Food and Agriculture Organization of the United Nations

8 - 10 September 2021

VIRTUAL MEETING

Launch of the "Recarbonizing global soils: a technical manual of recommended management practices"

Rosa M. Poch, ITPS Chair

GLOBAL SOIL PARTNERSHIP
9th Plenary Assembly

Recarbonizing global soils: A technical manual of best management practices

WHAT is it?

- A key tool for the implementation of the GSP’s RECSOIL initiative
- Provides examples of practices with demonstrated positive impact on SOC sequestration and SOC maintenance
- Multiple practices for different crops, land uses, and climatic zones
- First global example of quantitative data that can support carbon markets

Recarbonizing global soils: A technical manual of best management practices

WHAT IT IS

- The first attempt of gathering quantitative data on SOC sequestration when applying SSM practices
- A living document
- A compilation of practices/ case-studies showing an increase or a positive trend in soil organic carbon

WHAT IT IS NOT

- A compilation of scientific papers
- An edited book
- A catalogue of certified practices

Recarbonizing global soils: A technical manual of best management practices

HOW was prepared?

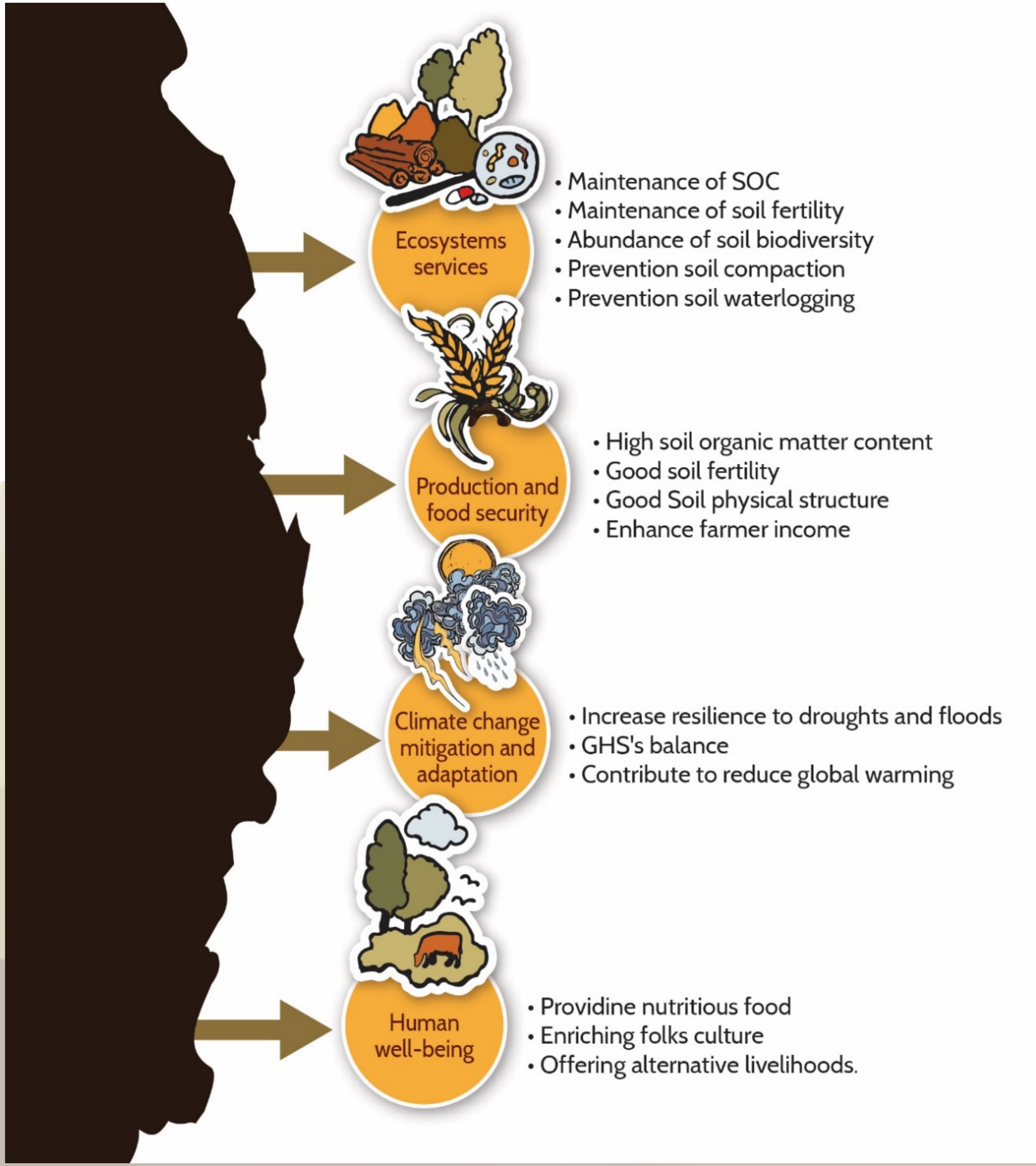
- **389** authors, peer reviewed
- **>1900** pages (!!)
- Targeting experts AND non-experts

