The agro-eco-systemic benefits of sustainable management in an Italian olive grove

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UNIVERSITÀ DEGLI STUDI DELLA BASILICATA 1982

DIPARTIMENTO DELLE CULTURE EUROPEE E DEL MEDITERRANEO

Soil is a natural capital that generates services

REGULATING

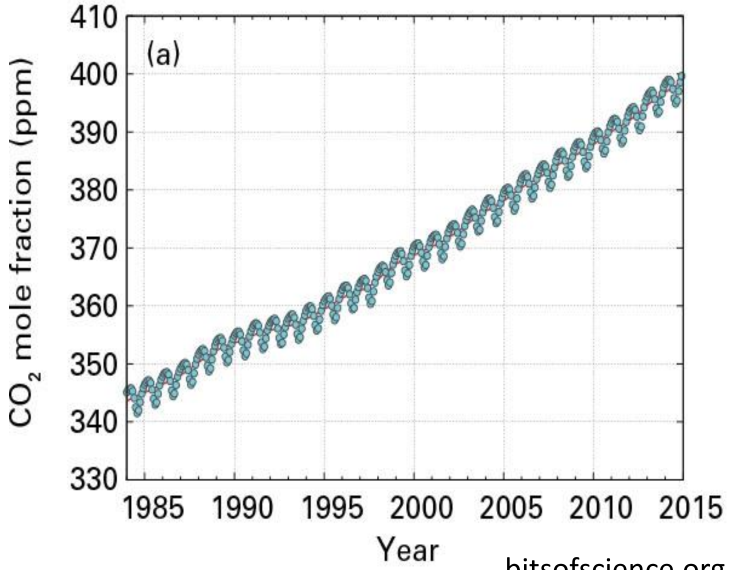
e.g. C fluxes,water retention, soil aggregates stability…

