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AGRICULTURE • ALIMENTATION • ENVIRONNEMENT

Sols et carbone

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2023-03-16-Acad Agric-C.Chenu

1

Une attention port e au croisement "sols et carbone"

Europe

2021 **EU Climate Law**
Neutralit  climatique en 2050
-55% GHG en 2030/1990

2022

The Commission is proposing the first EU-wide voluntary framework to reliably certify high-quality carbon removals. This is a necessary instrument to reach the EU's climate, environmental and zero pollution goals. Carbon removal can and must bring clear benefits for the climate, as well as preserving or strengthening other environmental objectives.

The EU has committed to being climate neutral by 2050. This will be done by reducing greenhouse gas emissions to a minimum. It is not possible to reduce all emissions to absolute zero. Emission reductions need to be coupled with the removal of several hundred million tonnes of CO₂ from the atmosphere every year to balance out remaining emissions.

France

2020

Ann�e	Produit Bois	Autres terres	CCS/CCU	For�t	Production de �nergie	Transports	B�timent	Agriculture	Utilisation de gaz	�missions �nerg�tiques	DROM	Total
1990	78	122	91	144	94							428
2015	47	137	88	81	89							342
2050	47	47	0	0	0	0	0	0	0	0	0	94

Net change: -6 MTCO₂e

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2

Une attention portée au croisement "sols et carbone"

Europe

2021

2023 Soil Health Law proposal

France

2021

**ZÉRO
ARTIFICIALISATION
NETTE**

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3

Une attention portée au croisement "sols et carbone"

REGENERATIVE AGRICULTURE SHIFTS THE PARADIGM

- Partner with Nature
- Protect Soil
- Diversity
- Holistic

COMPETE WITH NATURE

- Disturb Soil
- Monoculture
- Reductionist

KISS THE GROUND

INSPIRED BY WOODY HARRELSON

THE SOLUTION IS RIGHT UNDER OUR FEET

CO₂

VOTRE MISSION si vous l'acceptez...

Healthy Soil: Cornerstone of Life

- Biological Diversity
- Food Production
- Water Benefits
- Carbon Storage

#JeStockeDuCarbone

Carbon Farming

REGENERATIVE (No-Till) vs DEGENERATIVE (Till)

LABEL BAS CARBONE

LIVING SOIL

4

Préserver, augmenter les stocks de C des sols

Pour quoi ?

Comment l'inciter ? C farming

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5

5

Préserver, augmenter les stocks de C des sols

Pour quoi ?

