

Forest Inventory for Ecosystem Carbon Estimation at Forest Management Unit Level:

A Case Study at Wangyedian Forest Farm

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Outline

1. Background and objectives
2. Forest inventory for carbon account
3. Preliminary results
4. Next steps

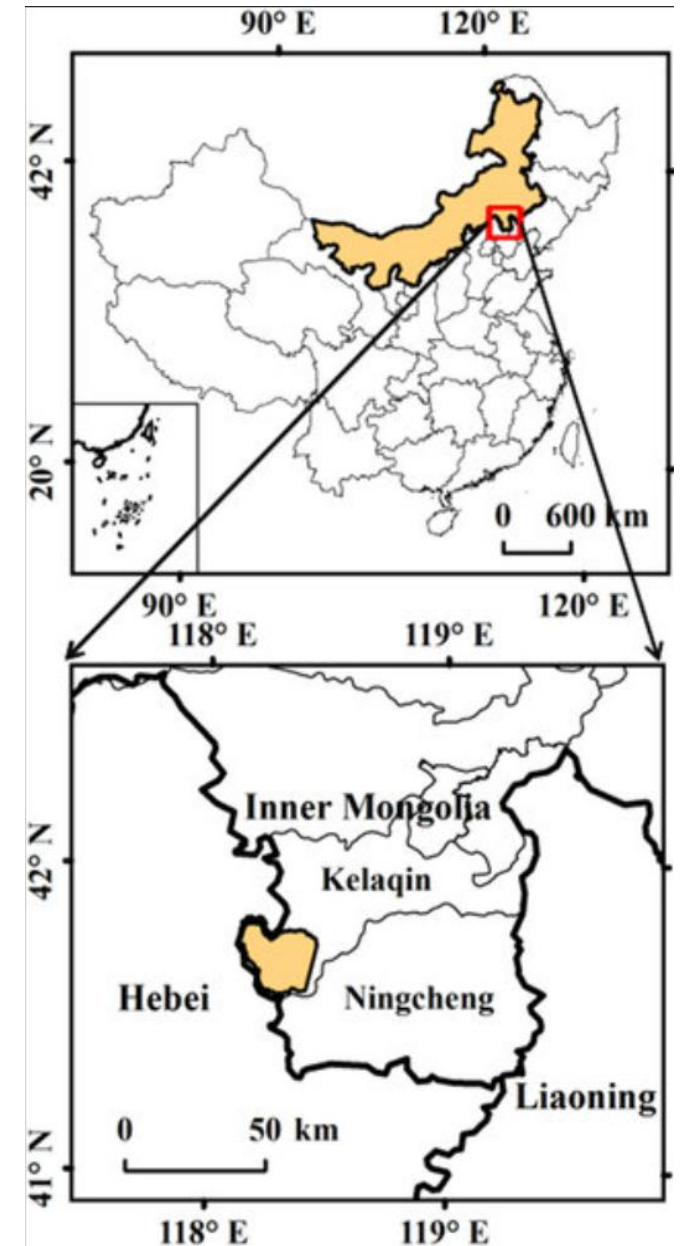
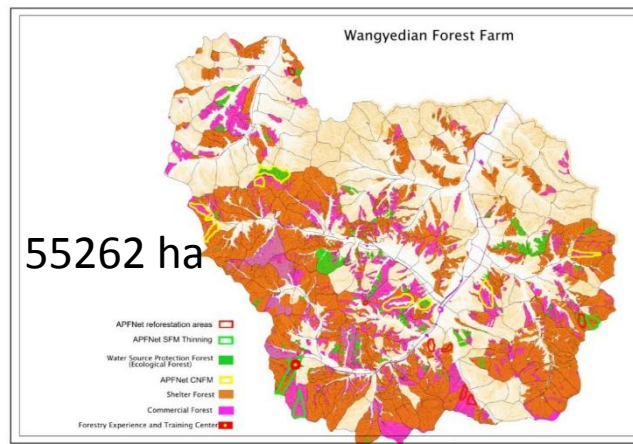
Background

- Criterion 5: Maintenance of forest contribution to global carbon cycles
- China's new climate targets-"Double carbon target" carbon peak (2030), carbon neutrality (2060)



Objectives

- **APFNet Forest Carbon Project at Wangyedian Forest Farm aims to**
 - ✓ Quantify forest carbon storage for the forest farm
 - ✓ Establish permanent sample plot monitoring system
 - ✓ Analyze the change and potential in carbon storage under forest management



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Inventory-based carbon estimation

Table 1 Four commonly used methods for estimating vegetation carbon storage based on inventory data

