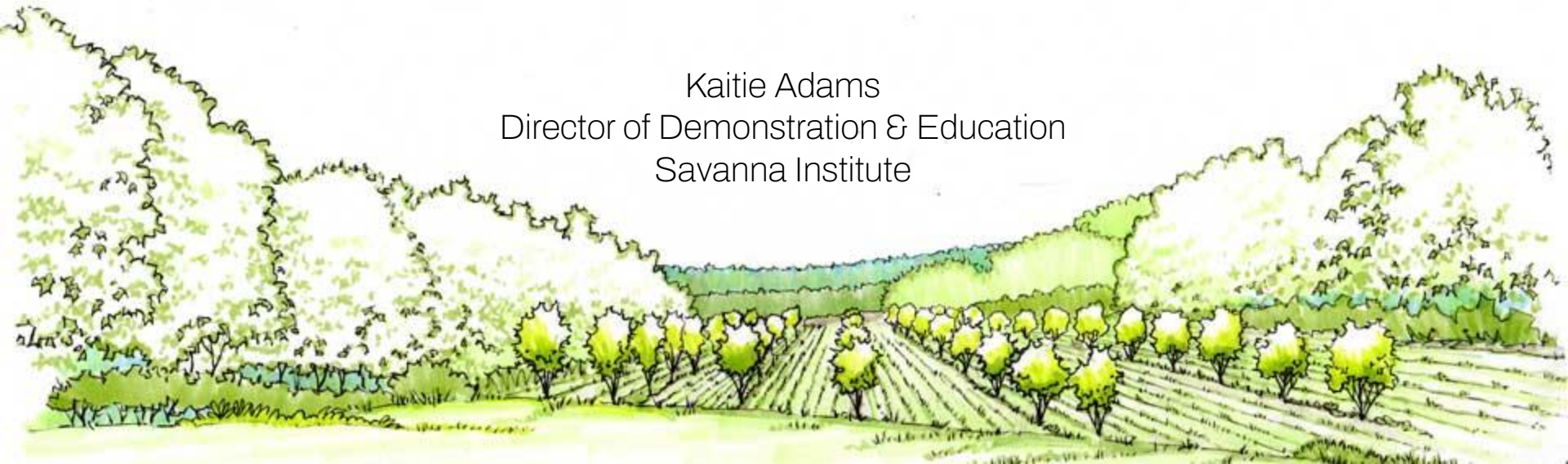


# Trees as Powerful Climate Allies

*Unit 17 Extension Master Naturalist Annual Meeting  
March 28th, 2022*

Kaitie Adams  
Director of Demonstration & Education  
Savanna Institute





**Inspired by the oak savanna ecosystem native to the region, the Savanna Institute conducts research, education, and outreach to support the growth of diverse, perennial agroecosystems in the upper Midwest.**

[savannainstitute.org](https://savannainstitute.org)



# Agroforestry

An integrated approach to farming with trees and livestock that produces many benefits for people and the land.



Healthy, local food

Clean air

Provides wildlife habitat

Diversifies farm income

Sustainable communities



Improves livestock comfort

Prevents erosion

Purifies water

Sequesters carbon

Captures fertilizer and pesticide

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# Who was here before ?



*The Illinois farmlands where I work and am a guest, are the unceded homelands and territories of the Piankashaw, Wea, Mascoutin, Odawa, Sauk, Meskwaki, Potawatomi, Ojibwe, Kiikaapoi, Peoria, Kaskaskia, Myamia, and Očhéthi Šakówinj peoples.*