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6

6

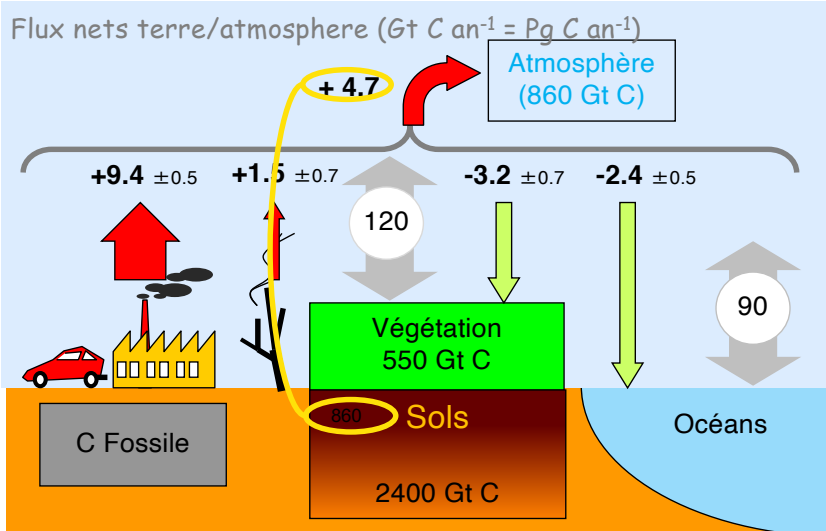
Atténuation du changement climatique

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7

7

Le carbone des sols à l'échelle planétaire



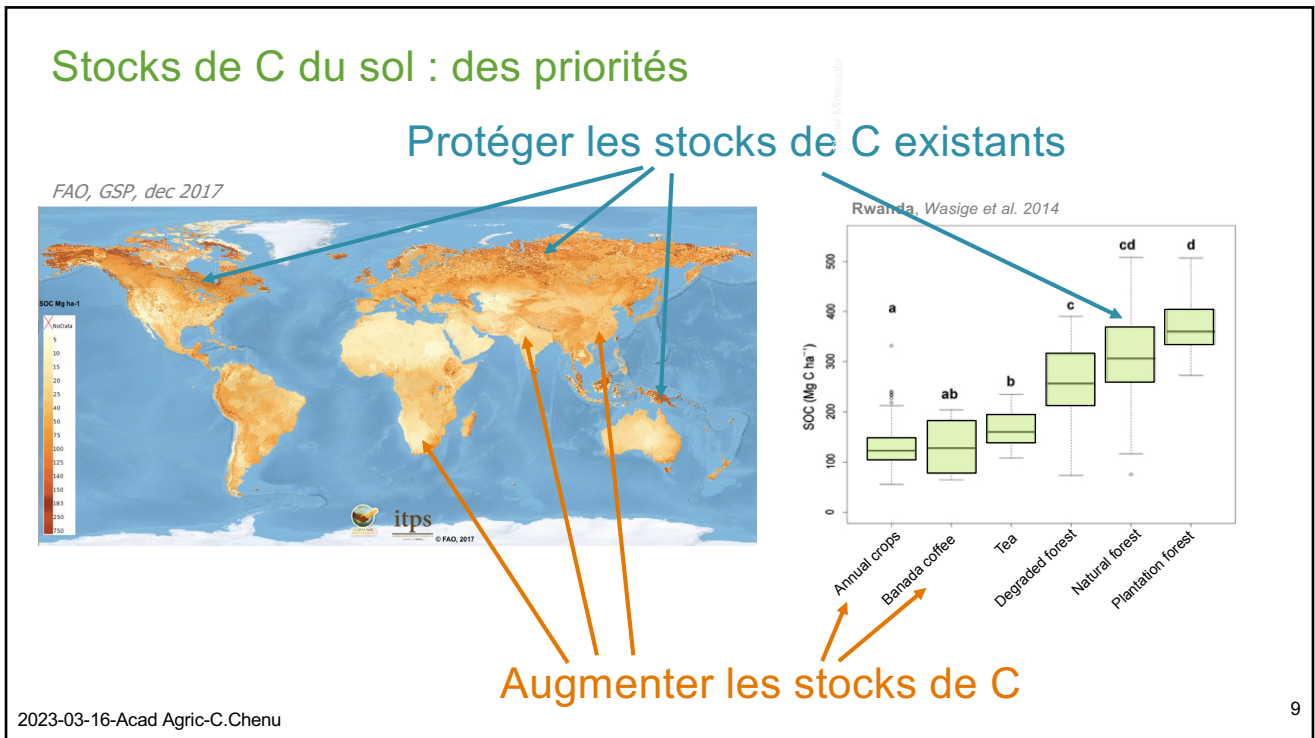
Valeurs moyennes pour 2009-2018 (Le Quéré et al., 2018)
Dessin d'après Balesdent 1996

Préserver le stocks de C organique des sols, les augmenter lorsque c'est possible