PROVISIONING

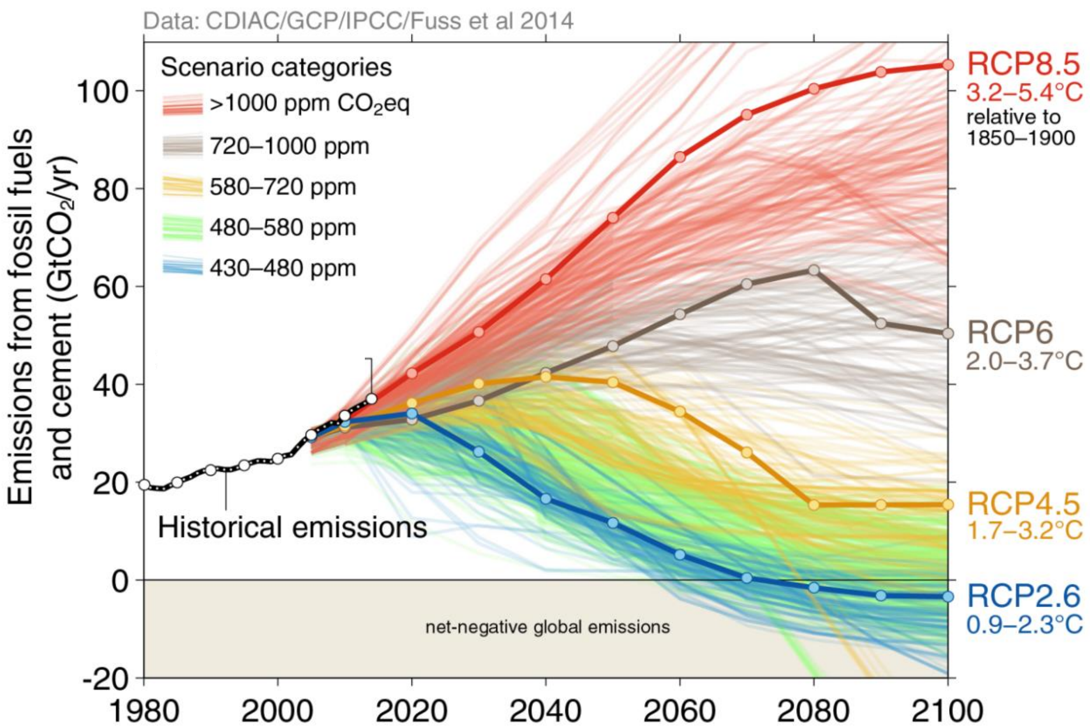
e.g. food, energy

HABITAT, CULTURAL, RECREATION

Air carbon dioxide concentration



bitsofscience.org



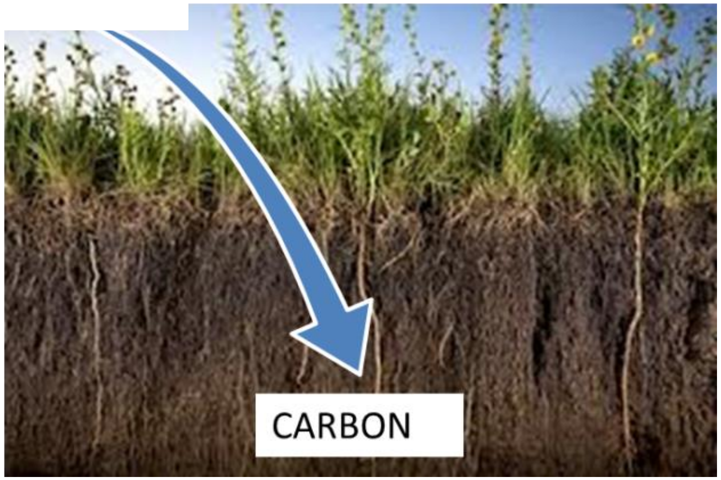
INTERNATIONAL AGREEMENT ON CLIMATE

Reduction of global warming **«down to 2º C»**

Soils impoverishment

Basilicata Region

Soil Organic Matter 0,8 - 1,3%



The 1% increase of carbon in the soil corresponds to 260 t / ha of CO_2 stably stored

(50 cm depth, 1.4 t/m3 bulk density)

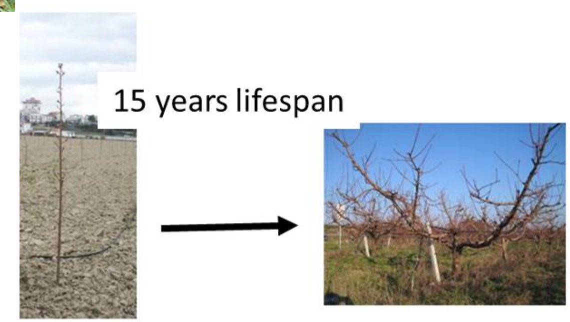
Orchards sequester CO_2....