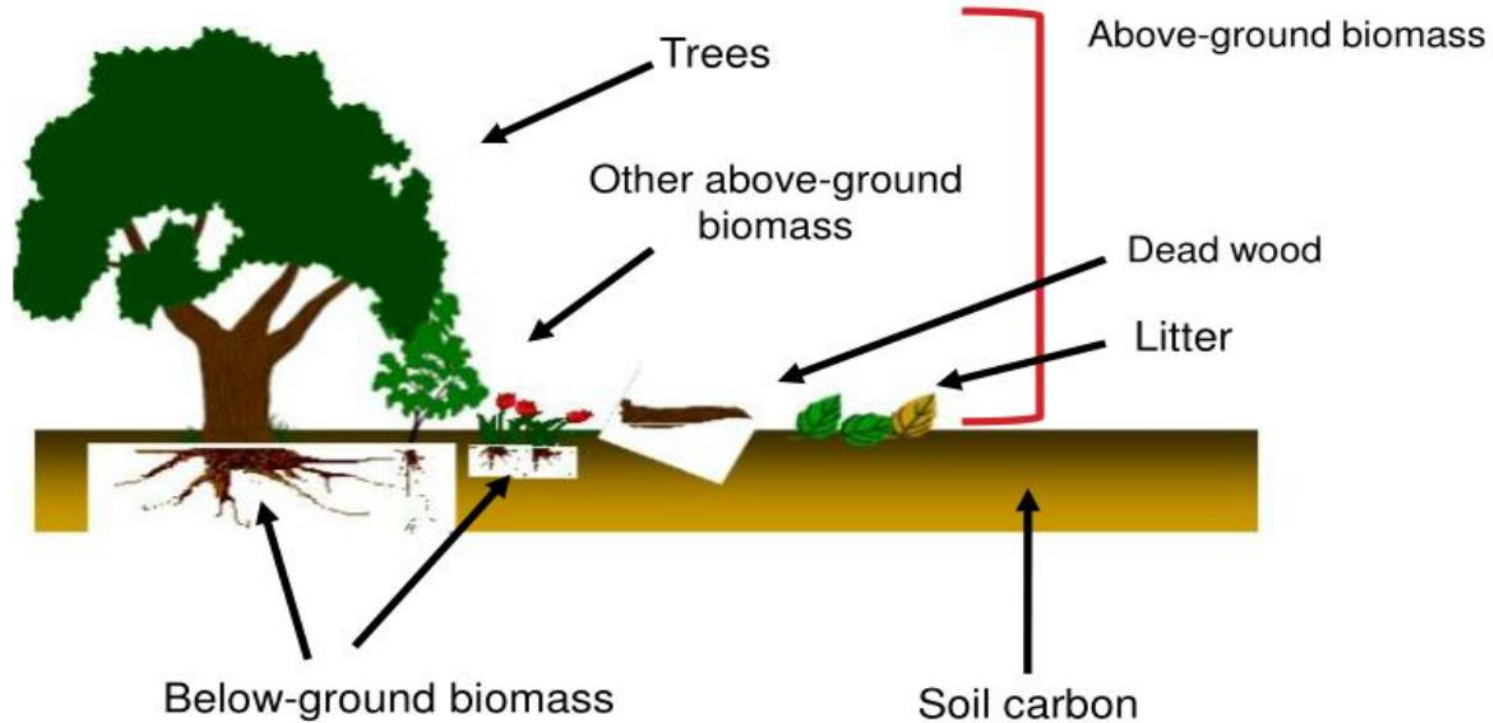
Methods	Description	Basic formula	Data needed	Application Scale
Inventory-based estimation	Average biomass method	$Y = A \times y \times d$	Average biomass or average carbon density, carbon content rate, forest area	regional
	Volume- derived method	$Y = A \times (a \times V + b) \times d$	Stand volume, forest area, carbon content rate	regional
	Biomass regression equation	$Y = A \times a \times (D^b H)^c \times d$	Diameter at breast height, tree height, forest area, carbon content rate	regional
	Conversion factor continuous method	$BEF = a + \frac{b}{V}$ $Y = A \times V \times BEF \times d$	Stand volume, forest area, carbon content rate	regional

while Y is vegetation carbon storage, A is the forest area, y is average biomass or average density, V is stand volume, D is diameter at breast height, H is tree height, d is carbon content rate of forest, BEF is biomass expansion factor, which was derived from stand volume, a , b , and c are constant changed along with forest types or climatic zones

