Session SSS9.7 (D2112)

From Grassland and Cropland to Nut Orchards: Carbon Sequestration Dynamics of temperate Agroforestry Systems

EGU2020-11195
presentation
6 mei 2020 (8:30-10:15)

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Introduction

The general discourse is that agroforestry systems (AFS) can sequester more carbon than crop- or grassland (Pardon et al., 2017).

Study	Country (AEZ)	Land use	C-sequestration rate (Mg C·ha^{-1} yr^{-1})	Range
Cardinael et al. (2017)	France (temperate)	silvoarable to regular AM	0.69	vegetation and soil
Hamon et al. (2009) as cited in Aertsens et al. (2013)	Europe (mainly temperate)	regular AM to agroforestry (e.g. based on Juglans)	1.5-4.0 [2.75]	vegetation and soil
Pardon et al. (2017)	Belgium (temperate)	regular AM to silvoarable	0.21	soil
Sharrow and Ismail (2004)	Oregon, USA (temperate)	pasture to silvopastoral	0.52	vegetation and soil
Wotherspoon et al. (2014)	Ontario, Canada (temperate)	regular AM to silvoarable (various tree species)	0.8–2.1	vegetation and soil

Research question:
To what extent does changing crop- or grassland into nut orchards in the temperate zone contribute to increased carbon sequestration in vegetation and soil?

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(Roest et al., 2020)

Method (1)

- Object of study: orchards of *Corylus* (hazelnut trees) and solitary trees of *Juglans* (walnut trees) in the province of Gelderland, The Netherlands.
- The research was conducted with the use of chronosequences.
- The basis of our study was to depict an overview of C-stocks & –fluxes in nut orchards.

