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SB 1383 Subgroup Meeting
Fostering Markets for Non-Digester Projects
Composting Dairy Manure
Issues related to GHG emissions

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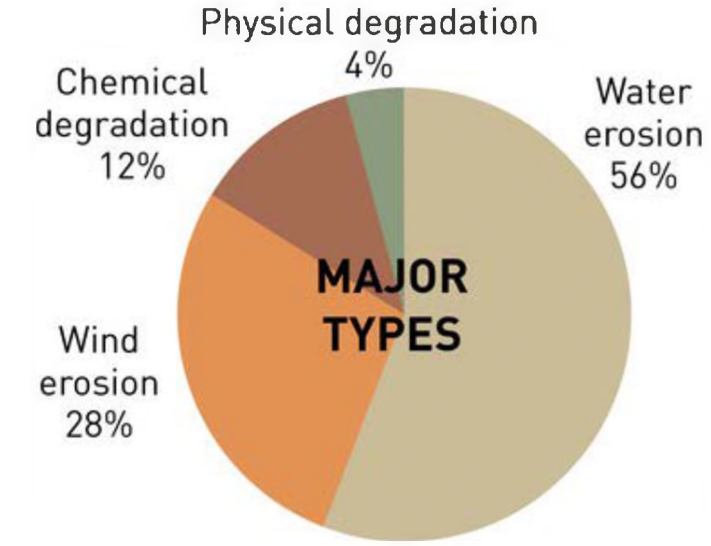
- We educate
- We inquire
- We actively engage
- We facilitate shifts in thinking

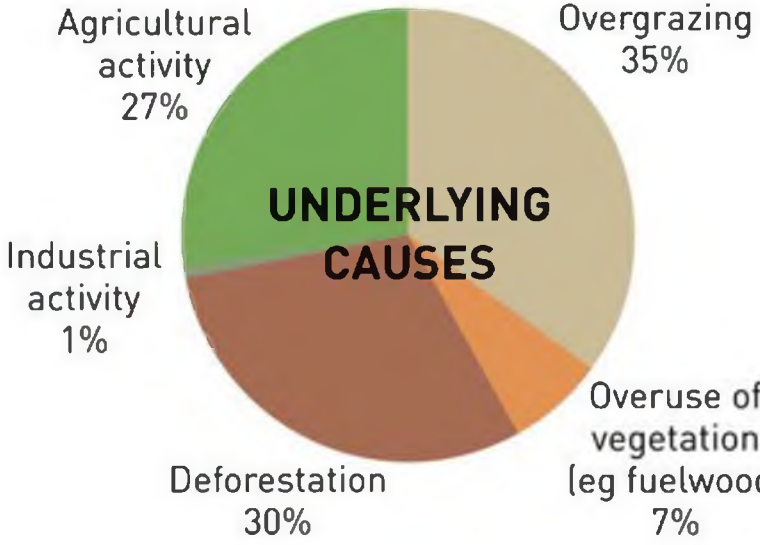
Regenerative farming practices build/enhance soil carbon

"A mere 2% increase in the carbon content of the planet's soil could offset 100% of all greenhouse gas emissions going into the atmosphere..."

