Global Soil Week 2012

Resource Efficiency to Diminish Land and Soil Degradation

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Abstract

Degradation processes are threatening land and soils worldwide. To formulate policies that enhance a more efficient land and soils use specific elements of these resources have to be taken into account. This issue paper provides information about the situation of degraded soils in Europe and beyond and outlines the relevant aspects policy makers should take into their decision when formulating land and soils related policies.

Keywords

Resource Efficiency; Soil and Land Degradation; EU Policy

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1. Introduction

In order to perform soil's many functions, it is necessary to maintain its condition. However, there is evidence that soil is increasingly threatened by a range of human activities, which may degrade it. Soil degradation has a direct impact on water and air quality, biodiversity and climate change. It can also impair the health of European citizens and threaten food and feed safety.

The final phase of the degradation process is land desertification when soil loses its capacity to carry out its functions. Other major threats that cause soil degradation are erosion, contamination, sealing, compaction, a decline in bio-diversity and salinisation. Both in the EU and worldwide, soil degradation has increased in the past decade. This trend is likely to continue unless a more efficient use of the resource soil is addressed.

The main objective of this issue paper is to provide information about the situation of degraded soils in Europe and beyond and outline specific barriers of efficient land and soil use that should be taken into account for policy making to enhance an efficient land use.

2. Interlinkages, Significance and Risks of Using Land and Preserving Soils

Land

Available productive land is itself a natural resource, whether used to deliver agricultural produce or eco-system services. Changes in land-use may increase the efficiency of land. However, for this to be the case, the current and future public and private benefits of alternative uses of the land need to be taken into account.

EU land cover is 4.2 million km² of which roughly is 40% forests, 44% agriculture, and 4% built-up areas[2]. The 2010 Status of the Environment Report (SOER 2010) of the European Environment Agency notes that "land-use specialisation (urbanisation, agricultural intensification and abandonment plus natural afforestation) is still a very strong trend and is expected to continue in the future" (EEA 2010: 4).

Much of the land being converted for housing, industry, roads or recreational purposes is highly agriculturally productive, due the historical location of cities at the centre of areas where soils are most fertile.

The loss of joined up habitat through fragmentation is also serious.

Intensification is problematic where the impacts of high stocking numbers, inadequate crop rotation and high water use are not controlled, resulting in excessive inputs of nitrates and pesticides into water, ammonia into air and water stress.

Agricultural abandonment is also an issue: a study by the European Commission estimates that 9% of agricultural land will be abandoned by 2020 (EC 2010: 129). This may have undesirable consequences for biodiversity, especially related to the loss of extensively grazed grasslands.

Soil

Soil provides us with food, biomass and raw materials. It serves as a platform for human activities and landscape and as an archive of heritage and plays a central role as a habitat and gene pool. It stores, filters and transforms many substances, including water, nutrients and carbon.

Soil captures about 20% of the world's manmade carbon dioxide emissions, giving good soil management significant cost-effective potential for mitigating climate change. Europe's soils contain an estimated 73 to 79 billion tonnes of carbon in the form of organic matter. It is important to note that about 20% of the European soil carbon stock is in peatlands, despite the fact that they only cover 8% of the EU-27 surface area (EC 2007: 129).

Soil quality and water issues are linked – soil organic matter can hold 3-5 times its weight in water, when it is preserved (FAO 2000: 11). In addition, a fully functioning soil reduces the risk of floods and protects underground water supplies by neutralising or filtering out potential pollutants and storing as much as 3,750 tonnes of water per hectare (EC 2010a).

[2] Land Use/Cover Area frame Survey (LUCAS), conducted in 2009. Land was surveyed in 23 EU Member States, where both the physical cover of the land and its visible socio-economic use were recorded. http://www.lucas-europa.info/NewsBASE/content_eftas_lucas01/frame_deutsch.php

3. Degradation in Europe and Worldwide

Land degradation in its various forms is a fundamental and persistent problem. The situation in Europe is mirrored and magnified in many parts of the world. It is also a global development issue, as soil degradation, poverty and migration are mutually reinforcing, but that is often largely ignored, because observed impacts are gradual.

