Dr. Dahlia Greidinger
International Symposium
Agricultural practices -
towards environmental sustainability

Agriculture as an option for mitigating climate change

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Haifa, March 1st 2023

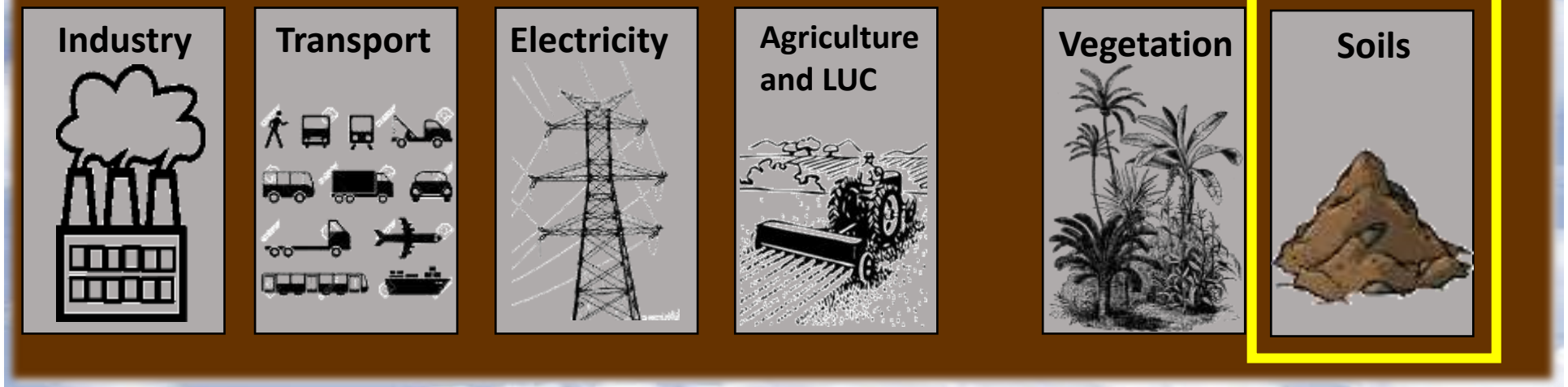
INTERNATIONAL ACTIONS AGAINST GLOBAL CLIMATE CHANGE

Reduce emissions

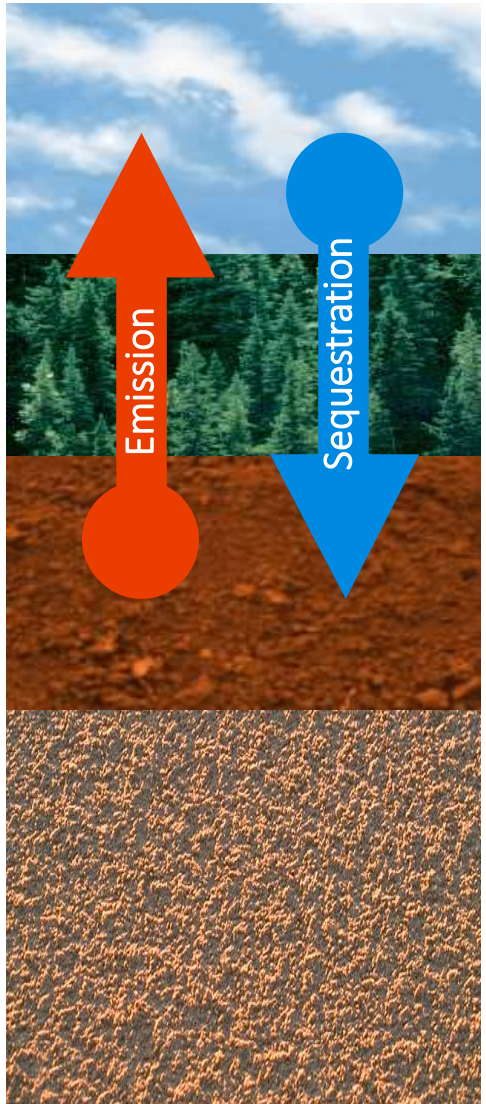
Priority!

Increase fixations

Offset- or Inset



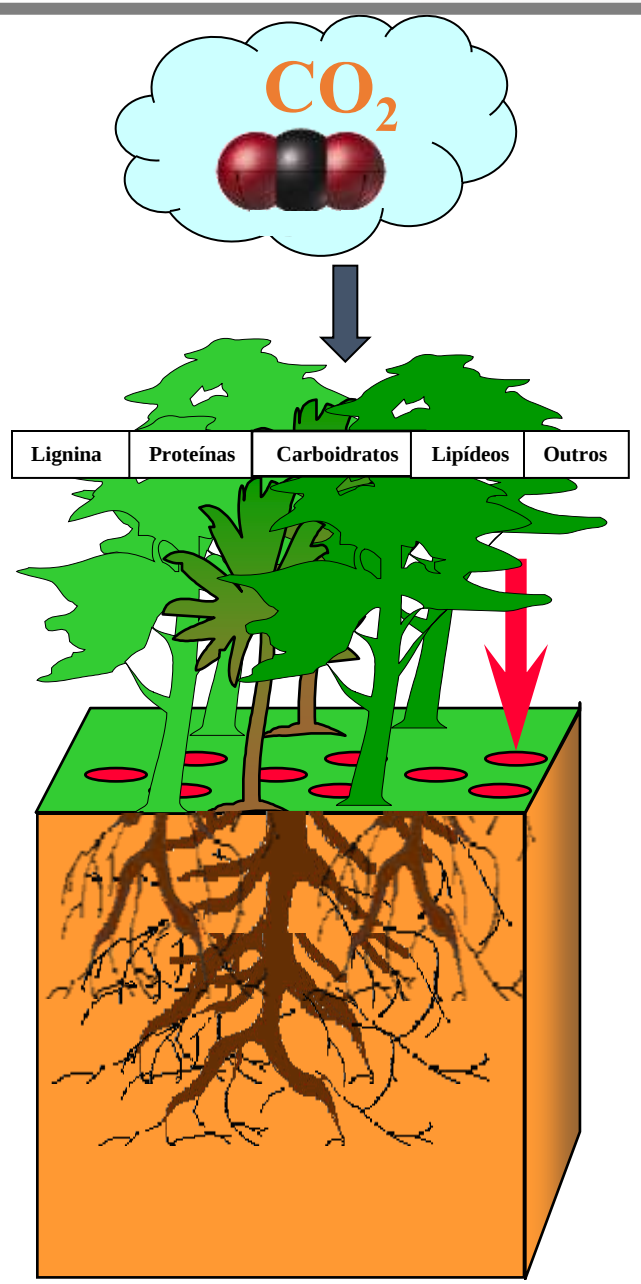
Importance of SOILS in the global carbon cycle

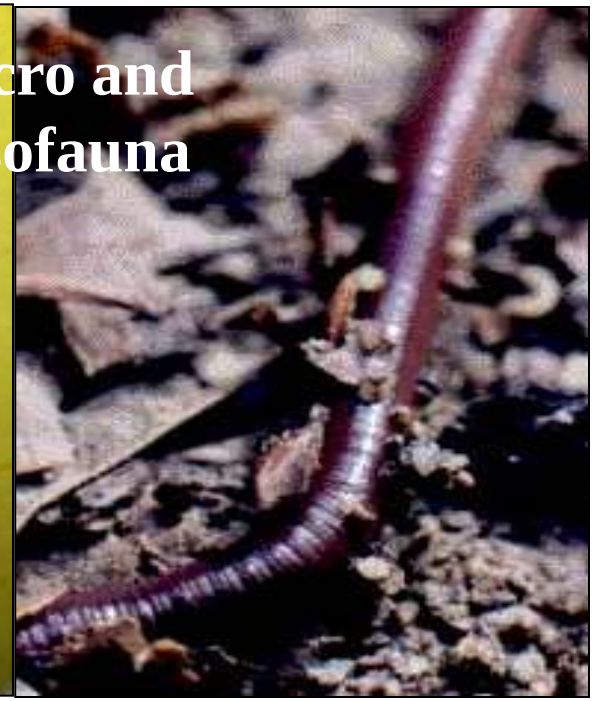


	Pg
Atmosphere	800 - Δ
Vegetation	550-650
Soil (0-30cm)	~800 + Δ
Soil (1m)	1500-2000

Values in Gt C (1Gt = 10^9 t = 1 Pg)