Scientific board:	ITPS
	4p1000 STC
	UNCCD SPI
	FAO (LEAP, Forestry, Agroecology)
	4 Guest reviewers

WHAT is it for?

Multiple benefits of sustainable management of carbon-rich soils.

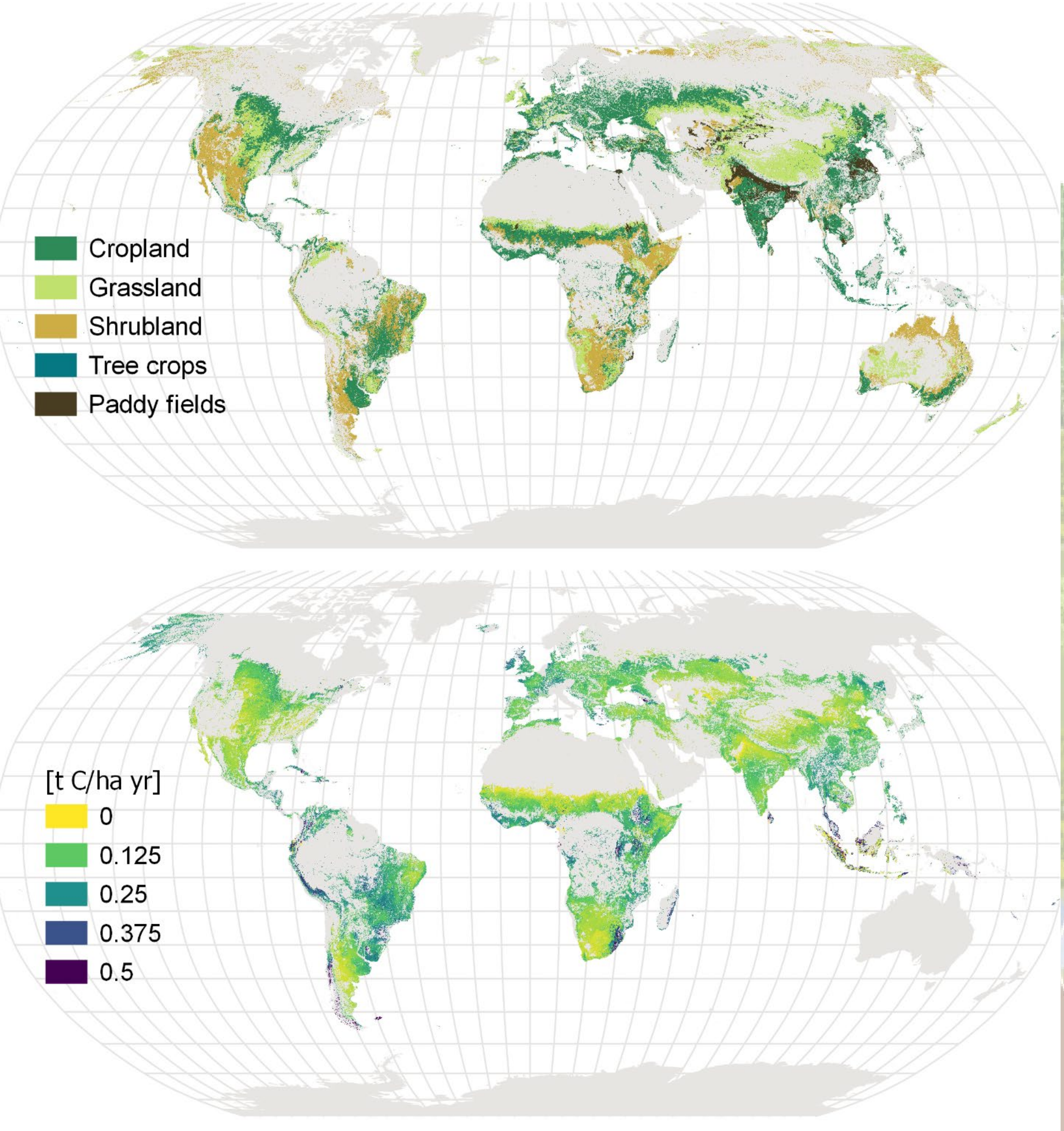
Moving towards a new agricultural model that is MORE environmentally and soil friendly, productive and resilient is possible worldwide