... globally...

Desertification, land degradation and drought affect over 1.5 billion people in more than 110 countries, 90% of whom live in low income areas. According to the United Nations Environment Programme, up to 50,000 km² are lost annually through land degradation, mainly due to soil erosion (UNEP 2007). Each year, the planet loses 24 billion tonnes of topsoil. Over the last two decades, enough has been lost to cover the entire cropland of the United States. Desertification costs the world more than $40 billion a year in lost productivity.

Soil degradation caused by human activities contributes to climate change. It is responsible for 20% of the carbon emitted to the atmosphere between 1850 and 1998 (Lal 2004). The drainage and conversion of the world's peatlands alone causes emissions of up to 0.8 billion tonnes of carbon a year, much of which could be avoided through restoration (EC 2010b).

A legacy of contaminated sites is common to all old industrial heartlands, but also affects developing countries and countries with economies in transition. A recent report estimates the number of contaminated sites (mainly waste dumps) in India (APSF 2011) at 36,000; experts believe that there are between 300,000 and 600,000 contaminated sites in China[3].

... and in the EU

In 2006, the Commission evaluated that soil degradation in EU-25 was costing the EU economy some €38 billion per year, with the European Environment Agency estimating a cost of agricultural land loss of €53/ha/year (EC 2006c).

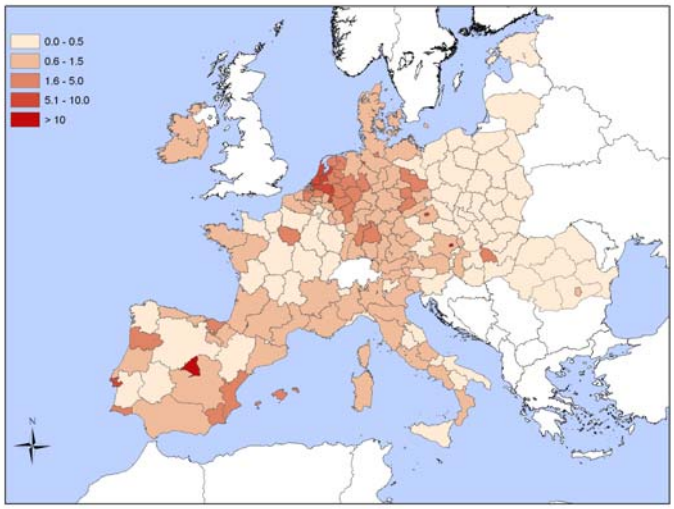
The 2010 Status of the Environment Report of the European Environment Agency demonstrates that soil degradation is increasing, as the following examples show (EAA 2010b):

Soil sealing (the permanent covering of soil with an impermeable material) and associated land take lead to the loss of important soil functions (such as water filtration and storage,

[3] http://www.chinadaily.com.cn/2011-03/10/content_12146168_2.htm.

and food production). In the EU, more than 1,000 km² are subject to 'land take' every year for housing, industry, roads or recreational purposes. About half of this surface is actually 'sealed' (Prokol et al. 2011). The availability of infrastructure varies considerably between regions, but in aggregate, every ten years we pave over a surface area equivalent to Cyprus. In the period 1990-2006, 19 Member States lost a potential agricultural production capability equivalent to a total of 6.1 million tonnes of wheat, with large regional variations (see Figure 1). This figure is far from being insignificant, given the levelling off of agricultural productivity increases that has already been experienced and the fact that, to compensate for the loss of one hectare of fertile land in Europe, it would be necessary to bring into use an area up to ten times larger in another part of the world (Gardi et al. 2011). If we are to reach the state of no net land take by 2050, following a linear path, we would need to reduce land take to an average of 800 km² per year in the period 2010-2020.

