# PEFCR Olive Oil: Carbon storage in olive grove soil

**Under various farming practices**

**Objective: To calculate the amount of (~stable) carbon stored in soil in t/Ha/y**

**Factors involved in the model for various farming practices**

a. Losses of SOC due to soil erosion by cultivation and exposure of bare soil.

b. Gains in SOC induced by addition of organic materials on soil,

b1. Intended addition: manure, compost, pruned wood, cover crop, other.

b2. Passive addition: Detritus (Dead leaves, roots etc, depending on crop growth)

c. Influence of environment on the proportion of added SOC that remains stored for long term (difference between input – output)(**Roth-C** model).

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Losses of SOC due to soil erosion by cultivation and exposure

Cultivation Intensity Index (CII):

- **H**eavy (frequency>2-3 /y, depth> 10 cm),
- **L**ight (1-2/y, depth < 10 cm),
- **R**educed (< 1/y, depth <5cm),
- **Z**ero (never)

Cultivation Intensity Index (CII)

| Heavy | Light | Reduced | Zero |
|---|---|---|---|
| -0,2 | -0,1 | -0,02 | 0,2 |

Change in soil organic carbon stock (t/Ha/y)

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**Assumptions**

1. Life expectancy for an olive grove ~500 years under same sustainable practice.
2. For simplicity, soil carbon change is considered as linear (known it is not).
3. Target soil depth for carbon storage 100cm (can be more).
4. Carbon storage in wood / roots is not examined here, only in soil
5. Environmental conditions: Defined by the limits for olive tree growth (temperature range, rainfall, soil texture and pH etc).

Starting point: **Roth C model a**s it stands now (for forests, not arable land)

**Information required for fine tuning of Roth C model:**

- Rate of SOM losses from olive groves, in t/Ha/y, due to cultivation & erosion.
- Weight (fr.wt or dr.wt?) per type and of plant organic matter added on soil (with- or without incorporation?)
- Soil & weather data needed to run Roth C model.

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**Data required to run Roth C model**

1. Monthly rainfall (mm)
2. Open pan (mm) evaporation data indirectly, via evapotranspiration & radiation
3. Average monthly mean air temperature (in C)
4. Clay content of soil (%).
5. Soil cover per month (Yes/No)
6. Monthly input of Farmyard Manure (FYM) or from grazing sheep (t C/Ha).
7. Depth of soil layer (cm) (sampled)
8. Monthly input of plant residues (t C/Ha).
9. Types of plant residues (DPM/RPM ratio)

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**Gains in SOC: Types of organic material estimated /measured in LIFE - oLIVE CLIMA project.**

- Total dead Weed Mass - cover crop (**TWM**) produced (estimated to be 0 to 5t d.w./Ha/y).
- Shredded pruned wood (**PRN**) dispersed (partly measured and estimated) (t d.w./Ha/y).
- Droppings of grazing sheep (**GRZ**) calculated as ~0.3 Kg/day*sheep-days/y (t d.w./Ha/y).
- Composted material (**COM**)(olive tree leaves, shredded pruned wood) (t d.w./Ha/y).
- Manure (purchased-fermented, from sheep) (**MAN)** (measured, in t d.w./Ha/y).
- Olive Oil Mill Waste Water (**OMW**) (measured, in t d.w./Ha/y)
- Detritus (**DTR**), depending on the size and density of the trees, expressed initially as Crop Growth Index (CGI) which can take values: **I** = Sparse (<100 trees/Ha, rain-fed, low yield), **II** = Medium (100-300 trees/Ha, Irrigated, medium yield), **III** = Intensive (> 300 trees/Ha, irrigated, high yield) .*May be modified (J.A.Pal.) and/or for trees in full production it may be quantified with a function linking biomass to yield (G.Montanaro) as well as amending the table below.

| | Crop Growth Index (CGI) | | |
|---|---|---|---|
| | I. Sparse | II. Medium | III. Intensive |
| Detritus: t d.w./Ha/y | **0,1** | **2,0** | **5** |

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**Starting point: All plant residues material are added indiscriminantly for Roth C model**

Plant Residue Material (t d.w./Ha/y)=(TWM+PRN+GRZ+COM+MAN+OMW+DTR) ➡ Roth C model

**Next phase: Adjustment for the type of plant residues material added**

Model option 1: DPM / RPM ratio = 1.44 (TWM? GRZ? COM?, MAN?)
Model option 2: DPM / RPM ratio = 0.66 (DTR? OMW?)
Model option 3: DPM / RPM ratio = 0.25 (PRN?)
Model option 4: DPM / RPM ratio = ? user set own

Help from experts will be needed here; possible a consultation round *via* Delphi?

Combined effect of tillage and addition of plant residue material (Loss+Gain)

SOC change (t/Ha/y) = CII + (TWM+PRN+GRZ+COM+MAN+OMW+DTR) ➡ Roth C

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**Output of Roth C model**