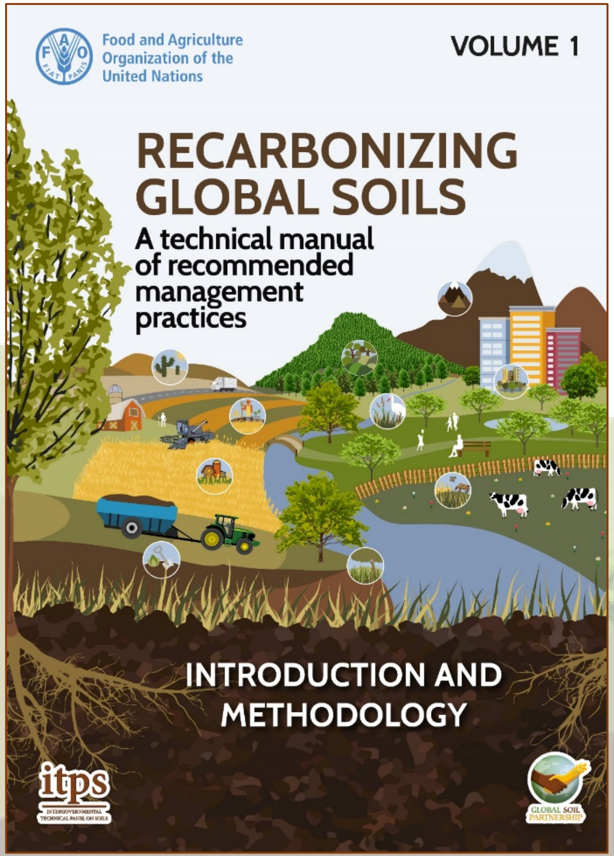
SOC sequestration potential

Global distribution of land uses of greatest interest for estimating carbon sequestration potential.

Potential SOC gains modeled in the upper 0-0.3 m under a scenario of implementing sustainable soil management practices with 20% carbon addition to soils