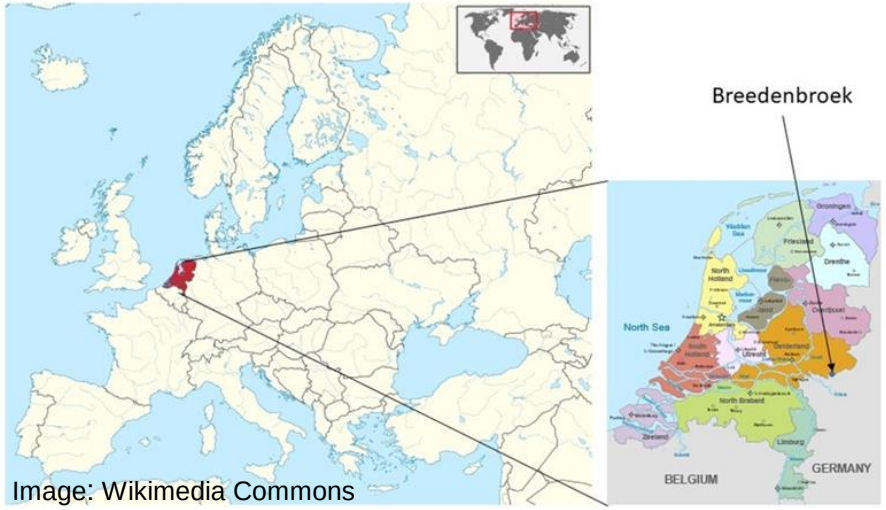

Image: Wikimedia Commons

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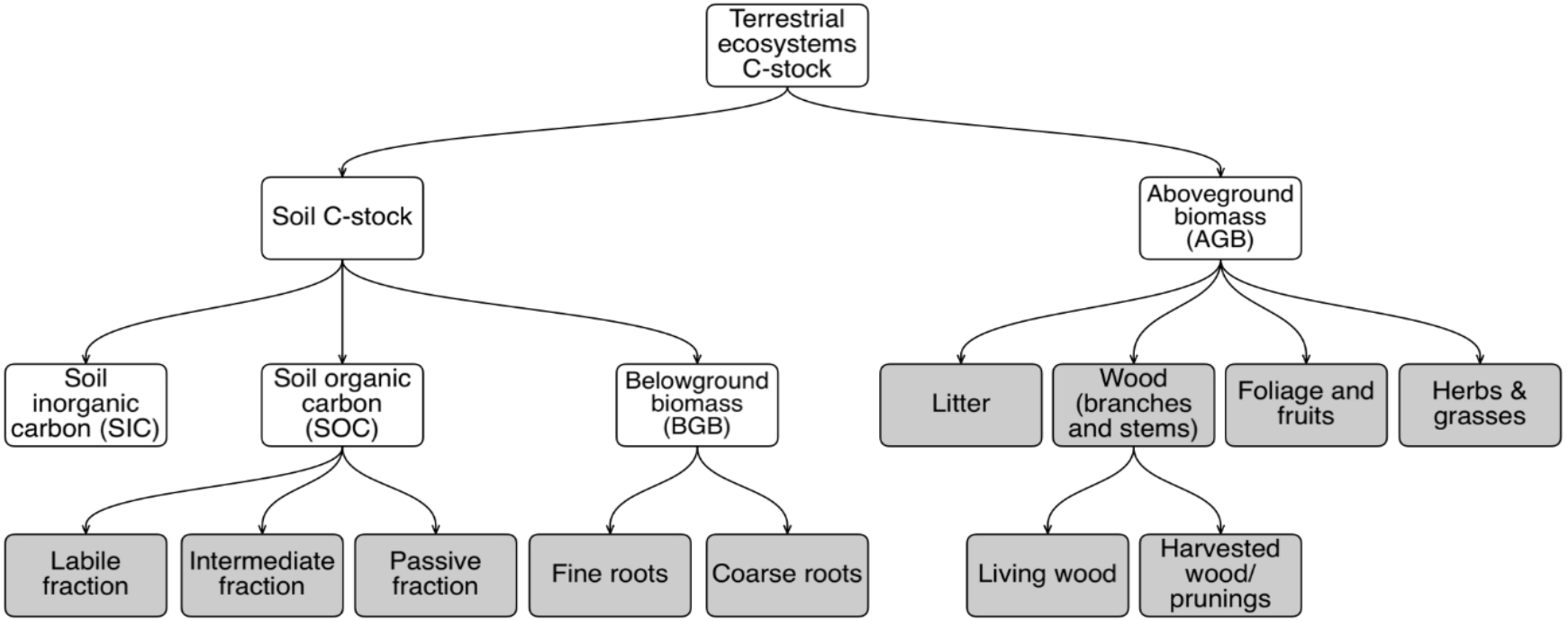
(Roest et al., 2020)

Method (2)



Carbon stocks in terrestrial ecosystems (partly based on Lal (2005).

Our research concentrated on three main stocks of carbon: soil organic carbon (SOC), belowground biomass (BGB) and aboveground biomass (AGB) and the fluxes that run from one to another.