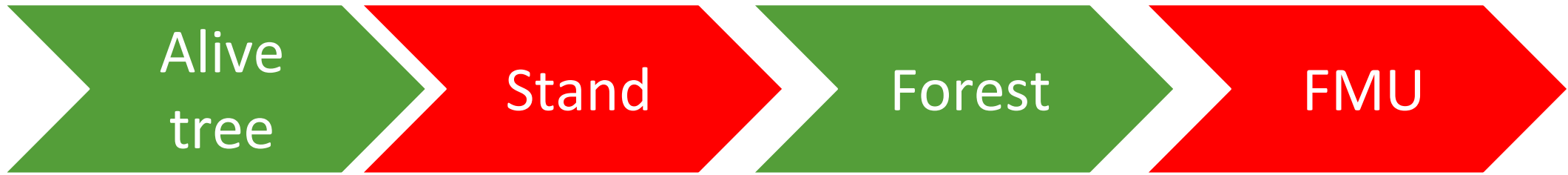
(Sun and Liu, 2020, Forest Ecosystems,7:4)

Five carbon pools

The IPCC GPG (2003) - five carbon pools:
aboveground biomass, belowground biomass, litter, dead wood, and soil organic carbon



USAID-CIFOR-ICRAF Project Assessing the Implications of Climate Change for USAID Forestry Programs (2009)



- Biomass allometric model
- DBH



National guideline for biomass allometric model of major tree species

- Sum of tree biomass
- Sampling for:
 - ✓ Shrub
 - ✓ Herb
 - ✓ Litter
 - ✓ Soil



Sample plot inventory

Mean biomass for carbon layers

- Forest area



Level II inventory

Sampling design-**stratified sampling**

Forest type

- Larch
- Chinese pine
- Scott pine
- Birch
- Poplar
- Oak
- Mixed conifer
- Mixed broad-leaved
- Mixed conifer-broad-leaved
- Shrub



Forest age

- Young
- Middle-aged
- Near-mature
- Mature
- Over-mature

$$n = \left(\frac{t_{VAL}}{E} \right)^2 * \left(\sum_i w_i * s_i \right)^2$$
$$n_i = n * \frac{w_i * s_i}{\sum_i w_i * s_i}$$

