4.6 Soil Carbon

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Carbon is incorporated into vegetation through the process of photosynthesis, whereby CO_2 is sequestered from the atmosphere. Following deposition of leaf litter and woody debris to the soil surface, decomposition of this plant matter along with root biomass transfers the carbon sequestered in vegetation to soil. Soil carbon is one of the largest carbon stocks in most terrestrial ecosystems. The amount of carbon present in the soil is determined by geology, soil type, climate and land use. In Ireland, peat soils dominate the terrestrial carbon budget. Changes in climate, in particular rainfall and temperature, impact on the carbon storage potential of soils. Peatlands are particularly vulnerable in this respect – particularly when the additional pressures on them caused by artificial drainage are taken into account.

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Measurements

Changes in soil carbon are very slow and therefore difficult to detect and at a given site require observations over several decades. There is currently no long-term programme of this kind in Ireland. Estimations of country-wide carbon stock are currently made based on knowledge of soil type, carbon density, soil depth and land cover.

'It is estimated that Ireland's soil carbon stock has decreased by 27 million tonnes between 1990 and 2000 due mainly to drainage and extraction of peat.'

Time-series and Trends

Research based on historical records of land use estimates that soil carbon stocks have recovered/ increased throughout the second half of the twentieth century. However, reliable data on the absolute quantities of soil carbon in the past are not available. Two recent studies (Table 4.1) have made estimates of the soil carbon stock for 1990 and 2000 to 1 m depth and also for the complete soil profile. These indicate that there has been a decrease of 27 Tg (million tonnes) between 1990 and 2000. Estimates of carbon stock change in Ireland are dominated by changes to the management of peatland, including drainage and peat extraction and to a lesser extent by changes in patterns of agricultural land use and urban development.

Table 4.1. Estimated Soil Organic Carbon (SOC) stocks in Teragrams (Tg) in peatland only and all land covers including peat (from Eaton et al. 2008).

Description	Year	Peat SOC stock (Tg)	Total SOC stock (Tg)	Source
Stock to 1 m depth	1990	580	1,496	Eaton et al. (2008)
	2000	535	1469	
Complete soil profile	1990	1,089	2,048	Tomlinson (2005)
	2000	1,065	2,021	

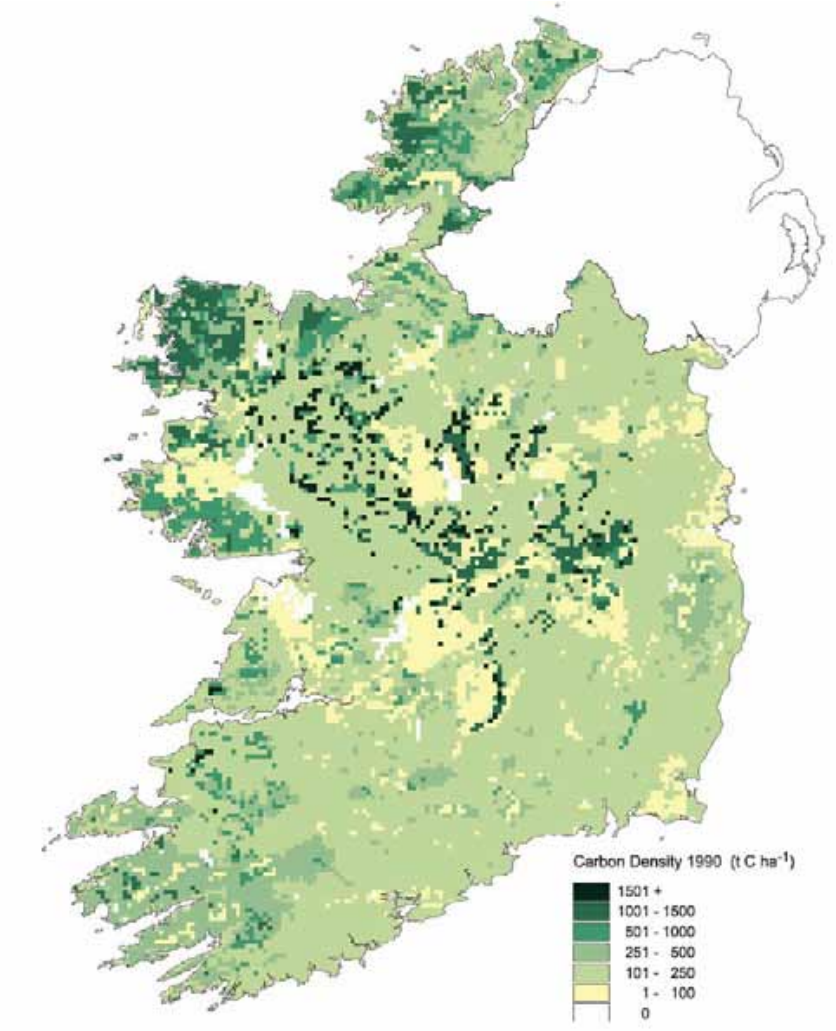

Figure 4.11. Estimated distribution of soil carbon density (1990). Reproduced from Tomlinson, 2005.

Soil carbon is highest in the west and northwest, where precipitation is highest; this encourages the formation of peat, and lowest in the east and southeast (where precipitation is lowest). This is reflected in Fig. 4.11 of soil carbon density (tonnes of carbon per hectare) where the highest densities, corresponding to raised bogs, stretch from the midlands towards the northwest. The lowest soil carbon densities are where shallow brown earths dominate.

'A network of permanent soil monitoring plots covering the main land uses for each soil type should be established.'

Maintaining the Observations

Reducing uncertainty of soil carbon dynamics in Ireland requires a better understanding of the variability and depth of peat soils, the role of erosion on soil carbon stocks, and the effect of afforestation on organic soils. Up to now the lack of a complete county level soil map has been a significant impediment. However, the EPA and Teagasc funded Irish Soils Information System project is under way, producing a 1:250,000 scale soil series map of Ireland to be completed by 2014. A network of permanent soil monitoring plots covering the main land uses for each soil type should be established.

Further Information and Data Sources

Daly, K. and Fealy, R. (2007) *Digital Soil Information System for Ireland – Scoping Study,* Final Report, EPA, Johnstown Castle Estate, Co. Wexford, Ireland: http://www.epa.ie/downloads/pubs/research/land/name,23747,en.html

Eaton, J.M., McGoff, N.M., Byrne, K.A., Leahy, P. and Kiely, G. (2008) Land cover change and soil organic carbon stocks in the Republic of Ireland,1851–2000, *Climatic Change*, Vol. 91, Nos 3–4, pp. 317–34.

Tomlinson, R.W. (2005) Soil carbon stocks and changes in the Republic of Ireland, *Journal of Environmental Management,* Vol. 76, pp. 77–93.

MIDA, http://mida.ucc.ie to view the general soils map (1:575,000) of Ireland.

Irish Soil Information System: http://www.teagasc.ie/news/2009/200903-23.asp