

Carbon storage in silvopastoral systems

Farm Woodland Forum Annual Meeting

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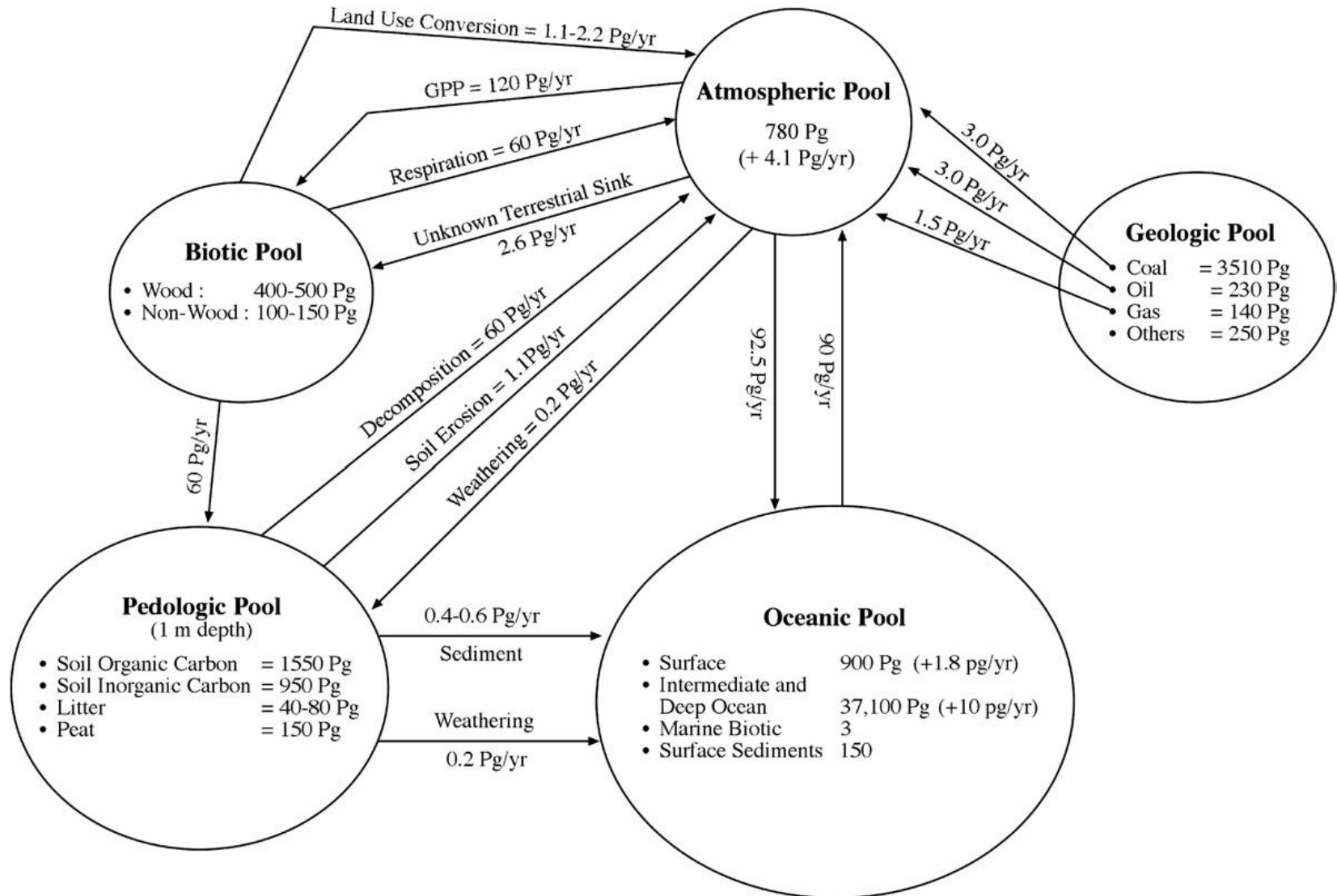
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What effect does planting trees have on
soil carbon storage?

Soil: an important carbon sink



Reproduced from Lal (2008). 1 Pg = 1,000,000,000,000,000 g

Scientific consensus?