3 main pools

Soil

litter

biomass

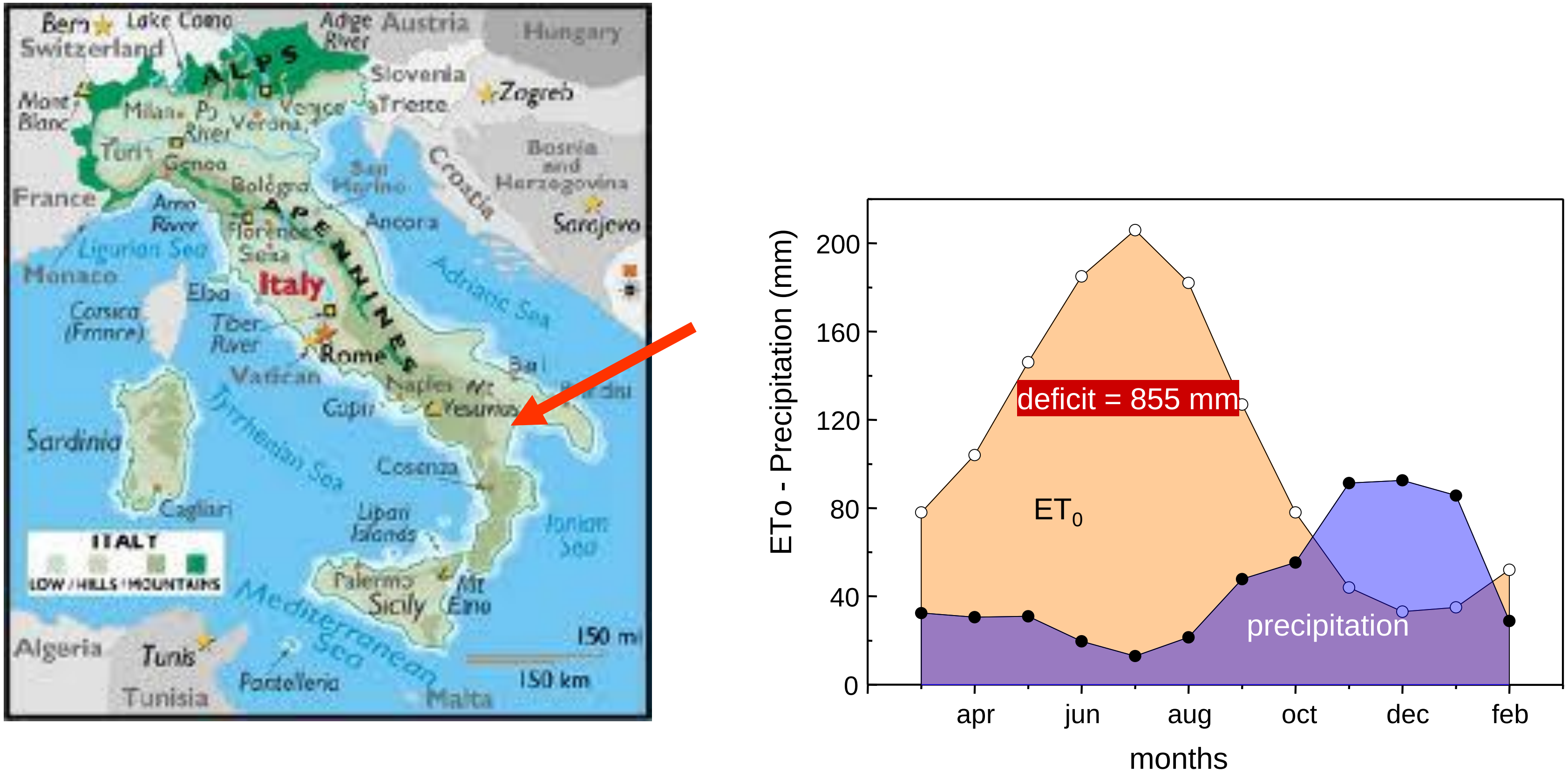


...depending on management

Soils with organic matter less than 1% are desert from microbiological point of view.

...in Southern Italy the mean soil organic matter is 0.8 – 1.3%

Source: Metapontum Agrobios e Regione Basilicata



Bern
Lake Como
Adige River
Austria
Hungary
Switzerland
ALPS
Slovenia
Zagreb
Mont Blanc
Milan
Po River
Verona
Venice
Trieste
Turin
Genoa
Bosnia and Herzegovina
France
Bologna
San Marino
Croatia
Arno River
Florence
Ancona
Sarajevo
Ligurian Sea
APENNINES
Monaco
Siena
Italy
Adriatic Sea
Elba
Corsica (France)
Tiber River
Rome
Bari
Vatican
Naples
Capri
Vesuvius
Sardinia
Tyrrhenian Sea
Cosenza
Cagliari
Lipari Islands
Ionian Sea
ITALY
LOW / HILLS / MOUNTAINS
Palermo
Mt Etna
Sicily
Mediterranean Sea
150 mi
Algeria
Tunis
150 km
Tunisia
Pantelleria
Malta
deficit = 855 mm
ET0
precipitation
ETo - Precipitation (mm)
0
40
80
120
160
200
apr
jun
aug
oct
dec
feb
months

SUSTAINABLE

Olive, apricot, kiwifruit, peach, grape..