Dr. Rattan Lal , Ohio State University Soil Scientist

Major types and causes of soil degradation

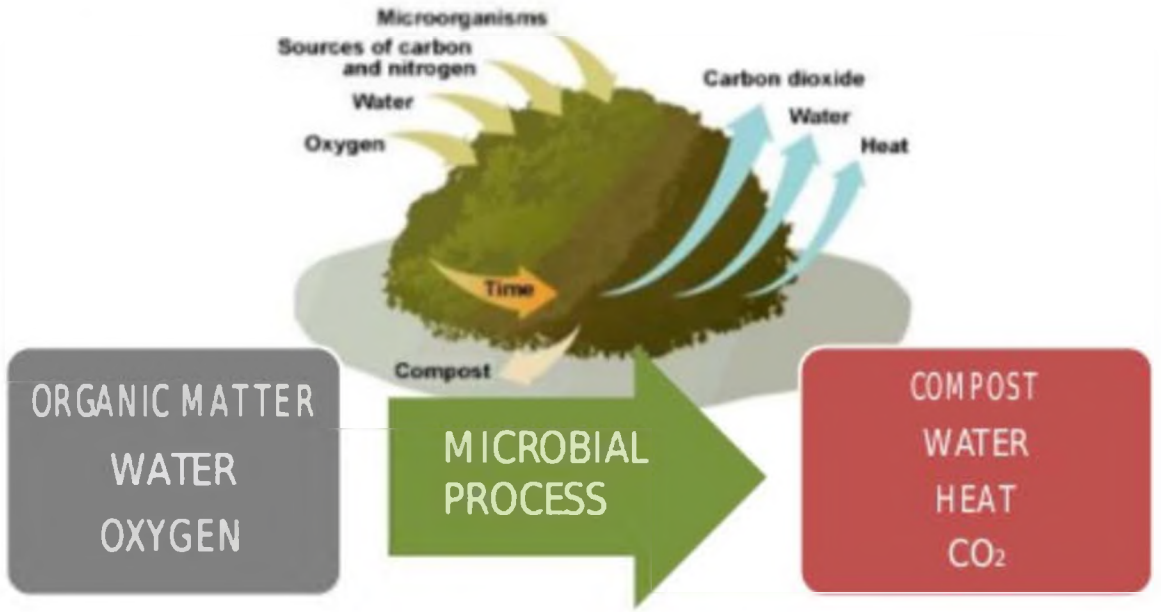




Source: FAO/UNEP

COMPOSTING PROCESS

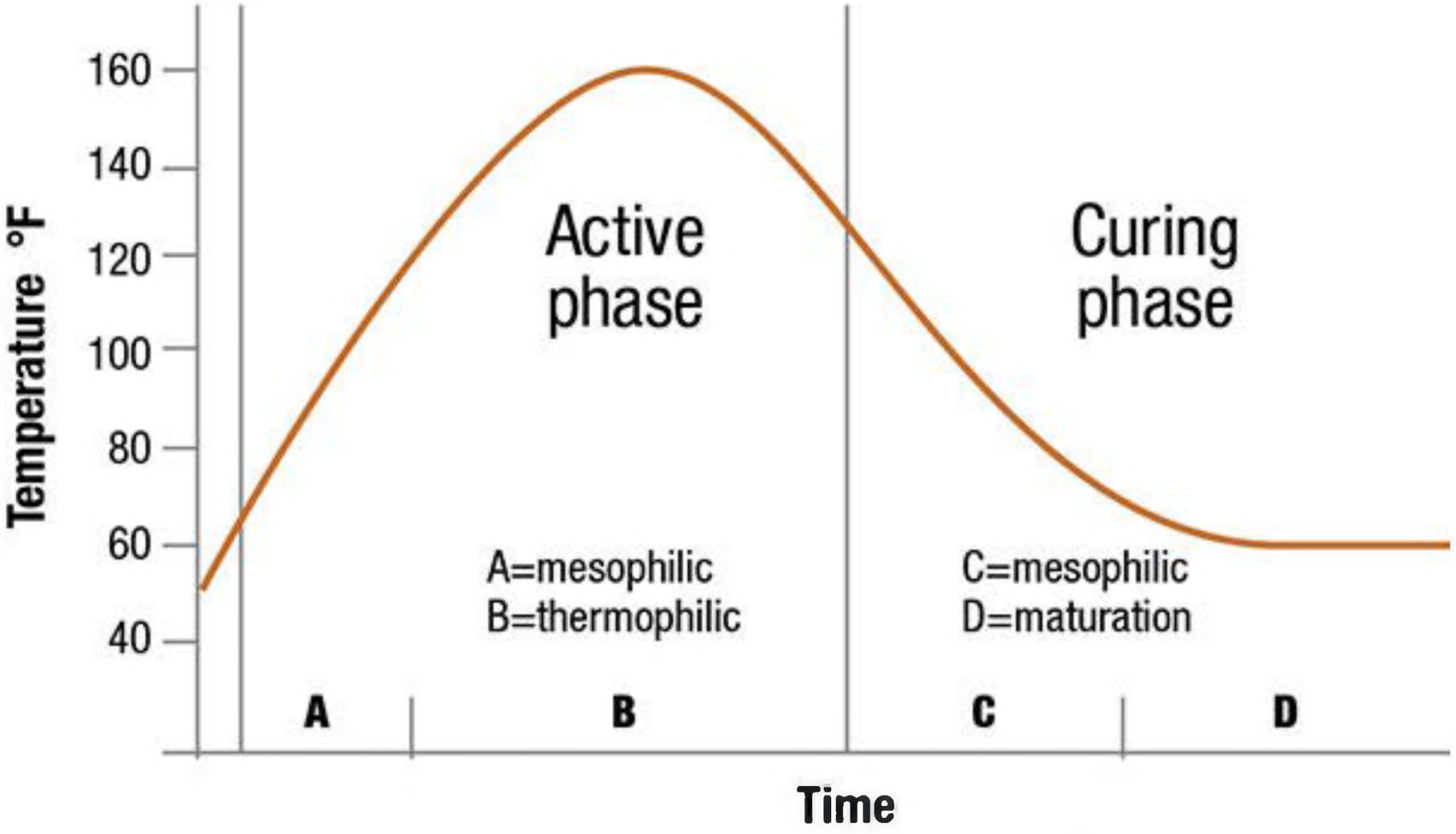
Organic waste + O_2 —Microorganisms→ CO_2 + H_2O + Heat + Compost



KEY FACTORS TO COMPOSTING

C:N Ratio	• The range between 25:1 to 40:1 → efficient process
Surface Area & Particle Size	• The smaller the size the faster the process
Aeration	• Air circulation enhances aerobic decomposition
Porosity	• Spaces between particle enable supply of oxygen
Moisture Content	• Optimum moisture content is 50% to 60%
Temperature	• Optimum temperature range is between 32°to 60° C
pH of Material	• Optimum pH ranges between 6.5 to 7.5
Nutrients	• Adequate levels of P and K are important
Toxic Substance	• Heavy metals are toxic to thermophilic bacteria

FIGURE 1 Temperature changes in an average compost pile



Composting is a biological process

Table 1.1 Microbial population changes during composting

Organism	Mesophilic Stage	Thermophilic Stage	Stabilization/ Curing Stage	No. Species Present
	(CFU g^{-1} dry mass)			
Bacteria				
Mesophile	10^8	10^6	10^{11}	6
Thermophile	10^4	10^9	10^7	1
Actinomycetes				
Thermophilic	10^4	10^8	10^5	14
Fungi				
Mesophilic	10^6	10^3	10^5	18
Thermophilic	10^3	10^7	10^6	16

From Sylvia et al (1999)

Volume shrink

When is it finished?

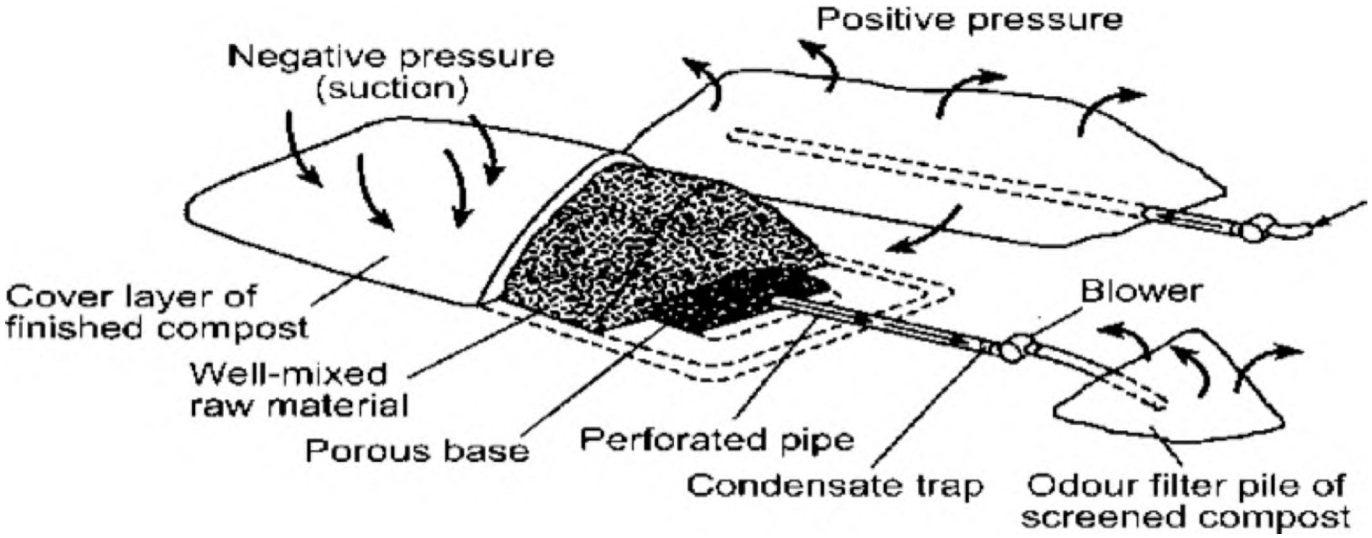
- Color is dark brown
- Crumbly, loose, and humus like
- Earthy smell
- Contains no recognizable feedstocks
- Shrunk to 1/3 it's original volume