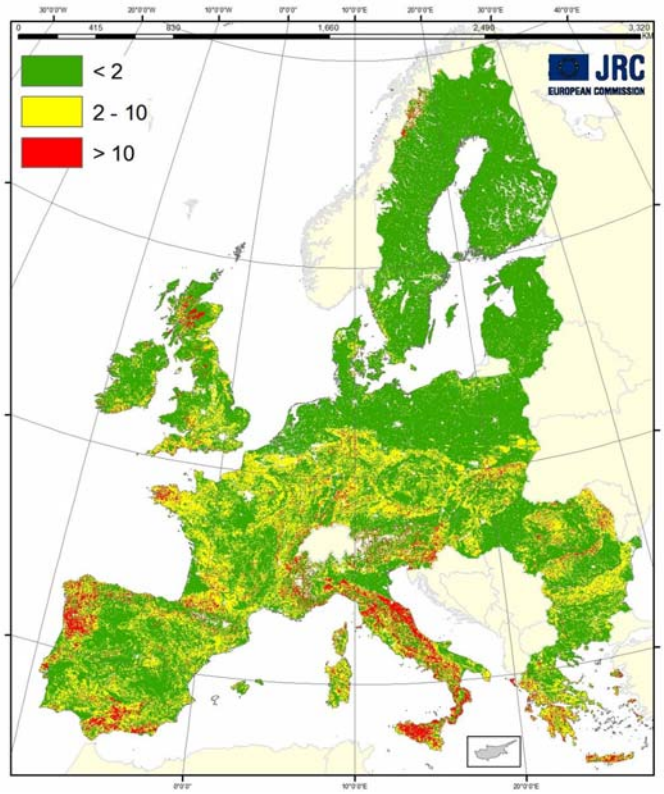
Figure 1: Potential wheat yield losses (%) in 19 EU countries (1990-2006).



A new model of **soil erosion** by water constructed by the JRC has estimated the surface area affected in EU-27 at 1.3 million km² (see Figure 2). Almost 20% of these are subjected to a soil loss in excess of 10 t/ha/y. Erosion is not only a serious problem for soil functions (estimated to cost €53 million per year in the United Kingdom alone); it also has an impact on the quality of freshwater, as it transfers nutrients and pesticides to water bodies (DEFRA 2009: 11). For example, agricultural losses of phosphorus exceed 0.1 kg/ha/y across much of Europe, but reach levels in excess of 1.0 kg/ha/y in hotspots (EEA 2010a). Addressing erosion will thus be a key contribution to achieving EU water objectives. Soil erosion is

particularly intensive in forest fires areas, estimated at 500,000 ha/y by the European Forest Fire Information System (EFFIS)[4].

Figure 2: Soil erosion by water in the EU (t/ha/y).