CONVENTIONAL

Soil Management

Nutrition

Empirically mineral apport

Reuse of pruning removal

- increase soil C input

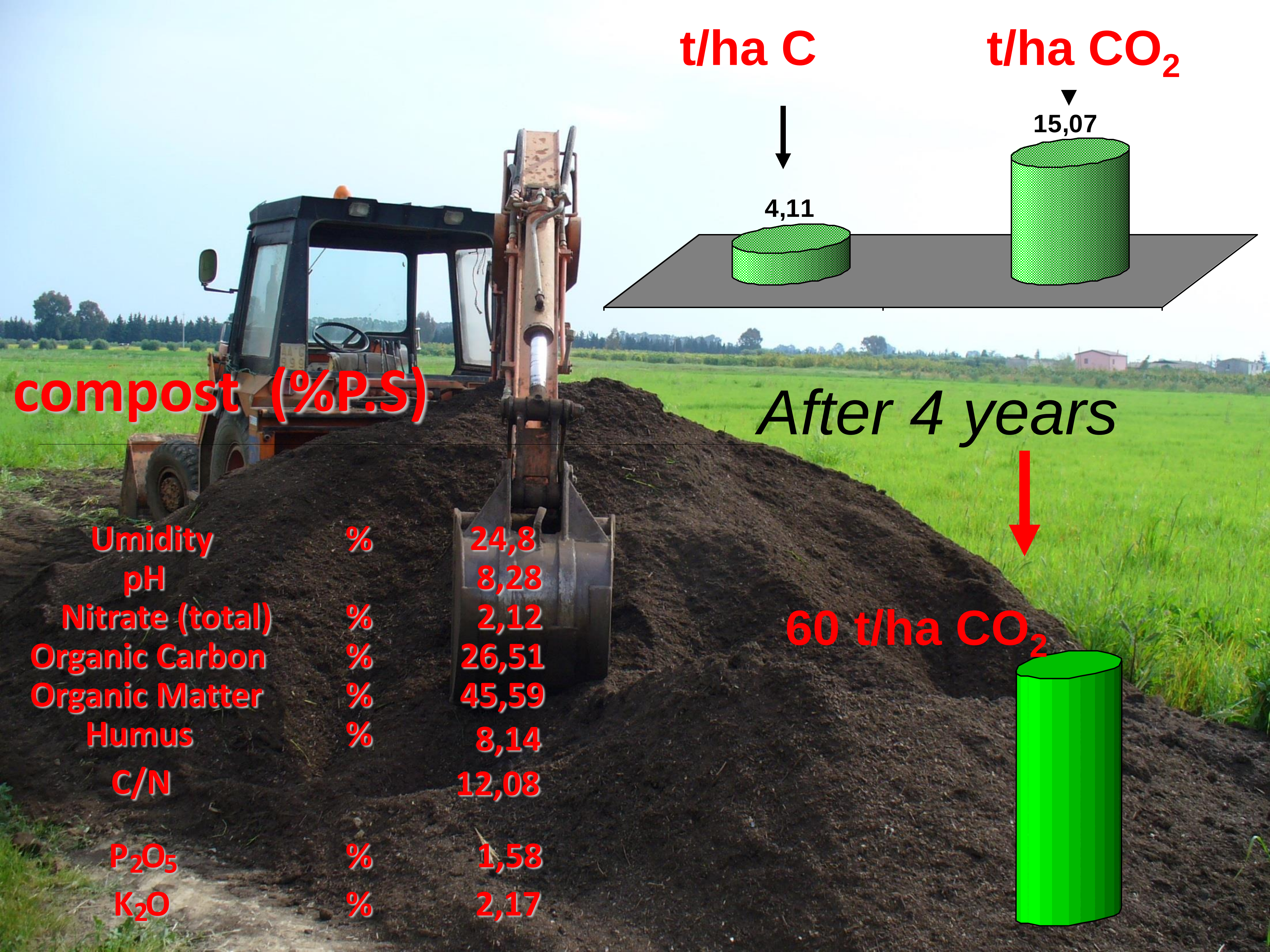
carbon sources

internal ↓

- cover crops
- pruning material
- senescent leaves

external ↓

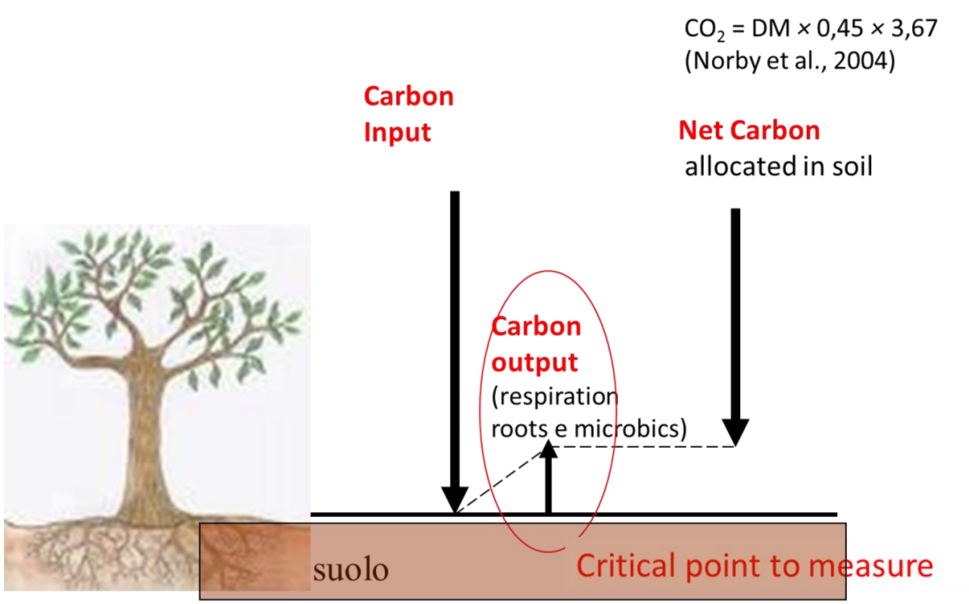
- stabilised manure
- compost
- others



t/ha C
t/ha CO_2
15,07
4,11
compost (%P.S)
After 4 years
60 t/ha CO_2
Umidity % 24,8
pH 8,28
Nitrate (total) % 2,12
Organic Carbon % 26,51
Organic Matter % 45,59
Humus % 8,14
C/N 12,08
P_2O_5 % 1,58
K_2O % 2,17