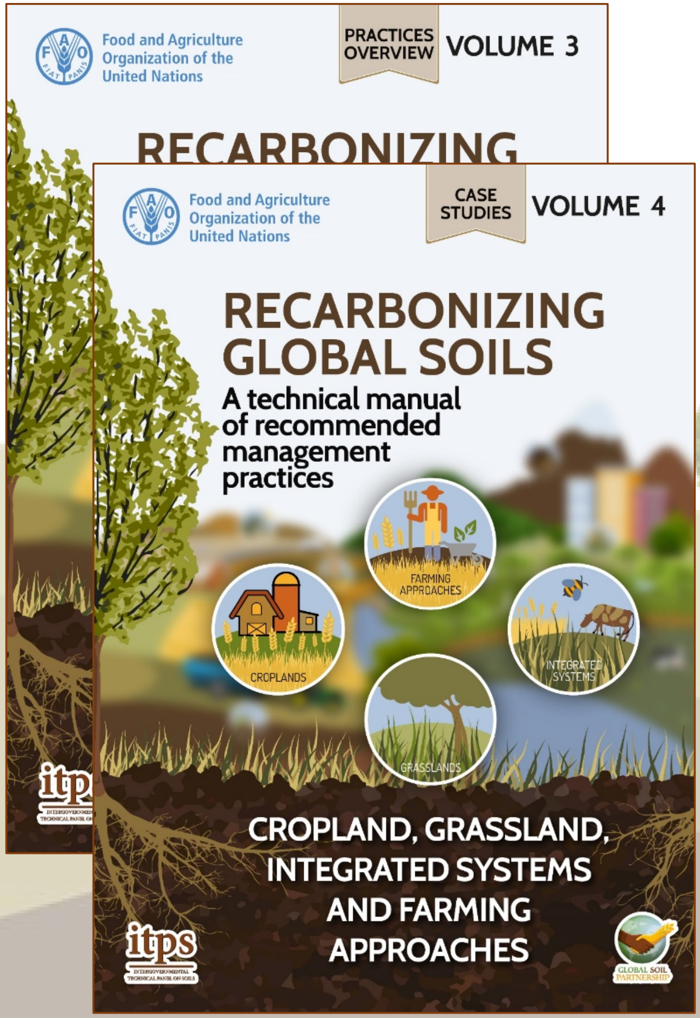
The technical manual: 6 volumes



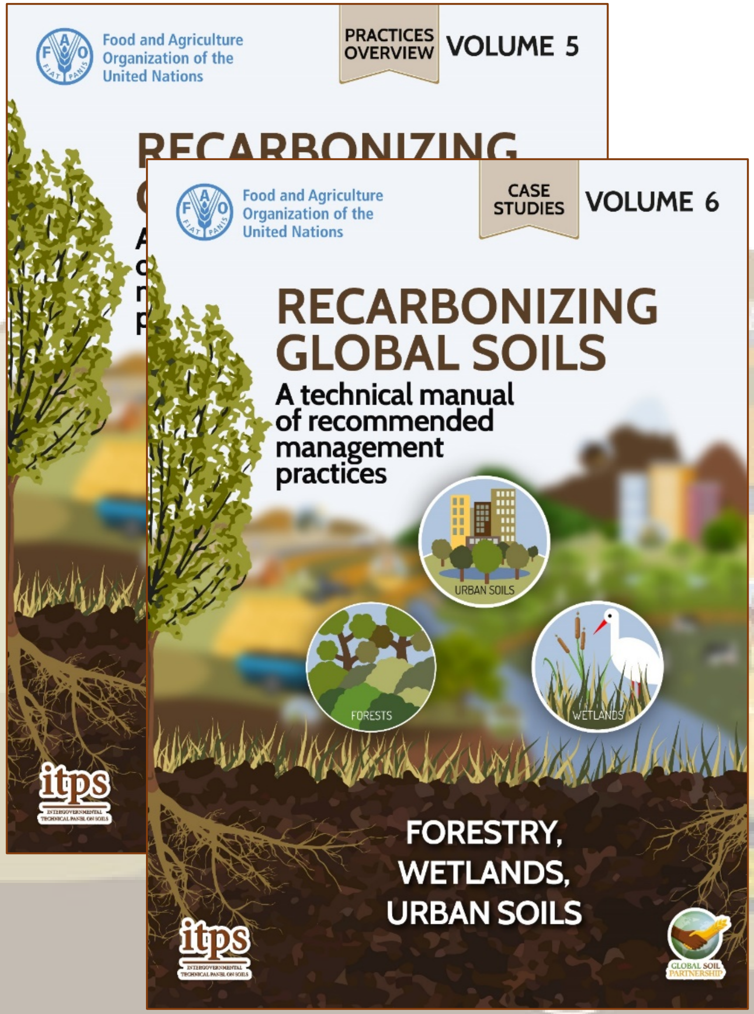
Introduction, Glossary and methodology

Description of 11 areas of interest for high SOC storage and/or sequestration potential: drylands, forests, wetlands, mangroves, black soils, permafrost,...

