Changes in soil organic matter in relation to land use and agricultural practices

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Four ways to manage carbon

1. Primary productivity
2. Vegetation
3. Litter
4. Soil C Stock

Arrouays et al. 2002.
National estimates: how much do you want?

STOCKS OF C in French soils (0-30 cm layer)

3.1 Pg

Arrouays et al. 2001; Soil Use & Manag.
Metropolitan France: 550 000 km²

- Arable lands
- Permanent grasslands
- Forests
- Rangelands
- Mountain grasslands
- Vine/fruits
- Artificial
- Others

Arrouays et al. 2002.
Land cover effect on present topsoil C stocks

$10^3$ kg/ha (0-30 cm)

- Vineyard/orchard
- Arable land
- Moorland
- Various types of forests and grasslands
- Mountain grassland
- Wetland

Arrouays et al. 1999
Effects of land cover changes on soil C stocks

C stock change (T/ha) vs. Duration (years)

- Arable => forest
- Arable => grass
- Forest => arable
- Grass => arable

Arrouays et al. 2002.
Examples of observed changes

Soil Organic Carbon

Elevation


Effect of baseline SOC content

No till versus conventional tillage

![Graph showing additional C sequestration (t.ha⁻¹) versus duration (years) for no till versus conventional tillage. The graph includes data points from international literature, French data, mean slope, model, and confidence intervals.](INRA, 2002)
Reducing frequency of ploughing

Stock C (t/ha)

- m = 3 t C/ha/an
- m = 2 t C/ha/an
- m = 1 t C/ha/an

Years between two ploughings

INRA, 2002
C sequestration depends on other soil properties

Arrouays et al. 2006
Soil Use & Manag.
Main factors affecting C storage in soils

Conversion arable lands ⇔ forests/grasslands

Reduced tillage or no-till ⇔ conventional tillage

Continuous soil cover ⇔ bare soils

Temporary grasslands ⇔ permanent grasslands

Potential variation in soils and climates
Concluding remarks

Managing C storage is possible

Preserving existing stocks might be more important than trying to create new ones.

Climate change could affect C storage sustainability.

Extension over space or sustainability over time of some practices is limited.

The carbon sink is a finite answer to mitigation.

But
Is C storage in soil a « win-win » strategy?

Increasing C in soils produces related environmental benefits: reduction of erosion, retention of pollutants, biodiversity...

But might have side effects in some cases: use of pesticides, N$_2$O emissions...

A verification should be undertaken for each specific case

For the soils and the climates of the next decades...
Thank you for your attention...

Soil carbon? Go easy on it!

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