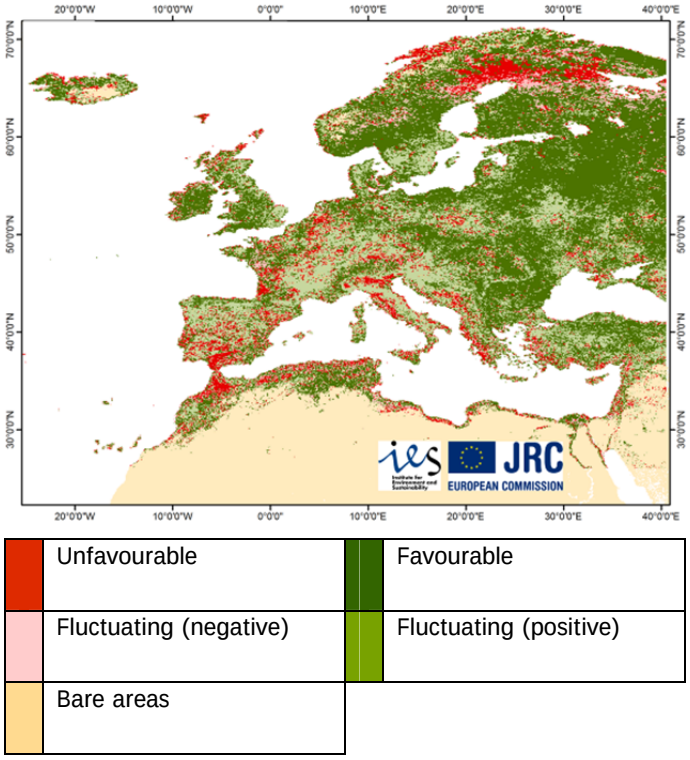


As an extreme form of land degradation, **desertification** results in a serious impairment of all soil functions. While there is still no scientifically-sound assessment at European level, one factor that contributes to desertification is an unfavourable trend in productive capacity. Figure 3, produced by the JRC in preparation for the World Atlas of Desertification[5], shows the areas where productive capacity has been constantly decreasing in the past few decades. If confirmed by other factors, this could indicate increasing desertification across Europe.

While naturally saline soils exist in certain parts of Europe, irrigation water – even if it is of high quality – includes minerals and salts that are gradually accumulated in the soil, causing **salinisation**. The continuing expansion of irrigation – with related problems of water scarcity and the increasing use of groundwater of marginal quality – accelerates salinisation, thereby affecting soil productivity. However, there are no systematic data available on trends across Europe.

[4] http://effis.jrc.ec.europa.eu.
[5] http://wad.jrc.ec.europa.eu. The Atlas is due at the end of 2012.

Figure 3: Evolution of net primary productivity (1982-2006).



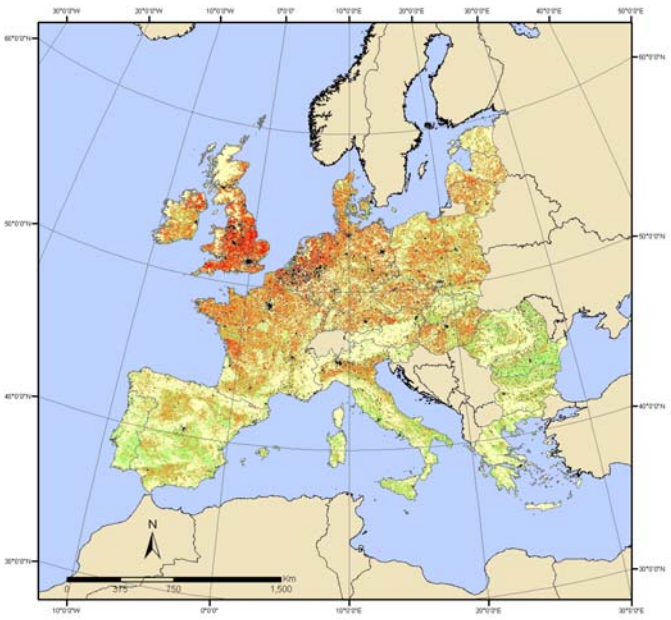
Deposition of acidifying air pollutants (e.g. ammonia, sulphur dioxide and nitrogen oxides) contributes to **soil acidification**, which lowers the pH of the soil, thereby modifying the soil ecosystem, mobilising heavy metals and reducing crop yields. While air deposition models predict a significant improvement in the period 1990-2010, at least a quarter of the measured samples in a recent assessment of forest monitoring plots showed that critical limits for acidifying substances were being exceeded to a substantial degree. The situation for other soil cover types is not known, as there is no systematic monitoring of soil acidification across Europe for non-forested soils (EEA 2010c: 16).

Soil biodiversity provides numerous essential services, including releasing nutrients in forms that can be used by plants and other organisms, purifying water by removing contaminants and pathogens, contributing to the composition of the atmosphere by participating in the carbon cycle, and providing a major source of genetic and chemical resources (e.g. antibiotics). An indicator-based map prepared by the JRC (see Figure 4) shows a preliminary assessment of where soil biodiversity is threatened (Jeffery et al. 2010: 62f) . This includes areas of high population density and/or intense agricultural activity (e.g. cereals and industrial crops, animal husbandry, greenhouses, fruit orchards, vineyards and horticulture).