How compost works on-farm

How compost works on-farm

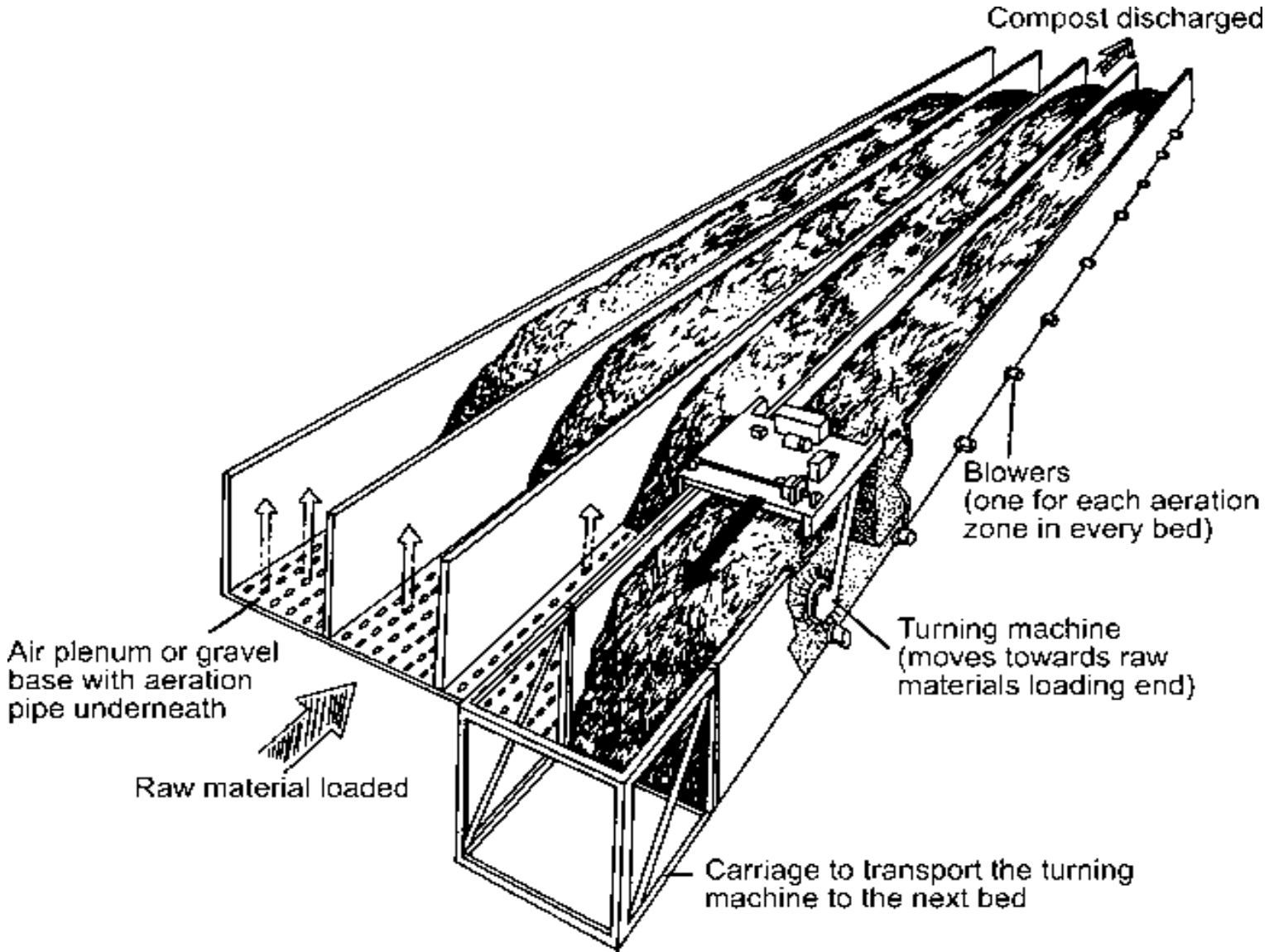
How compost works on-farm

Aerated Static Pile



Aerated windrows of material

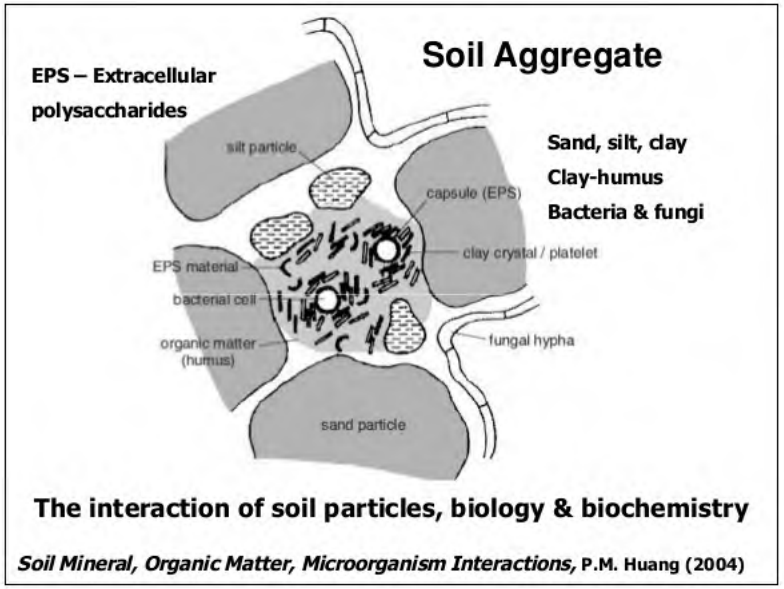
Rectangular agitated beds



In-vessel Composters

Physical Benefits of Compost

- Improves soil structure and porosity
- Increases gas and water permeability
- Improves water holding capacity
- Reduces erosion



