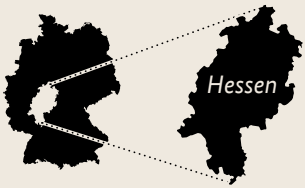
of Germany's total area (excl. Saxony-Anhalt) is under settlements and transport infrastructure.[40]

Approximately

6.2%

of Germany's total area (excl. Saxony-Anhalt) is covered by impervious surfaces.

This equates to the area of:



Which means that:

loses its ecosystem function.[41]

05

So, what exactly is …

… DEGRADATION?

The term ‘soil degradation’ is used when soils lose their fertility and productivity – often as a result of inappropriate management. In addition to wind and water erosion of soil, factors contributing to soil degradation include humus decomposition, water-logging as a result of compaction or a lack of drainage, salinisation, and damage resulting from biological, physical or chemical impacts caused by the use of heavy machinery, fertilisers and herbicides in farming. Soils can no longer fulfil their diverse functions and also become unsuitable for farming purposes.

… DESERTIFICATION?

The term ‘desertification’ refers to the increasing degradation of landscapes and soil in dryland regions. A large proportion of the world’s human population lives in relatively arid climates where ongoing desertification threatens their livelihoods. Natural resource scarcity and strong population growth lead to intensive utilisation and expansion of cropland and pastureland. As a result, water reserves are being exhausted, existing

vegetation vanishes, and soils are degraded by erosion, leaching or salinisation. This loss of soil fertility in turn leads to cropland expansion or shifting cultivation and thus to ever increasing land consumption, ultimately driving a vicious cycle of poverty and desertification.

... EROSION?

The term 'erosion' describes the wearing away of the soil surface under the influence of wind, water or ice. What is of concern is the human-induced increase in soil erosion. As a result of soil compaction, overgrazing, or the removal of natural vegetation, soils are fully exposed to rainfall, storm events and flooding. This causes the fertile uppermost soil layers to be eroded and the soil to lose its capacity to sustain agricultural use as well as its natural functions. The affected regions may then suffer ecological, economic or sociological problems.

... EUTROPHICATION?

'Eutrophication' is the result of unintentional nutrient enrichment of watercourses: rainwater run-off causes soil erosion and takes with it agricultural fertilisers which are washed into watercourses.[42] This results in increased algal growth and decreased biodiversity. In the Baltic Sea, for example, dead zones have been created by massive algae blooms. When the algae die and sink to the bottom of the sea, their decomposition requires oxygen. If the oxygen concentration in the water drops too low, life can no longer be sustained.

… LAND GRABBING?

'Land grabbing' means the large-scale appropriation of land, by way of purchase or lease, by domestic or foreign investors, putting the local population at a significant disadvantage.[43] Products grown or raised on this land are often exported to industrialised countries, e.g. to Europe. In such situations, the lands' fertile soils are no longer available to the local people for subsistence farming or to contribute to local added value, which may result in food shortages and local food price rises. Large-scale investments in land are often associated with the displacement of local communities, e.g. as a result of rapidly rising land prices, or even with violent evictions.

Often short-term leases are taken out so as to maximise yields and minimise costs. For many companies there is little incentive to comply with environmental and labour standards; the soils are often abandoned in a highly degraded state after a few years of intensive use.

… HIDDEN HUNGER?

To be full does not necessarily mean that one has eaten a healthy meal; one's body may continue to be 'hungry' for important nutrients. Due to a lack of financial means many people buy cheap food lacking in nutrition. There are also many countries in which unbalanced diets focused for example on rice, maize or white bread are lacking in vitamins and minerals. People so affected suffer from 'hidden hunger' which in the long term leads to illness. Hidden hunger can be found not only in developing and newly industrialising countries but also in industrialised nations such as Germany.

... SEALING OF SOIL SURFACES?

'Sealing of soil surfaces' means to cover natural soil with surface structures such as buildings, industrial plants or residential units which are impervious to precipitation. Fertile soil is covered up and irretrievably lost.

... VIRTUAL LAND?

The term 'virtual land' describes arable land needed to produce certain agricultural or forestry products. As the land itself remains at the site of production, the products embody this 'virtual land'. Imported products therefore 'consume' land in other countries. For the beefsteak on our BBQ we thus utilise the proportion of Brazilian cropland required to grow the soya beans fed to the cattle that yielded the meat.

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