Accounting carbon fluxes at orchard scale

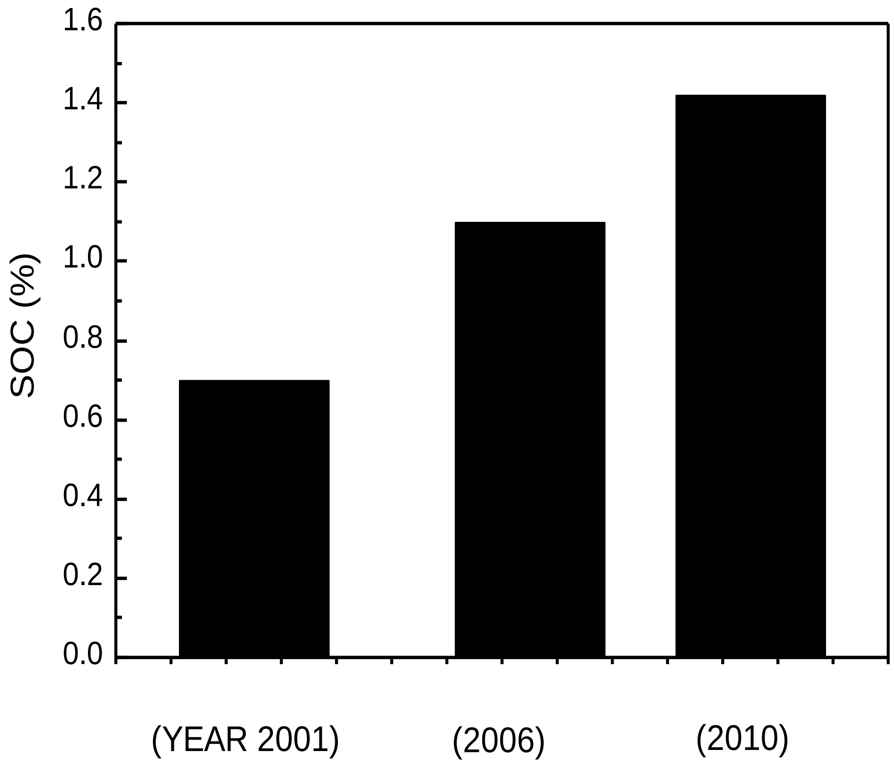
..... Carbon balance in the orchard



SOIL RESPIRATION
The critical point

portable

SOC changes in olive orchard (approx. 5 t/ha/yr C input)



31,5 t/ha C
(30 cm depth, 1,46 t/m3 BD)

3,5 t/ha/yr C

Experience – Redction of environmental impact

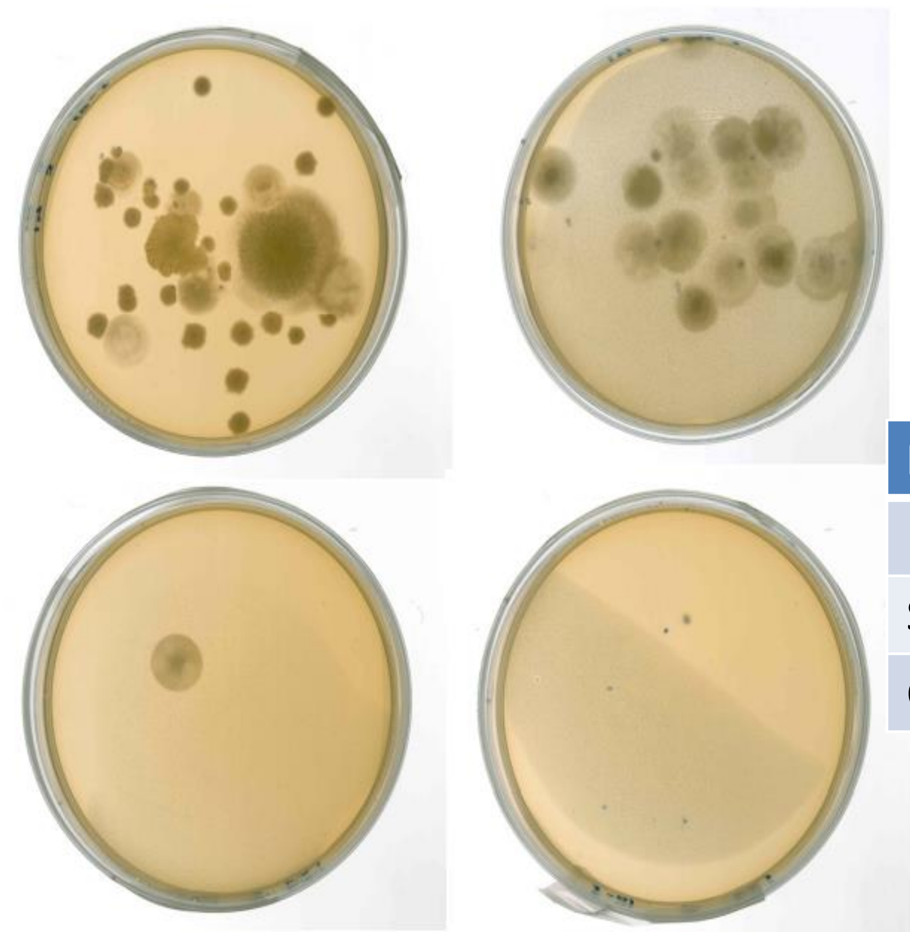
CARBON FOOTPRINT (Kg CO_2eq/L)
functional unit = 1 L bottled olive oil

	Olive grove	Mill	Package	CF
Sustainable Oil produced 1,552 Kg	-8.93	0.13	1.81	**-6.99**
Conventional Oil produced 672 Kg	17.59	0.13	1.81	**+19.53**




Experience – Restore of soil fertility

SUSTAINABLE



CONVENTIONAL

Fungi and bacterial communities in the soils		
Management	Fungi	Bacterial
Sustainable	214.000	35.600.000
Conventional	29.000	10.000.000

1 g of dry soil

Sofo et al., 2014. Pascazio et al., 2015

Experience – Restore of soil fertility

Improvment of Phyllosphere and carposphere by soil sustainable management

Table 1. Classification of the bacterial species from olive fruit pulp (mesocarp) identified on the basis of their genomic sequences (NCBI BLAST® hits).