- Heavily dependent on previous land use.
- Planting on arable = **large gains in soil carbon**
- Planting on pasture = **small gains** OR **losses in soil carbon**

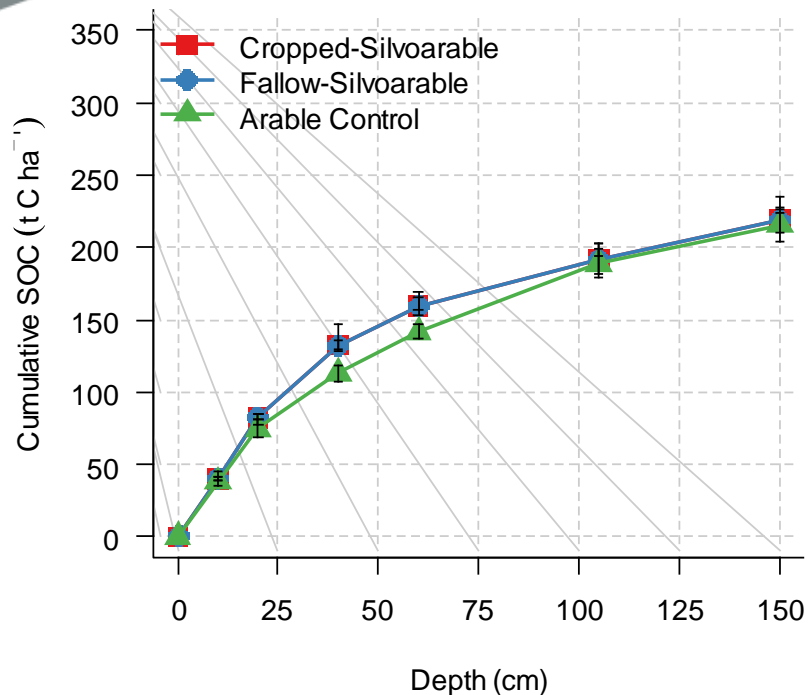
Guo & Gifford (2002), Paul & Polglase (2002), Laganiere et al. (2010)

- Few UK studies in the literature.
- Even fewer relating to agroforestry.
- Fewer still that sample to any great depth (>50 cm).

Silvoarable Agroforestry



- 19 year old poplar system
- Compared arable control with two silvoarable treatments.



- No differences at 0-20 cm.
- More carbon stored in agroforestry for 0-40, 0-60, 0-105 cm.
- No difference when 150 cm considered.

Error bars indicate standard error of the mean.
Reproduced from: Upson & Burgess (2013).

- 14 year old silvopastoral site in Bedfordshire.
- Established as part of an EC funded project in 1998 (Burgess et al., 2000).
- Parkland/pasture since 1880s.
- Most recent usage (since 1990s): grazing for beef-suckler herd.

Silvopastoral system (7.98 ha)

- 34 groups of trees
- Native broadleaf mix (30% ash)
- Area under trees: c. 0.45 ha

- Farm Woodland
- Pasture
- Silvopasture

Farm woodland (6.11 ha)