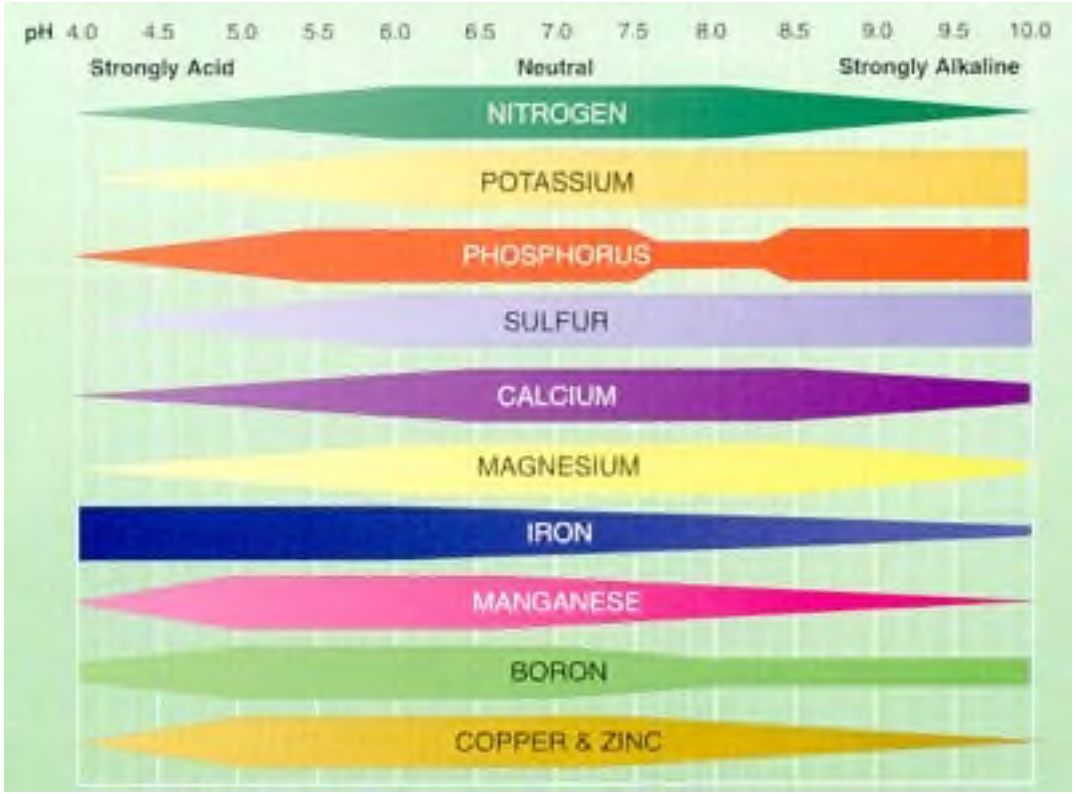
Soil Aggregation

Conventional Till No-Till Minimum till

Conventional Till No-Till Pasture

Chemical Benefits of Compost

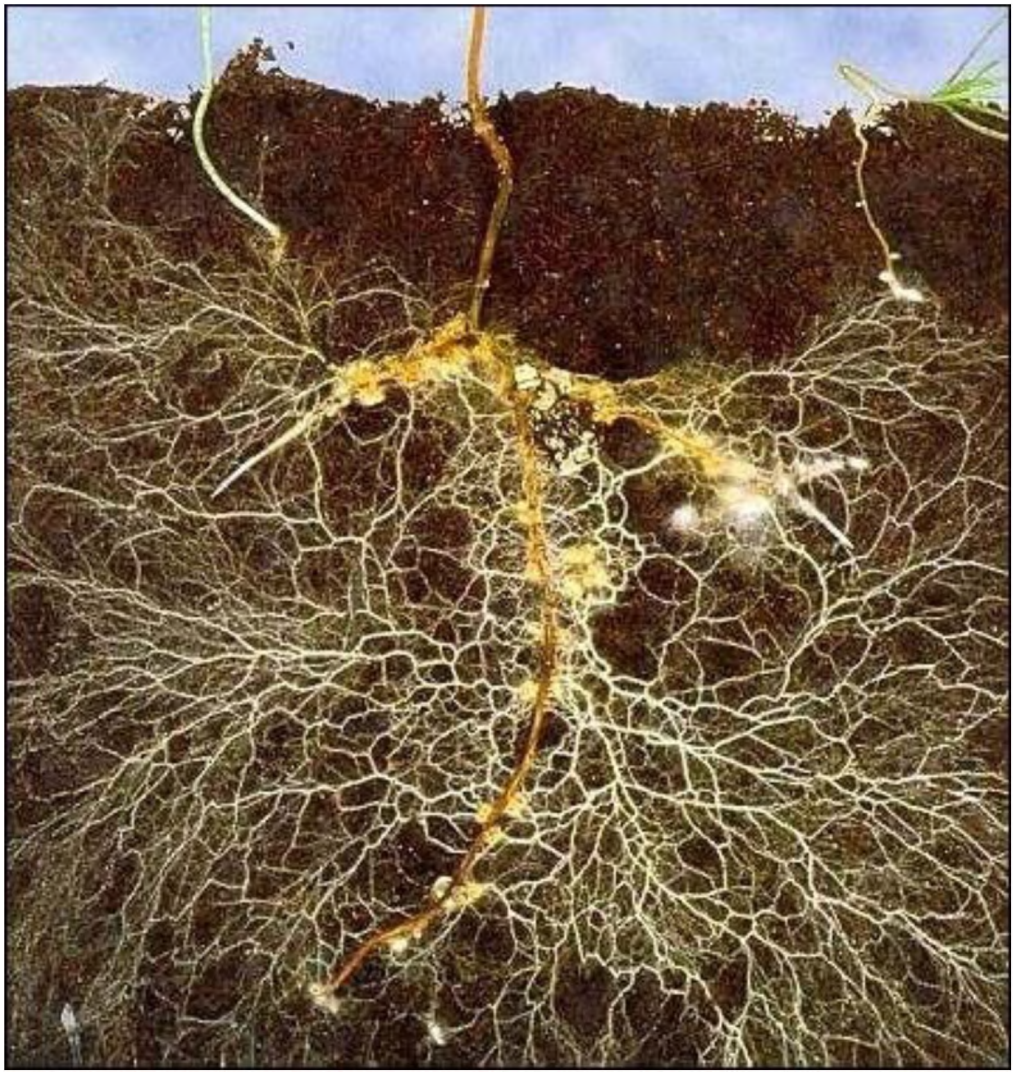
- Modifies soil pH
- Neutralizes pH
- Acts as a buffer
- Improves cation exchange (holds nutrients longer)
- Makes nutrients more available to plants