N. species	Phylum	Class	Order	Family	Genus	Species
Sustainable						
8	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Rahnella*	aquatilis
5	Firmicutes	Bacilli	Lactobacillales	Enterococcaceae	*Enterococcus*	unknown
5	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Kluyvera*	*intermedia*
4	Actinobacteria	Actinobacteridae	Actinomycetales	Microbacteriaceae	*Curtobacterium*	unknown
2	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Averyellaa*	*dalhousiens*
1	Actinobacteria	Actinobacteridae	Actinomycetales	Microbacteriaceae	*Frondihabitans*	*suicicola*
1	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Hafnia/Rahnella*	*alvei*
1	Proteobacteria	α-Proteobacteria	Rhizobiales	Methylobacteriaceae	*Methylobacterium*	unknown
1	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Pantoea*	unknown
1	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Serratia/Rahnella*	unknown
1	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Serratia*	unknown
Conventional						
2	Proteobacteria	γ-Proteobacteria	Enterobacteriales	Enterobacteriaceae	*Pantoea*	*agglomerans*

[page 18] [International Journal of Plant Biology 2015; 6:6011] OPEN ACCESS

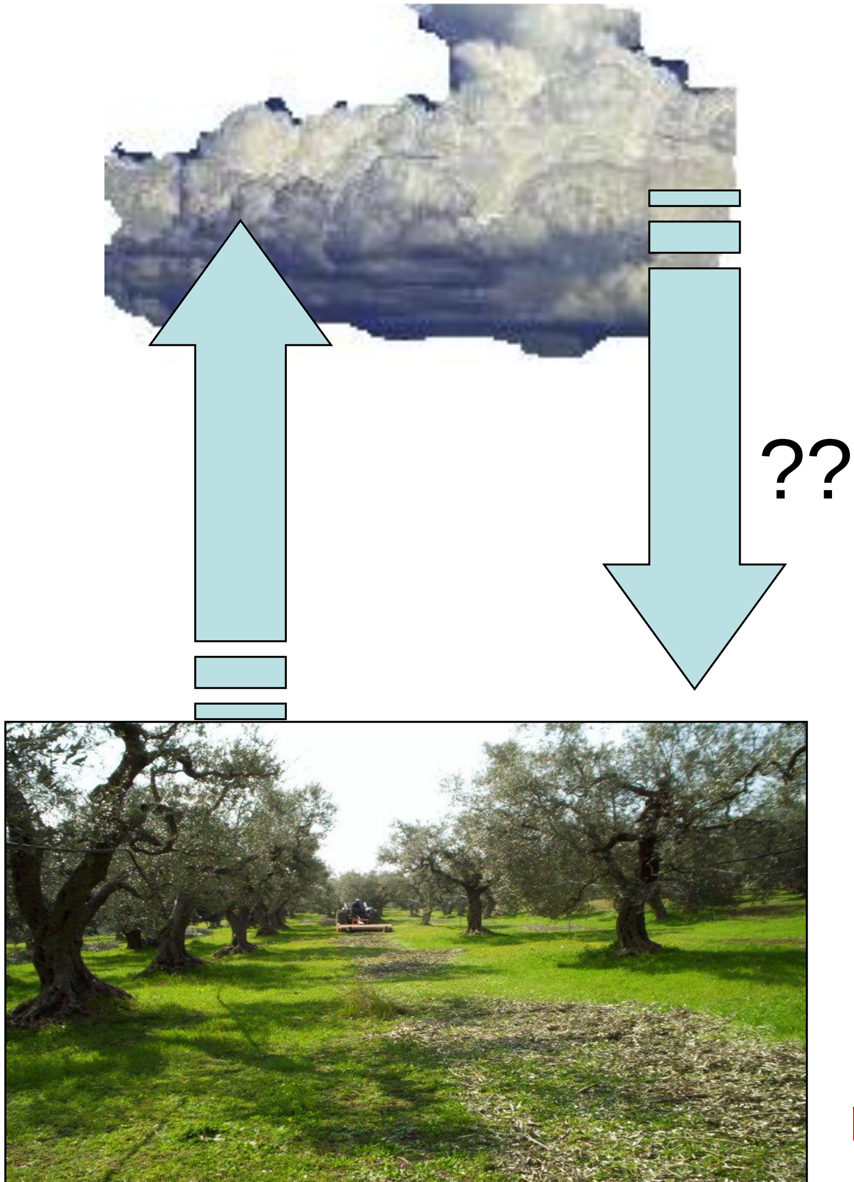
da Pascazio, Sofo et al., 2015

we lack knowledge of how above and below ground comunities and the ecosystem processes, that depend on them, are linked and how these links may subsidize primary production and other ecosystem services as well as ecosystem multi-functionality.

