Soils for Food Security and Climate
The ‘4 per 1000’ Initiative and its international research program

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on behalf of CGIAR, CIRAD, INRA, IRD, and Ohio State University
Context

• The Lima-Paris Action Agenda
• The ‘4 per 1000’ initiative: two components...
  – A multi-partner action plan
  – An international research and scientific cooperation program

... in coordination with other initiatives and with other domains

• A voluntary multi-stakeholder Initiative:
  – States and communities (46 countries),
  – international organizations,
  – research institutes,
  – technical institutes and producers organisations,
  – civil society,
  – private sector.
• 1 objective:

Improve levels of organic matter and foster carbon sequestration in soils

• 3 major outcomes:
  – Improvement of food security by enhancing soil fertility and combating land degradation.
  – Adaptation of agriculture to climate disruption.
  – Mitigation of climate change.
Outline

1. Climate negotiations and the land sector
2. Soil carbon sequestration
3. The international ‘4 per 1000’ Initiative
The Agriculture, Forestry and Land Use sector (AFOLU)

24%: share of AFOLU sector in global anthropogenic GHG emissions [IPCC WGIII AR5]

129 countries include the AFOLU sector in their NDCs (Nationally Determined Contributions)

- At least 25% of total committed GHG mitigation [International Institute for Applied Systems Analysis, IIASA]

100 countries also included adaptation in their NDCs and the land sector is a key sector for adaptation
A large gap in emission’s reduction by 2030

By 2030, a gap of 12 Gt CO$_2$e with conditional INDCs prevents staying under the +2°C threshold.

Could this gap be matched by the ‘4 per 1000’ initiative?

...While contributing to food security?

...And to climate change adaptation?

[Emission Gap report 2015, UNEP]
Why Soil Carbon? Key facts and figures

2-3 times more carbon in soil organic matter than in atmospheric CO$_2$ [IPCC, 2013]

1.4 billion metric tons of carbon could be stored annually in agricultural soils, (i.e. 0.48%/year in top soil) [after IPCC, 2007, 2014]

Half of the agricultural soils are estimated to be degraded, leading to global grain losses estimated at $1.2 billion [FAO, 2006]
Why Soil Carbon? Key facts and figures

24-40 million metric tons additional grains could be produced in developing countries by storing an additional ton of carbon per ha in soil organic matter [Lal, 2006]

Reduced yield variability after soil restoration leading to increased soil organic matter [Pan et al., 2009]
Soil organic matter: multiple benefits

- **Soil physical quality**
  - Soil structure, tilth
  - Bulk density, porosity
  - Soil temperature
  - Infiltration rate
  - Available water capacity
  - Erodibility

- **Agroecological quality**
  - Use efficiency of water, nutrients
  - Soil resilience
  - Agronomic productivity
  - Sustainability

- **Soil biological quality**
  - Species diversity
  - Microbial biomass carbon
  - Elemental transformation

- **Soil fertility and chemical quality**
  - pH
  - Buffer capacity
  - Cation exchange capacity
  - Nutrient retention and availability

- **Food Security**

**UNCCD**
Why ‘4 per 1000’?

Global Carbon cycle in 2030-2050 [based on Paris agreement]
Why ‘4 per 1000’?

Global Carbon cycle in 2030-2050 with the 4 per 1000 Initiative

Measures:

- Halt deforestation and tropical forests degradation
- Agriculture (cropland, pasture)
- Salinized soils,
- Afforestation & agroforestry,
- Soil carbon sequestration: 3.5 Gt C/year, i.e. 0.4% of C stock for 0-40 cm topsoil (860 GtC)
Limits and co-benefits of soil carbon sequestration

- Co-benefits with food security (lower mitigation costs) and climate change adaptation (water infiltration and retention)
- Adoption of SOC sequestration measures will take time,
- SOC will increase only over a finite period (30-50 yrs locally), up to the point when a new SOC equilibrium is approached,
- The additional SOC stock will need to be monitored and preserved by adapting land management practices to climate change,
- Soil phosphorus (P) and nitrogen (N) should be available (root symbioses could help)
- Soil and water management need to be combined, especially in dry regions
Technical and economic potential

- Technical potential for soil C sequestration
  - Agricultural soils: 1.4 GtC/yr (ca. 0.48% of top soil organic C stock)
  - Forests and agroforestry soils: 1.3 GtC/yr (plus 2.7 Gt C/yr in biomass) (IPCC, 2014, combined with estimate for soil C fraction by Pan et al., 2011; IPCC, 2000 SR LULUCF for agroforestry estimate)
  - Salt affected and desertified soils: 0.5-1.4 GtC/yr (Lal, 2010)

- There are technical uncertainties about the potential, but 3.4 GtC/yr in soils (‘4/1000’ target) is technically achievable

- Achieving that potential would double by 2030 the total mitigation encompassed by the currently published INDCs

- Economic potential is estimated at 1 Gt C/yr in agriculture
  - For a price of $120 per metric ton of CO₂ (compatible with the 2°C warming target)
  - In addition, local studies in Asia, Latin America and Africa show that best practices providing a 4/1000 increase in soil carbon have a large co-benefit: on average, a 1.3% increase in crop yields (unpub., Rosenstock, Richards, Lamanna et al., CGIAR)
The ‘4 per 1000’ Initiative: 2 components

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<th>Action Plan</th>
<th>A multistakeholders platform to foster partnerships, A project assessment mechanism based on a reference framework</th>
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<td>Scientific program</td>
<td>An international research and scientific cooperation programme A digital resource center on soil carbon</td>
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Themes of the international research program on soil carbon sequestration

• **Potential**: Improve estimates of the baseline and of the potential of soil carbon sequestration (or loss) according to a large range of land management practices;

• **Implementation#1**: Design and co-construction of agronomic strategies and practices for soil carbon sequestration, including an assessment of their co-benefits for food security and climate change adaptation;

• **Implementation#2**: Institutional arrangements and public policies, including financial mechanisms, that aim at promoting and rewarding relevant practices;

• **Verification**: Metrics and methods for monitoring, reporting and verification (MRV) of soil carbon sequestration (farm, landscape, region, country).

[As per the conclusions from a side-event to the ‘Our Common Future under Climate Change’ Science Conference, July 7, 2015]
The 4 per 1000 International program

• An evidence based and policy relevant program...
  – Aimed at providing options for countries, stakeholders and the private sector and at supporting the multi-partner initiative
• ... nested in existing international programs
  – GRA – Integrative Research Group
  – CGIAR – CCAFS and WLE (Water, Land & Ecosystems) programmes
• ... well connected to other research & knowledge programs
  – e.g. GSP, Geoglam, ELD, AgMIP, EU FACCE JPI...
The ‘4 per 1000’ Initiative: Governance structure

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<td>Decision – making body</td>
<td>Meetings of the members of the consortium</td>
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<td>Executive body</td>
<td>International secretariat</td>
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The Governance will be officially set up in COP22 in Marrakesh on Nov. 17 alongside a ‘4 per 1000’ scientific side-event co-organized by INRA
Thank you for your attention

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