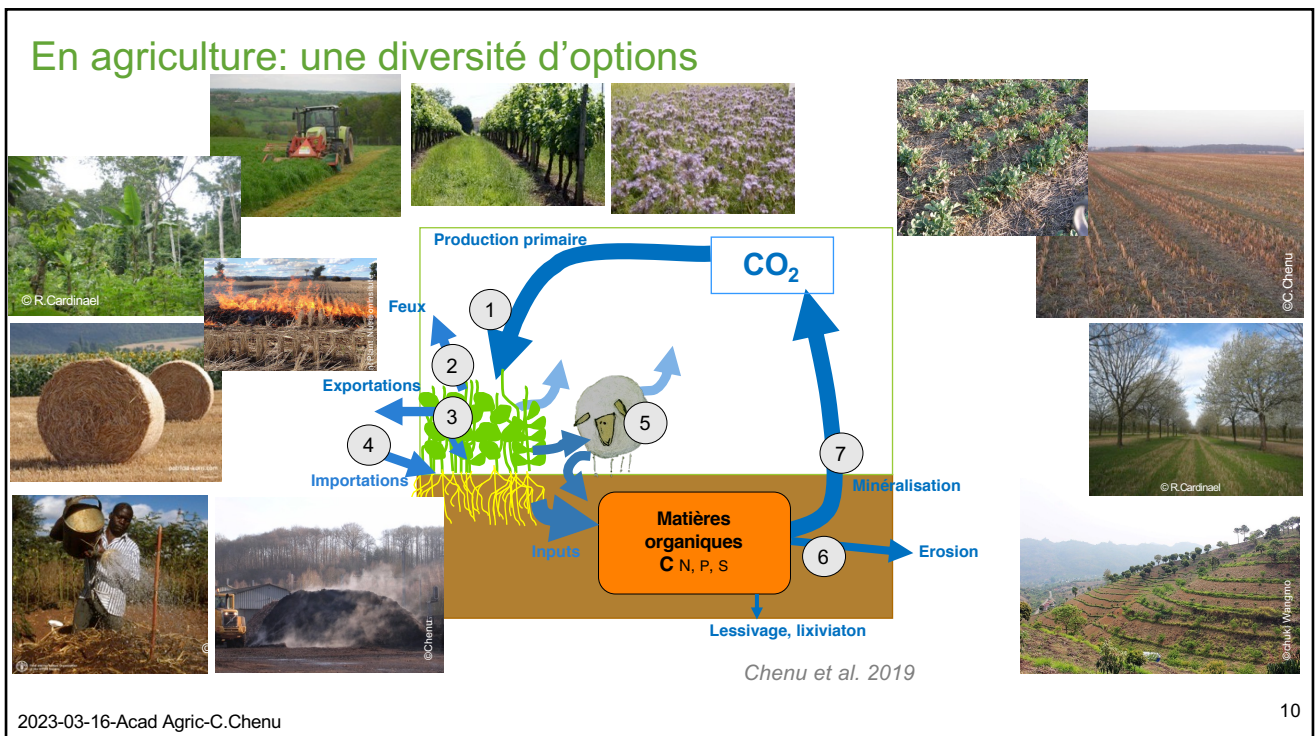
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8