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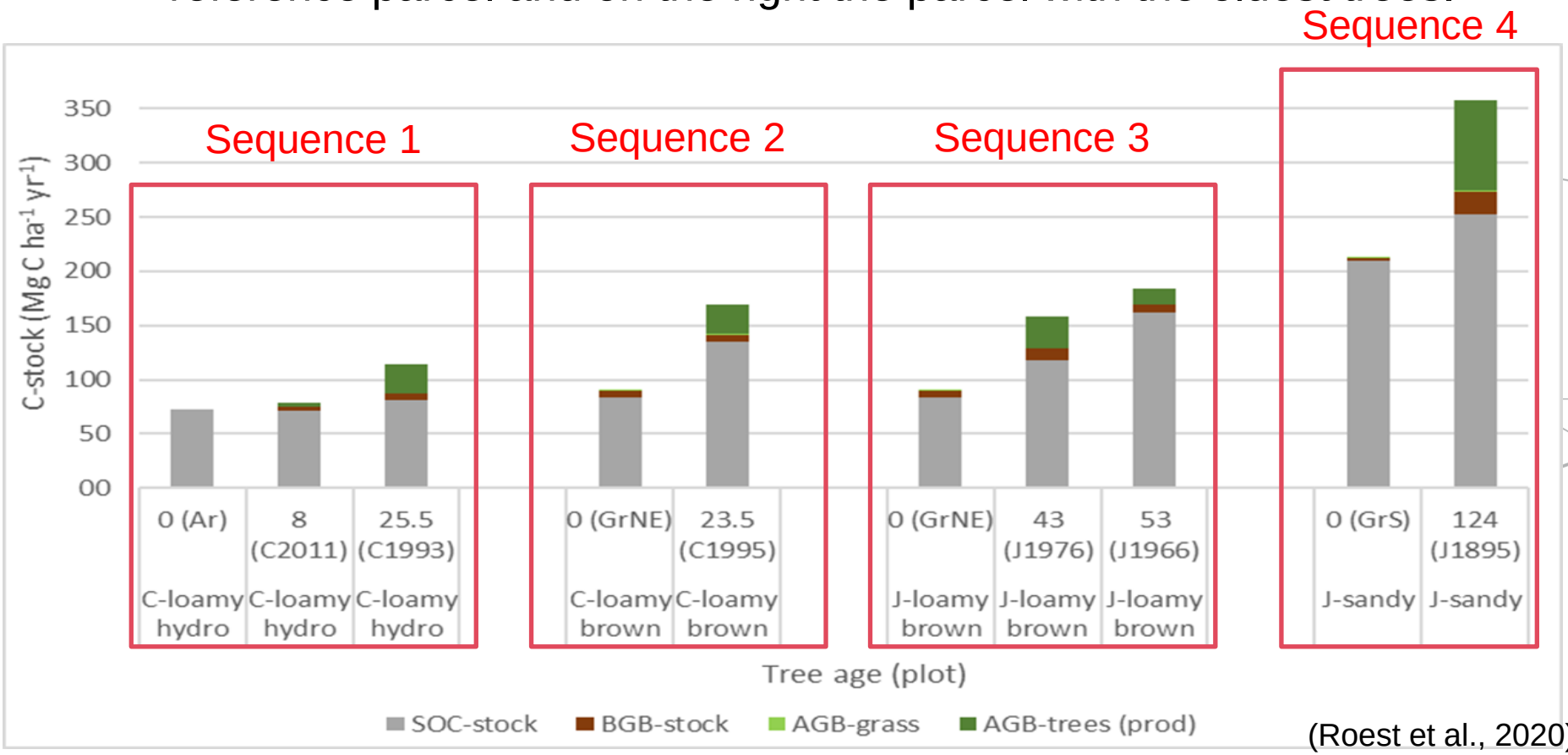
(Roest et al., 2020)

Results (1)