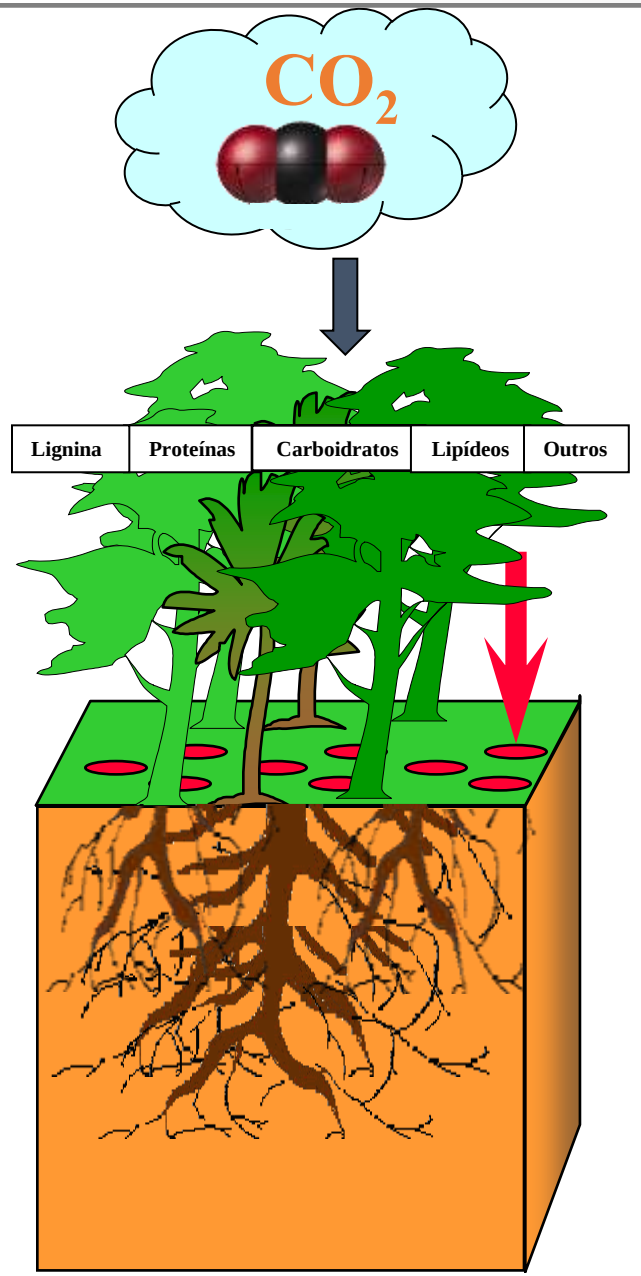
Soil Carbon Sequestration

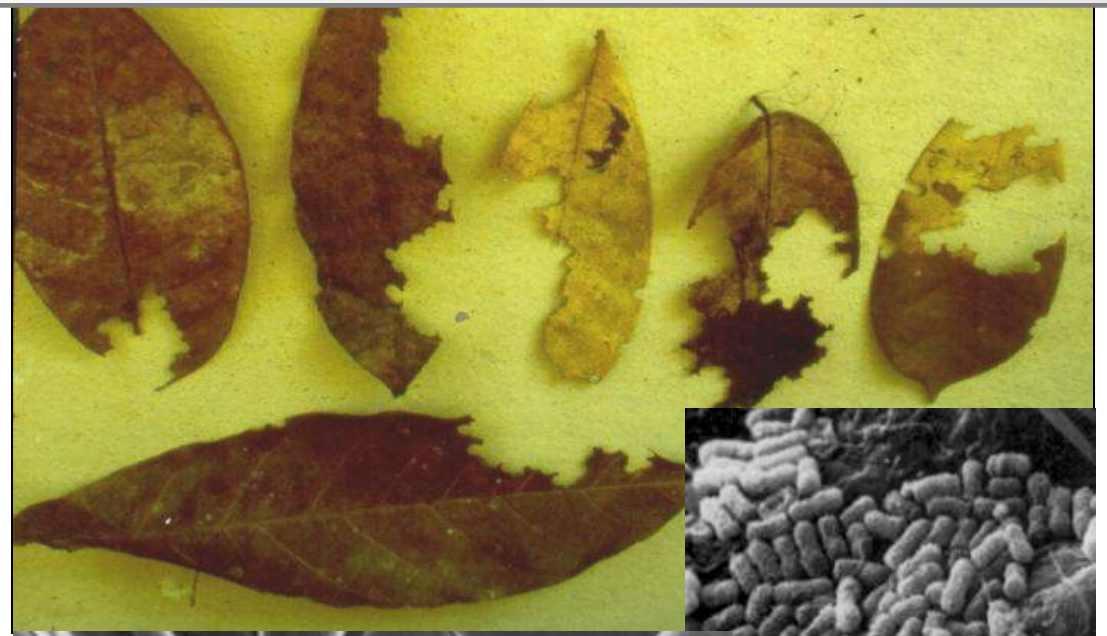


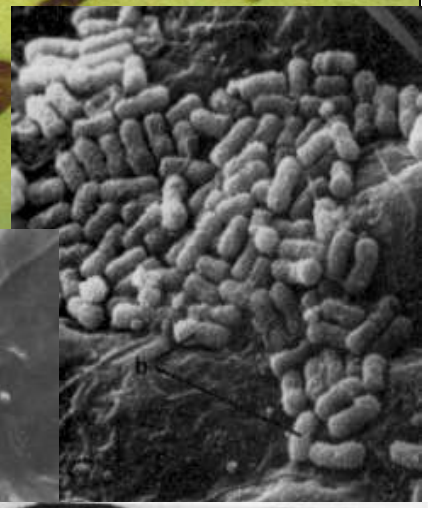


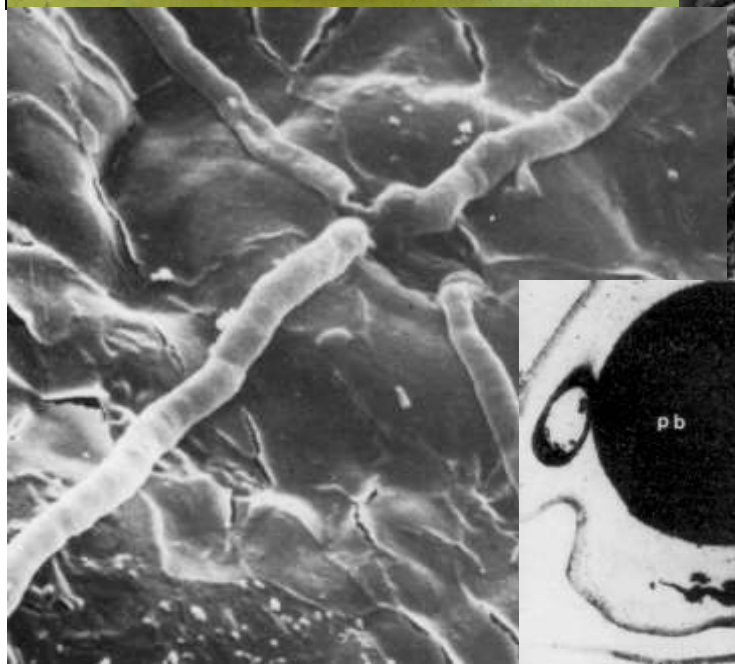
Macro and mesofauna

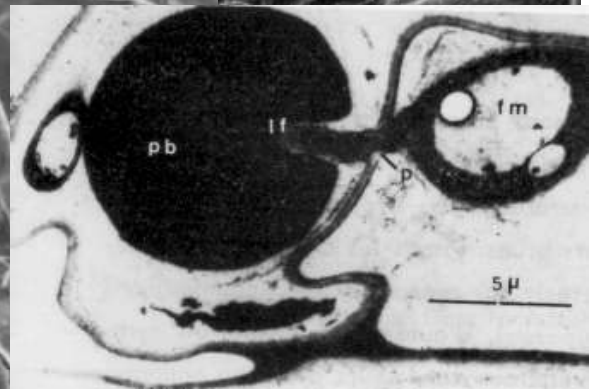
Soil Carbon Sequestration



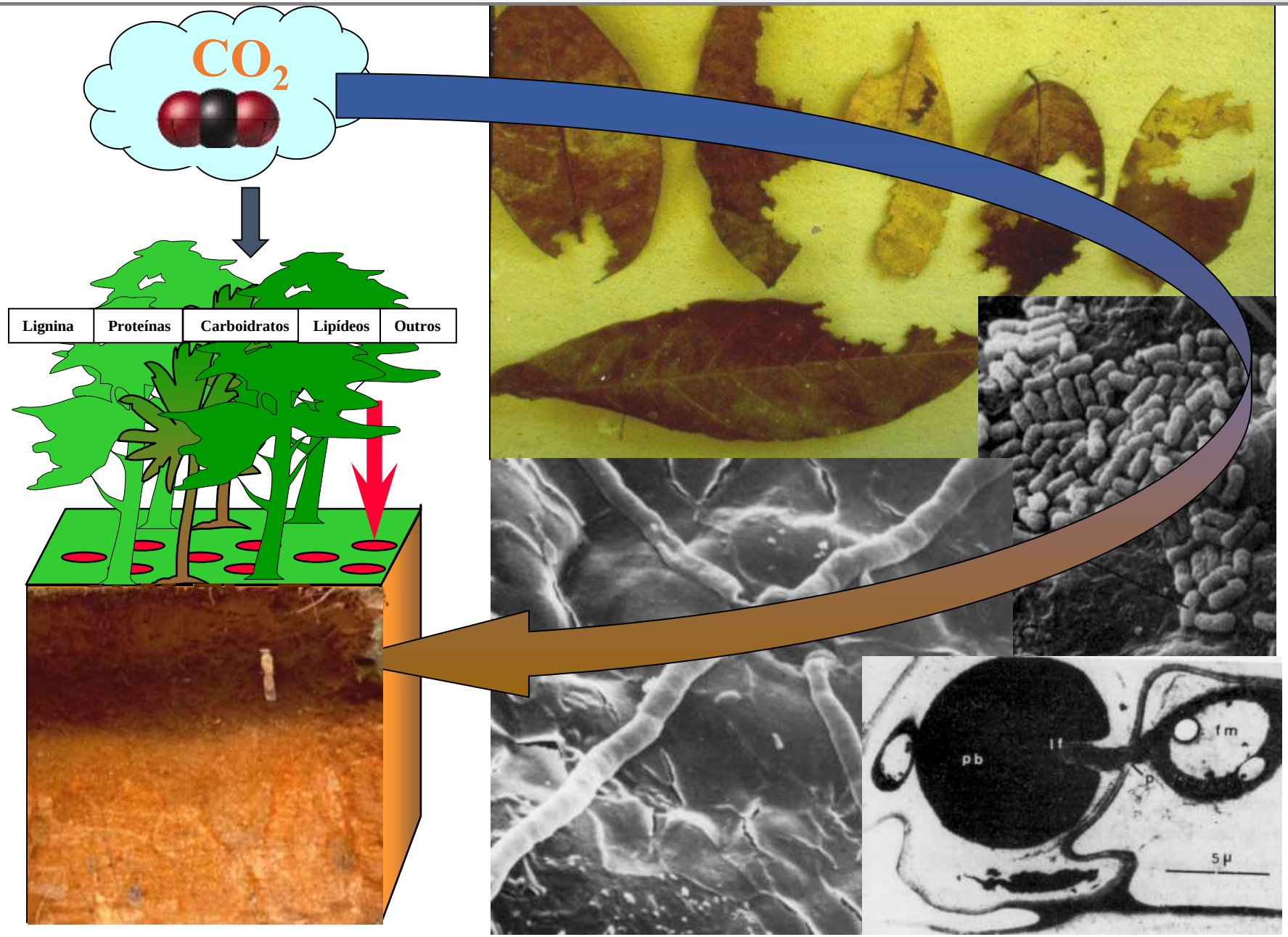




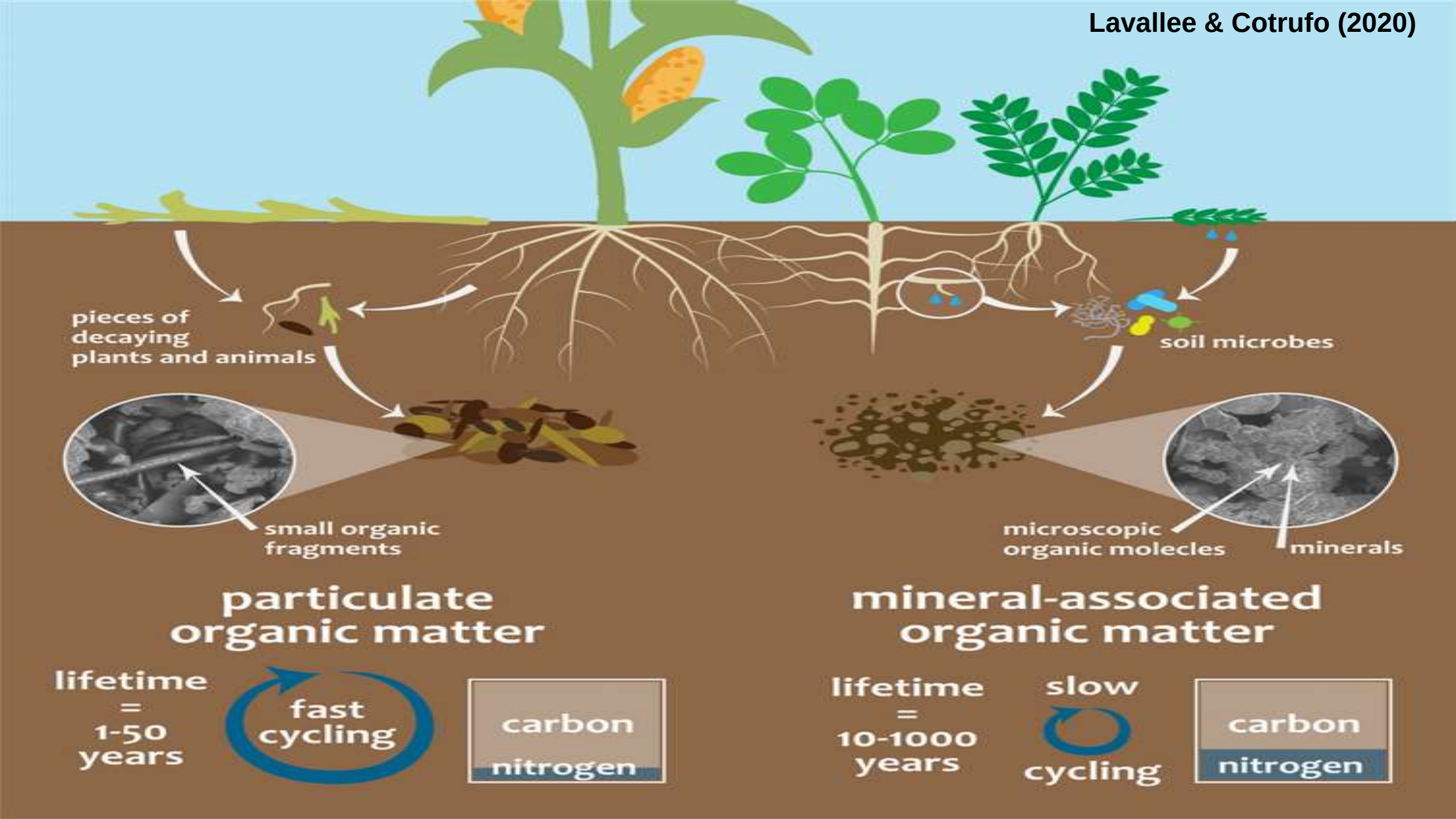


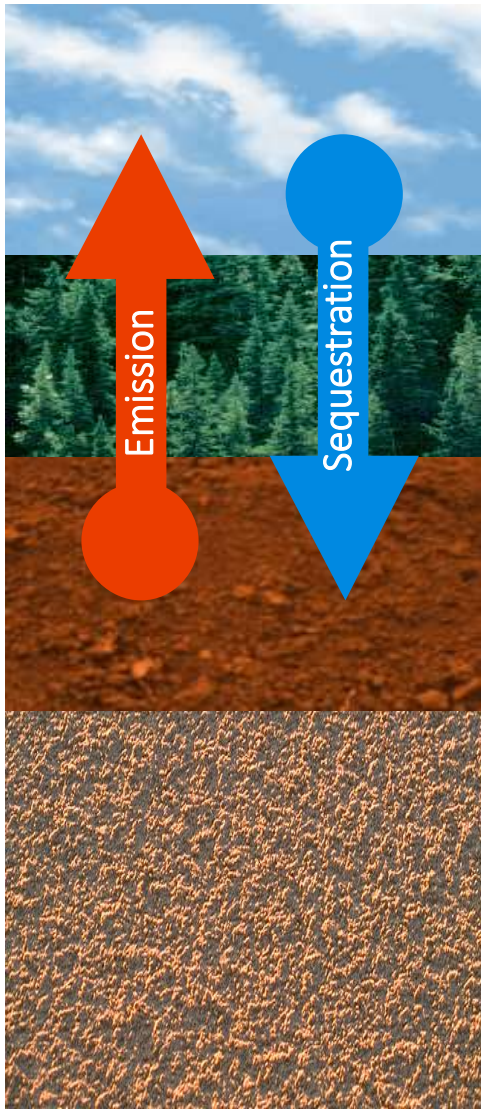


Soil Carbon Sequestration



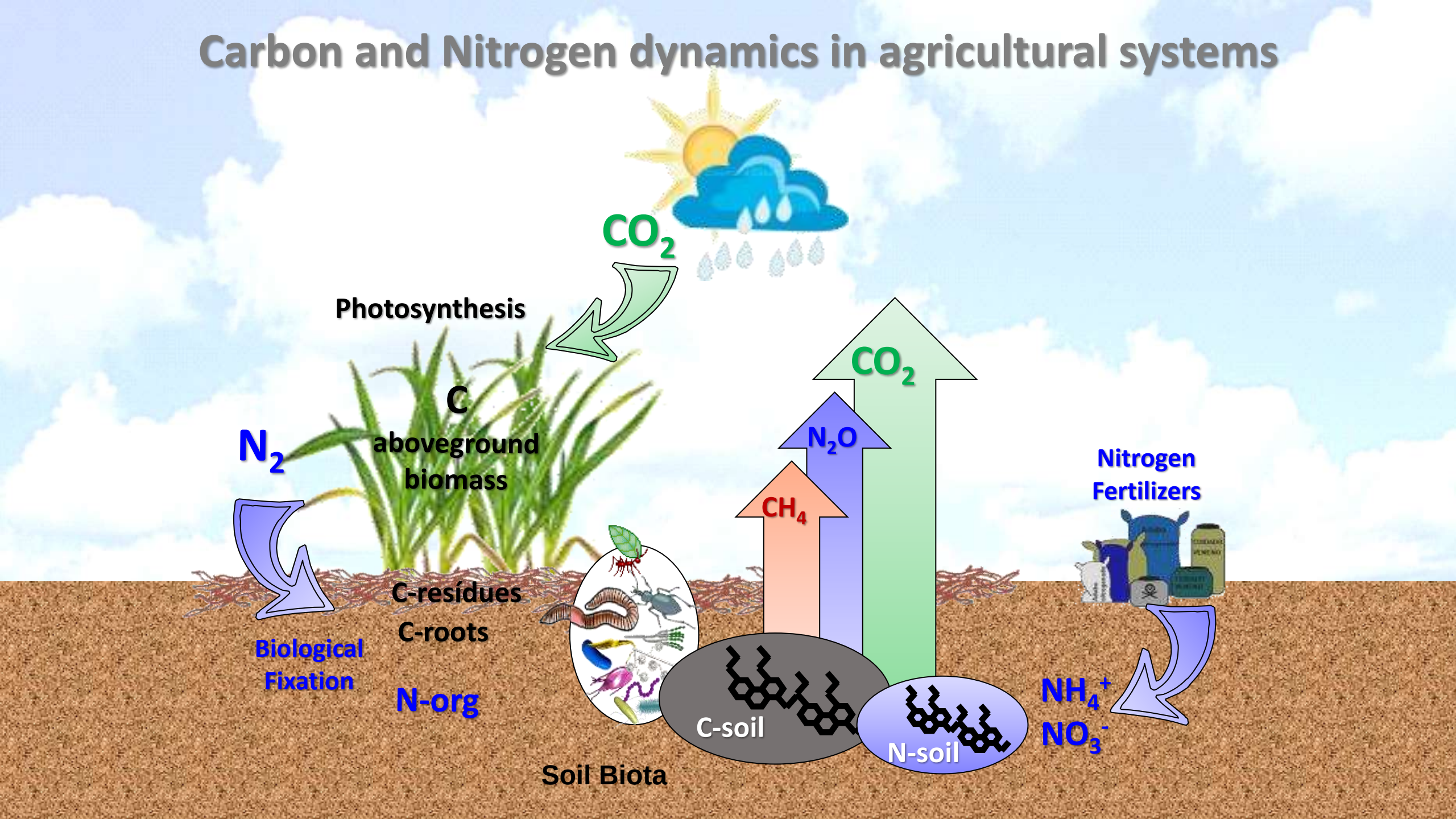
Lavallee & Cotrufo (2020)



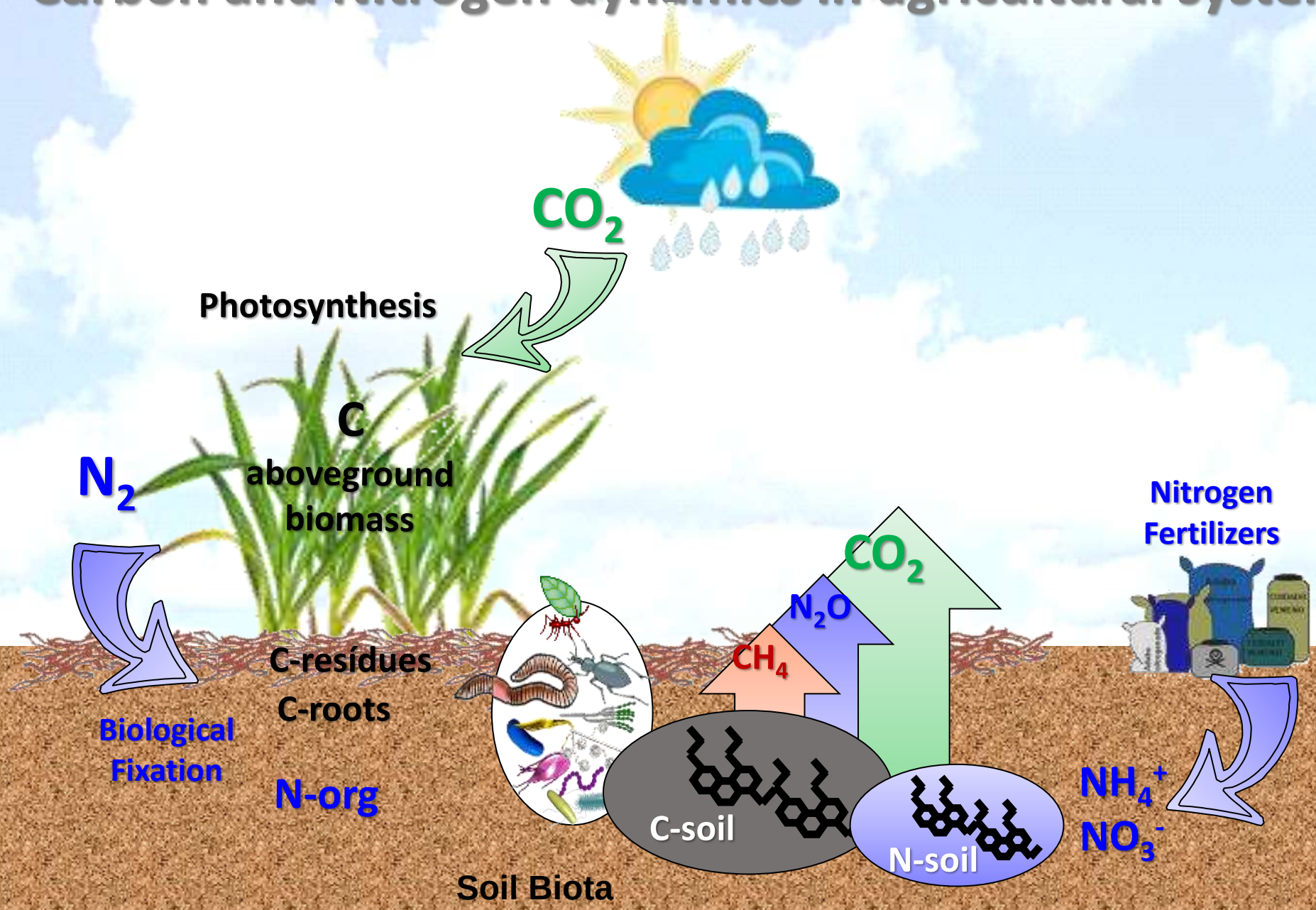


Complex Carbon and Nitrogen dynamics in agricultural systems

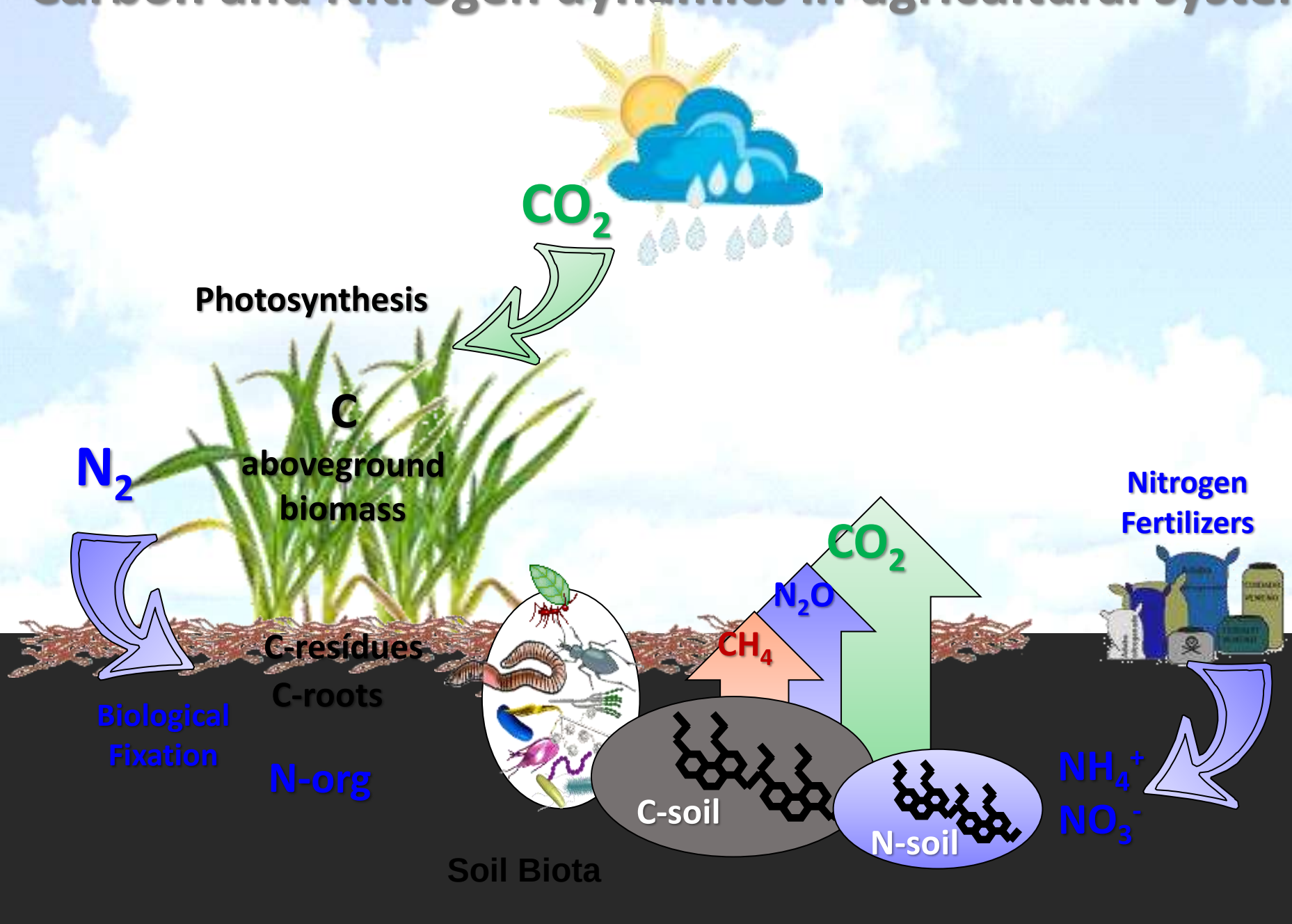
Carbon and Nitrogen dynamics in agricultural systems