SUSTAINABLE SOIL MANAGEMENT AND

soil water holding capacity

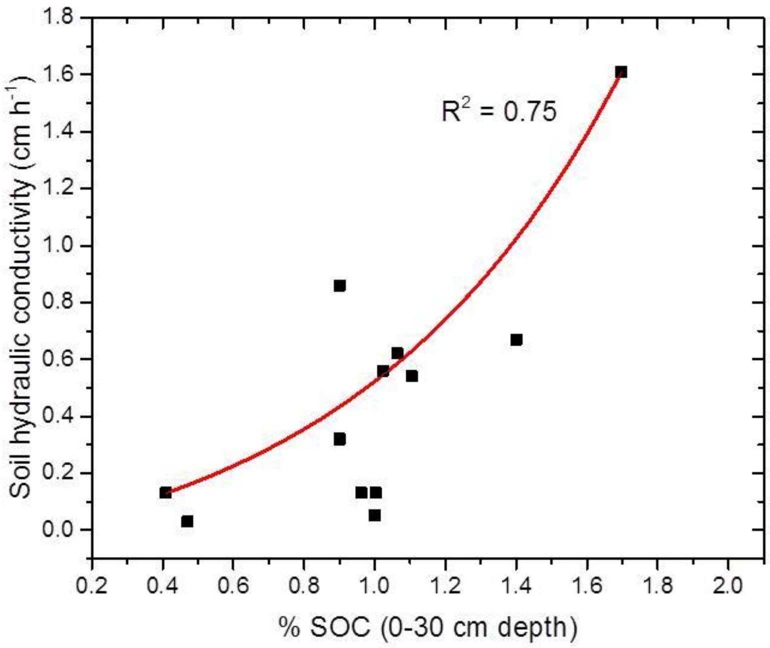
water evaporated and transpired from the orchard (almost 99% of the total) returns to the atmosphere…



…..will it return to the same region???

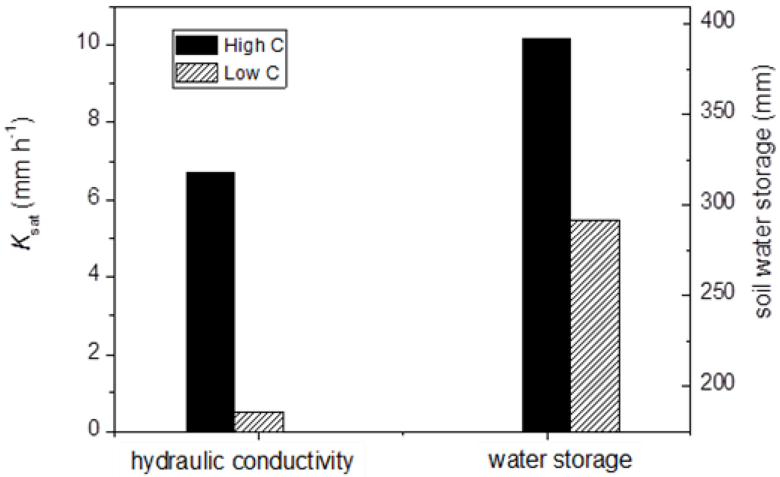
Increasing SOC improves soil hydraulic conductivity

data from peach, kiwifruit, apricot and olive orchards are grouped
(Xiloyannis, unpublished)