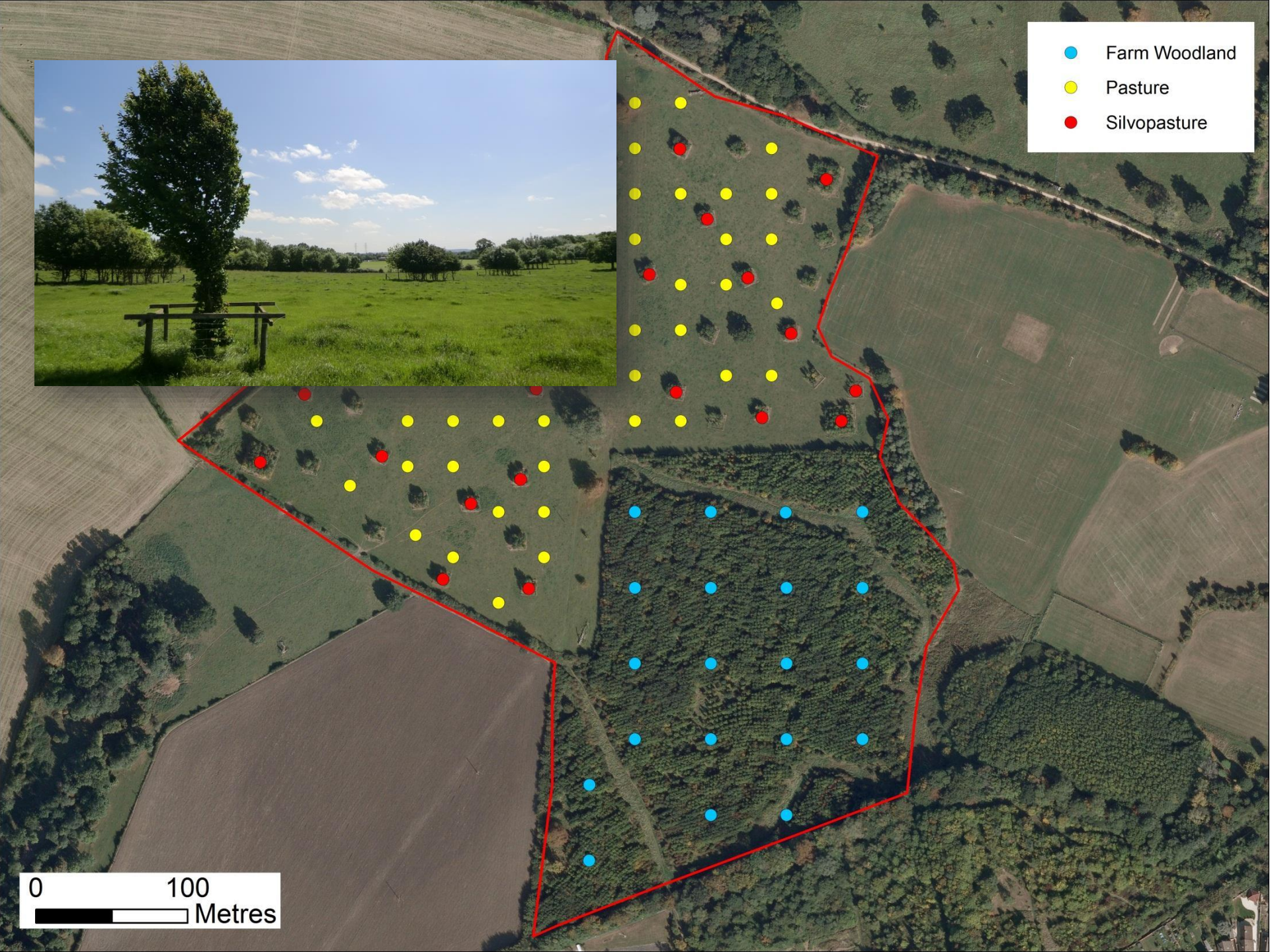
- Native broadleaf mix (60%), shrub mixture (20%), open ground – rides, footpaths (20%).
- Fenced.