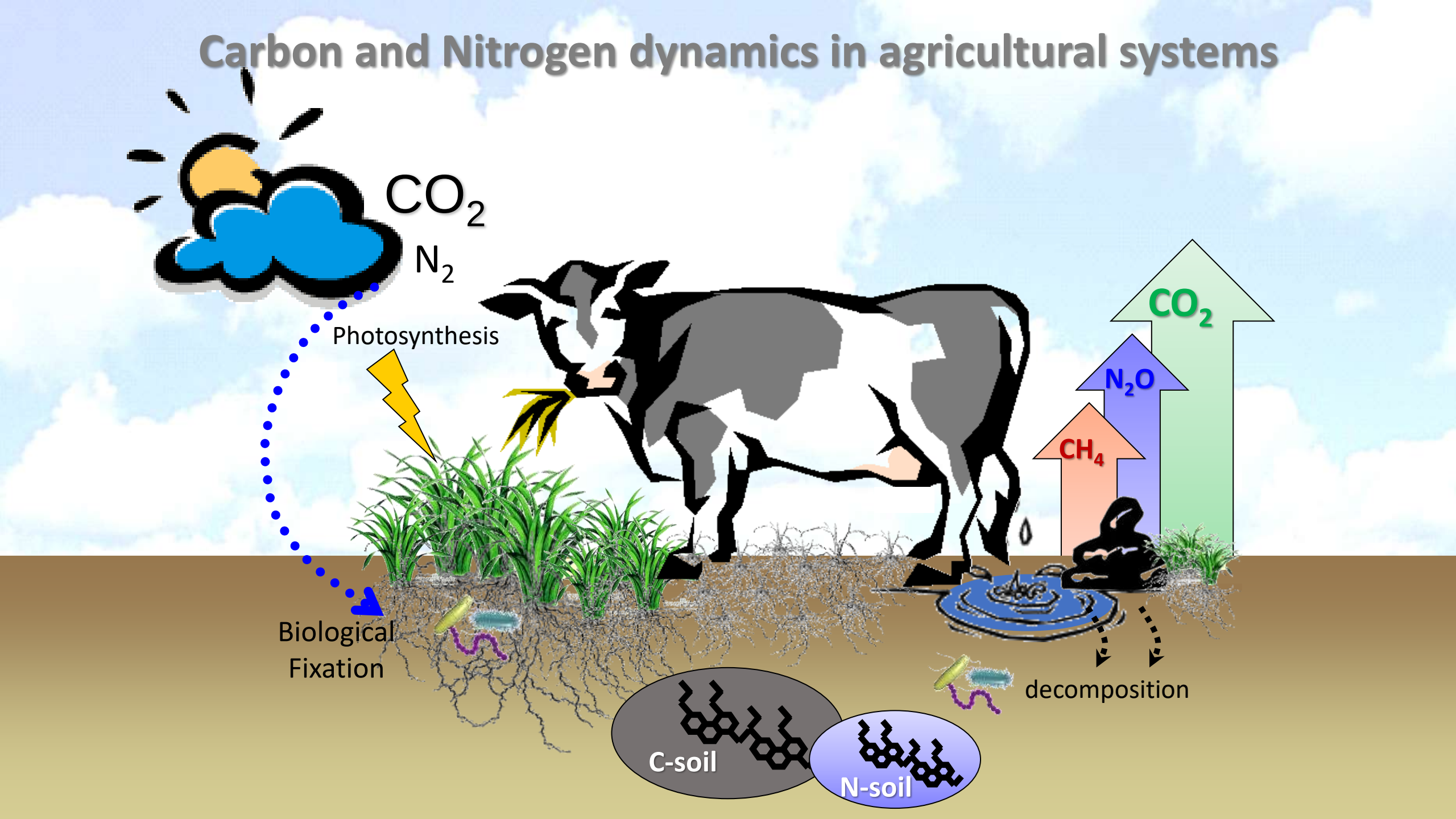
Carbon and Nitrogen dynamics in agricultural systems



Carbon and Nitrogen dynamics in agricultural systems



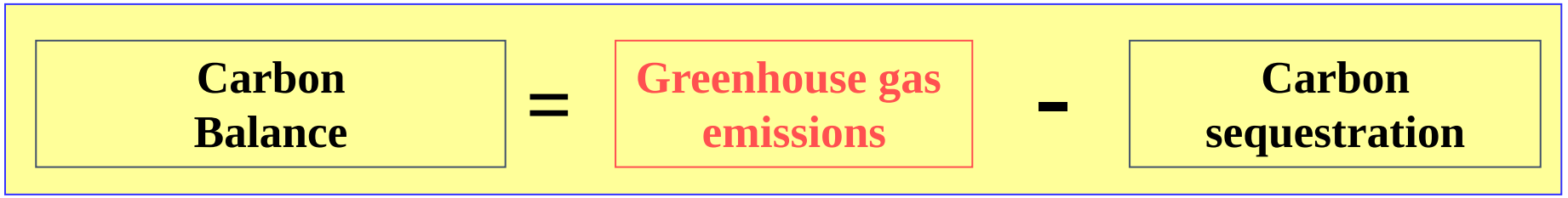
Carbon and Nitrogen dynamics in agricultural systems



CARBON BALANCE IN AGRICULTURAL SYSTEMS

Carbon Balance	=	Greenhouse gas emissions	-	Carbon sequestration

CARBON BALANCE IN AGRICULTURAL SYSTEMS



C Footprint: coffee

SEEDLING PRODUCTION

TRANSPORT

SOIL PREPARATION

PLANTING

MECANIZING
Management of weeds
Management of pests and deseases
Fertilization

48 MONTHS

HARVEST

CONSUM

ROASTING
PACKING

CONSUM

TRANSPORT BY SHIP

TRANSPORT

BENEFIT

STOREHOUSE

SOLID COMPOST AND WATER

DRYER

MUCILAGE REMOVAL
PULP REMOVAL
WASHER

TRANSPORT

SOYBEAN FOR BIODIESEL PRODUCTION

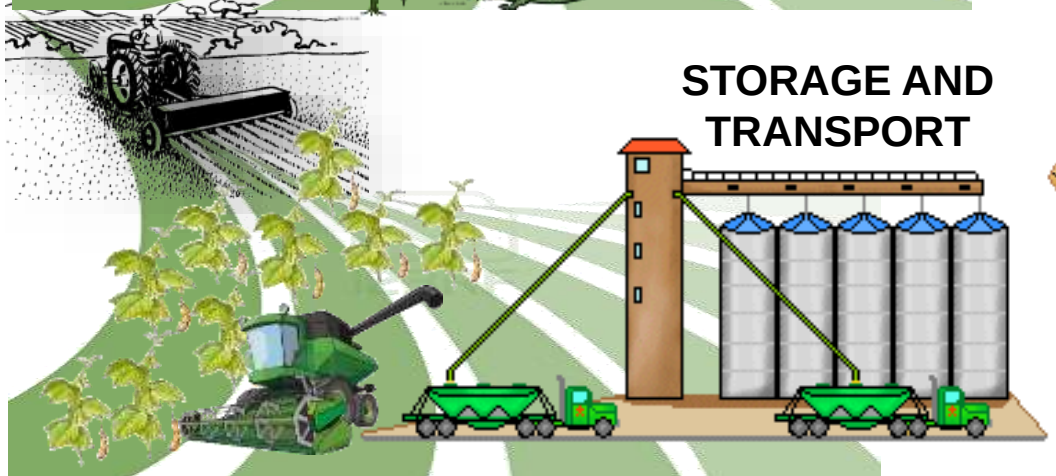
SOIL PREPARATION

SOWING

INPUTS
Fertilizers
Lime
Pesticides
Seeds
Harvest residues

FUELS
Diesel
Gasoline
Ethanol
Lubricant oil
Electricity

SECOND CROP
MAIZE



STORAGE AND
TRANSPORT

European Community seaport

TRANSPORT BY SHIP

Santos seaport

TRANSPORT BY TRUCK

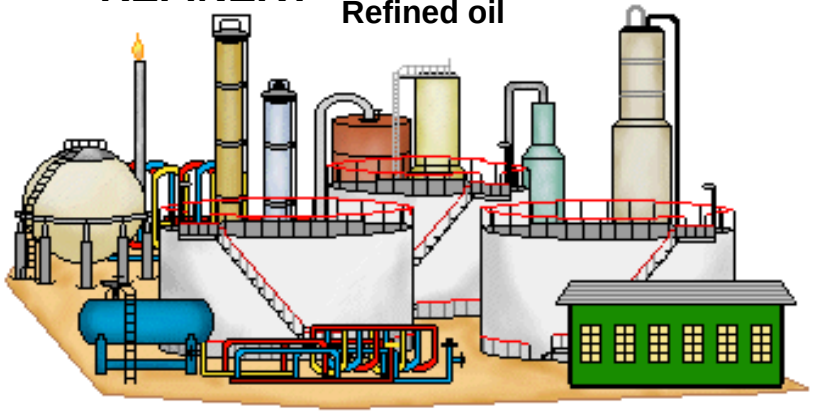
Paulínia refinery

PRODUCTION
B100

GLICERIN and BIODIESEL

REFINERY

Kitchen oil
Refined oil

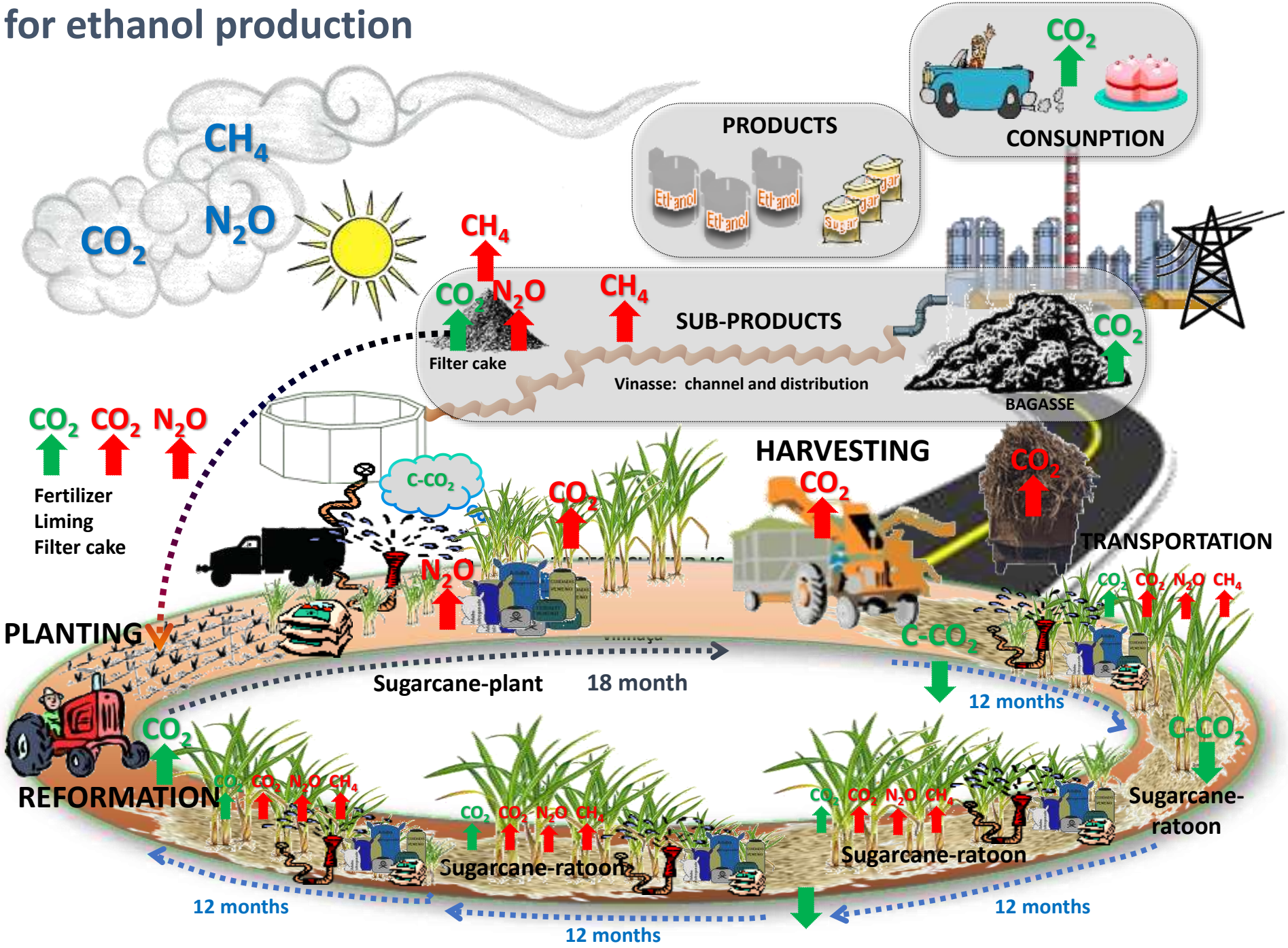


EXTRACTION

RAW OIL

BRAN

Sugarcane for ethanol production



C footprint: orange juice

SEEDLING PRODUCTION

SOIL PREPARATION

PLANTING

60-70%

MANAGEMENTS
≈ 20 X

36 MONTHS

HARVEST

CONSUM

CONSUM

TRANSPORT BY SHIP

STORING

TRANSPORT

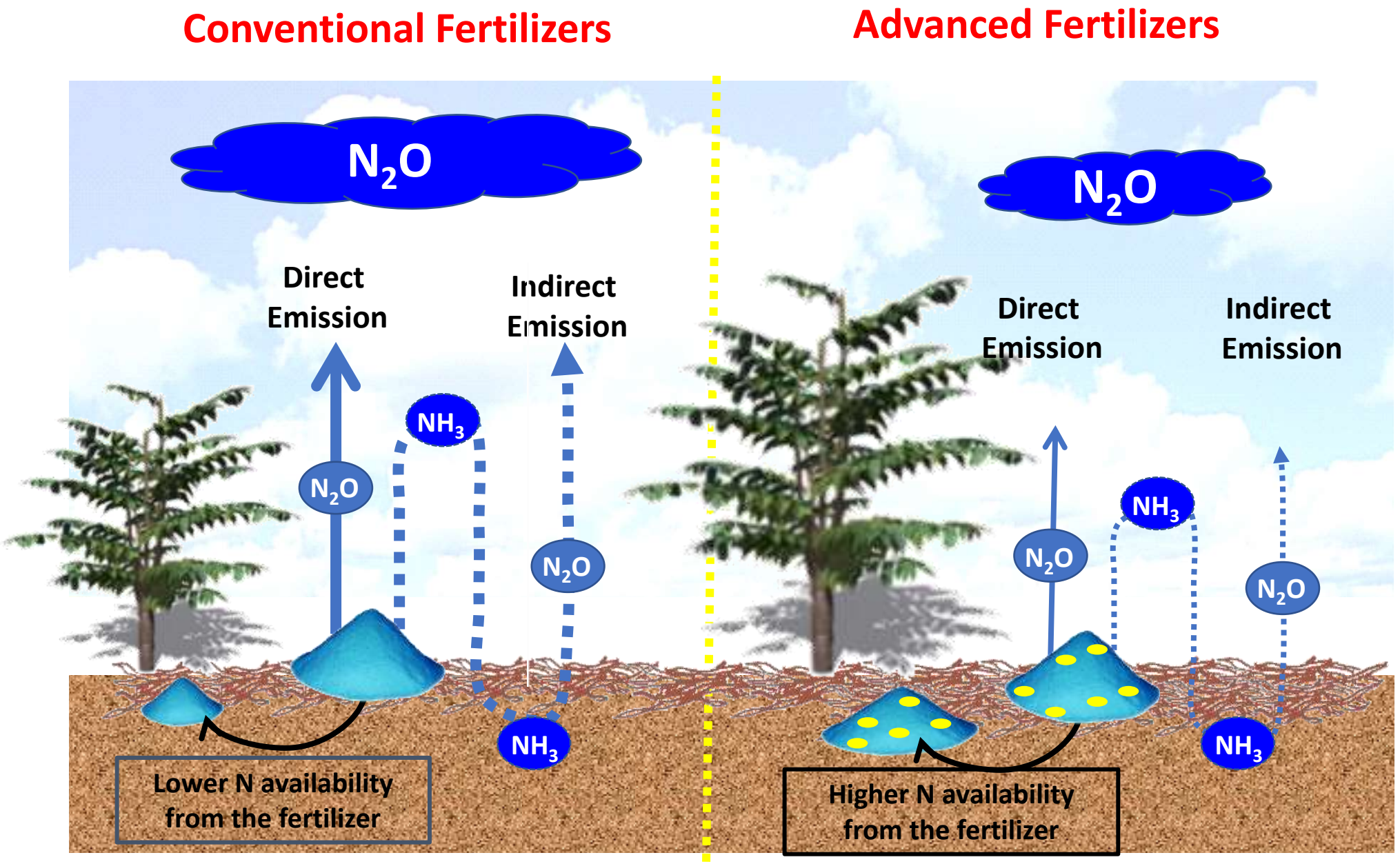
CONCENTRATED JUICE

BYPRODUCTS
oils
pulp
alcohol

OTHER PRODUCTS

FACTORY

TRANSPORT

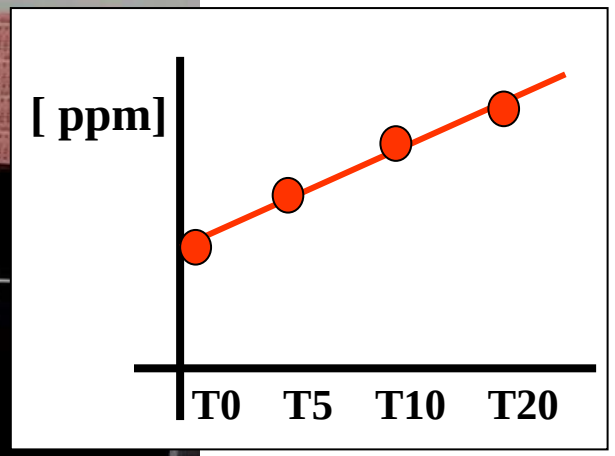

Conventional Fertilizers
Advanced Fertilizers
N2O
N2O
Direct Emission
Indirect Emission
Direct Emission
Indirect Emission
NH3
N2O
N2O
NH3
N2O
NH3
N2O
NH3
Lower N availability from the fertilizer
Higher N availability from the fertilizer

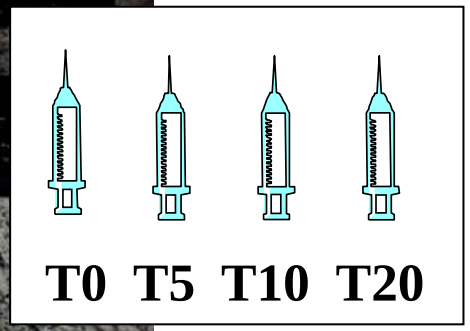
Greenhouse gas emissions (CO_2, CH_4, N_2O)