n=186



Larch plantation



Chinese pine plantation

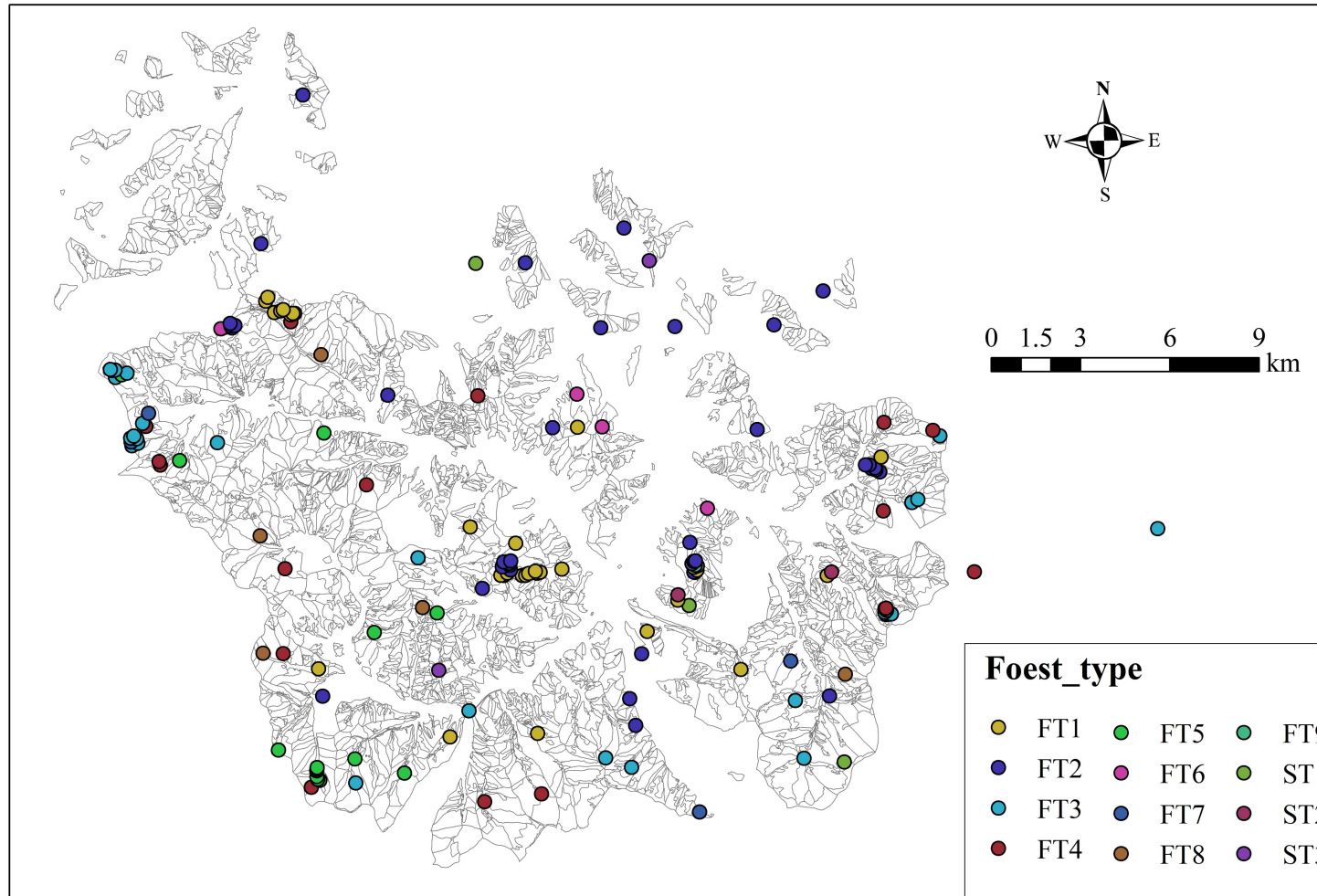


Natural birch forest



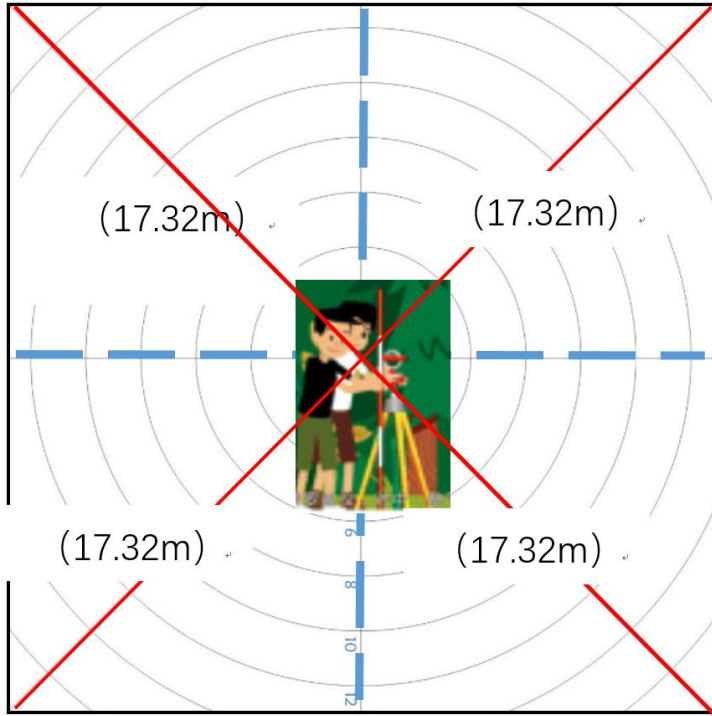
Mixed forest

Sampling design-stratified sampling



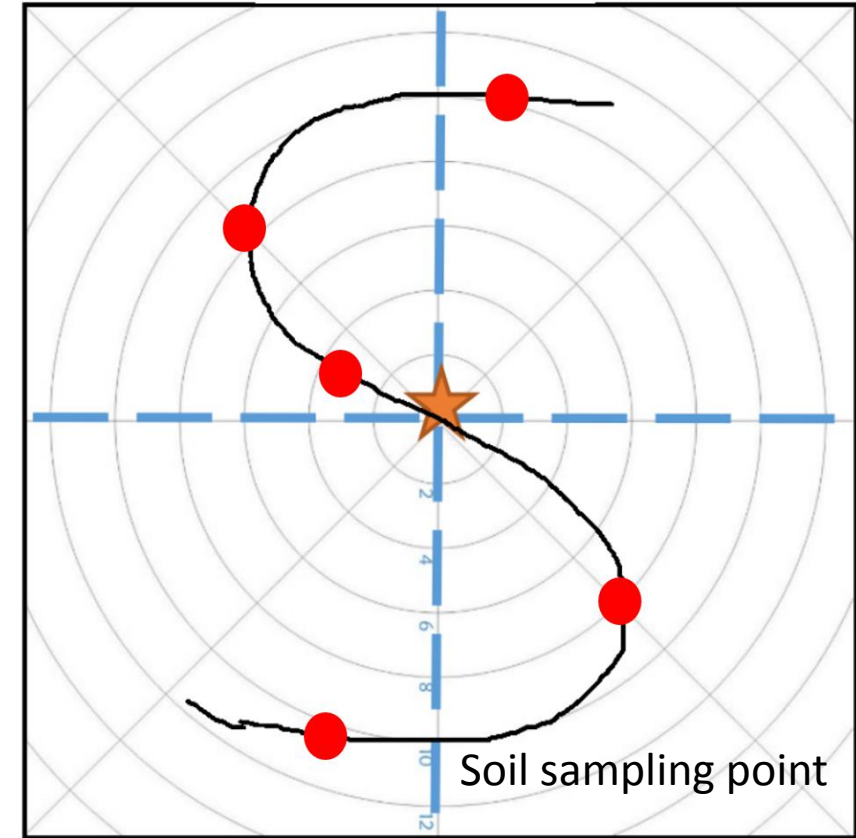
Sampling design-stratified sampling