8

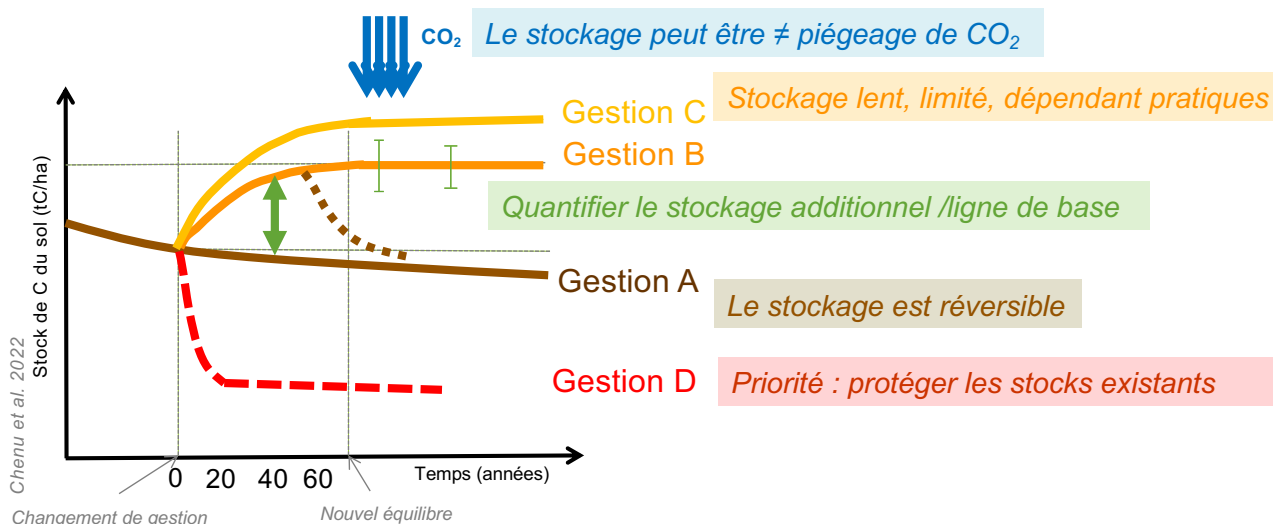


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10

Stockage de C: des limites intrinsèques



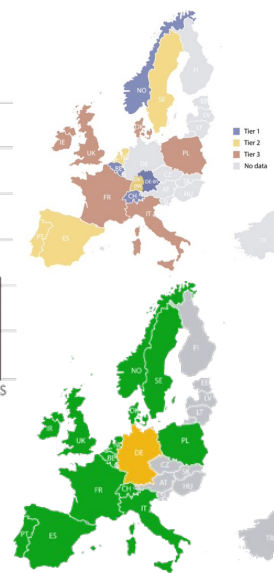
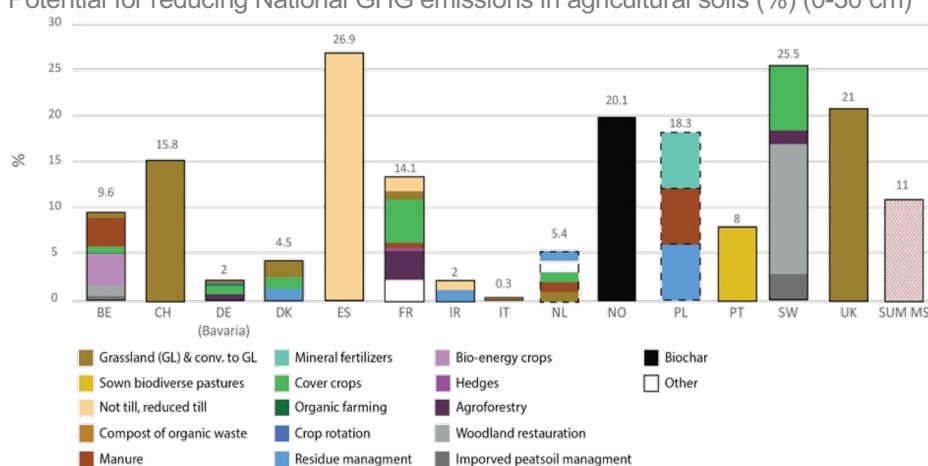
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11