3

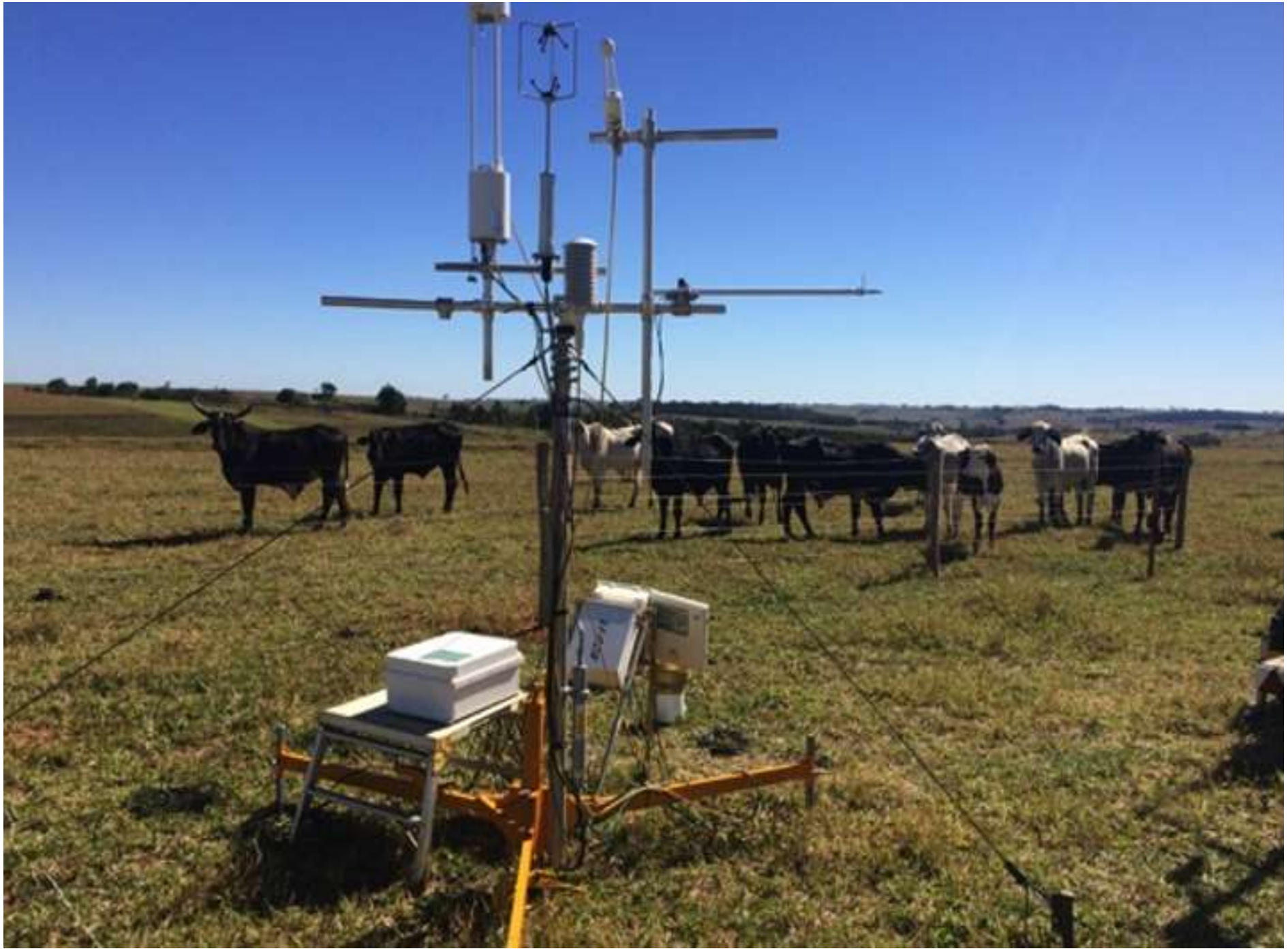

METTLER TOLEDO
-52
23
Read
FG2 2
1

GAS CHROMATOGRAPHY





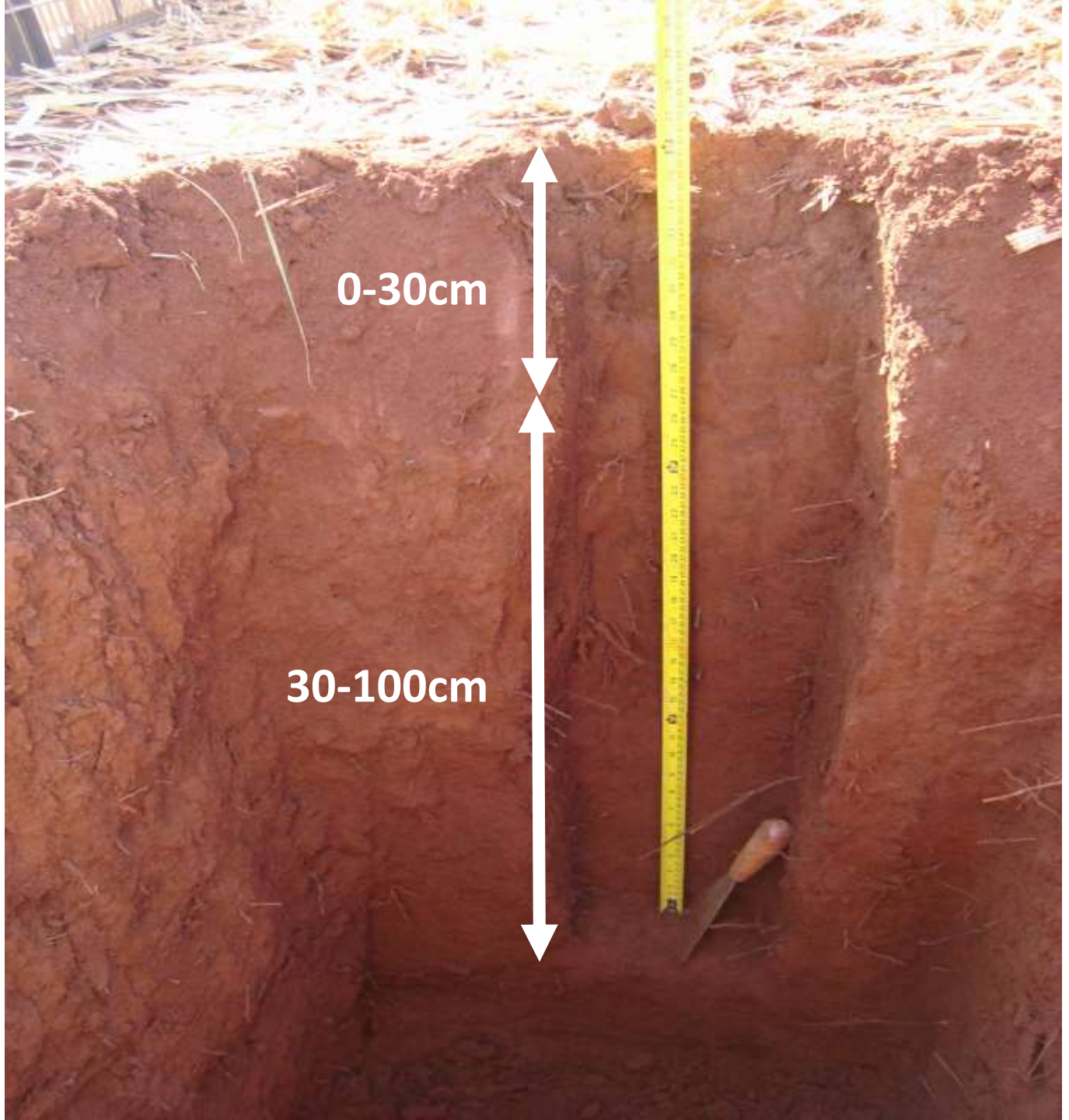
Detectors:
ECD: CO_2 and N_2O
FID: CH_4



CARBON BALANCE IN AGRICULTURAL SYSTEMS

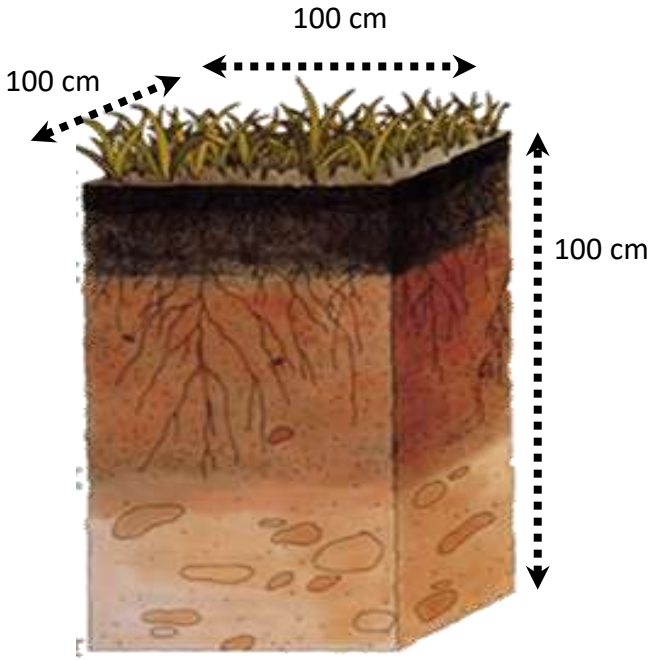
Carbon Balance	=	Greenhouse gas emissions	-	Carbon sequestration


Soil sampling


0-30cm
30-100cm

Sample preparation and analyses

Soil carbon stocks



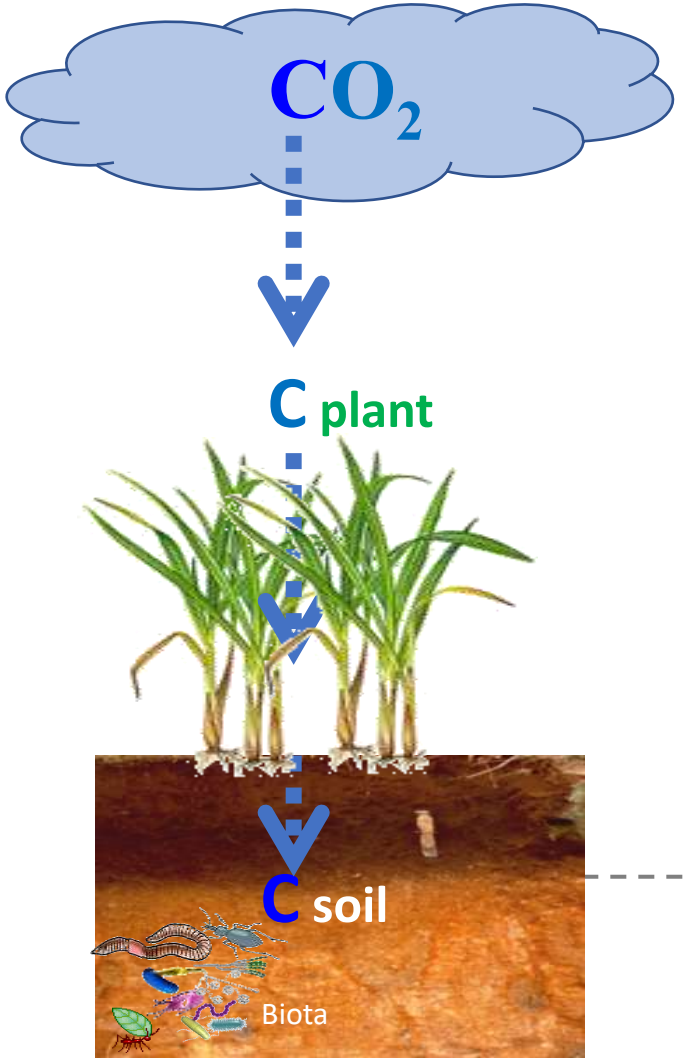
Stock = C content x d x layer

% C

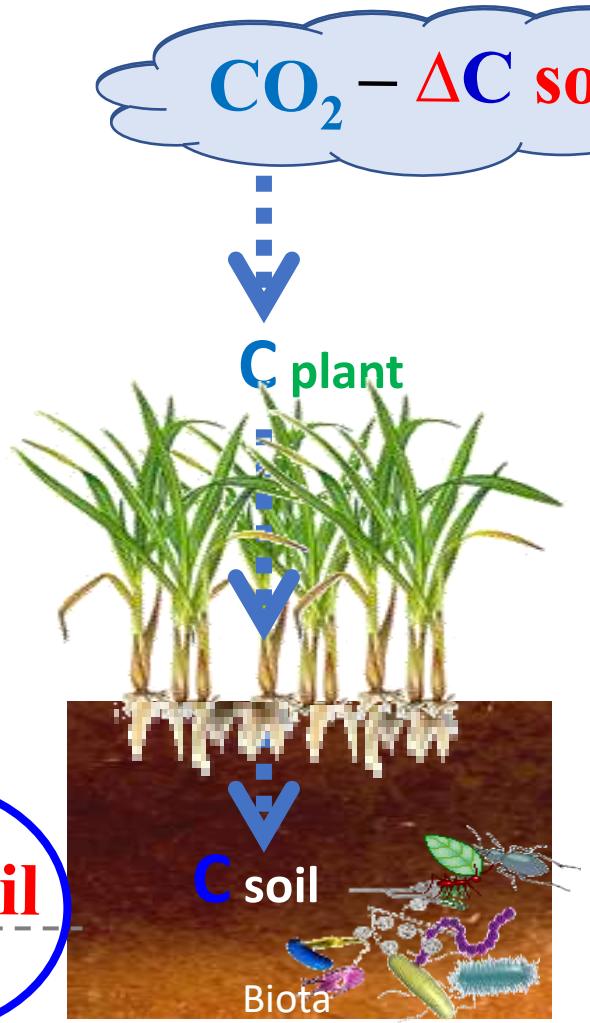
d = m / V

kg C m^{-2} or Mg C ha^{-1}

Conventional Systems



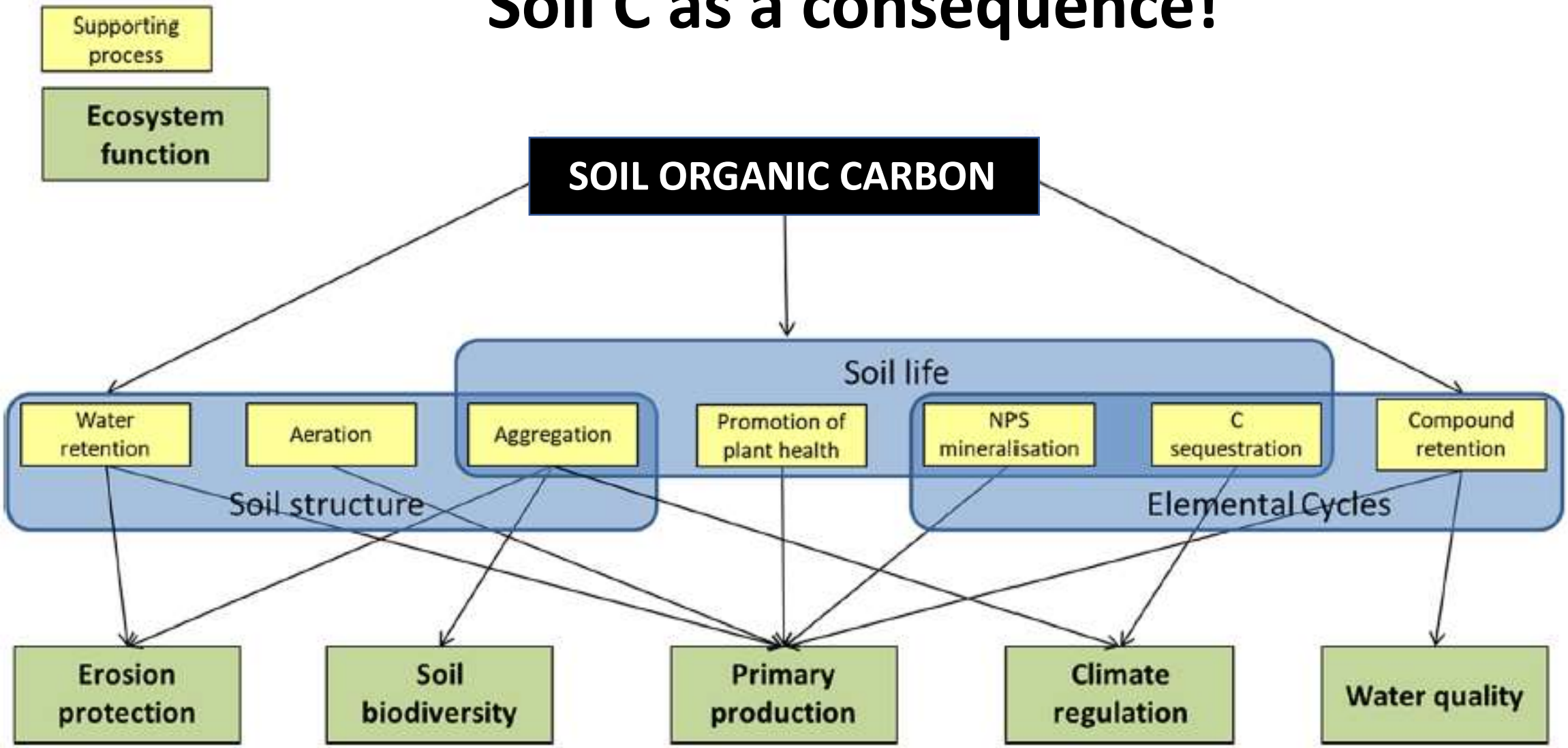
Best Management Practices



ΔC soil

Root System!

Soil C as a consequence!