The technical manual



49 practices described
49 case-studies



24 practices described
31 case-studies

WHAT is in it?

73 practices

- **cropping systems** *(e.g. crop rotations, no-till, intercropping)*
- **grassland and pastures** *(e.g. conservation of grassland, pastoralism)*
- **forest management and sylviculture** *(e.g. Reduced impact logging, afforestation)*
- **wetland ecosystems** *(e.g. conservation of peatland, paludiculture, mangrove restoration)*
- **urban soils management** *(e.g. urban farming, green roofs)*
- **Farming approaches and integrated systems** *(e.g. crop-livestock systems, organic agriculture)*

+ *80 case-studies* from all regions (short, medium and long term studies)

Duration of experiments
(long enough, +4 yrs)

Statistical analysis and **significance** of results

All **regions equally represented**

All **topics equally represented**

Practices showing SOC increases
(some exceptions)

Some examples of practices and data gathered: Compost application in croplands

Table 49. Evolution of SOC stocks after compost application

Location	Soil type	Type of application	Additional C storage (tC/ha/yr)	Duration (Years)	Depth (cm)	Method	Reference
Global (India, Brazil, Madagascar, Niger, Zimbabwe, Mexico, etc.)	Various	Manure or compost applications (different rates)	0.51	Various	0-30	Review of sampled values	Fujisaki *et al.* (2018)
Italy (Campania region)	Sandy loam	Biowaste compost (15-30 t/ha/yr)	3.3	5		Sampled	Baiano and Morra (2017)
Canada (Ontario region)	Clay loam	Yard waste and biowaste compost (75 t/ha/yr each)	0.9 (yard waste compost); 0 (bio waste compost);	10			Yang *et al.* (2014)

- The complete use/composting of available farm biomass (e.g. crop residues, green waste, manure) avoids the rotting and thus GHG emissions.
- A good quality compost reduce the need for application of chemical fertilizers.
- Compost helps to regulate soil temperature and water and thus, increases the topsoil's resilience against climate change impacts.

Some examples of practices and data gathered: SOC sequestration with integrated crop-livestock systems

Location	Climate zone	Soil type	Baseline C stock (tC/ha)	Additional C storage (tC/ha/yr)	Duration	Depth (cm)	More information	Reference
Argentina	Temperate	Typic Argiudoll	55.1	0.63 (t=0)	7 yr	0-15	Pasture-crop rotation sequence with different years of pasture and cropping	Studdert, Echeverria and Casanovas (1997)
Australia	Subtropical	Typic Chromustert	24.7	0.65 (BAU)	4 yr	0-30	Following 4-yr perennial pasture compared with continuous cropping	Dalal *et al.* (1995)
Brazil	Subtropical with warm, humid summer	Rhodic Hapludox	50.8	0.96 (BAU)	9 yr	0-20	Soybean rotated with annual ryegrass/black oat pasture; Moderate grazing intensity (only 0.1 t C/ha/yr with highest grazing intensity)	Assmann *et al.* (2014a)
Brazil	Tropical	Typic Acrustox	61	-0.62 (t=0)	13	0-30		Marchao *et al.* (2009)
Brazil	Tropical	Typic Acrustox	66.9	-0.11 (t=0)	22	0-30	ICLS compared with native vegetation condition; ICLS had 2.9 t C/ha more than no-till cropping alone	Sant-Anna *et al.* (2017)
China	Temperate	NA	49.1	2.04 (BAU)	9 yr	0-100	Following 9-yr lucerne crop compared with continuous cropping	Hou *et al.* (2008)
France, Denmark, Sweden	Mediterranean, temperate, and nordic	Luvisol, Arenosol, Cambisol (FAO)		Mediterranean = 0.26 ± 0.09 (t=0) Temperate = 0.32 ± 0.11 (t=0) Nordic = 0.43 ± 0.15 (t=0)	20 yr	0-30	Simulations based on exogenous organic matter inputs of 1 tC/ha/yr	Peltre *et al.* (2012)
Uruguay	Subtropical	Abruptic Argiudoll	32.9	0.52 (t=0)	6 yr	0-20	Pasture-crop rotation compared with continuous cropping under no tillage	Garcia-Prechac *et al.* (2004)
United States of America	Temperate	Typic Kanhapludult	43.3	0.89-1.31 (t=0)	7 yr	0-30	Corn, sorghum, wheat grown with winter and annual summer crops for grazing (marginally greater rates of organic C sequestration rates occurred without grazing)	Franzluebbers and Stuedemann (2014)

