

Science for Environment Policy

Good agricultural practices reduce soil erosion and increase organic carbon stocks in Italy

Soil erosion in Italy could be reduced by 43% if Good Agricultural and Environmental Conditions (GAEC) were fully adopted, a recent study has found. Reducing soil erosion would also increase soil organic carbon stocks, particularly on cultivated sloping land.

Soil erosion is one of the biggest threats to European soils. Erosion degrades soil ecosystems and can lead to reduced crop yields, threatening food security and farmers' incomes. When soil is eroded by [water](#) it can carry agricultural pollutants into waterways, which risks harming the aquatic environment.

Protecting European soils from erosion is therefore a priority under the [European Commission's soil protection thematic strategy](#)¹. To encourage environmentally sound agriculture, actions to protect soil are included in the cross compliance mechanism attached to pillar 1 farm subsidies under the [Common Agricultural Policy \(CAP\)](#). Under the CAP [Good Agricultural and Environmental Condition \(GAEC\)](#) requirements, Member States are obliged to prevent soil erosion and maintain soil organic matter through national or regional standards, such as minimal soil cover maintenance (GAEC 4); minimum land management reflecting site specific conditions to soil loss (GAEC 5); and maintenance of soil organic matter level (GAEC 6). Should farmers not comply with these requirements, they are liable to a small penalty (approx. 5%) on their subsidy.

The concept of GAEC includes protecting soils against erosion and maintaining soil organic matter and soil structure (other GAECs are aimed at protecting water, [biodiversity](#) and animal health). It is up to Member States to establish standards which are appropriate to their conditions. Example actions include minimising the area of bare soil (e.g. by leaving vegetable matter on soil surfaces); limiting soil loss through methods such as growing crops across or perpendicular to a slope; and maintaining soil organic carbon stocks (e.g. by residues management including restrictions on burning crop residues).

Although Member States must notify the commission on how they implement the GAECs, little is known about the effect GAEC standards have had on reducing soil erosion and increasing soil carbon stocks in Europe. In the first study of its kind, researchers, including from the [European Commission's Institute for Environment and Sustainability](#), have assessed the impact of the GAECs at the national level. They chose Italy as a case study because arable land there often has steep slopes with soil that is particularly susceptible to being eroded by heavy rainstorms.

The researchers linked an erosion model with an agro-ecosystem model to calculate the impact of GAEC practices on soil losses and soil organic carbon stocks. Average annual soil erosion losses due to changes in climate, land cover, soil properties, landscape features and [agricultural](#) practices were assessed using data from climate, land cover and agricultural databases, as well as satellite images.

The researchers looked at three scenarios. The first, 'baseline', represented the absence of any specific national policy on erosion prevention and carbon conservation and was based on conditions prior to the GAECs on soil being included in the cross compliance mechanism. The 'current' scenario is based on the implementation of compulsory GAEC standards, beginning in 2005. As a result of changes to practice, this scenario had different soil erosion rates to the baseline. Finally, the 'technical potential' scenario reflects the avoided erosion and the amount of soil organic carbon that could be stored by 2050, if GAEC standards were to be implemented across all arable land.

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<http://www.sciencedirect.com/science/article/pii/S0264837715003257>

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1. Thematic Strategy for Soil Protection [SEC(2006)620] [SEC(2006)1165]. See: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52006DC0231>

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2. Morgan, R.P.C. (1995) Soil Erosion and Conservation. Longman, Harlow, England, 198 pp.

3. Lugato, E., Paustian, K., Panagos, P., Jones, A. & Borrelli, P. (2016) Quantifying the erosion effect on current carbon budget of European agricultural soils at high spatial resolution. *Global Change Biology*. DOI: 10.1111/gcb.13198

In short, the three scenarios represent: no GAECs; current GAEC implementation; and application of GAECs to the entire surface of arable land in Italy.

For the baseline, the researchers estimated that soil is being lost at 8.33 tonnes per hectare per year (t/ha/yr) across all arable land in Italy. Around 29% of the arable land had losses greater than 10 t/ha/yr, which is the water erosion threshold indicator for tolerable soil losses in Mediterranean environments, at which point the rate of soil erosion becomes unsustainable². The researchers estimate that approximately 73% of soil erosion is occurring in 25% of the Italian cropland. Farms located on slopes (greater than 10%) experience around 64% of the total annual soil loss, as they are the most exposed to soil erosion.

For the current scenario, soil loss was estimated to be 7.43 t/ha/yr. Approximately 25% of the arable land has losses greater than 10 t/ha/yr, which is around an 11% decrease compared with the baseline scenario. The 'technical potential' scenario could significantly reduce soil losses to 4.1 t/ha/yr, a 51% reduction compared with the baseline scenario and approximately 43% compared with the current scenario.

Top-soil organic carbon stock varied in the three scenarios depending on the location of arable land and land management practices. The study suggests that current GAEC practices have led to an overall 17% carbon accumulation through avoided soil erosion, compared with the baseline scenario. If these standards were fully implemented on all arable land, the soil organic carbon stock in Italy may increase by up to 11% in the long-term.

As monitoring soil erosion and carbon levels across all farms is not viable, the researchers suggest their modelling approach could help policymakers to assess the effectiveness of soil conservation measures at national, regional and even global levels. Research is also being conducted to assess sediment and carbon budgets, including transport and depositional processes³.