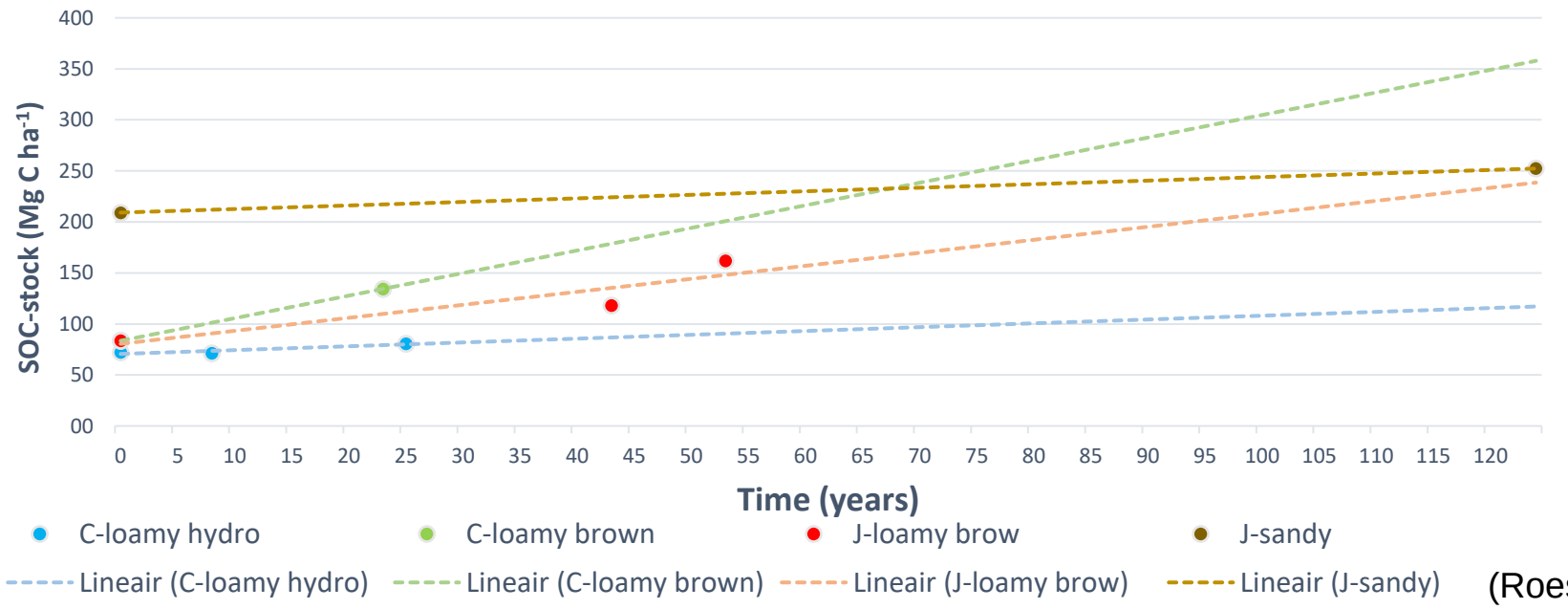
- C-stocks in *Corylus* and *Juglans* orchards are larger than C-stocks in reference parcels (used as grassland or cropland).
- The figure below shows the C-stocks in the four chronosequences we distinguished, with on the left the reference parcel and on the right the parcel with the oldest trees.



(Roest et al., 2020)

Results (2)

- C-stocks in orchards show a positive correlation with tree age.
- In general carbon in soil (SOC) and in biomass (aboveground biomass and belowground biomass) have an almost similar contribution to the additional C- sequestration (the figure below shows the SOC-stock in the four different sequences).
- Our results on C-fluxes are largely in line with sequestration rates found in various studies on agroforestry systems in the temperate zone.



(Roest et al., 2020)

Discussion & conclusions

- Changing crop- or grassland into *Corylus* and *Juglans* orchards in the temperate zone can attribute to increased C-sequestration (wood harvest included).

C-flux	Unit	*Corylus*	*Juglans*
SOC	Mg C ha^{-1} y^{-1}	-/-0.12-2.16	0.35-1.48
BGB	Mg C ha^{-1} y^{-1}	0.04-0.41	0.02-0.14
AGB	Mg C ha^{-1} y^{-1}	0.53-1.15	0.25-0.67
Total	Mg C ha^{-1} y^{-1}	0.82-3.36	1.16-1.75

- Composing uniform chronosequences is difficult.
- Changing crop- or grassland into *Corylus* and *Juglans* orchards seems promising to mitigate part of the anthropogenic CO_2 emissions to the atmosphere.
- Additional research on sequestration rates, preferably by time studies, is recommended.

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(Roest et al., 2020)

References and colofon

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Colofon

Financing of all laboratory analysis came from the Province of Gelderland, The Netherlands under the project named ‘Notenbomen als toplaagverbeteraar’. The project ‘Notenbomen als toplaagverbeteraar’ was initiated and led by Ton Baltissen from the company Cropeye.

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(Roest et al., 2020)