← 24.49m →



25m²
Shrub subplot

1m²
Herb/Litter
subplot







-Sept. 8, 2021

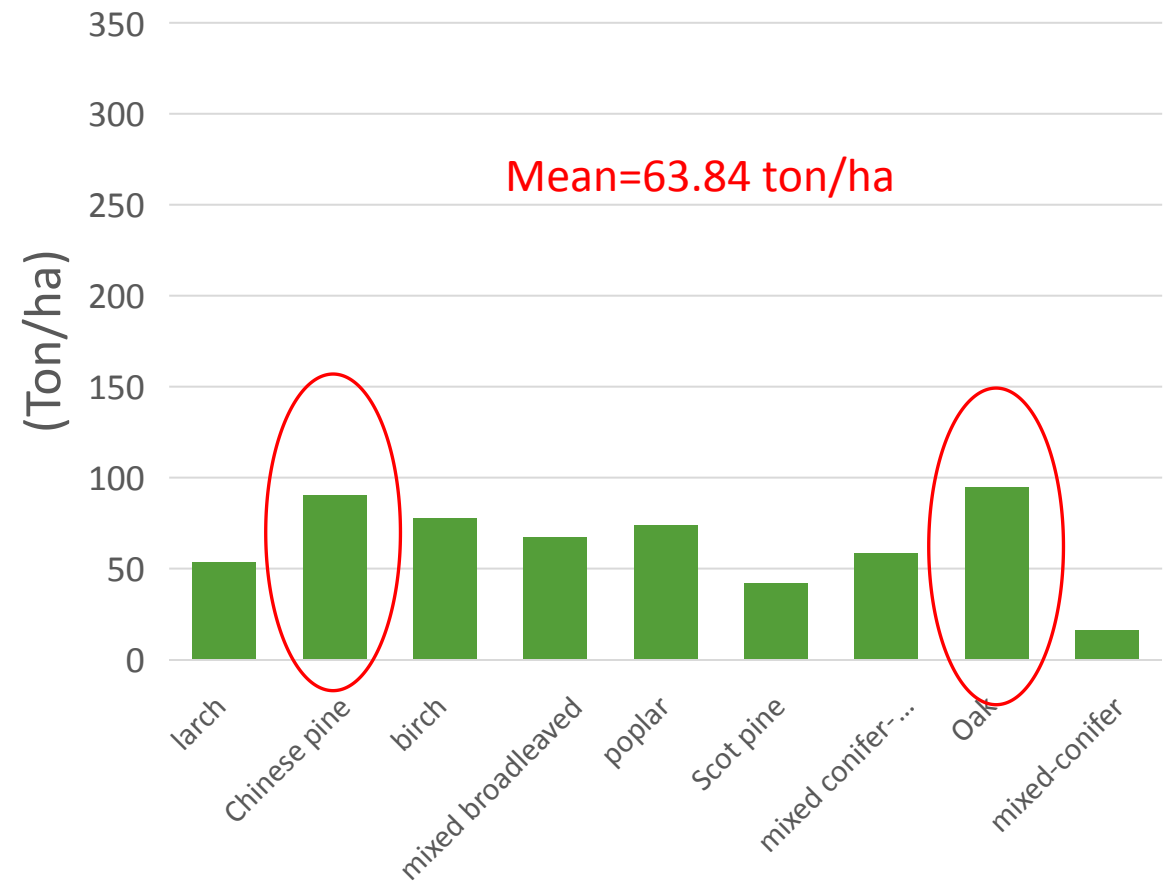
- 50 people for 2 months
- 7800 compartments
- 186 plots
- 558 Shrub, herb and litter samples for dry biomass
- 744 soil samples for soil organic carbon and soil bulk density