....and water storage capacity

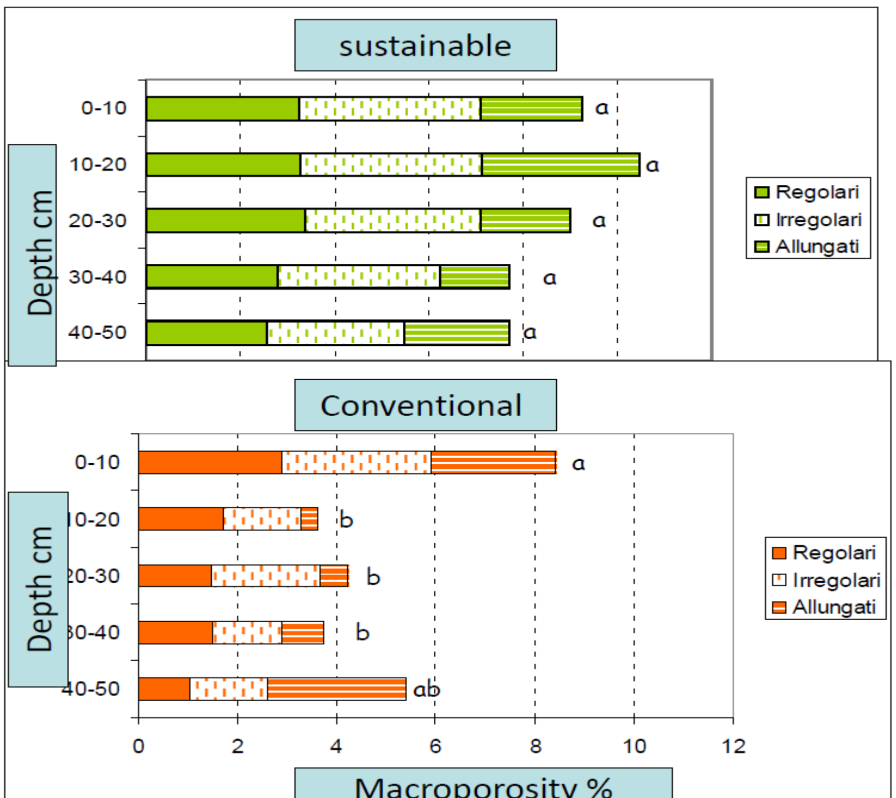
Redrawn from Palese et al., 2014



Experience – Increase of soil water reserve

High vertical infiltration capacity H_20

Reduction of water stress



Effect of soil management on water infiltration

Management	Infiltration (mm/day)
Sustainable	160
Conventional	13

At 12 cm of depth (point of compacted layer) Palese et al., 2014

Experience – Increase of soil water reserve

SOIL WATER CONTENT (TILL TO 2 m of depth)
in two different orchard management system

SUSTAINABLE

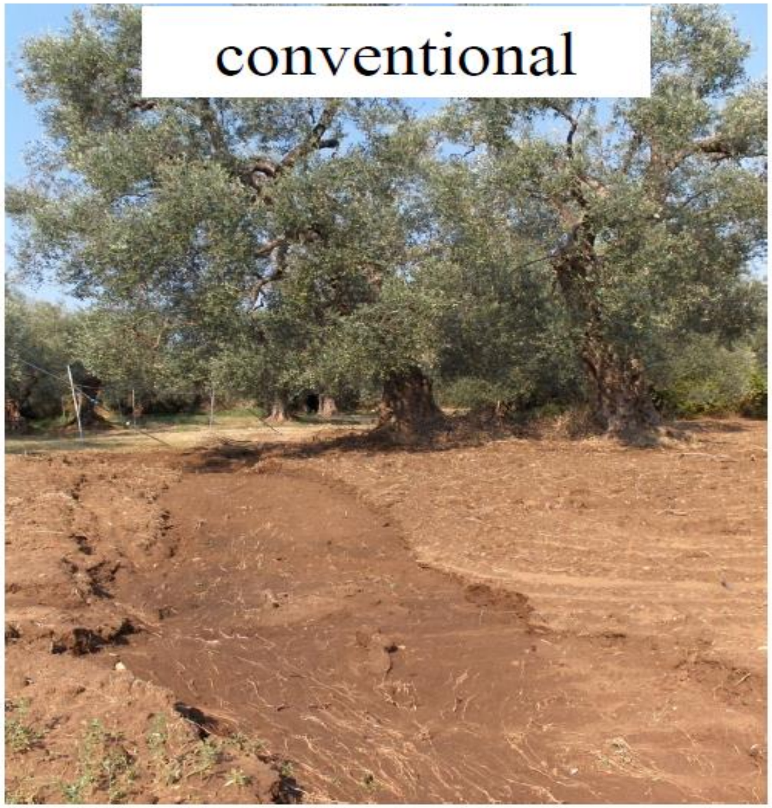
4250 m^3/ha

CONVENTIONAL

2934 m^3/ha

Celano et al., 2011; Palese et al., 2014

Experience – Reduction of soil erosion



Soil losses

60-105 t ha^{-1} y^{-1}

(a soil layer of about 1 cm)

Palese et al., 2015

Soil losses

< 1 t ha^{-1} y^{-1}

…..Gestione del suolo

Metaponto, novembre 2004

Siamo sicuri che fu dovuto solo all'intensità della pioggia?????

Environmental & Economic effects of soil erosion on DAMs

- DAMs capacity losses
- Improvement of management costs
- Supplement cost for drainage (10-30€/m^3)
- Frequent Floods

-Beginning activity in 1961 (105Mm3 water storage capacity)
-Loss of capacity in 50 years 30 Mm^3…
-Cost 300 M€ to clean up the sediments

Accounting orchard carbon sequestration:
Three main frameworks…

COMMERCIAL (e.g. LCA)	ECOLOGICAL	ISTITUTIONAL
In farm and external processes, material… soil, litter seq. not considered	Biological carbon sequestration + farmer impact (In OUT)	Accounting Biological carbon sequestration in CROPLAND by 2021 within national GHGs inventory (EC 529/2013)

Benefit for growers?

Increasing benefit for growers may boost adoption of environmental friendly managements

….economic advantage?

Sustainable

Soil

CO

CO_2 CO_2

CO_2 CO_2 CO_2

CO_2 CO_2 CO_2 CO_2

???? Euro per t CO_2

Conventional

CO_2 CO_2 CO_2 CO_2 CO_2 CO_2 CO_2

Soil

<u>I frutteti sequestrano C</u>
<u>Svolgono un servizio alla comunità che andrebbe remunerato</u>

Direttiva UE 529/2013

Dal 1 Gennaio 2021 gli stati membri devono monitorare e contabilizzare il sequestro di carbonio nelle terre coltivate (incluso frutteti) *(Art. 3 Decision 529/2013)*

<u>Siamo pronti per questo?</u>

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Thank you for your attention!

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