- Perennial pastures rotated with crops improve SOM, soil health and water infiltration
- Use of forages with high nutritional value (annual forages of small grains and/or mixed species of grasses and legumes), with higher digestibility and lower fiber concentration → lower CH_4 emissions
- Integrated crop-livestock systems can have positive socio-economic benefits from the diversity of crops and livestock produced that offers risk abatement and opportunities for family members

Some examples of practices and data gathered

Positive impact on soil threats

Soil threats	
Soil erosion	Better soil structure of more stable soil aggregates which is more resistant (FAO, 2015).
Nutrient imbalance and cycles	Compost provides nutrients but most importantly it increases nutrient holding capacity and enhances biological cycling through a better soil structure (FAO, 2015).
Soil acidification	Enhancing soil buffer properties and improving cation exchange capacity (Amlinger *et al.*, 2007; FAO, 2015).
Soil biodiversity loss	Compost provides bacteria, fungi and carbon which allow an improved soil fauna and microbiology (FAO, 2015). Good quality compost has a phytosanitary effect (Amlinger *et al.*, 2007).
Soil water management	Better soil structure helps to increase meso p capacity. Surface-applied compost keeps the

Barriers to adoption of practice

Barrier	YES/NO	
Biophysical	Yes	If there is not enough biomass for composting (crop residues, manure, kitchen waste, biowaste) then this could be a barrier for compost production.
Economic	Yes	Proper composting requires knowledge, time and eventually money for labour force. Industrial compost making costs ~25 (10-40) USD/tonne on small scale (e.g. for 30 ha and 5 t/ha application) and on large scale (e.g. for 3000 ha and 10 t/ha application), not considering special technical legal regulations in industrialized countries (source: SMI). Compost making means higher short-term costs which will be profitable on the long-term (Viaene *et al.*, 2016).
Institutional	Yes	In industrialized countries, especially in the EU, there are legal restrictions, e.g. through the European Nitrate Directive, which can be a barrier for compost making.
Legal (Right	Yes	In many countries there are farmers who don't own their land and thus don't est in it (e.g. in compost).
		is a lack of knowledge, thus the available biomass will not be but rots or is to be sold.