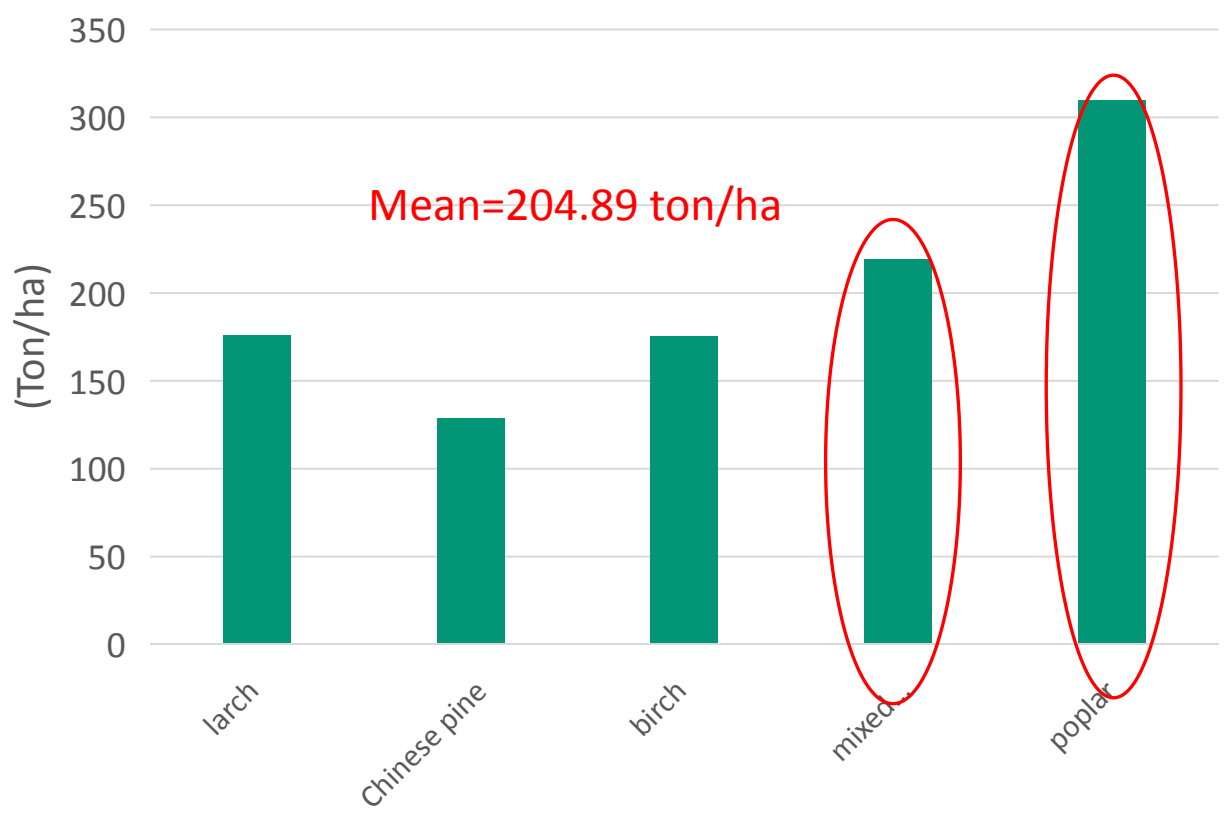
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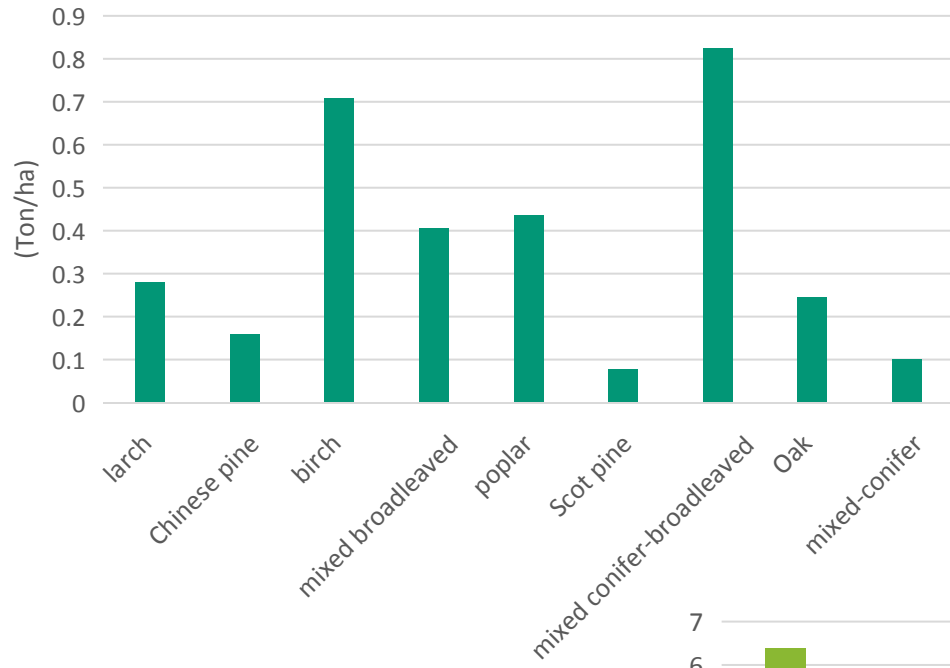
C_Tree