11

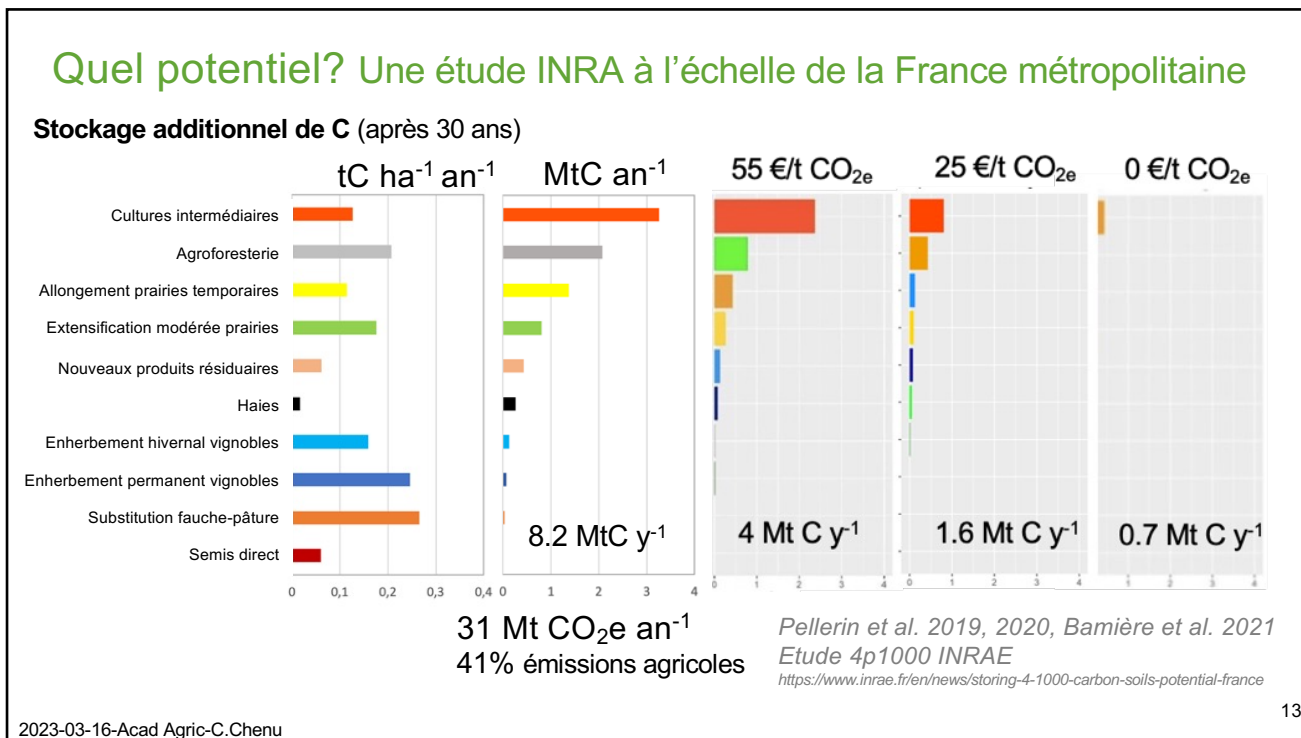
Quels potentiel? Une revue des études à l'échelle nationale

Stocktake of existing studies at the national scale:
Potential for reducing National GHG emissions in agricultural soils (%) (0-30 cm)