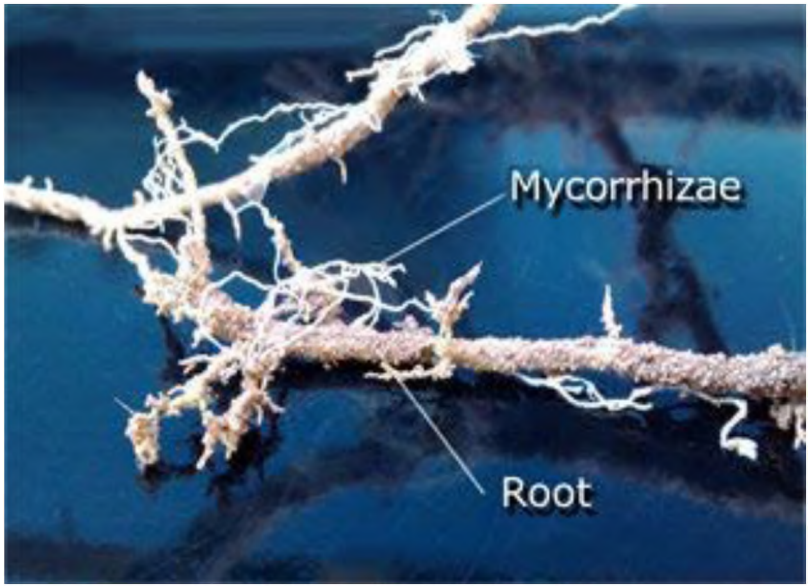


Biological Benefits of Compost

- Soil probiotic
- Rich in bacteria, protozoa, actinomycetes, and fungi
- Biology makes nutrients more available to plants
- Suppresses plant disease

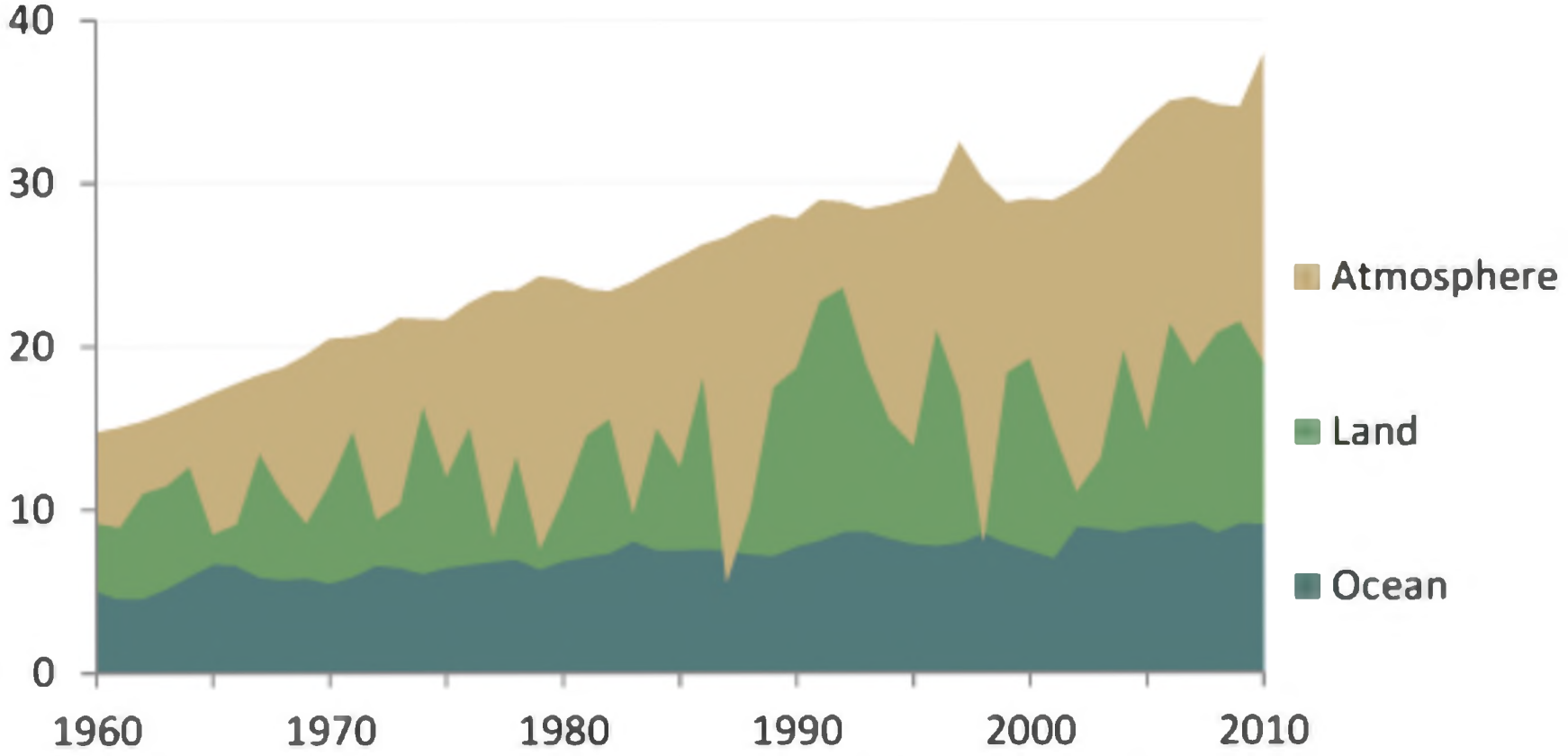
Mycorrhizae Fungus





Sinks for Global Carbon Emissions

Annual sink absorption of human carbon emissions (Gt CO2)



Data: Global Carbon Project and CDIAC

shrinkthatfootprint.com

Nutrient Cycling in Agroecosystems
June 2005, Volume 72, Issue 2, pp 173–187 | Cite as

Quantifying the Reduction of Greenhouse Gas Emissions as a Resultof Composting Dairy and Beef Cattle Manure

