

# From Pasture and Cropland to Nut Orchards

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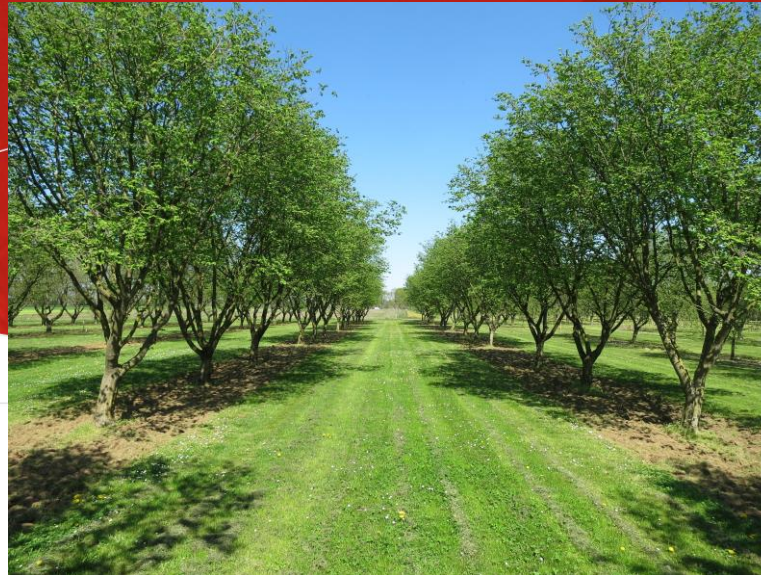
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Session SSS9.7 (D2112)

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



**EGU2020-11195**

**presentation**

6 mei 2020 (8:30-10:15)

Erik Roest<sup>1</sup>, co-authors: Angelique Lansu<sup>1</sup>, Ton Baltissen<sup>13</sup> and Stefan Dekker<sup>12</sup>

<sup>1</sup>Open University Heerlen (NL), <sup>2</sup>Utrecht University, <sup>3</sup>Cropeye

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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 <sup>-1</sup> yr <sup>-1</sup> ) | 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?

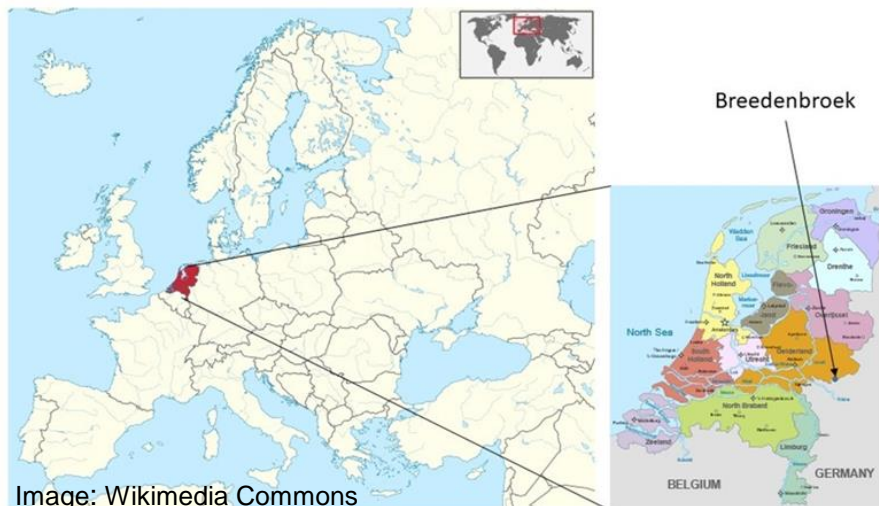
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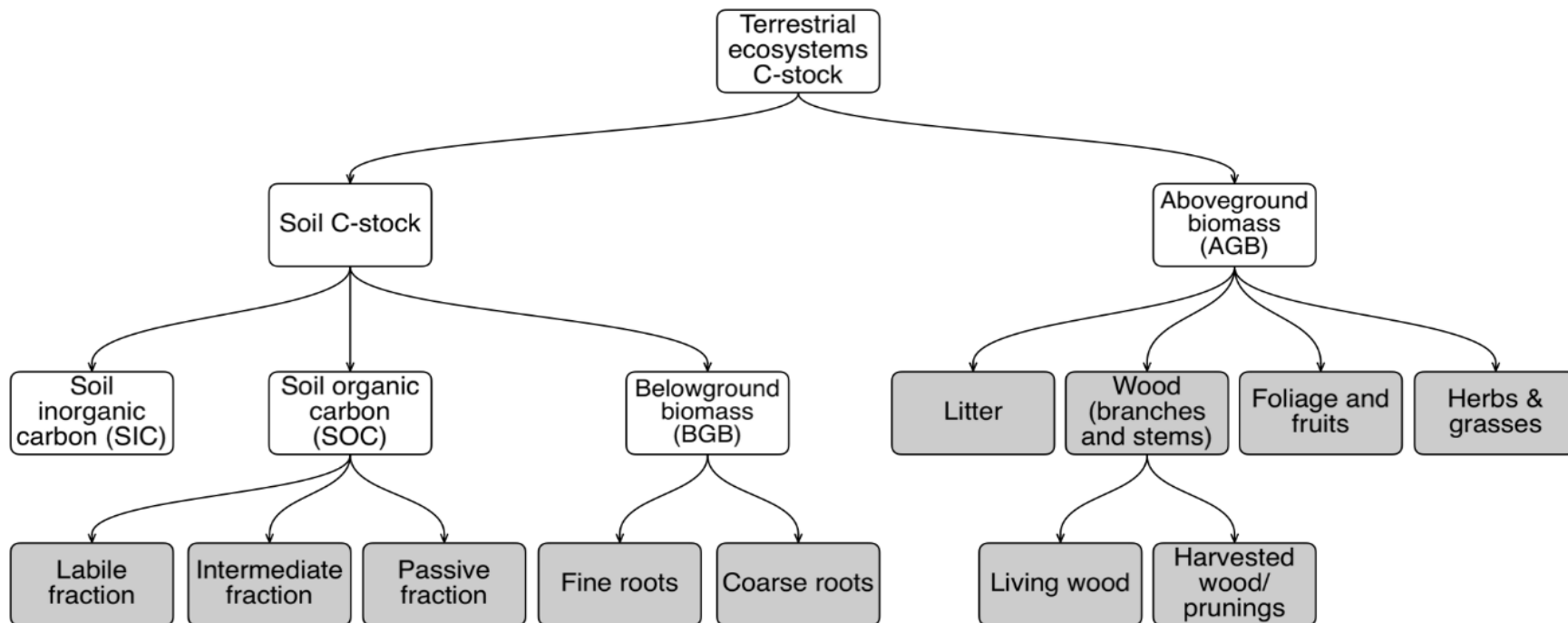
(Roest et al., 2020)