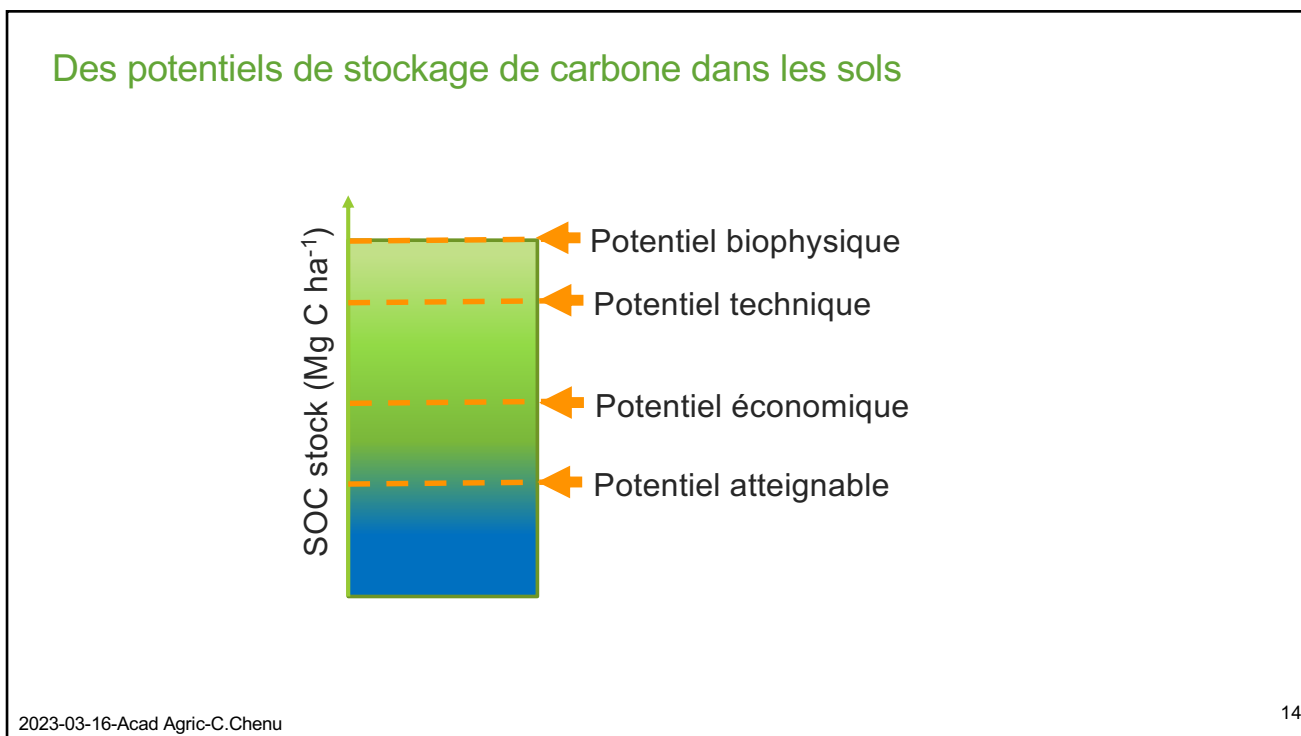


Roigues et al. 2021- Global Change Biology 12

12

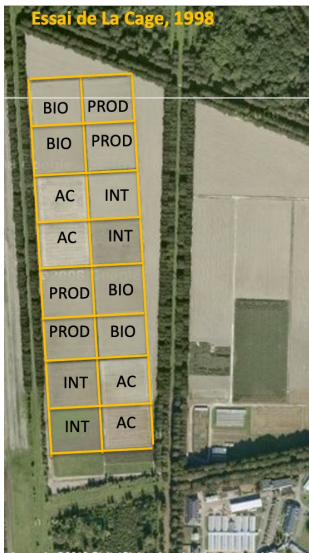


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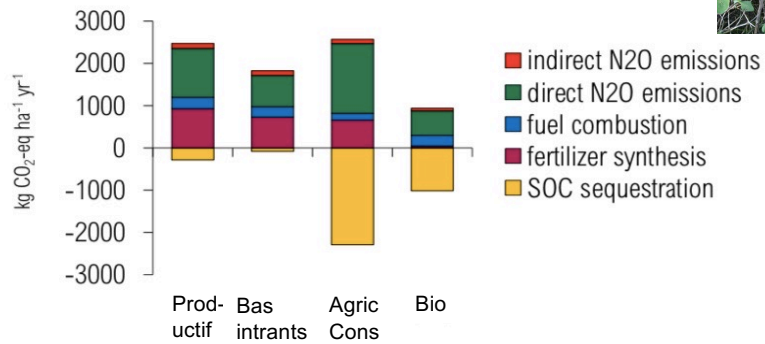


14

Stockage de C ≠ bilan global de gaz à effet de serre



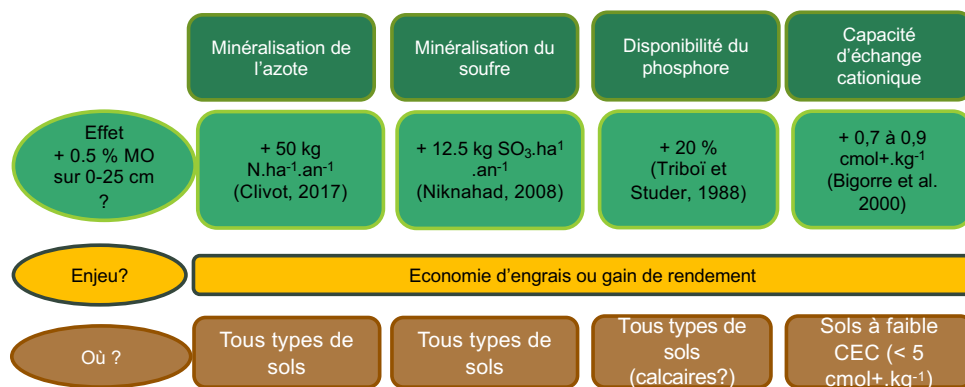
Essai La Cage, INRAE, 78000, comparaison de différents systèmes de culture