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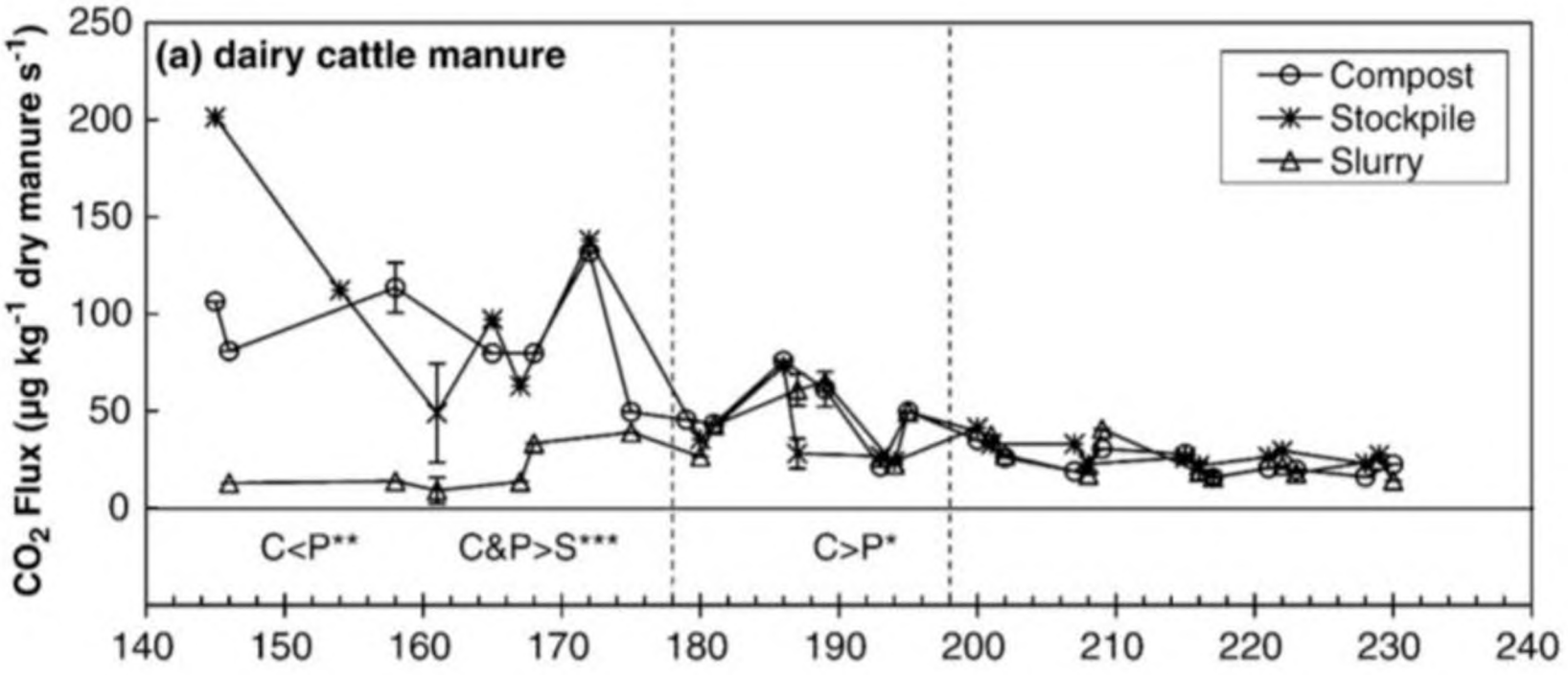

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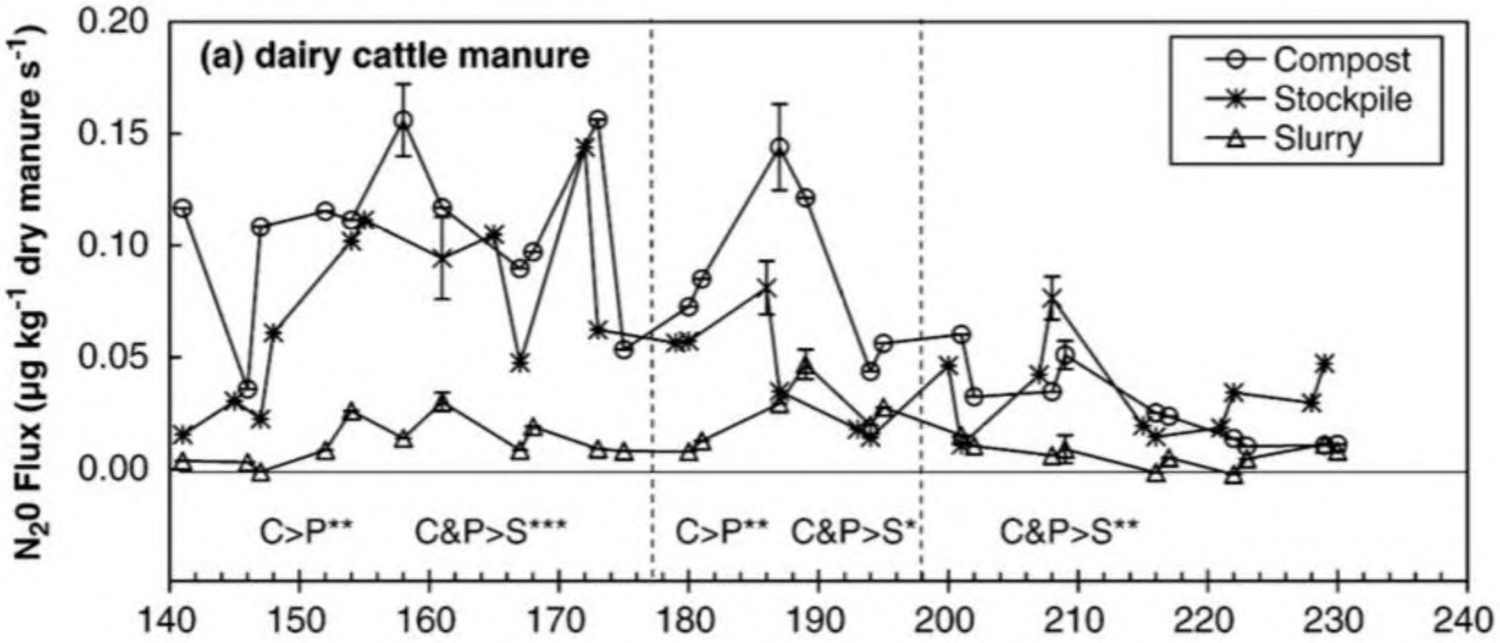