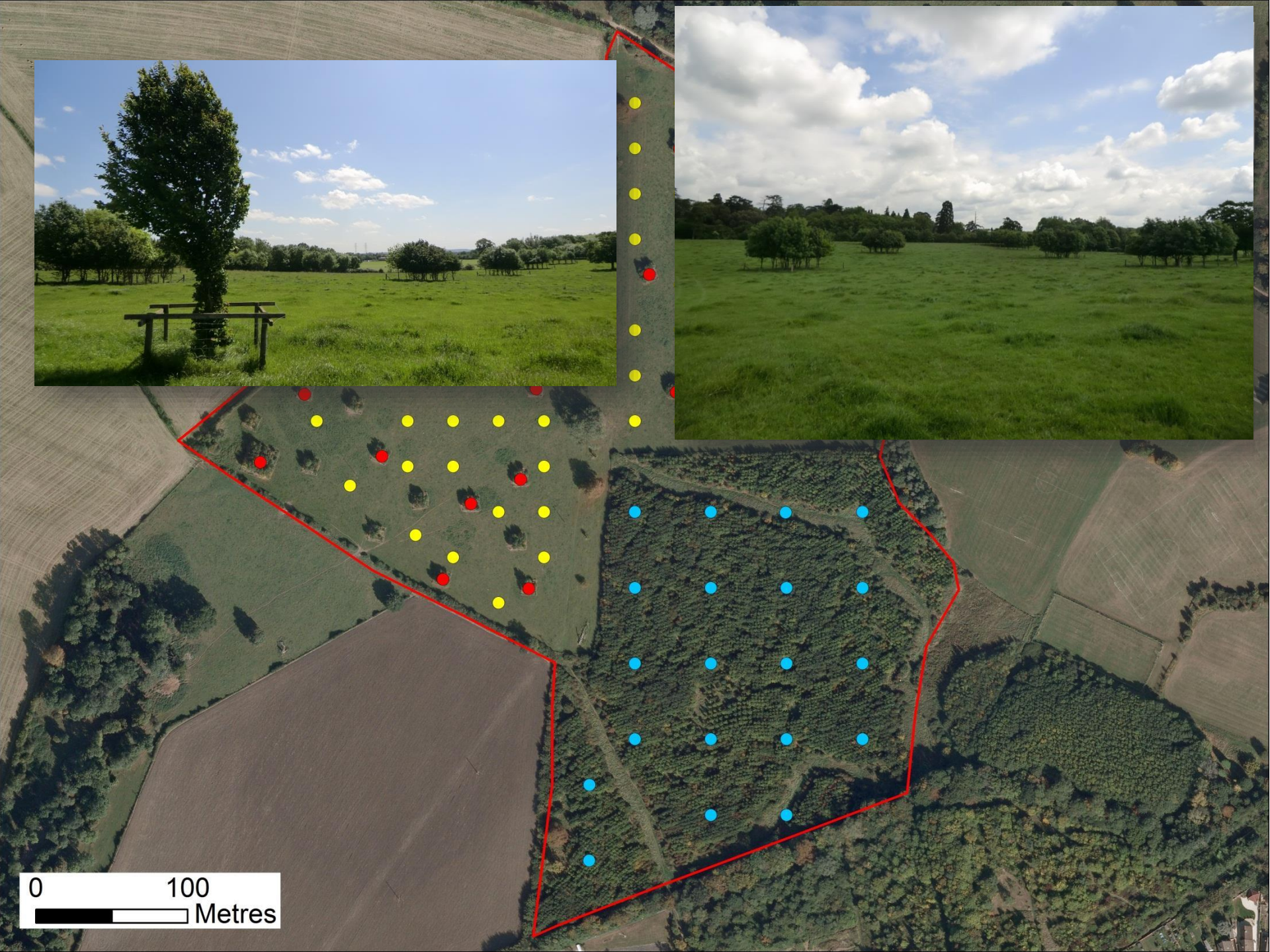
0 100
Metres



- Farm Woodland
- Pasture
- Silvopasture

0 100
Metres





0 100
Metres



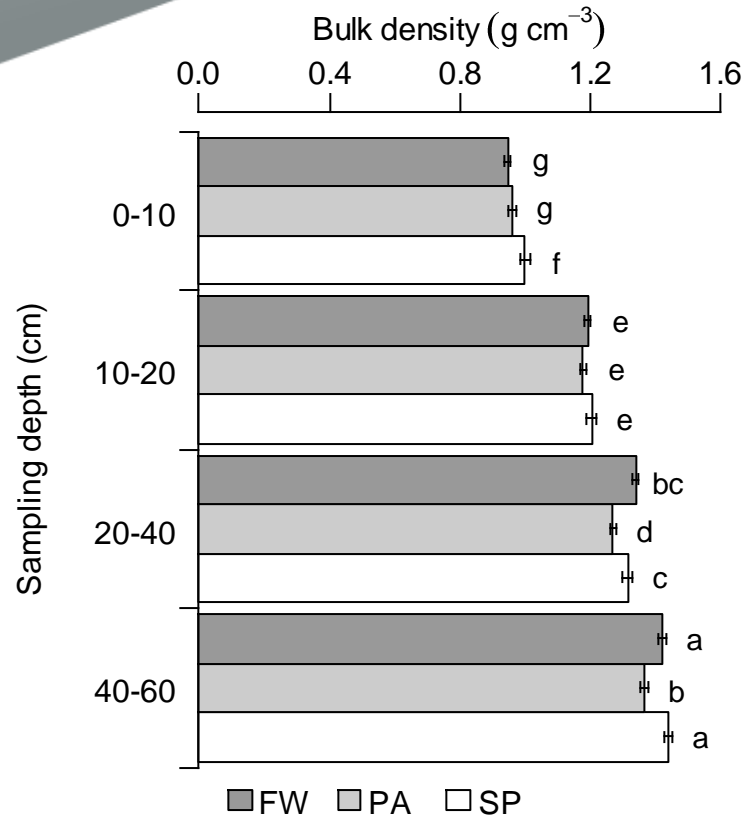
0 100 Metres



- 80 stratified sampling points.
- >1000 samples.
- Soil bulk density.
- Organic carbon content.