Autret et al. 2018

Fertilité, qualité des sols

Matières organiques et fertilité chimique des sols



Dia A. Bouthier

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17

17

Matières organiques et fertilité physique des sols

Attendus	Type de sol	Importance effet
↗ stabilité structure	Sols limoneux battants	+++
↗ vitesse d'infiltration pluies	Sols peu perméables, sols battants	+++
↗ réserve utile	Sols texture sableuse, sols caillouteux	++
↗ Jours disponibles	Sols peu perméables	++
↗ résistance au tassement	Tous sols	++
↗ réchauffement	Sols clairs	+

Voir Etude 4p1000, Pellerin et al. 2019, 2022

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18

18

Matières organiques des sols et rendement

Yield (t ha⁻¹) vs SOC (%)

N input (kg N ha⁻¹): 0, 100, 200, 300, 400, 500

Oldfield et al. 2019

European survey shows poor association between soil organic matter and crop yields
ORIGINAL ARTICLE
Wyse J. Vonk · Martin K. van Ittersum · Pytrik Reidsma · Laura Zavattaro · Luca Bechini · Gema Guzmán · Annette Pronk · Heide Spiegel · Horst H. Steinmann · Greet Ruyschaert · Renske Hijbeek

Do organic inputs matter – a meta-analysis of additional yield effects for arable crops in Europe
REGULAR ARTICLE
R. Hijbeek · M.K. van Ittersum · H.F.M. ten Berge · G. Goert · H. Spiegel · A.P. Wilmers

(a) Type of organic input

- straw & green residues (32)
- straw (20)
- slurry (8)
- farm yard manure (38)

Yield change: -5%, 0%, 5%, 10%

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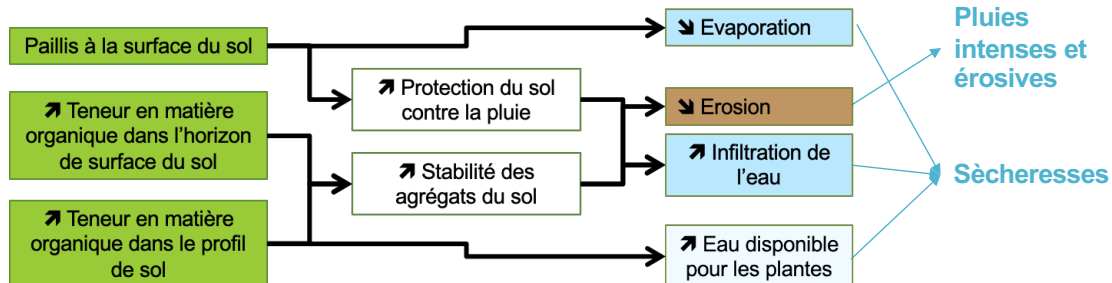
19

Adaptation au changement climatique

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20

Matières organiques et adaptation au changement climatique



Photos C. Chenu

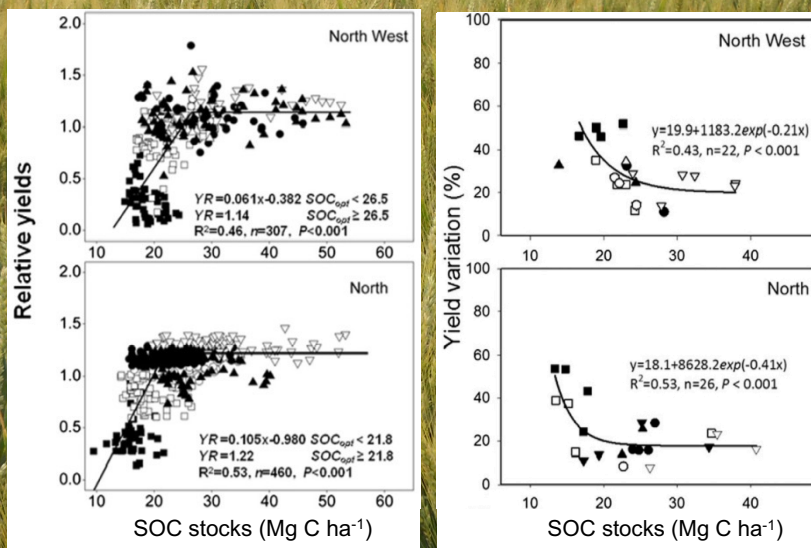
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21