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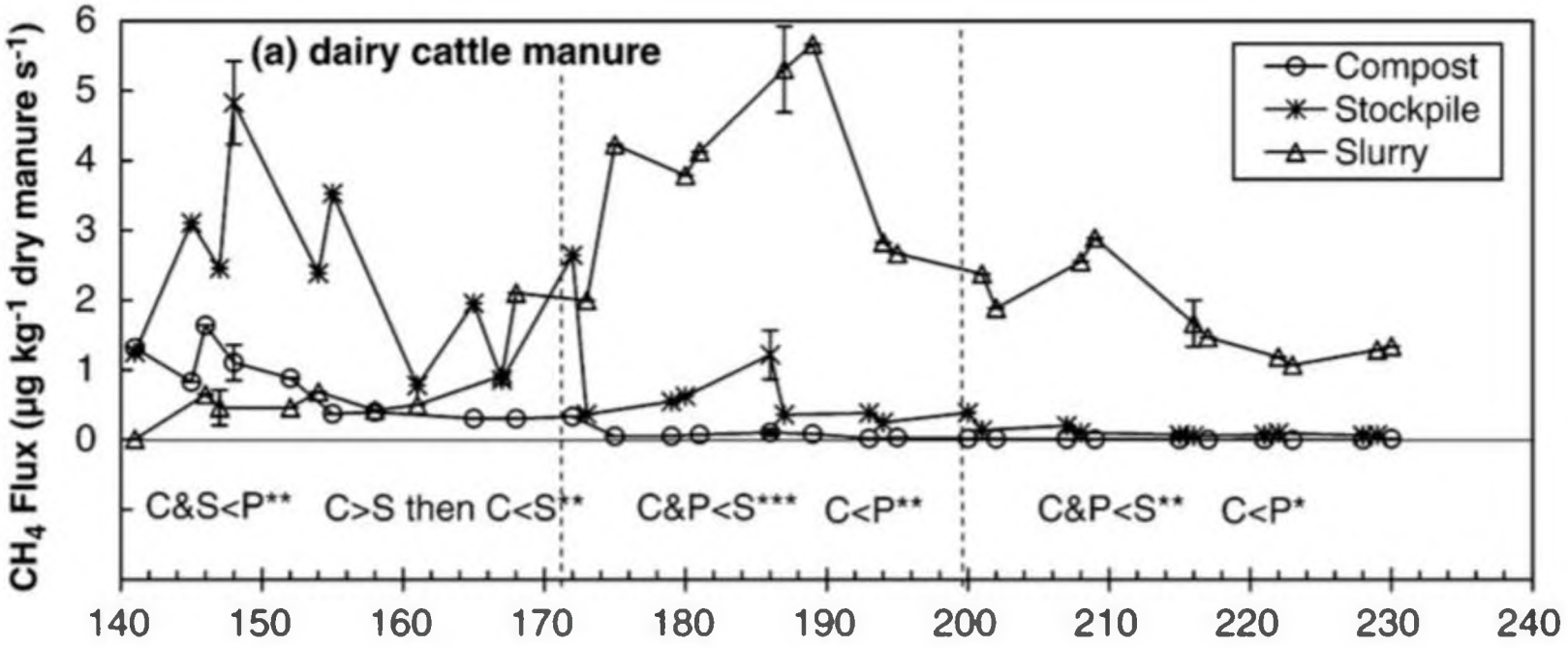


Soil is a methane sink

Soil carbon - can it save agricultures bacon?
Christine Jones, PhD
www.amazingcarbon.com

Aerobic soils are net sinks for methane, due to the presence of methanotrophic bacteria, which utilize methane as their sole energy source (Dunfield 2007).

Soil is a methane sink

Professor Mark Adams, Dean of the Faculty of Agriculture at Sydney University, found that one hectare of pasture land could oxidize as much methane as emitted by 162 head of cattle in an entire year (Cawood 2009).

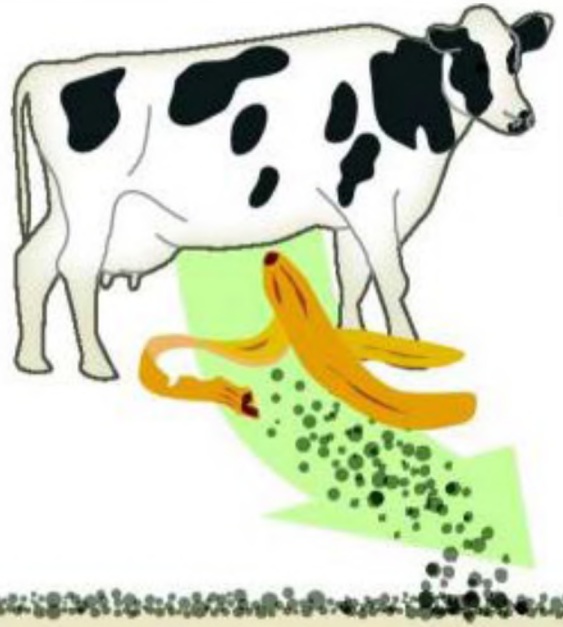
The highest methane oxidation rate recorded in soil to date has been 137mg/m_2/day (Dunfield 2007) which, over one hectare, equates to the absorption of the methane produced by approximately 1000 head of cattle.

Burying carbon

The "carbon farming" technique restores overgrazed rangelands into fertile fields by using photosynthesis to pull in carbon dioxide from the atmosphere and store it in the soil.

COMPOST

Green waste, everything from household scraps to cow manure, creates a nutrient-rich compost.



PHOTOSYNTHESIS

❷ Plants draw in carbon dioxide from the atmosphere.

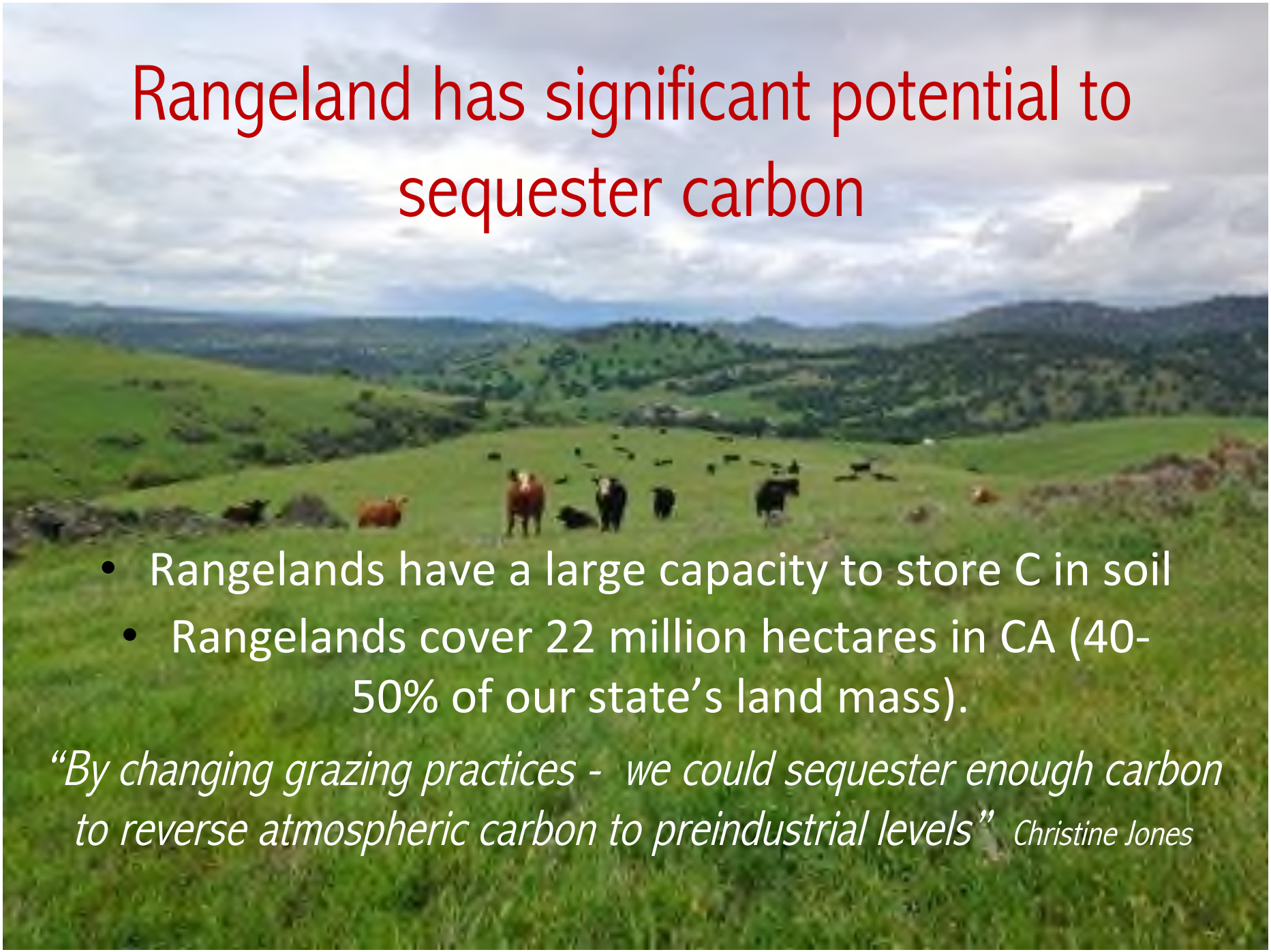
❸ Through photosynthesis, oxygen is released and carbon is transferred to the soil through the plants' roots.