0 100 Metres

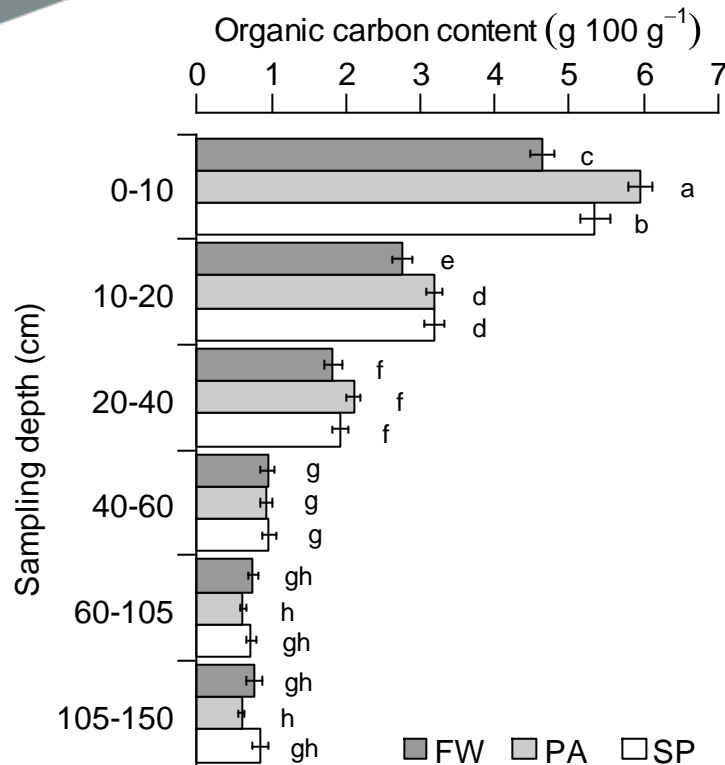
Soil bulk density



Error bars indicate standard error of the mean.
Similar letters indicates no significant difference.

- Tree planting often associated with reduced soil bulk density.
- Bulk density in tree treatments as high, if not higher than pasture at all depths.
- Probably a results of changes in clay volume.
- Similar to findings in silvoarable.

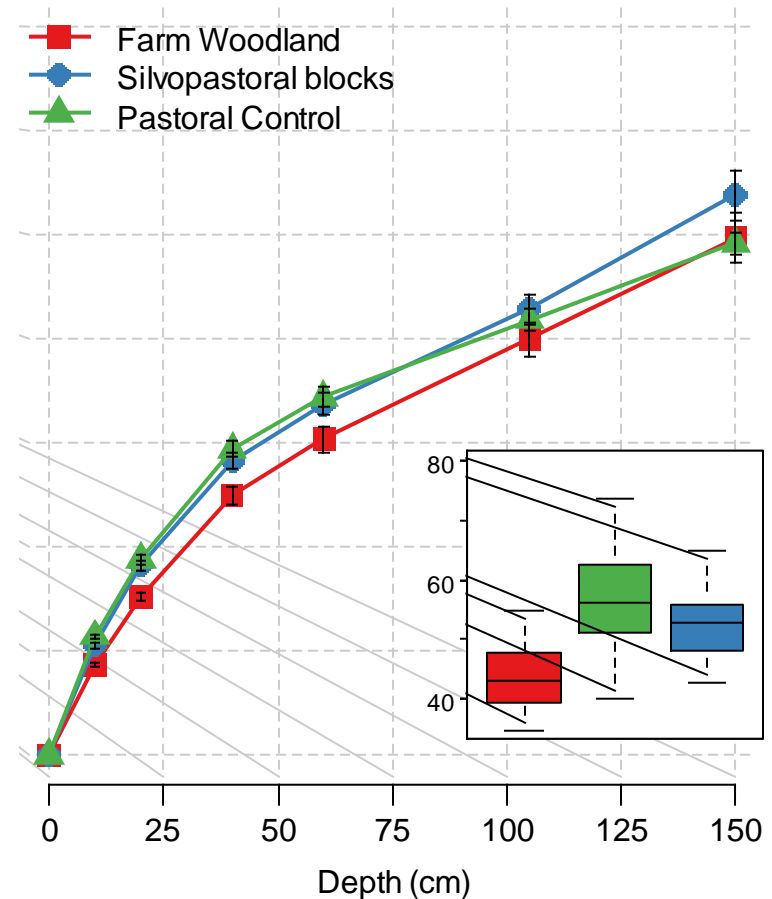
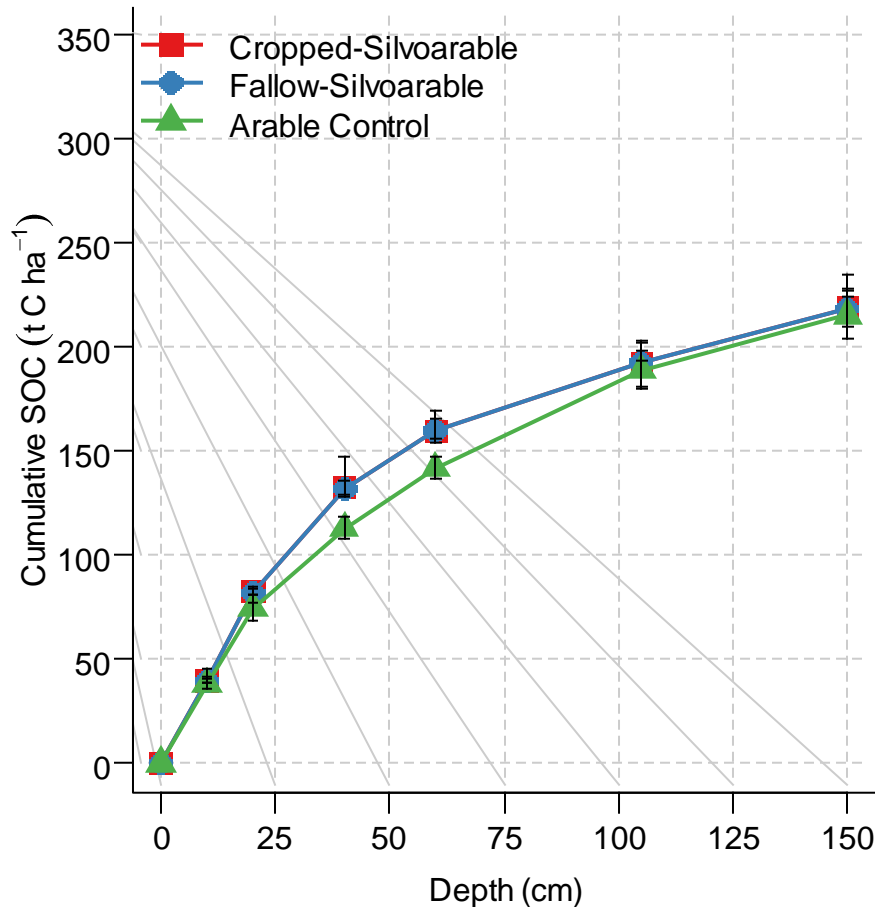
Soil organic carbon