21

Matières organiques et adaptation au changement climatique

China



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Zhang et al. 2016

22

Préserver, augmenter les stocks de C des sols

Comment l'inciter ? C farming

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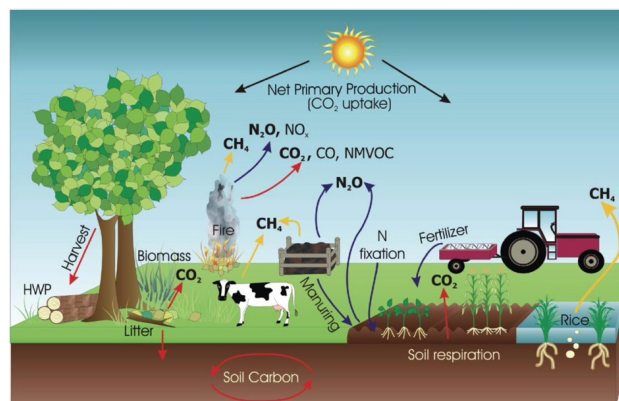
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23

Carbon farming?

= managing carbon pools, flows and greenhouse gases at farm level to mitigate climate change

= the business model that aims to upscale climate mitigation by paying farmers to implement climate-friendly farm management practices



©IPCC, 2006

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24

24

Carbon farming: business models

Option	Actors	MRV action/ results based	e.g.
Land management practice payments	Public or NGO funder		CAP
Corporate supply chain	Agri-food company		SPAR
Voluntary market with intermediary	Private sector, individuals → Intermediary		Label Bas Carbone
Voluntary market exchange-based	Private sector, individuals → Certification mechanism		Verra

Adapté de Mc Donald et al. 2021

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25

25

Mesure, suivi et vérification du C du sol

Téledétection M R V

- Biomasse cultures
- Sols
- Usage et pratiques

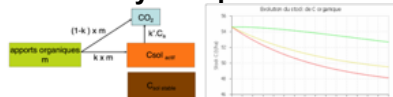
Données spatialisées M R

- Climat
- Sols
- Occupation des sols

Description des pratiques M R

Parcelle/ferme

Modèles de la dynamique du carbone/GES



Evolution des stocks de C des sols au cours du temps M R

Essais de longue durée **Sites de référence** Réseau de suivi de la qualité des sols

Adapté de Smith et al. 2020, Global Change Biology
Ruyschaert et al. 2022- projet MARVIC

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26

26

Cadre UE de certification d'absorption carbone

Critères QU.A.L.ITE

QUANTIFICATION

ADDITIONALITE

STOCKAGE LONG-TERME

DURABILITE

+ méthodologies de certification sur mesure pour les différents types d'activités d'absorption carbone (prochaine étape)

Règles de certification

VERIFICATION TIERCE-PARTIE

SYSTÈMES DE CERTIFICATION FIABLES

REGISTRES PUBLICS

+ La Commission reconnaît les systèmes de certification qui peuvent certifier la conformité aux critères QU.AL.ITE

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27

C farming : bilan global, impacts et co-bénéfices?

Additional SOC storage & N₂O emissions when implementing management options

Meta-analysis
n = number of experiments

Water?

Nutrients?

Biodiversity?

Guenet et al. 2020, GCB

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28

 à discuter

- Carbone et sols -> plutôt matières organiques des sols
- Préserver et si possible augmenter les matières organiques des sols
- Evaluer quantitativement les bénéfices : fertilité/qualité/santé des sols, adaptation au changement climatique.
- Surveiller le carbone /les matières organiques des sols
- Rétribuer les services écosystémiques rendus, pas que la contribution à l'atténuation du changement climatique
- Vision systémique : ferme, territoire, filière

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29

29



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4PER1000
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30

30

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31