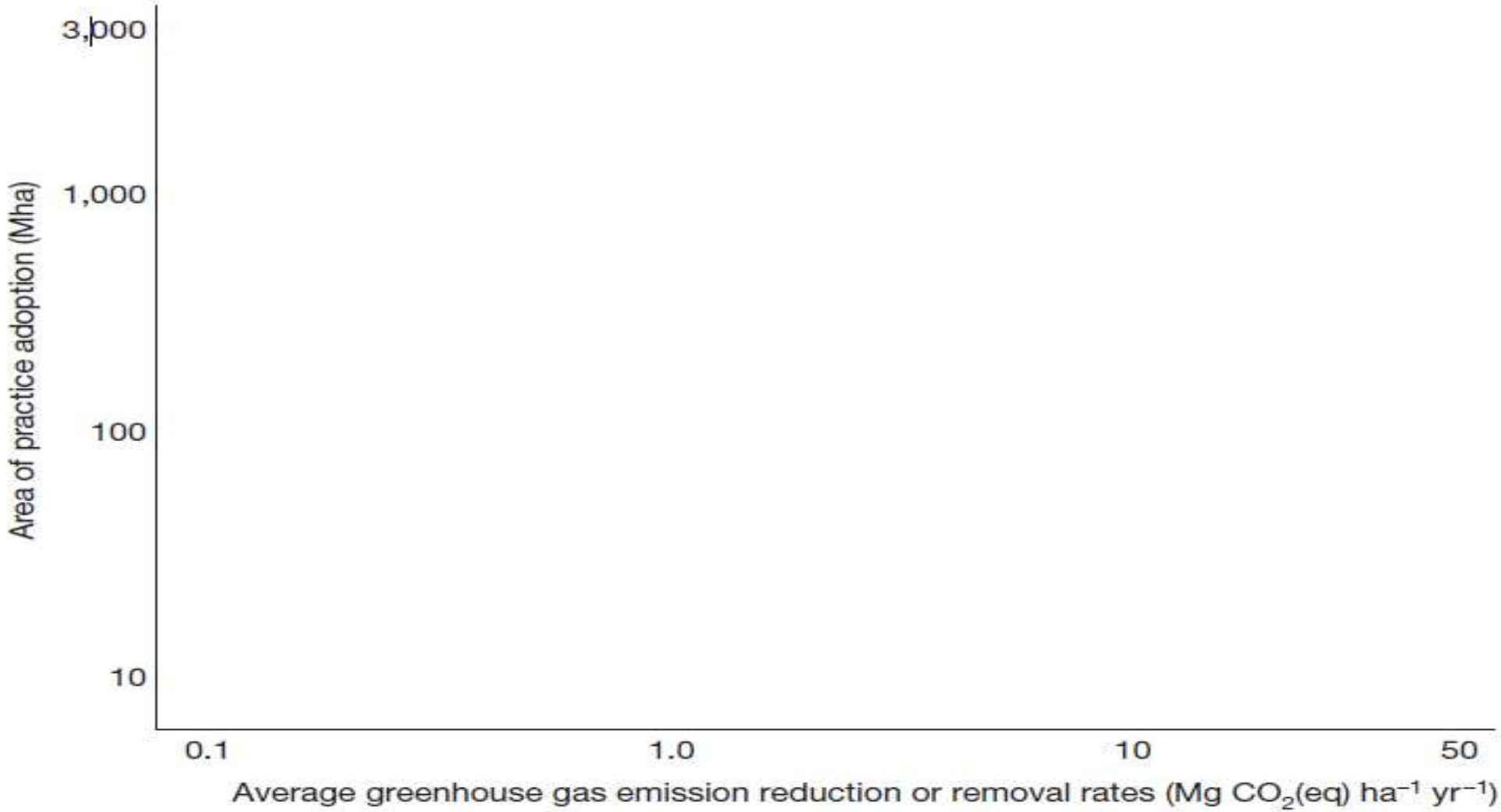


Hoffland et al., 2020

Climate–smart soils

7 APRIL 2016 | VOL 532 | NATURE

Keith Paustian[1,2], Johannes Lehmann[3], Stephen Ogle[2,4], David Reay[5], G. Philip Robertson[6] & Pete Smith[7]



Climate-smart soils

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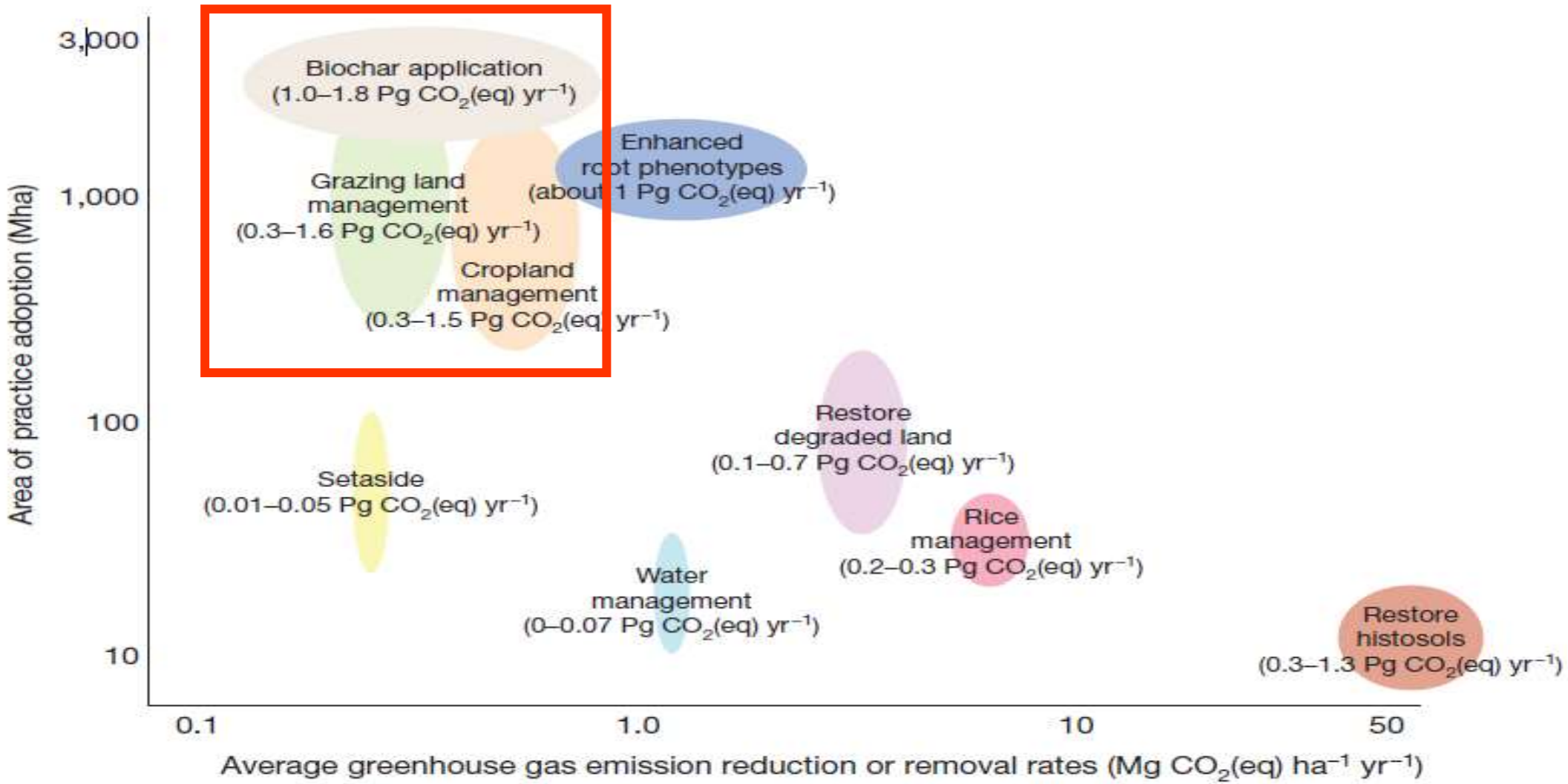

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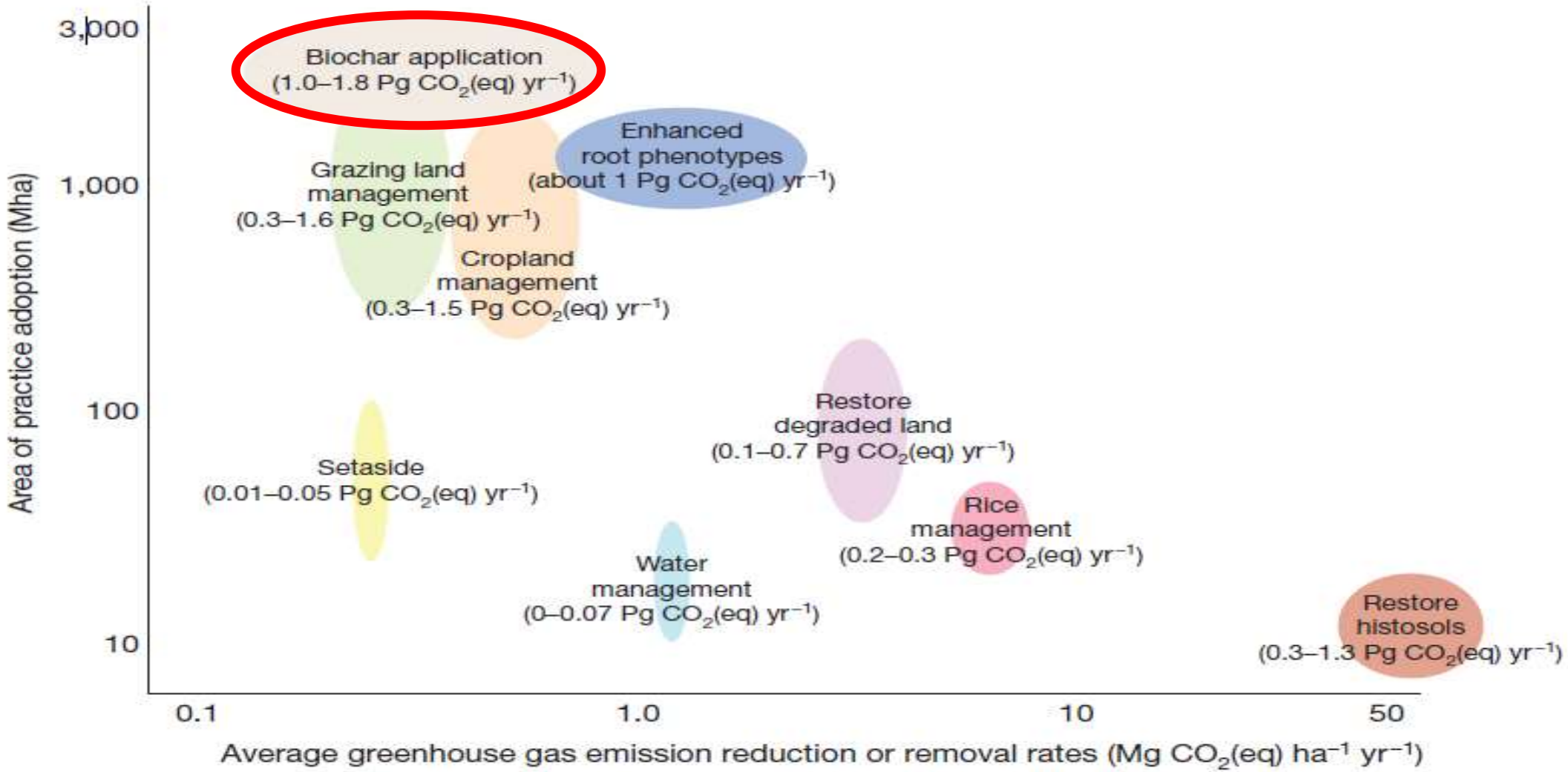
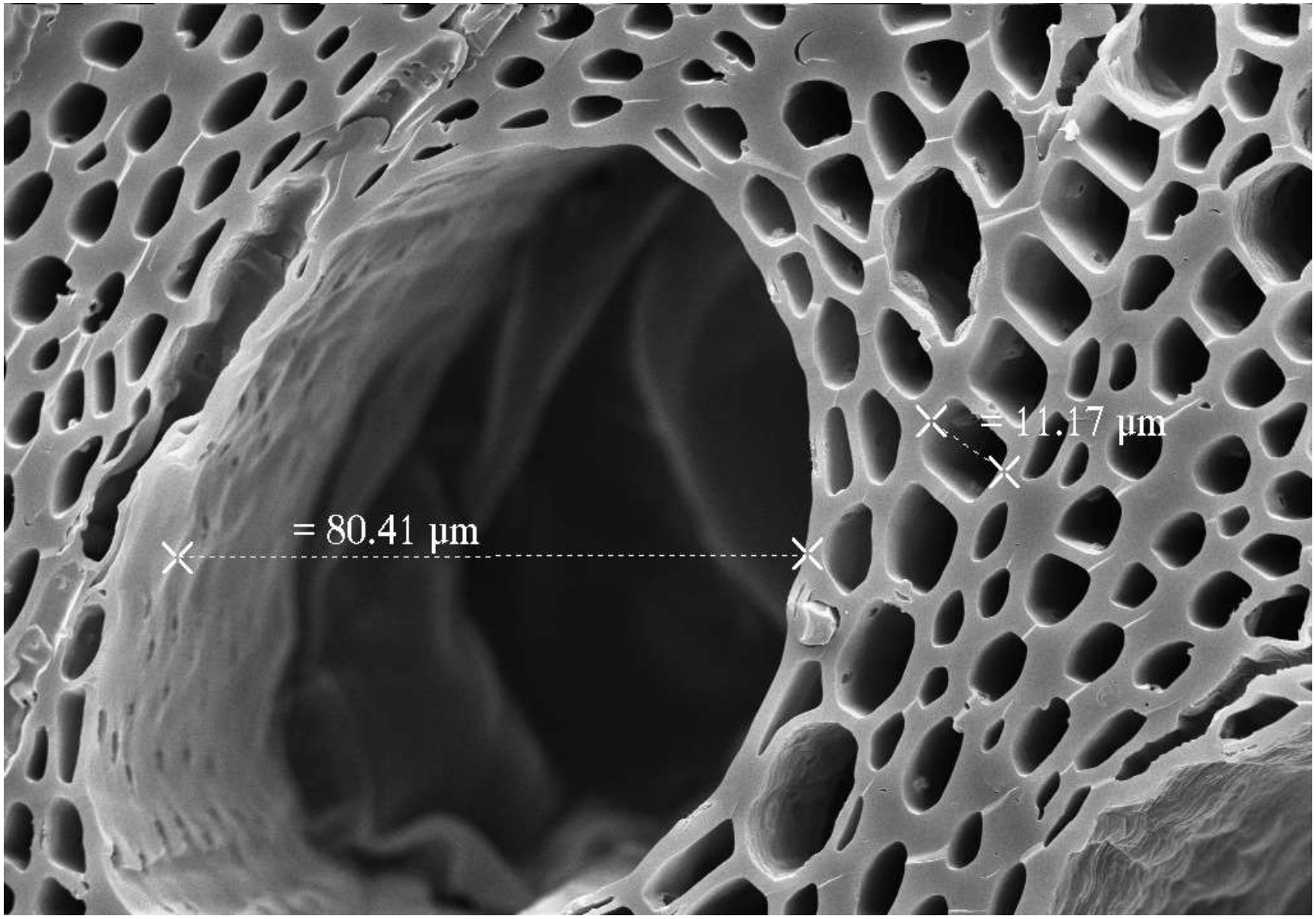
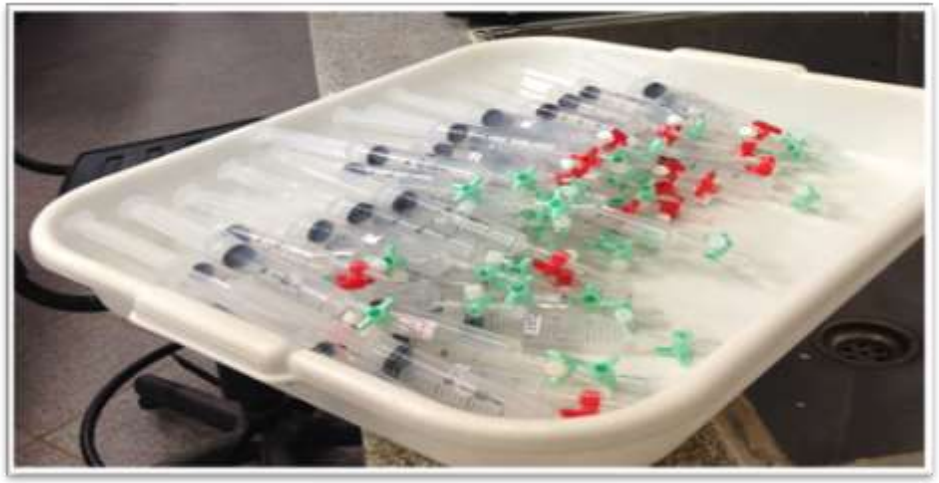


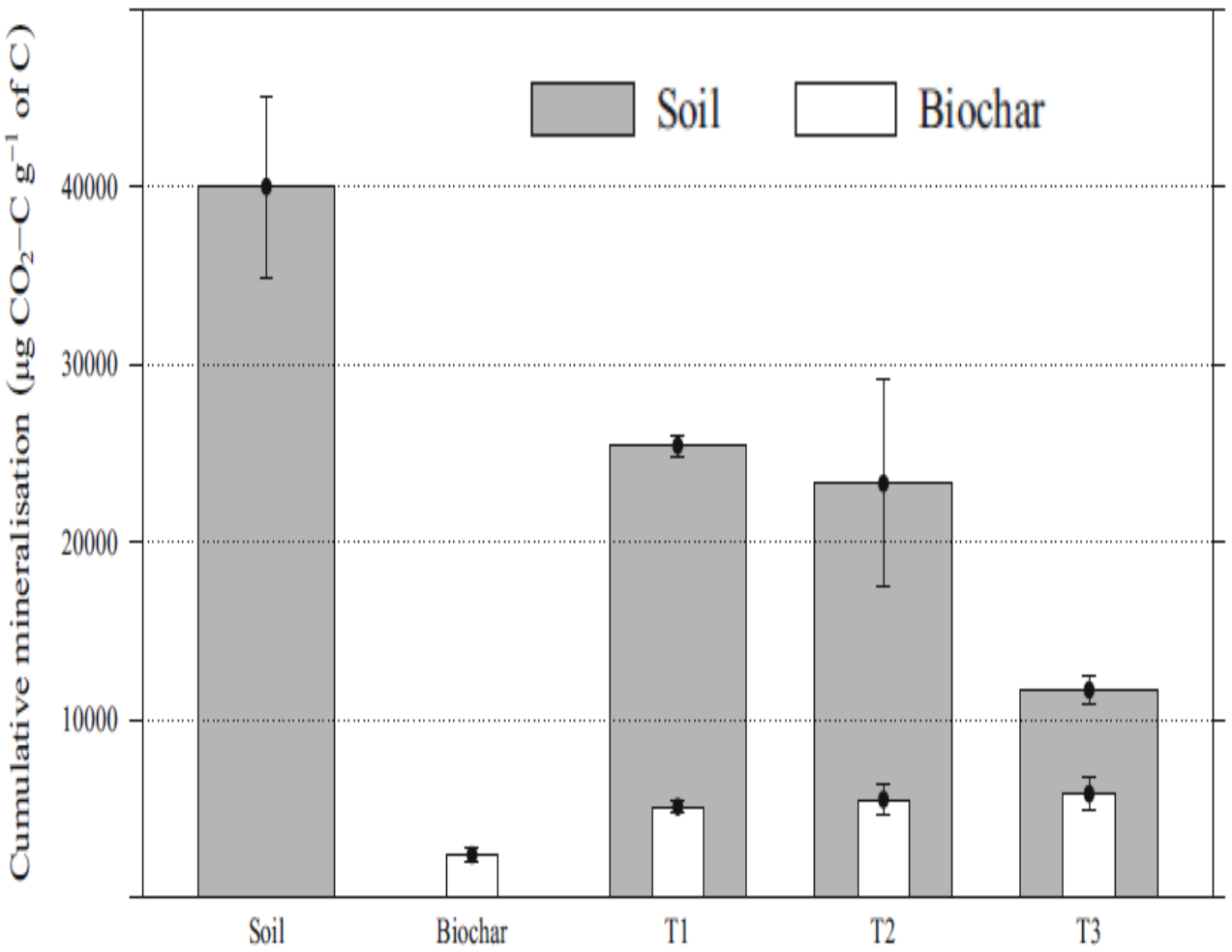
Biochar (sugarcane leaves)