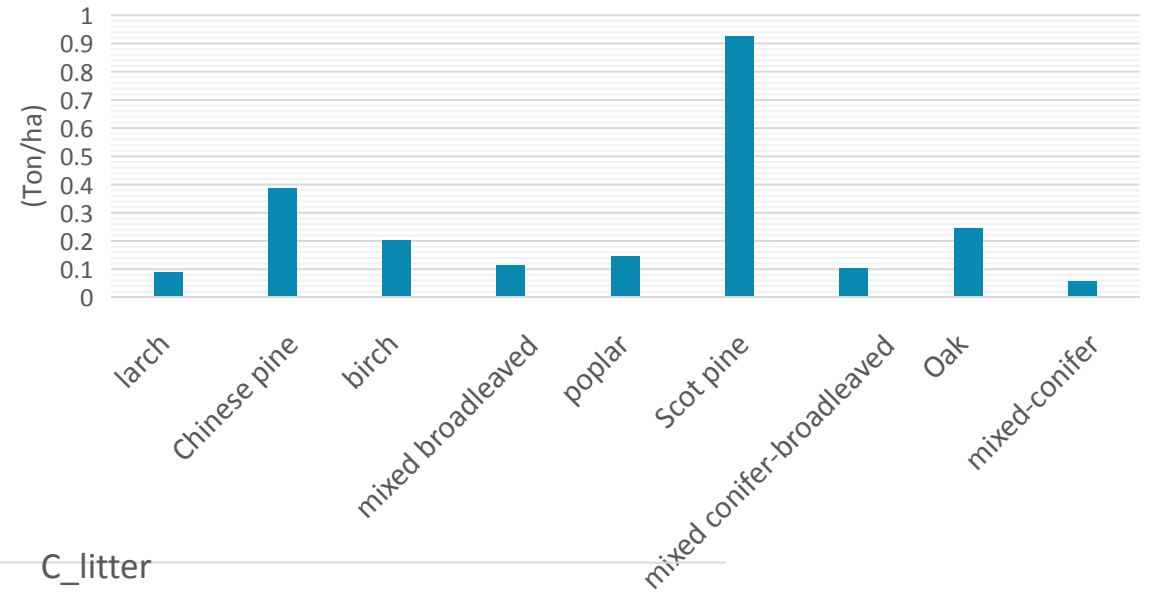
C_Soil (0-50cm)