Landslides are a major threat in mountainous and hilly areas across Europe (land abandonment being an aggravating factor), often producing serious impacts on population, property and infrastructure. Over 630,000 landslides are currently registered in national databases.

Once contaminated, soil functions may be impaired and human as well as ecological health and food quality may also be prejudiced. It is difficult to quantify the full extent of local **soil contamination**, as the vast majority of Member States lack comprehensive inventories, although this is covered by the proposed Soil Framework Directive (EC 2006b). But Europe has a problem of soil contamination, particularly historical contamination. In 2006, the European Environment Agency estimated that there were a total of three million potentially contaminated sites in the EU, of which 250,000 were actually contaminated. Remediation is progressing, although there are wide variations between Member States, reflecting the presence or absence of national legislation. It has been estimated that, in 2004, the turn-over of the soil remediation industry in EU-27 amounted to €5.2 billion, of which 21.6% spent in Germany, 20.5% in the Netherlands, and 5.9% each in France and the United Kingdom (Ernst & Young 2006: 30).

Figure 4: Potential threats to soil biodiversity.



	Extremely low		High
	Very low		Very high
	Low		Extremely high

	Intermediate / moderate

4. Specific Barriers to Resource Efficiency of Land and Soils

Land

As land-use change is frequently long-term, and often practically irreversible, or costly to reverse (e.g. conversion of natural/agricultural land into transport infrastructure), decisions made now may not be optimal over time.

The use of land is nearly always a compromise between social, economic and environmental needs including additional housing to deal with an aging population and improved infrastructure to facilitate economic development.

Yet many individual decisions often do not consider the cumulative effects of land-take and longer-term, strategic goals. Most land is in private ownership and owners may not always consider the indirect or public benefits of land-use. One of the challenges for land use policies is successful engagement of the interested parties.

Some land use risks vary strongly from region to region, and here subsidiarity is important. With regards to fragmentation and sealing of land, significant infrastructure decisions are increasingly being taken at the EU level, which means that EU level checks and balances are required.

Soil

Natural soil formation is very slow: it can take more than 500 years to form two centimetres, so soil losses over 1-2 t/ha/year are in practice irreversible for most soils.

Longer-term and public benefits from soil are often not factored into to private decision making.

Member States have a key role in taking action on soils. However, very few Member States have soil monitoring schemes in place allowing a quantified evaluation of soil conditions changes in time (EEA 2010c). Although identification of contaminated sites and their subsequent remediation would facilitate land use, only a minority of Member States has a proactive policy in this field. Even with significant increases in activity, only a fraction of the identified sites will be remediated by 2020.

5. Strategy of the European Commission to Improve Resource Efficiency

The challenges outlined above and the fact that soil degradation in Europe continues, make it important that the EU improves the way in which it deals with soil-related issues, particularly in the absence of Union legislation.

In 2006 the European Commission adopted the *Soil Thematic Strategy* to ensure an adequate level of protection for all soils in Europe (EC 2006a). The objective of the Strategy is to protect the soil while using it sustainably, through the prevention of further degradation, the preservation of soil function and the restoration of degraded soils. The Strategy has already acted as an important driver for numerous soil awareness raising tools and networks that have been developed in Member States and funded several soil related projects. It has helped raise the profile of soil issues, for instance by integrating it into other policies, but six years after its adoption there is still no systematic monitoring and protection of soil quality across Europe. This means that knowledge about the status and quality of soils remains fragmented and soil protection is not undertaken in an effective and coherent way in all Member States.

The *Resource Efficiency Roadmap* provides a framework in which future actions can be designed and implemented coherently (EC 2011). It sets out a vision for the structural and technological change needed up to 2050, with milestones to be reached by 2020. The soil and land related milestone indicates that by 2020, EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land take is on track with an aim to achieve no net land take by 2050; soil erosion is reduced and the soil organic matter increased, with remedial work on contaminated sites well underway.

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