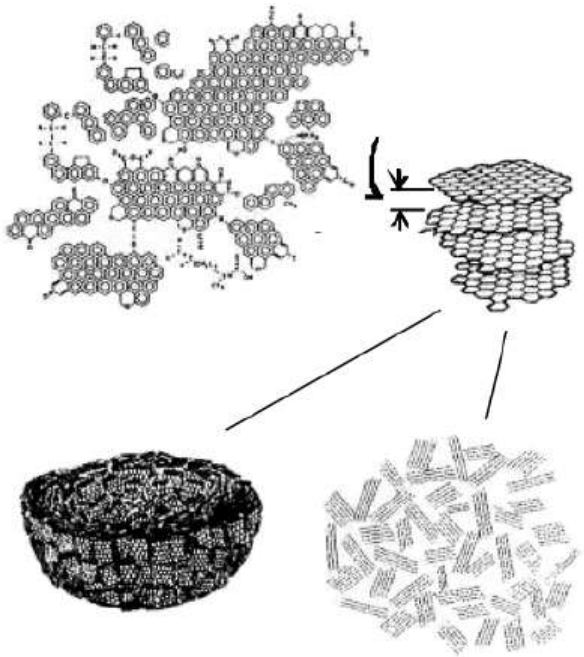


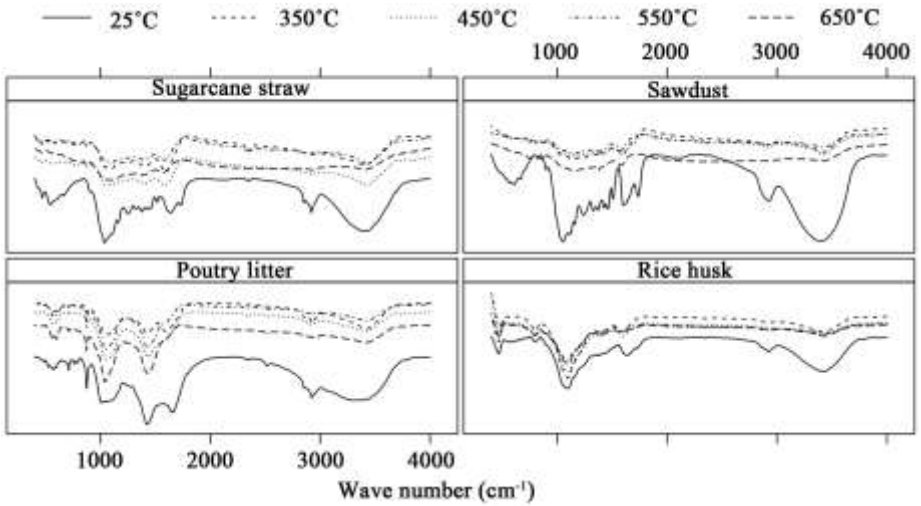
Fluxes of CO_2, CH_4 and N_2O



CO_2 emissions (^{13}C-CO_2)