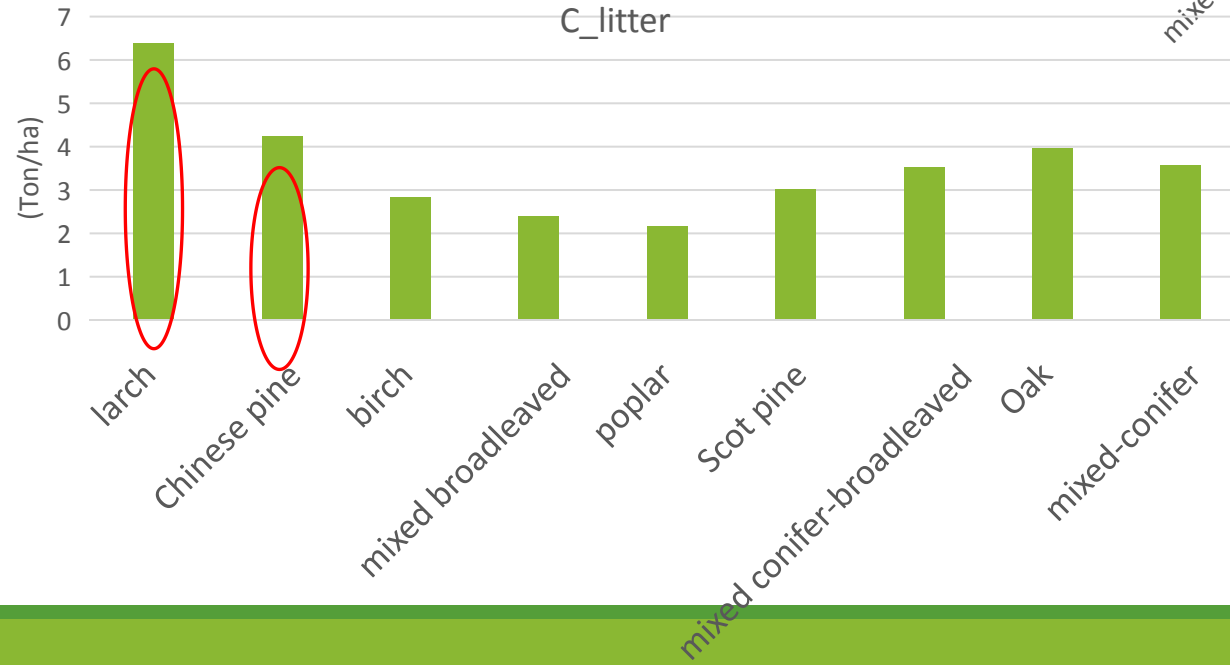
C_Shrub



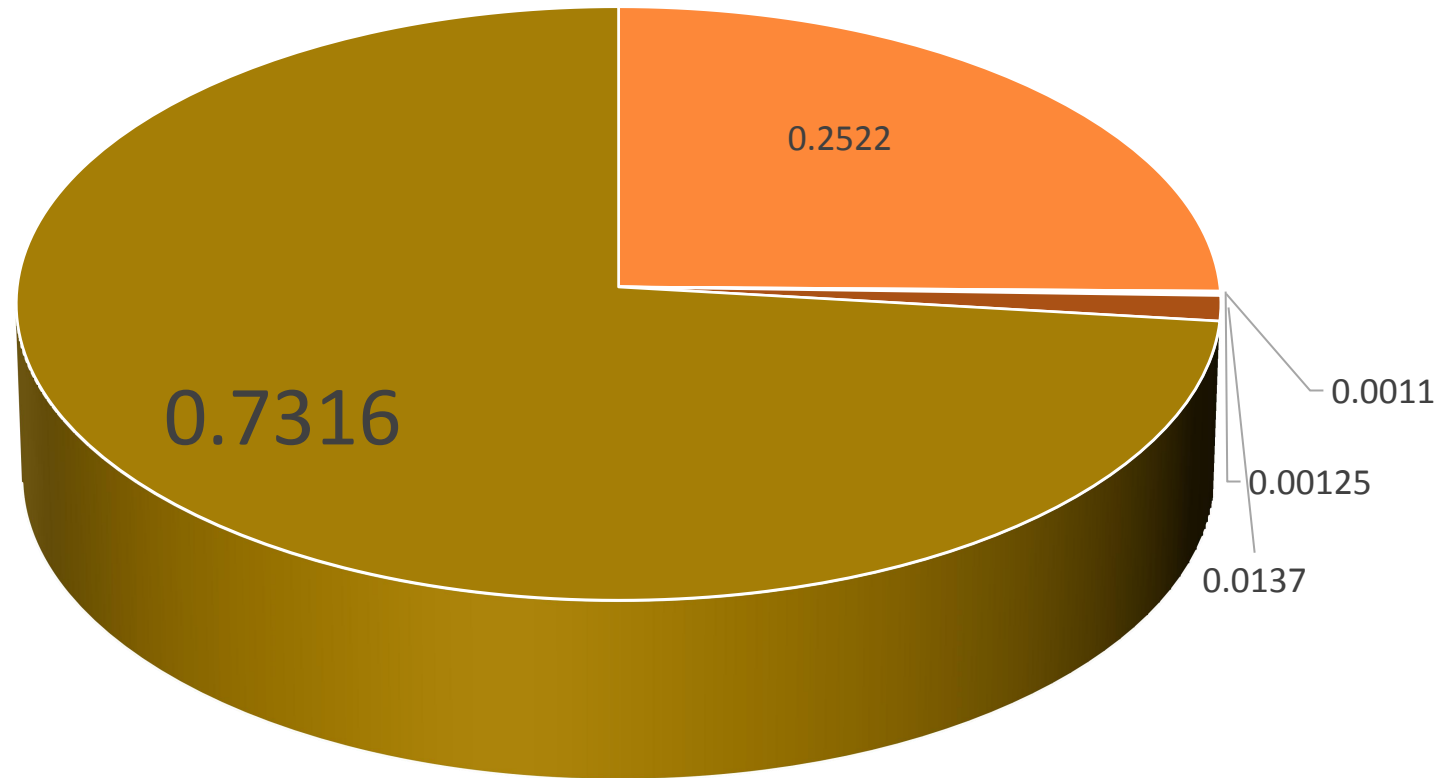
C_Herb



C_litter



Carbon component ratio



Tree Shrub Herb Litter Soil

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Next steps

- Total forest carbon storage for the forest farm
- Relationship between carbon and stand factors
- Growth model-based potential carbon projection
- Management plan for increasing carbon sink

Thanks for your attention!