# 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.



# Method (2)

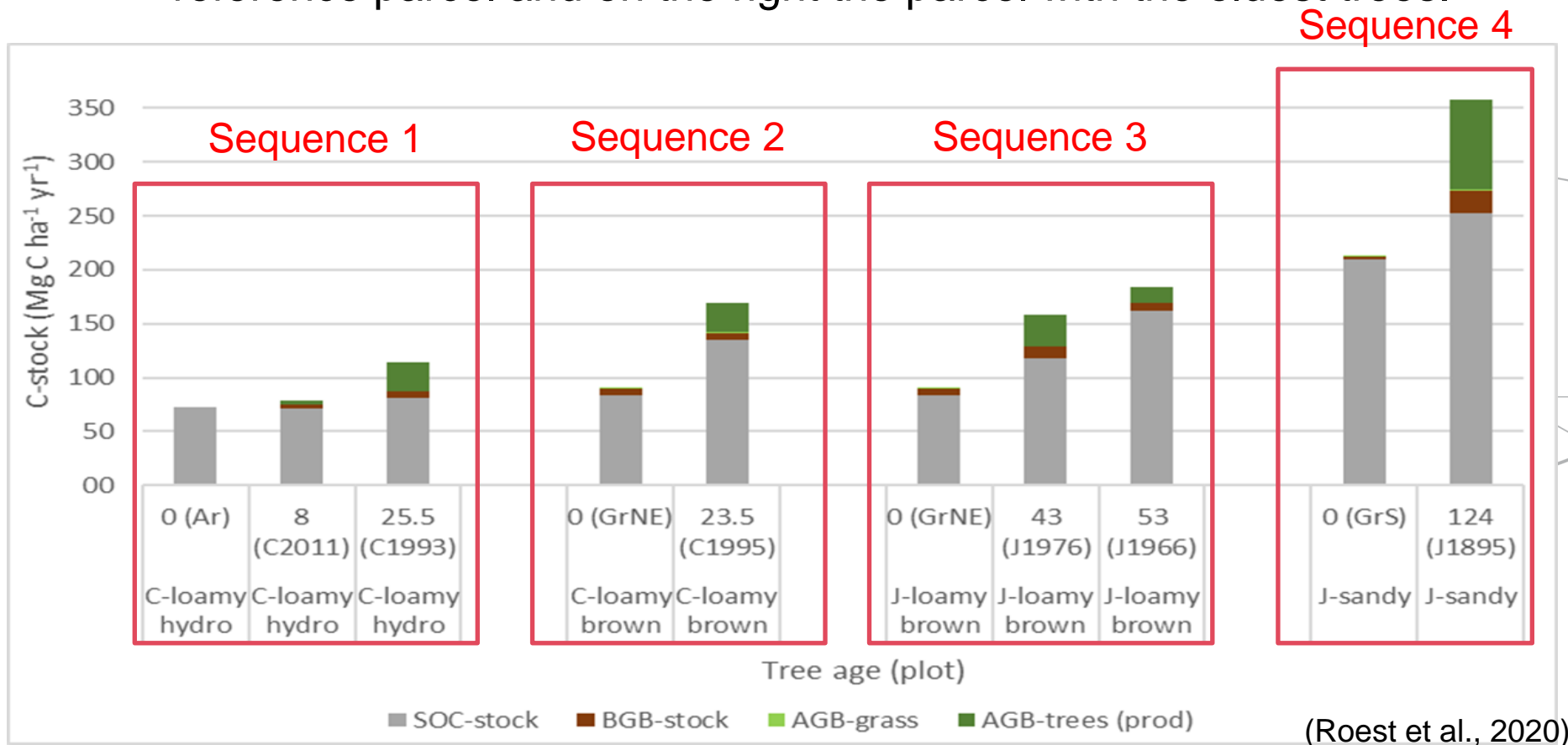


Carbon stocks in terrestrial ecosystems (partly based on Lal (2005)).

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.

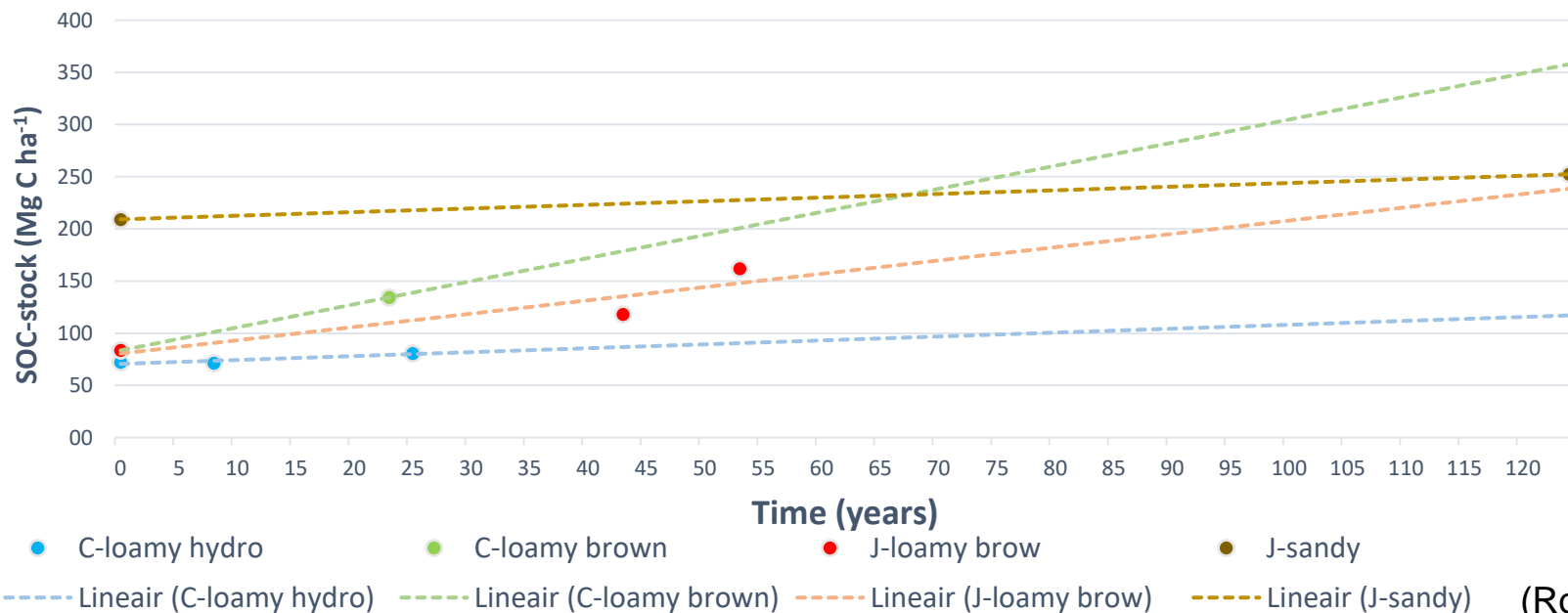
# Results (1)

- 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.



# 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.





# 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                                  | <i>Corylus</i> | <i>Juglans</i> |
|--------|---------------------------------------|----------------|----------------|
| SOC    | Mg C ha <sup>-1</sup> y <sup>-1</sup> | -/-0.12-2.16   | 0.35-1.48      |
| BGB    | Mg C ha <sup>-1</sup> y <sup>-1</sup> | 0.04-0.41      | 0.02-0.14      |
| AGB    | Mg C ha <sup>-1</sup> y <sup>-1</sup> | 0.53-1.15      | 0.25-0.67      |
| Total  | Mg C ha <sup>-1</sup> y <sup>-1</sup> | 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<sub>2</sub> emissions to the atmosphere.
- Additional research on sequestration rates, preferably by time studies, is recommended.



# References and colofon



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## Colofon

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(Roest et al., 2020)