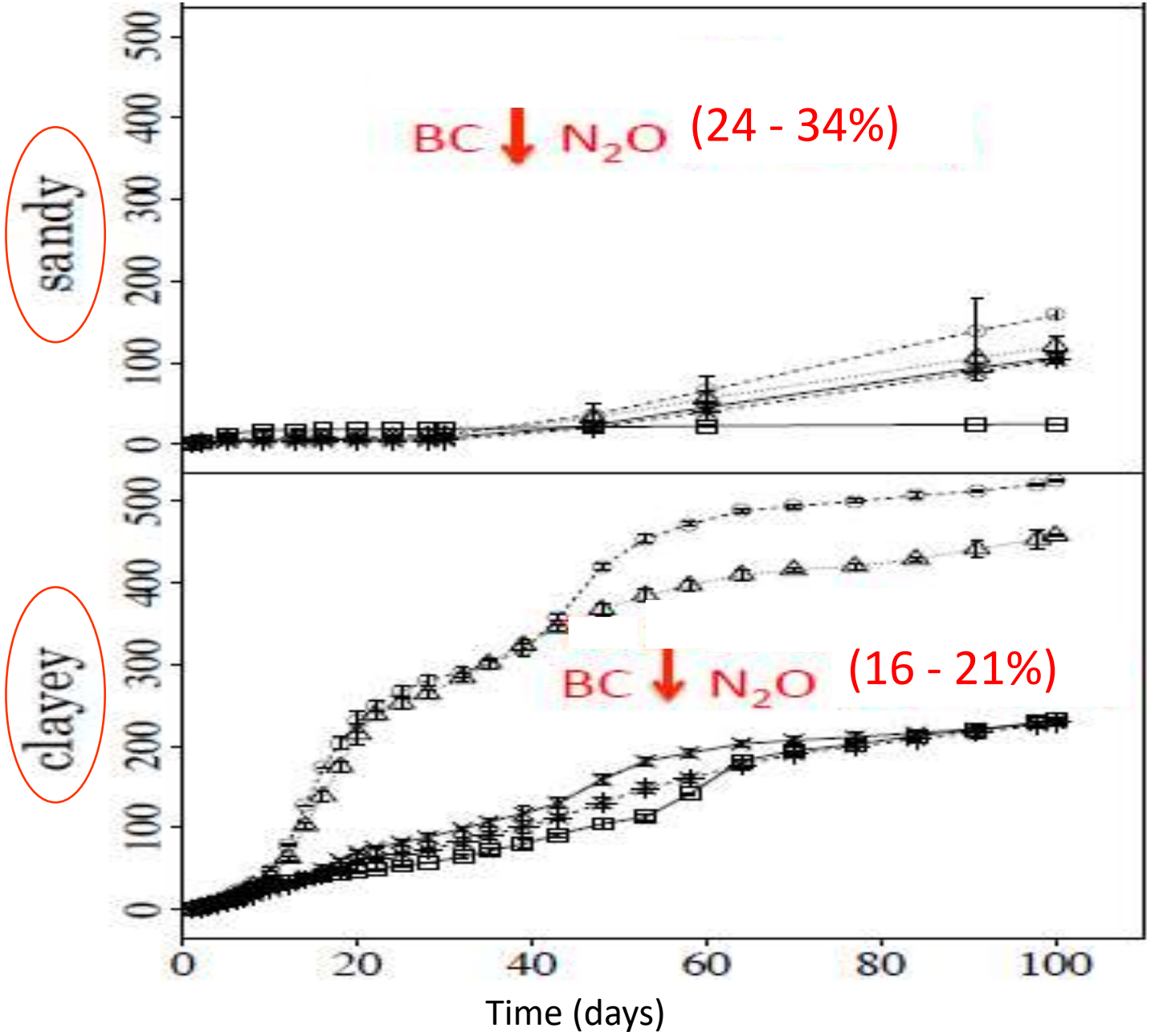




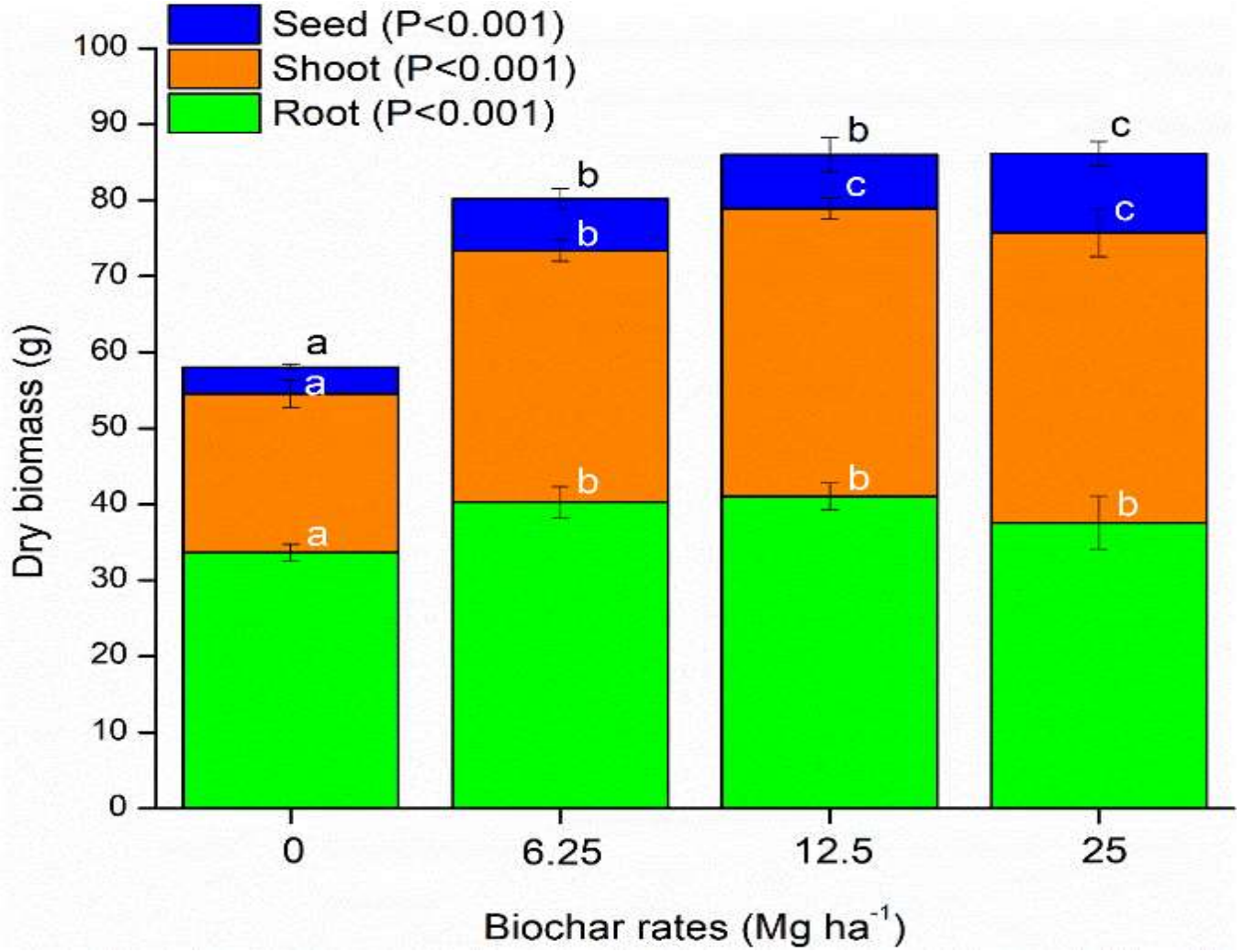


Abbruzzini et al., 2022

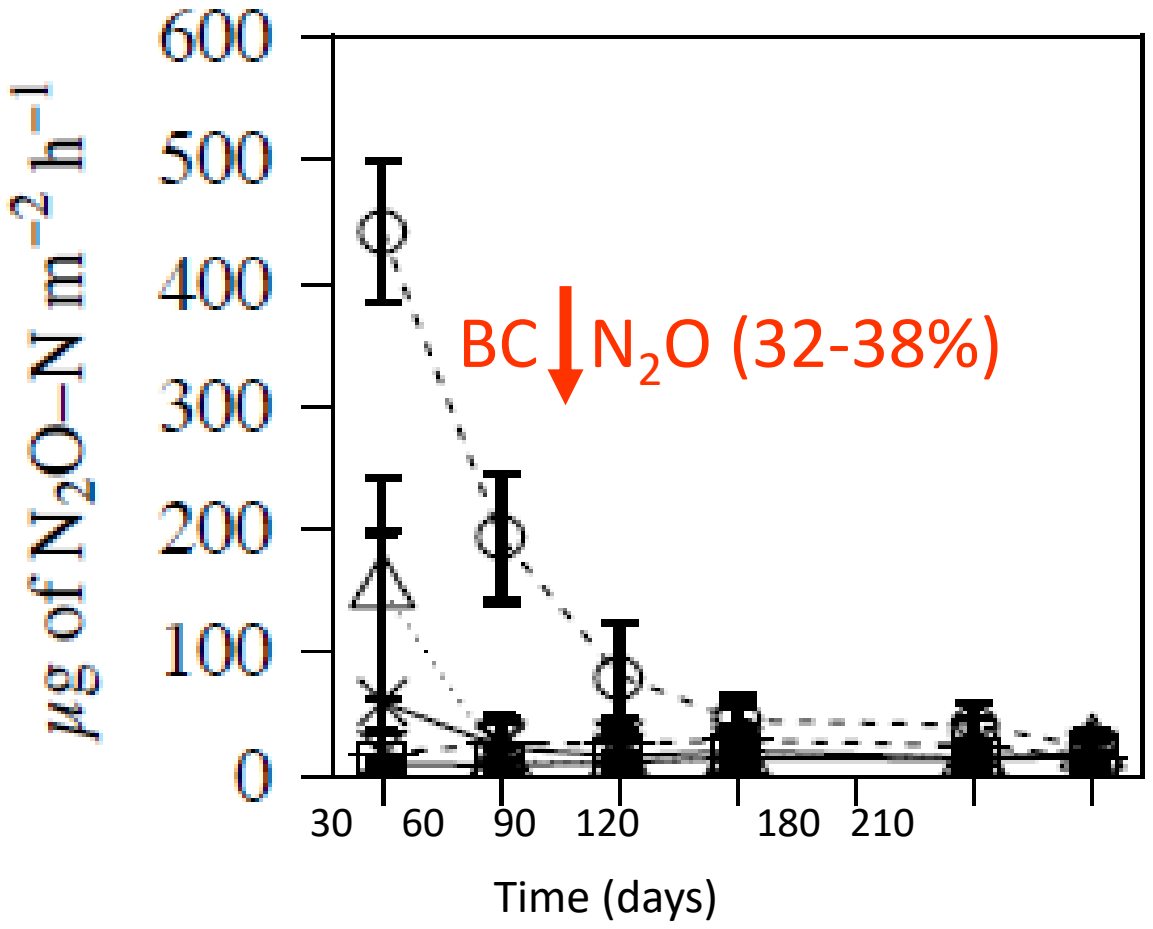
N_2O emissions



Increase in plant productivity



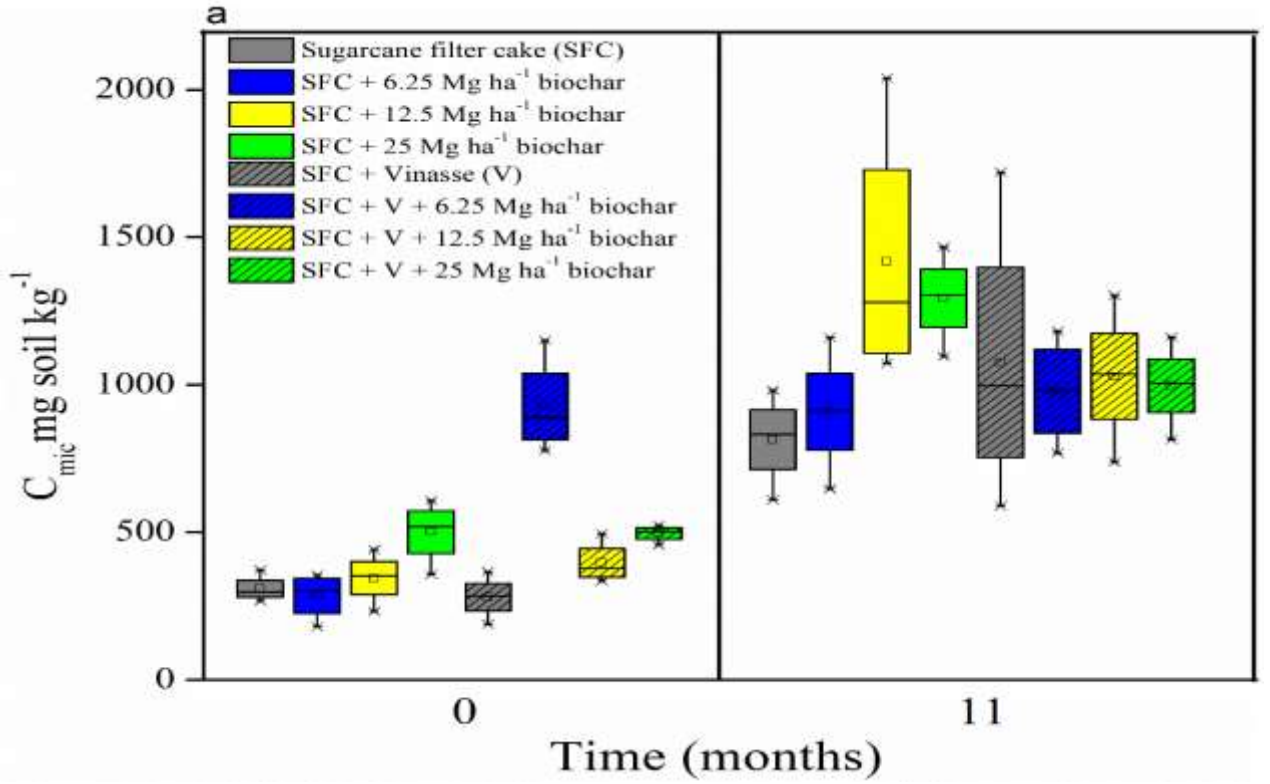
N_2O emissions

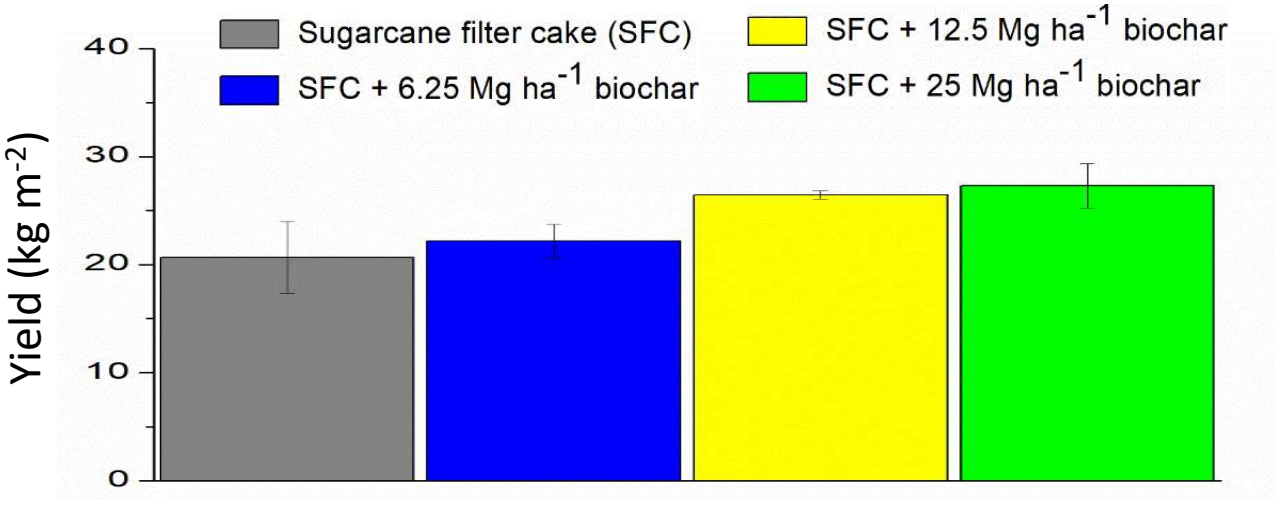


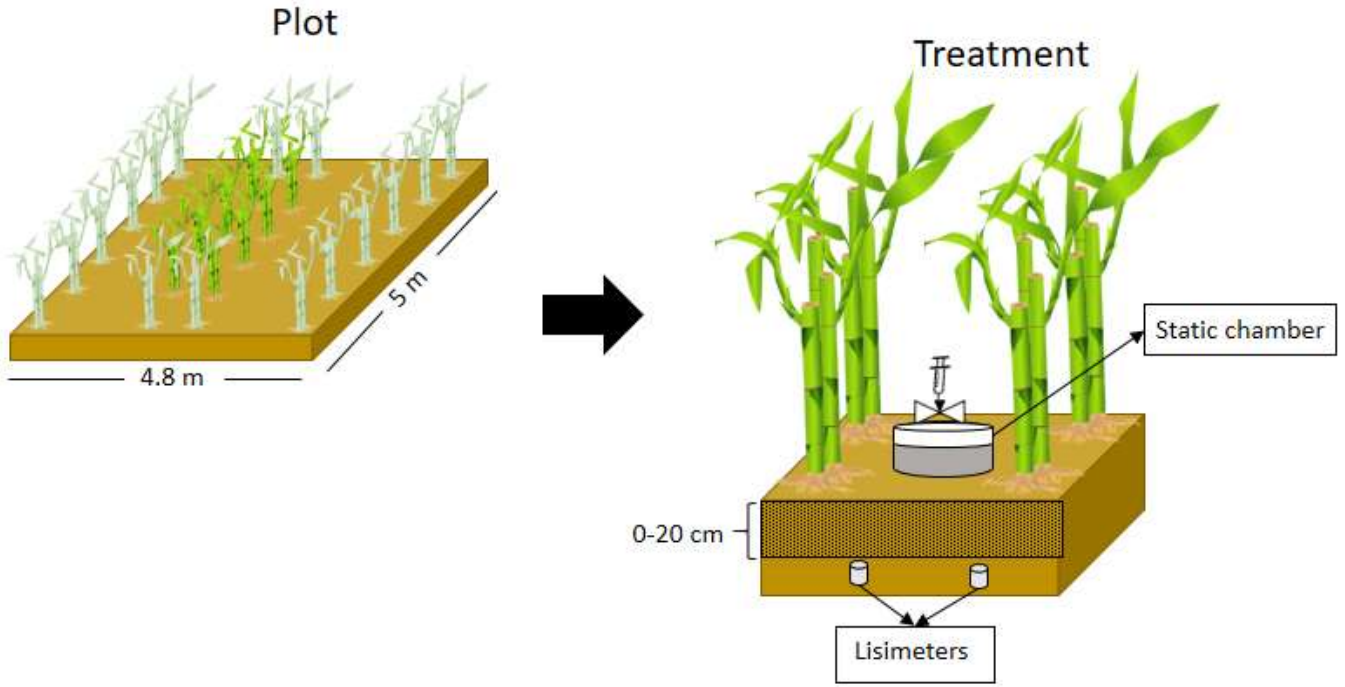
Gas Soil Leaching

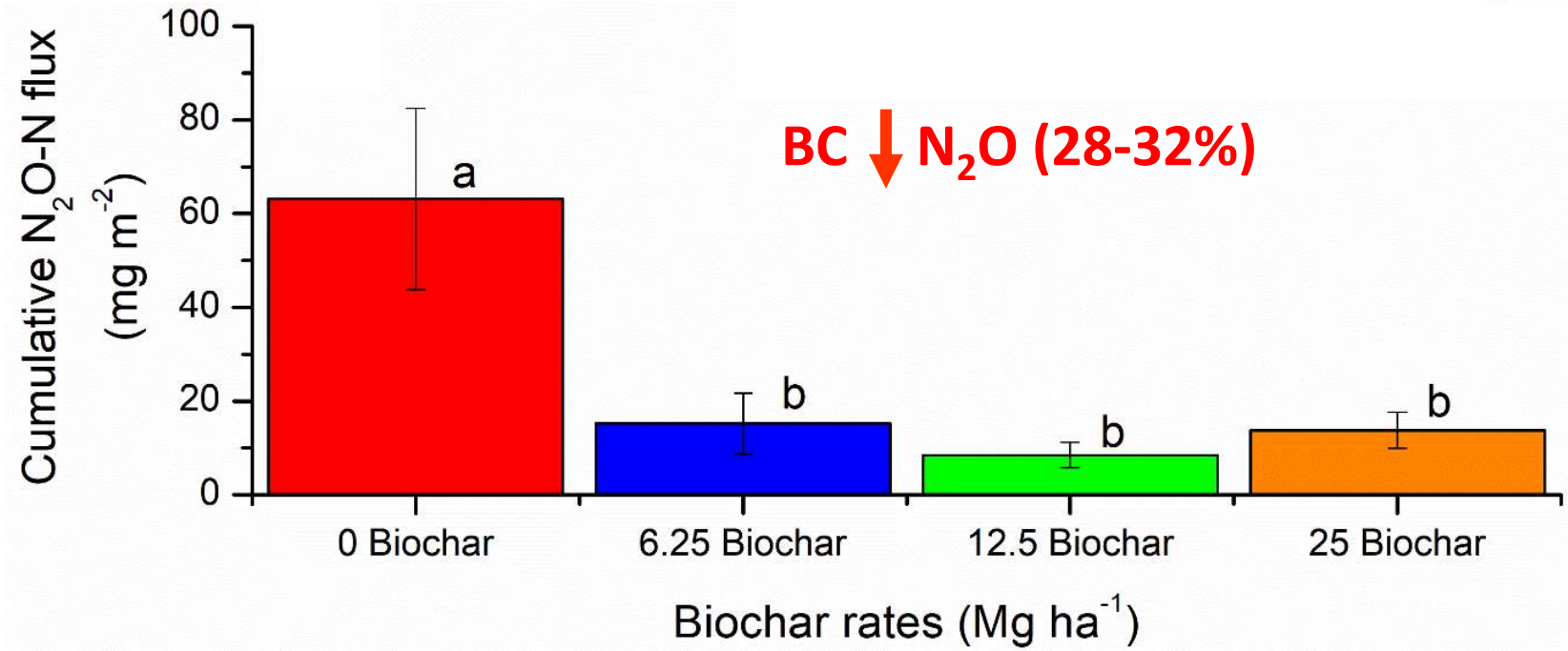
Productivity Microbial biomass

2016							2017				
Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Fev	Mar	Abr	May






Plot
4.8 m
5 m
Treatment
Static chamber
0-20 cm
Lisimeters


Cumulative N2O-N flux
(mg m-2)
100
80
60
40
20
0
a
b
b
b
0 Biochar
6.25 Biochar
12.5 Biochar
25 Biochar
Biochar rates (Mg ha-1)

BC ↓ N_2O (28-32%)

Climate-smart soils

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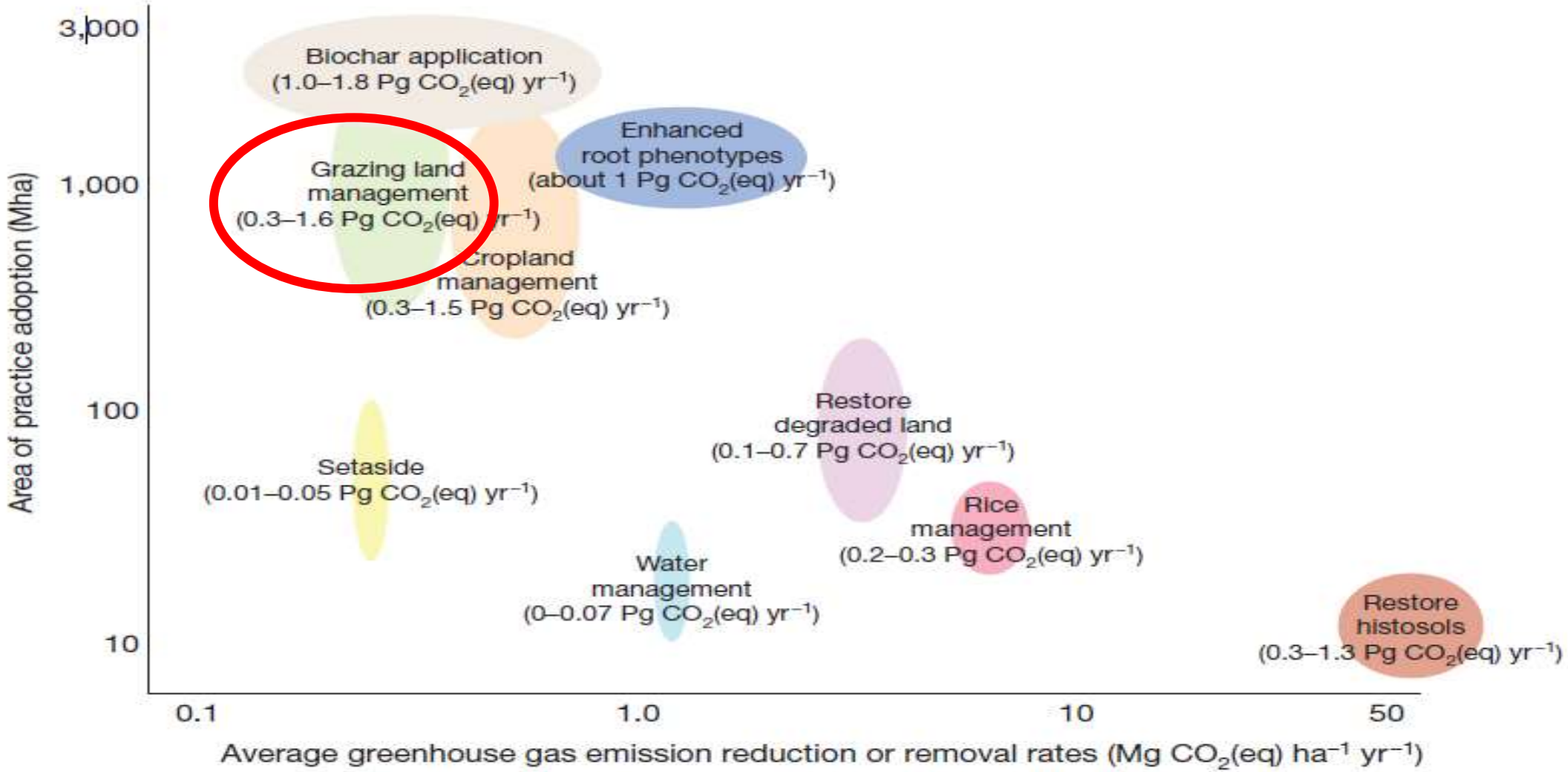
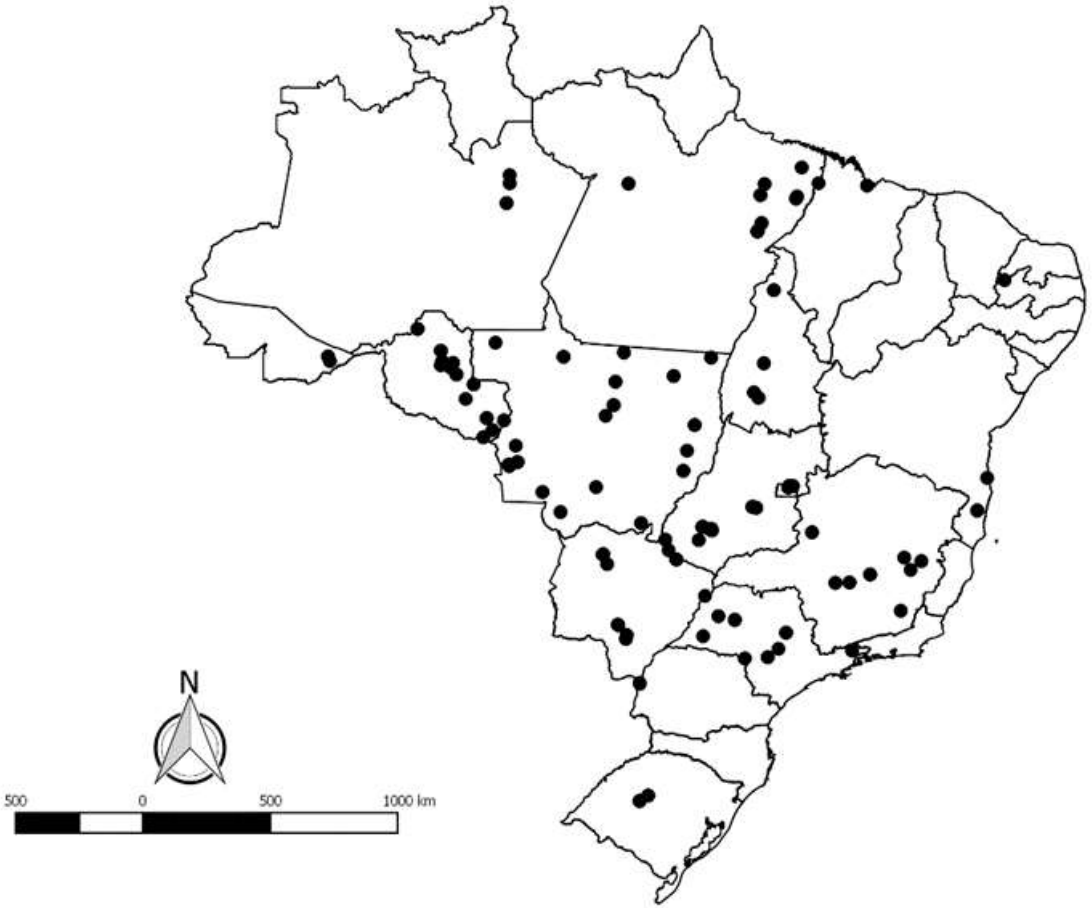
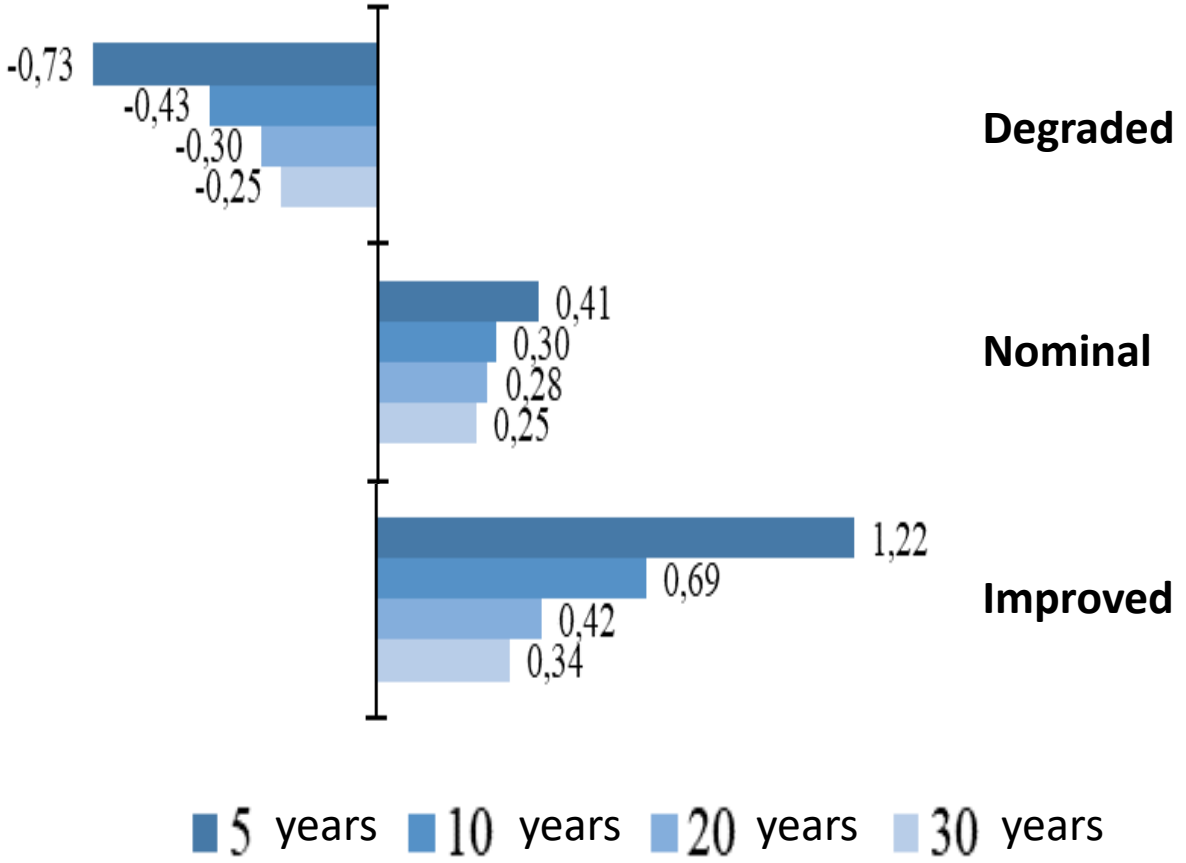