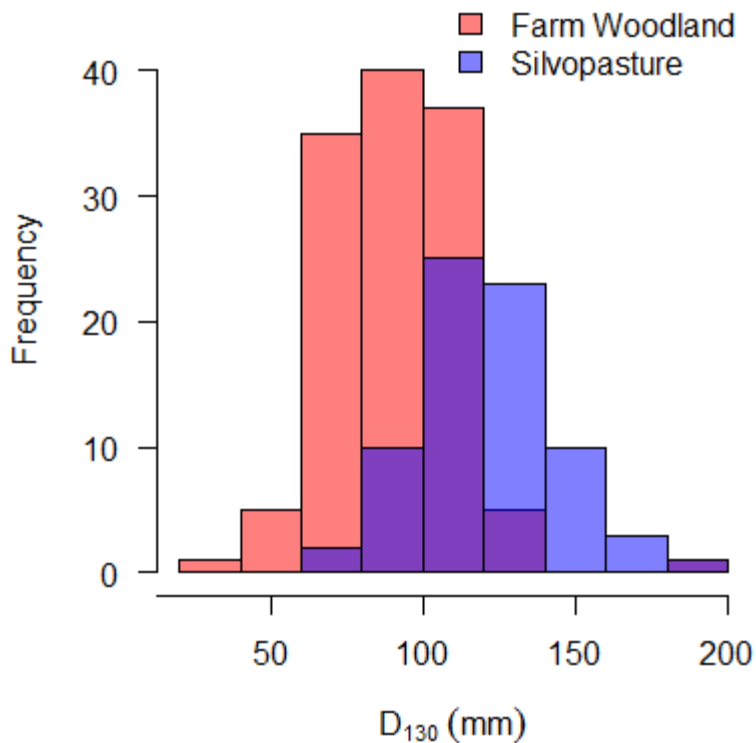
Error bars indicate standard error of the mean.
Similar letters indicates no significant difference.

- Tree planting resulted in carbon losses at 0-10 cm and 10-20 cm increments.
- Pro-rata reduction?
- Below 40 cm carbon contents broadly similar, but further analysis needed.

