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7-10 July 2015 • Paris, France

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# Soil carbon sequestration: towards an international research program and action plan

## OVERVIEW

**Organizers:** INRA, Paris, France, CIRAD, Montpellier, France, IRD, Eco&sols research unit, Montpellier, France

**Date:** July 7th, from 4pm to 7pm

**Location:** INRA, 147, rue de l'Université, Paris, France

**Expected number of participants:** 1-50

**Nature of participants:** Research scientists, representatives of international agencies and of ministries

**Keywords:** Carbon sequestration, Soil, Ecosystem services, Food security

## KEYNOTE SPEAKERS

- R. Lal Ohio state university, School of natural resources, Columbus - ohio, United States of America
- L. Montanarella EC-JRC, Soil bureau, Ispra, Italy
- P. Smith Aberdeen University, Soils and global change, Aberdeen, United Kingdom
- C. Chenu AgroParisTech, Ecosys research unit, Paris Grignon, France
- R. Valentini University of Tuscia, Agrofood and forest, Viterbo, Italy
- P. Ciais LSCE, Gif sur Yvette, France
- J. Mousset ADEME, Agriculture, Angers, France
- H. Haberl Vienna University, Social ecology, Vienna, Austria
- M. Bernoux IRD, Eco&sols, Montpellier, France
- M. Le Henaff Ministère de l'Agriculture, de l'Agro-alimentaire et de la Forêt, Paris, France
- C. Kao Ministère de l'Agriculture, de l'Agro-alimentaire et de la Forêt, Paris, France
- D. Arrouays INRA, Infosol, Orleans, France
- J. Jeagermeyr PIK, Earth system science, Postdam, Germany
- Z. Bai WUR, Isric, Wageningen, Netherlands
- P. Gerber World Bank, New-York, United States of America
- L. Lipper FAO, Roma, Italy
- A. Franzluebbers USDA, Raleigh, United States of America
- M. Scholten WUR, Animal sciences, Wageningen, Netherlands
- A. Karsenty CIRAD, Montpellier, France
- P. Canadell Global Carbon Project, Canberra, Australia
- D. Bossio CIAT, Nairobi, Kenya
- B. Campbell CIAT, Nairobi, Kenya
- Jean-Luc François AFD, Paris, France
- Sebastien Treyer IDDRI, Paris, France
- Benoît Leguet CDC Climat, Paris, France
- Tantély Razafimbelo Réseau Carbone du Sol pour une Agriculture Durable en Afrique
- Nicolas Baghdadi Pôle Theia (télétection surfaces continentales), Paris, France

## SUMMARY

Storing annually four per mil of the soil organic carbon stock (i.e. 4PM target) to offset current anthropogenic CO<sub>2</sub> emissions is a proposal recently made by the French authorities ahead of COP21. It will be discussed in light of state-of-the-art scientific understanding. The combined implementation of policies reducing GHG emissions and increasing the land carbon sink would facilitate reaching the 2°C target, or if possible a lower level of global warming. Storing carbon in soil organic matter, allows to restore soil nutrients and to increase soil quality. Assuming a global

soil organic carbon stock of ca. 820 GtC (over a meaningful depth for carbon sequestration, i.e. 0-40 cm), the 4PM target would result in the doubling of the current land carbon sink from 2.8 to 6.3 GtC/yr. If we further assume that net land use change CO<sub>2</sub> emissions would be halted, this additional land carbon sink would counterbalance the current growth in atmospheric CO<sub>2</sub>, provided that it could be established within a few years. Nevertheless, the gradual development of a carbon sink in soils requires combining options for both agricultural lands and other land uses, including forests, highly degraded and desertified lands and wetlands and this would necessarily take several decades. The technical soil organic carbon sequestration potential of agricultural lands is usually estimated in the range 0.7 - 1.2 GtC/yr and options concerning other land uses (or integrated systems like agroforestry) have an extra technical potential that may reach 2.5 GtC/yr. However, with perennial vegetation restoration, C sequestration will first take place in the biomass. Moreover, carbon stocks in soils are vulnerable to changes in land use, in land management practices and to climatic hazards (e.g. droughts).

Soils rich in organic matter also better retain water (increased water holding capacity) which promotes the adaptation to climate change. Therefore biological carbon sequestration in soils is usually seen as a climate-smart agriculture 'win-win' option for sustainable intensification (compatible with agroecology and with transition to bioenergy), for mitigation and for adaptation to climate change. The adoption of best agronomic practices already allows a significant carbon sequestration rate, reaching locally up to 4 per mil (4‰) of the soil organic carbon stock for some of the documented examples. However, these examples are unevenly distributed with, in particular, little data for tropical soils. In addition, implementation of new agricultural practices is a highly complex objective since it has to fit with several social, economic and environmental conditions and drivers.

Therefore, an international action plan for soils should be inclusive and long term to achieve the 4 per mil target. Research needs relate to action relevant knowledge and evidences regarding the following issues: a) Sequestration (or loss) of soil carbon; b) The design and co-construction of agronomic strategies and practices at various scales (individual to collective) targeting the '4 per mil' objective, and the assessment of their performances and of their trade-offs with other objectives; c) The design, experimentation and assessment of institutional arrangements and public policies, including financial mechanisms, that aim at promoting and rewarding relevant practices d) Metrics and methods for monitoring, reporting and verification of carbon sequestration on the basis of a net-net accounting that could take place at several scales (farm, landscape, region, country).

The articulation of these 4 axes in an international research program will be discussed, as well as the scientific partnerships and the data sources that need to be mobilized. Such an interdisciplinary program (soil science, carbon and nutrient cycling, agronomy, remote sensing, socio-economics) could be launched at the time of COP21. A map of the carbon sequestration potential by region, soil type and farming system would be a first milestone, to argue the options and assess the barriers and the costs, and to fine tune the research programming.