Associated soil threats

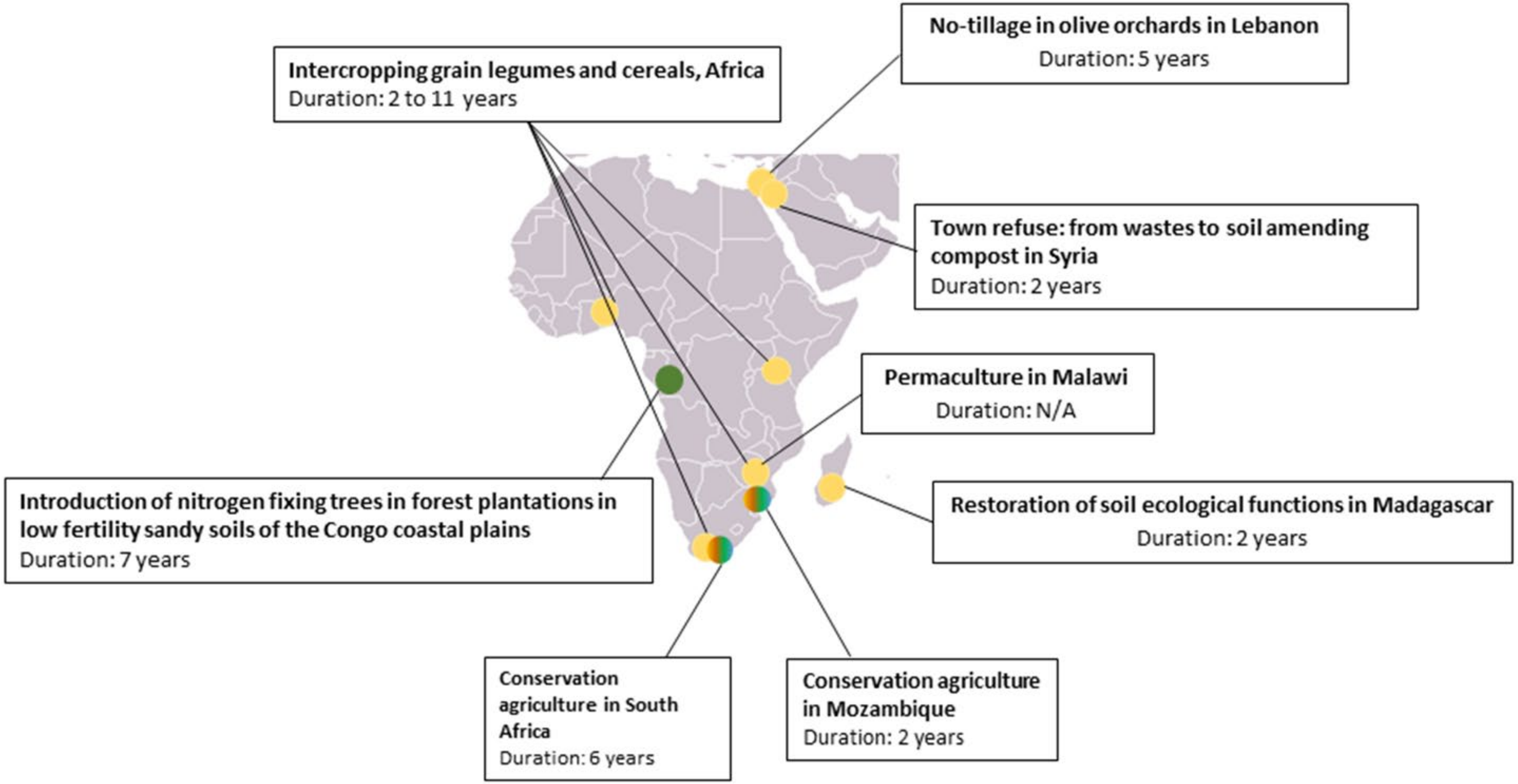
Soil threats	
Soil contamination / pollution	Depending on the source of the composting ingredients (e.g. municipal waste), there can be a significant input of heavy metals, pesticides or organic pollutants. Likewise, the quality of the compost (degree of maturation) determines the mobility of heavy metal mobility (Amlinger *et al.*, 2007).
Soil biodiversity loss	If compost making was not adequate (e.g. no heat phase in thermophilic compost), then the phytosanitary effect will be the opposite and can degrade soil microbiology.

Recarbonizing global soils: A technical manual of best management practices

Some examples of case-studies: Africa and NENA

Colour code for all case-studies :

- Cropland
- Grassland and pastures
- Forestry
- Wetlands
- Urban soils
- Integrated systems



Challenges of the publication:

- Lack of data on SOC for some practices (e.g. gypsum applications on sodic soils)
- Some case-studies only show trends and do not prove ($p<0.05$) a clear increase
- Some practices / hot-spots might be missing

Recommendations:

- Publish an updated version in the next 10 years or less
- Publish an analysis of the SOC Manual (Visual, with graphics) for general public: 2021-2022

Thank you
for your attention!