Soil organic carbon (SOC)

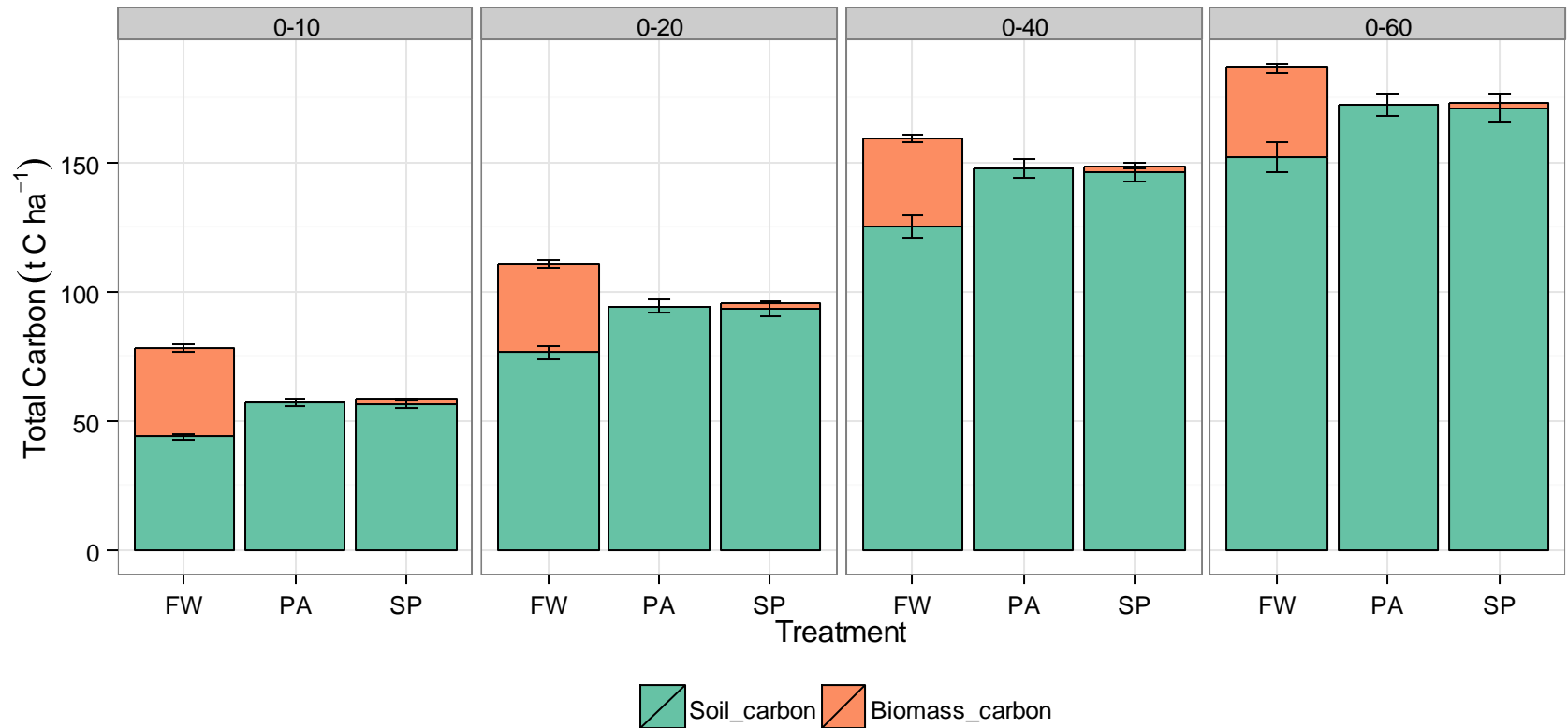


Cumulative soil organic carbon (t C ha^{-1}) for the silvoarable experiment (left) and silvopastoral (right). Error bars indicate standard error of the mean. Inset shows differences at 0-10 cm increment.



- Assumption that ash data can be generalised.
- Ash trees in silvopasture and farm woodland sampled (diameter, height, form, n=198)
- Destructive sampling of aboveground biomass (n=38, belowground to follow).
- Creation of allometric biomass equation.