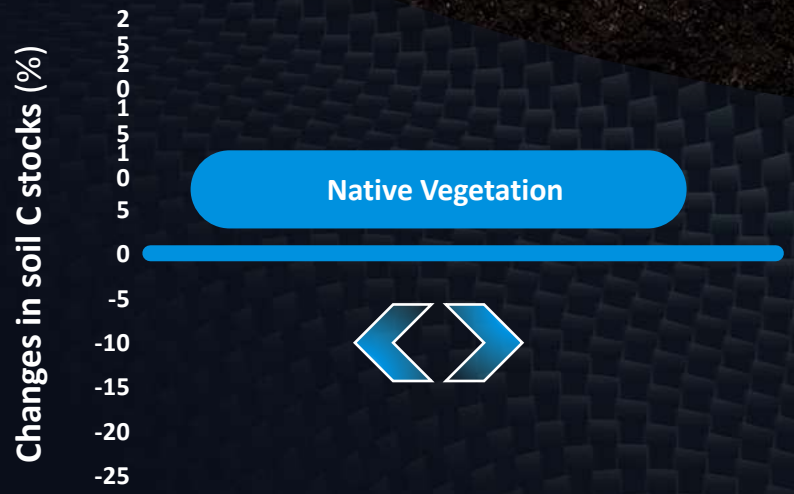
Soil C stocks under pastures in Brazil



Soil C stock change rates
Mg ha^{-1} year^{-1}



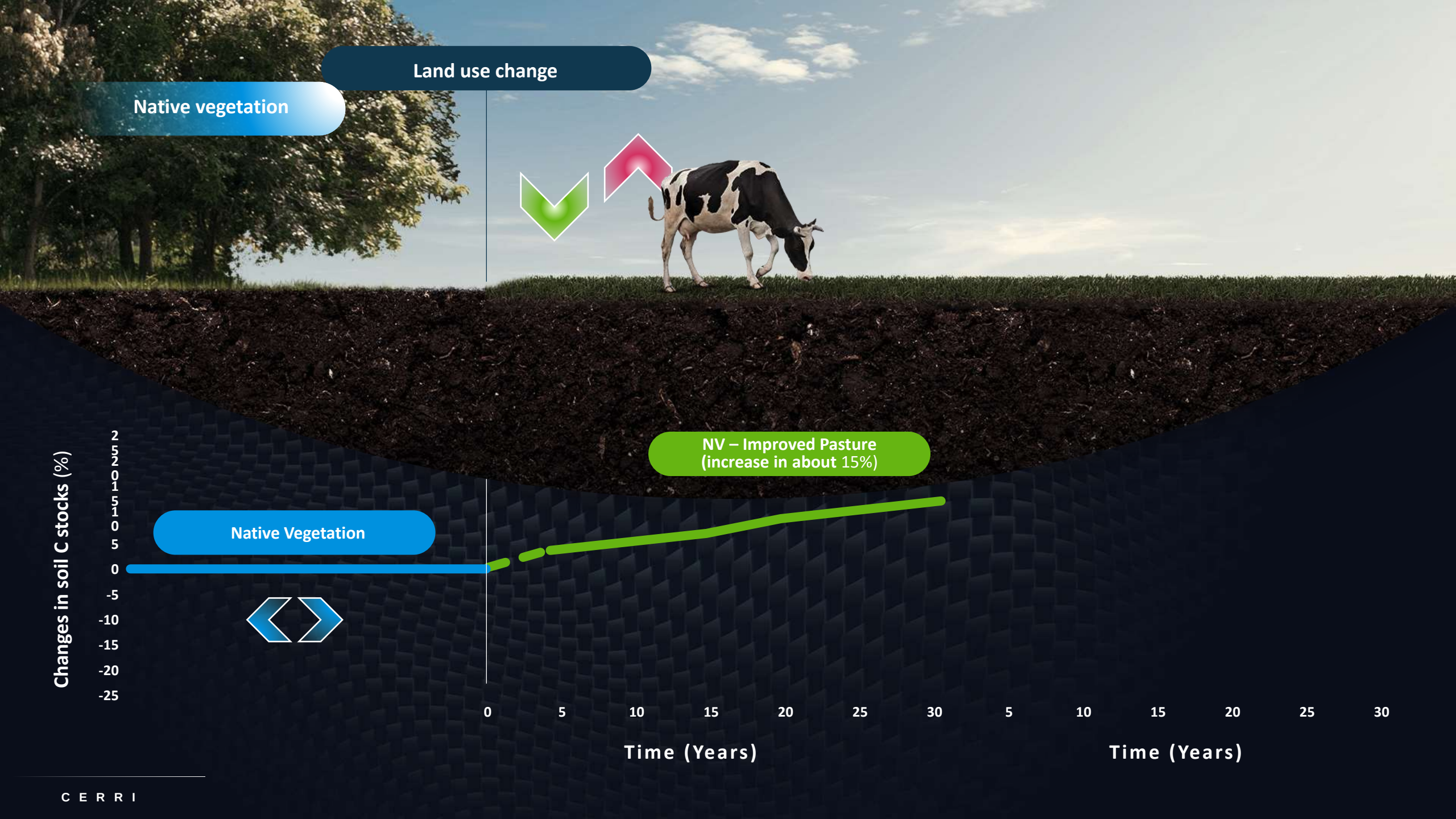

Native vegetation

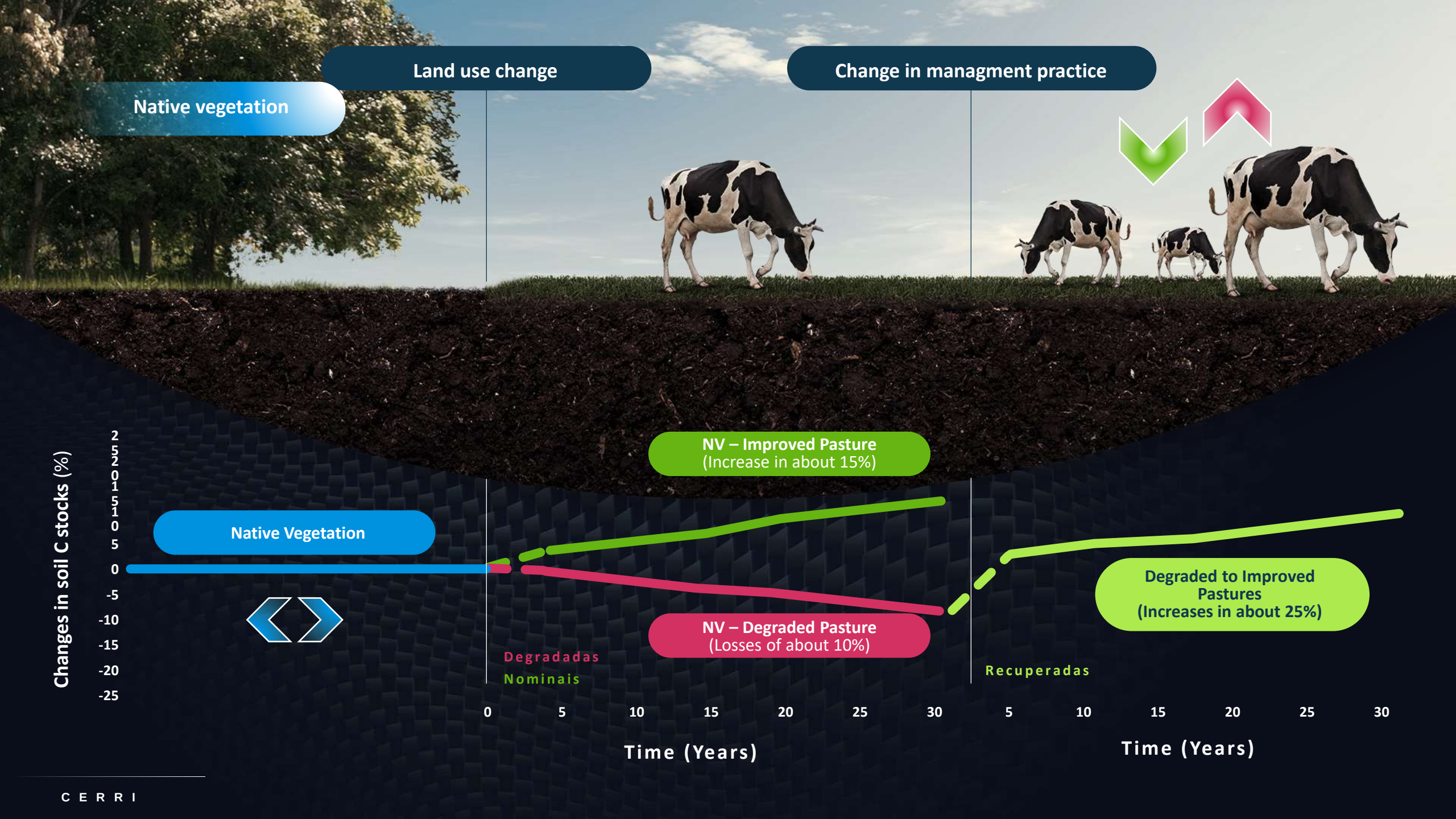

Changes in soil C stocks (%)
25
20
15
10
5
0
-5
-10
-15
-20
-25
Native Vegetation


Land use change
Native vegetation


Changes in soil C stocks (%)
25
20
15
10
5
0
-5
-10
-15
-20
-25
Native Vegetation (NV)
NV – Degraded Pasture
(Losses of around 10%)
0
5
10
15
20
25
30
5
10
15
20
25
30
Time (Years)
Time (Years)

CERRI


Land use change
Native vegetation
NV – Improved Pasture
(increase in about 15%)
Native Vegetation
Changes in soil C stocks (%)
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
5
10
15
20
25
30
5
10
15
20
25
30
Time (Years)
Time (Years)


Native vegetation
Land use change
Change in managment practice
NV – Improved Pasture
(Increase in about 15%)
Native Vegetation
NV – Degraded Pasture
(Losses of about 10%)
Degraded to Improved Pastures
(Increases in about 25%)
Degradadas
Nominais
Recuperadas
Changes in soil C stocks (%)
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
5
10
15
20
25
30
Time (Years)
Time (Years)

Climate-smart soils

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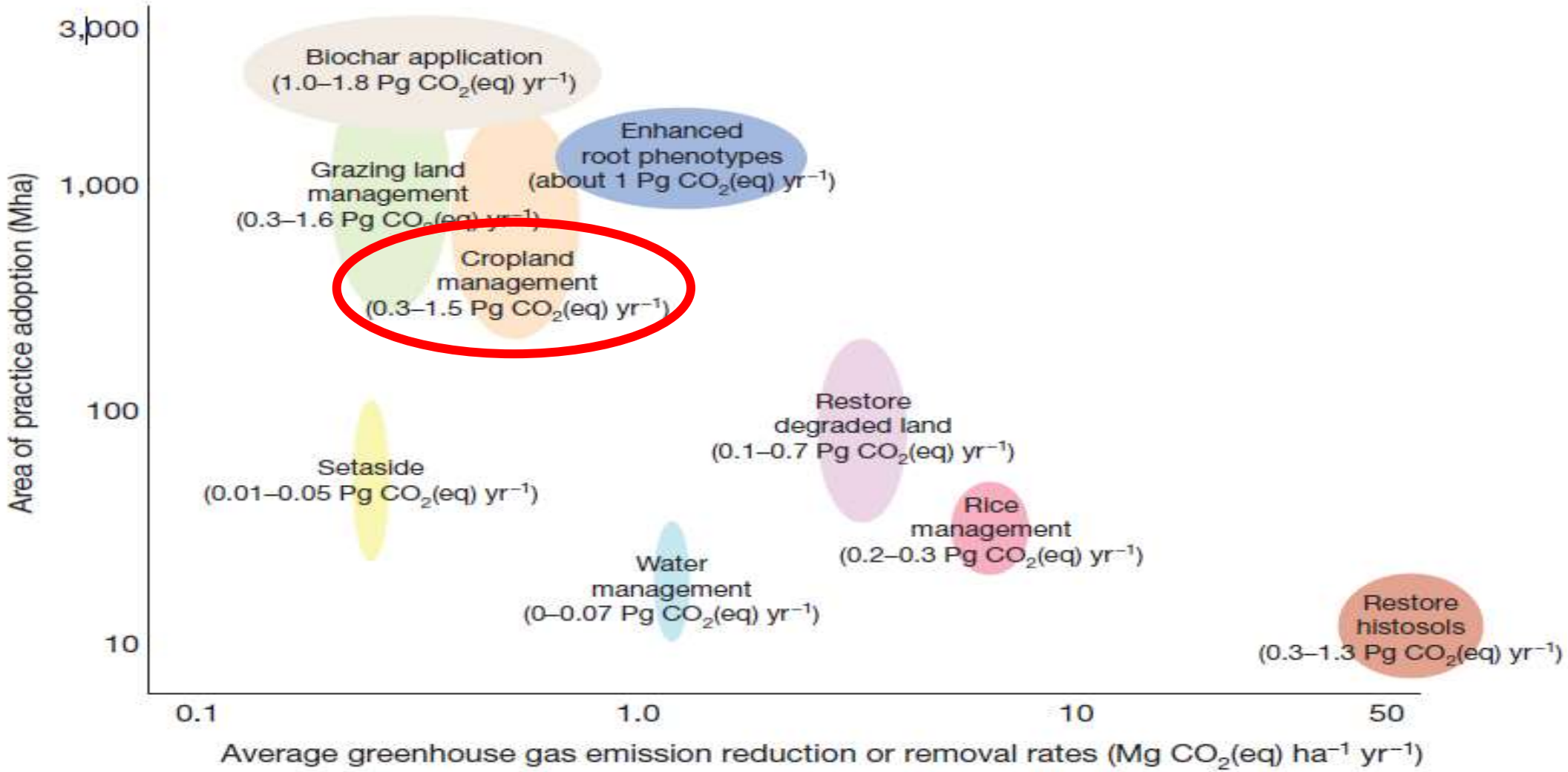
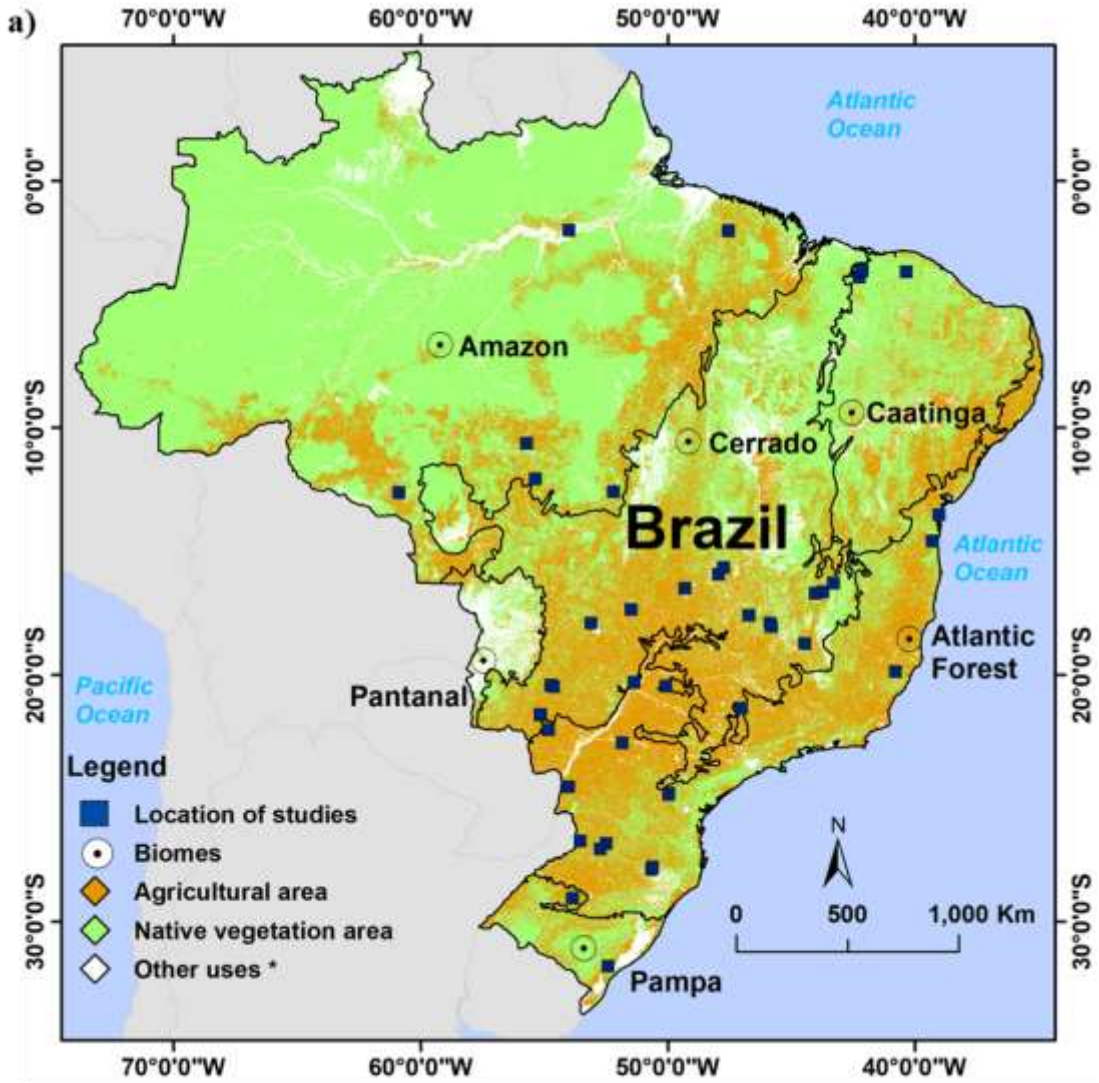
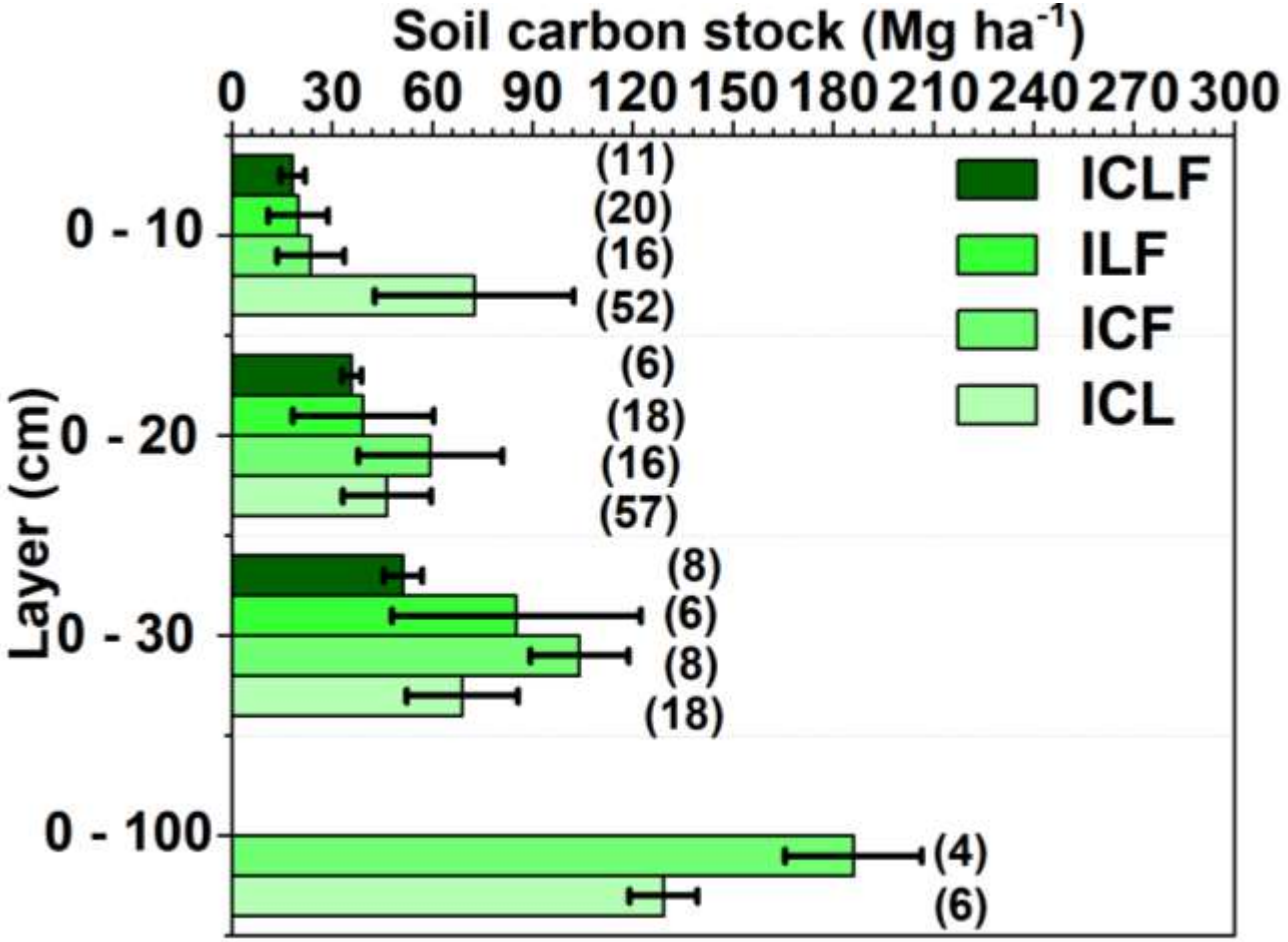
Keith Paustian[1,2], Johannes Lehmann[3], Stephen Ogle[2,4], David Reay[5], G. Philip Robertson[6] & Pete Smith[7]



Soil C stocks in Integrated Agricultural Systems





Vilella et al., 2022

Potential of mitigation (Mg Ceq yr^{-1})

Year 2020

Pasture

Reduction emission from animal eructation

Effect of the number of animals

Reforestation

Agriculture

Ex

ng system

Ethanol from sugarcane

Bagasse Cogeration

Biodiesel

	11-46
	2.5
	16-28
	68-133
	26-50
	11-12
TOTAL	178-445

Adoption of best agricultural management practices

Greatest challenges for humanity

Dr. Dahlia Greidinger
International Symposium
Agricultural practices -
towards environmental sustainability

Agriculture as an option for mitigating climate change

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Haifa, March 1st 2023