❶ A thin layer of compost stimulates plant growth.

Research has shown that carbon is stored in the ground for at least six years and possibly up to several decades.

John Blanchard / The Chronicle

Rangeland has significant potential to sequester carbon



- Rangelands have a large capacity to store C in soil
- Rangelands cover 22 million hectares in CA (40-50% of our state's land mass).

"By changing grazing practices - we could sequester enough carbon to reverse atmospheric carbon to preindustrial levels" Christine Jones

Carbon Marin Project

Carbon Impact by Field Treatment

Carbon Sequestration (kg C / ha /year)

David C. Johnson- NMSU Institute for Sustainable Agricultural Research (ISAR)
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New Mexico State University

August 29, 2017

New Mexico State University

Regenerative Agriculture as a solution to Climate Change

Cover crops, green manure & crop rotation

Compost and animal manures.

No-till/ Minimum Tillage

Managed Adaptive Multi-paddock

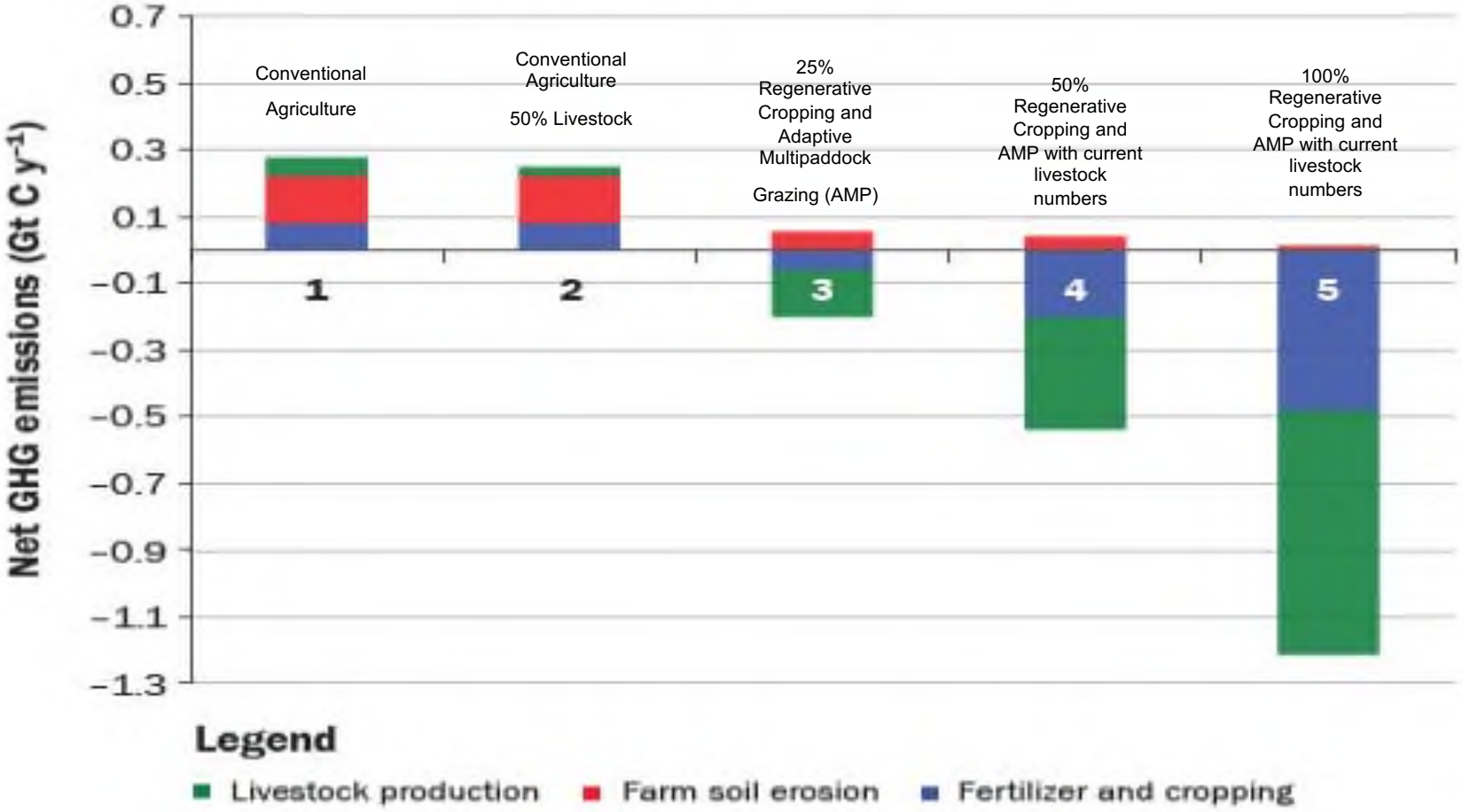
Richard Teague, et al., Texas A&M University

The role of ruminants in reducing agriculture's carbon footprint in North America

Journal of Soil & Water Conservation (2016) 71(2), 156 - 164

Figure 2

Hypothetical North American net greenhouse gas (GHG) emission scenarios for: (1) current agriculture; (2) current agriculture with 50% current ruminants; (3) 25% conservation cropping and adaptive multipaddock (AMP) grazing with current numbers of ruminants; (4) 50% conservation cropping and AMP grazing with current numbers of ruminants; and (5) 100% conservation cropping and AMP grazing with current numbers of ruminants.



Thank you.