Biomass carbon



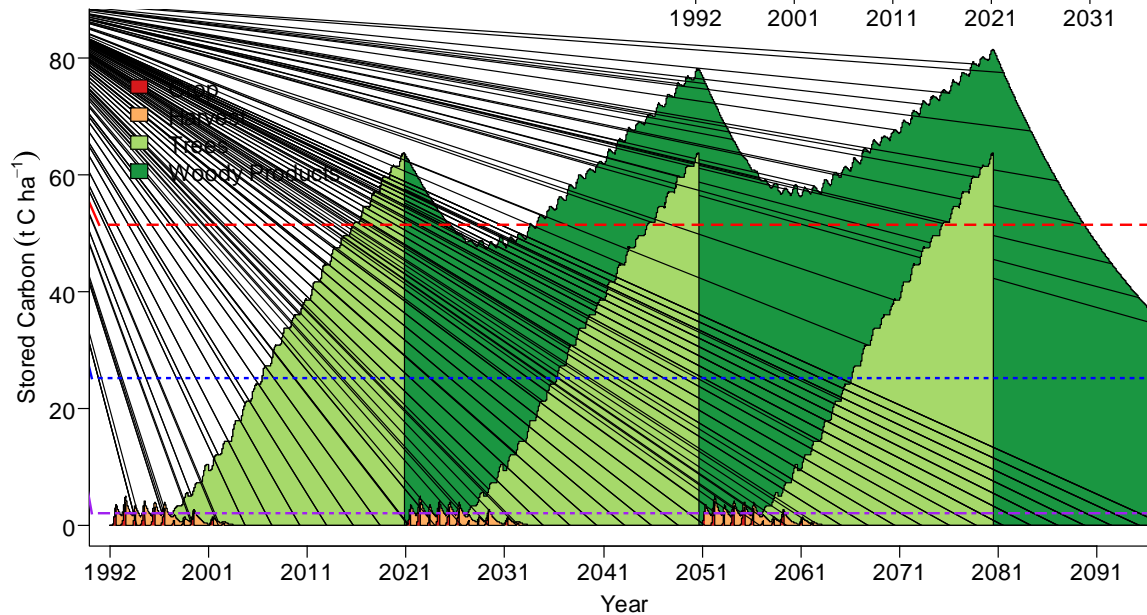
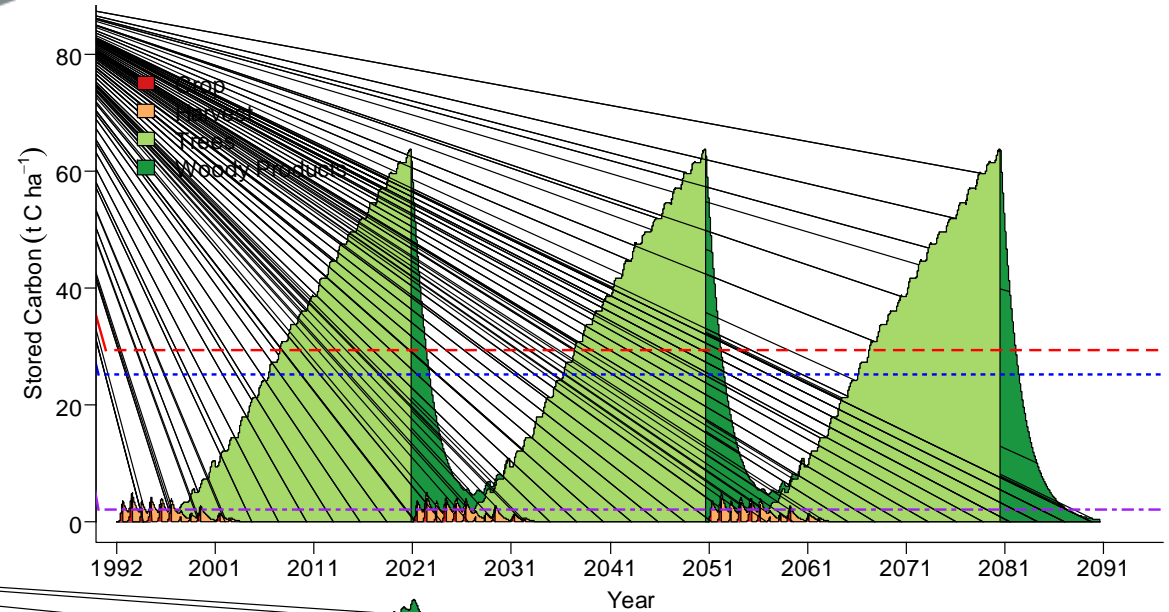
Error bars indicate standard error of the mean.

Differences between the pasture and the farm woodland (FW), and silvopastoral (SP) treatment (t C ha^{-1}) over 0-60 cm

	SOC	Biomass C	Final
FW	-20.2	34.4	14.2
SP	-1.1	1.9	0.8

- Carbon pools not created equal.
- Biomass generally considered a 'labile' pool.
- Some loss of shallow particulate organic matter expected after planting, but...
- ...could also be long lived (recalcitrant) carbon.

Longevity



- Tree planting on pasture can cause losses of soil carbon...
- ...but only if shallow depths are considered.
- Tree planting should aim to produce quality timber to sequester carbon in durable woody products...
- ...preferably displace more carbon intensive materials.

References

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