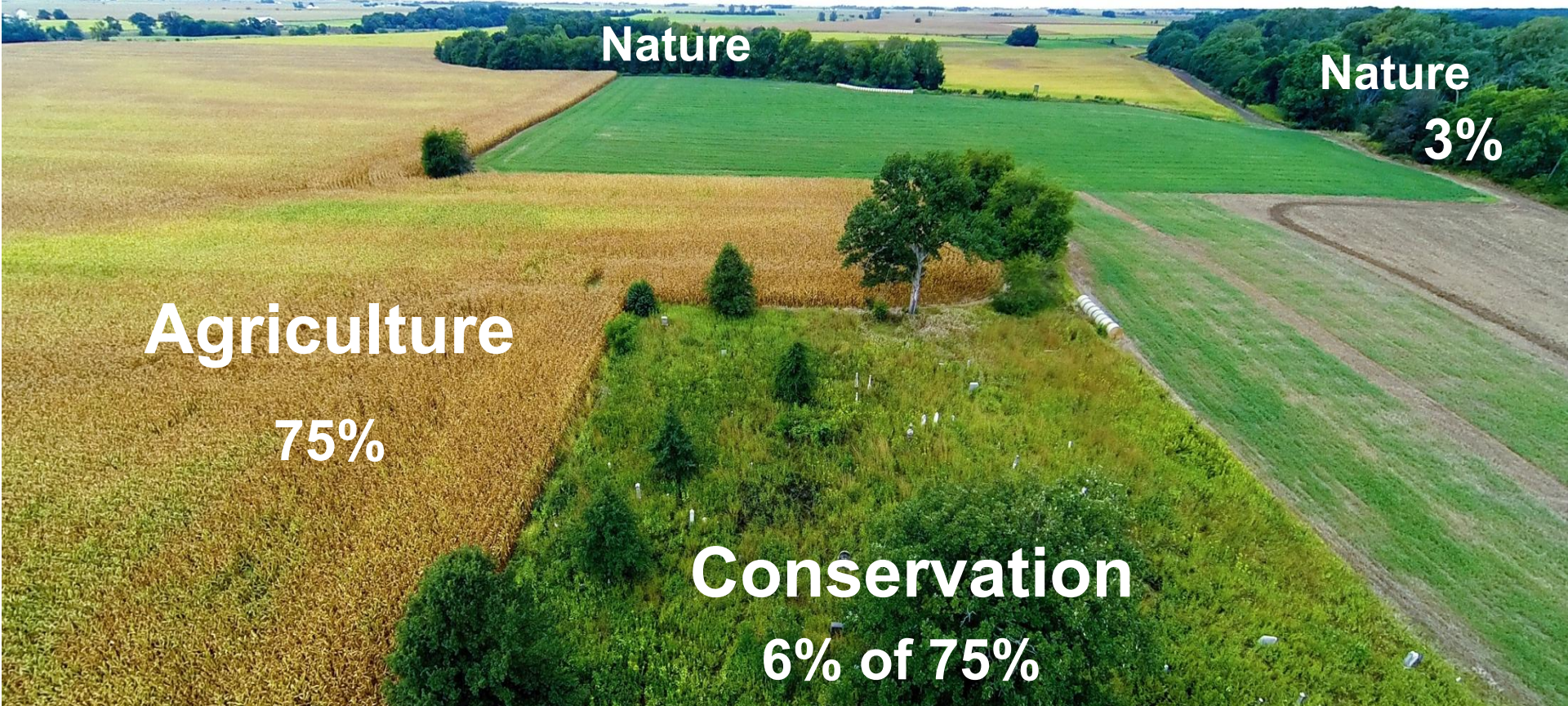
*Currently, east central Illinois represents the heart of America's corn and soybean belt and contains some of the nation's most valuable agricultural land. The area, however, was not always viewed favourably, for initially this was a landscape stigmatized for its sloughs, swamps, and presence of malaria, making it a region which repelled travelers.*

Roger A. Winsor, Environmental imagery of the wet prairie of east central Illinois, 1820–1920, *Journal of Historical Geography*, Volume 13, Issue 4, 1987, Pages 375-397,



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**Nature**

**Nature**  
**3%**

**Agriculture**

**75%**

**Conservation**

**6% of 75%**

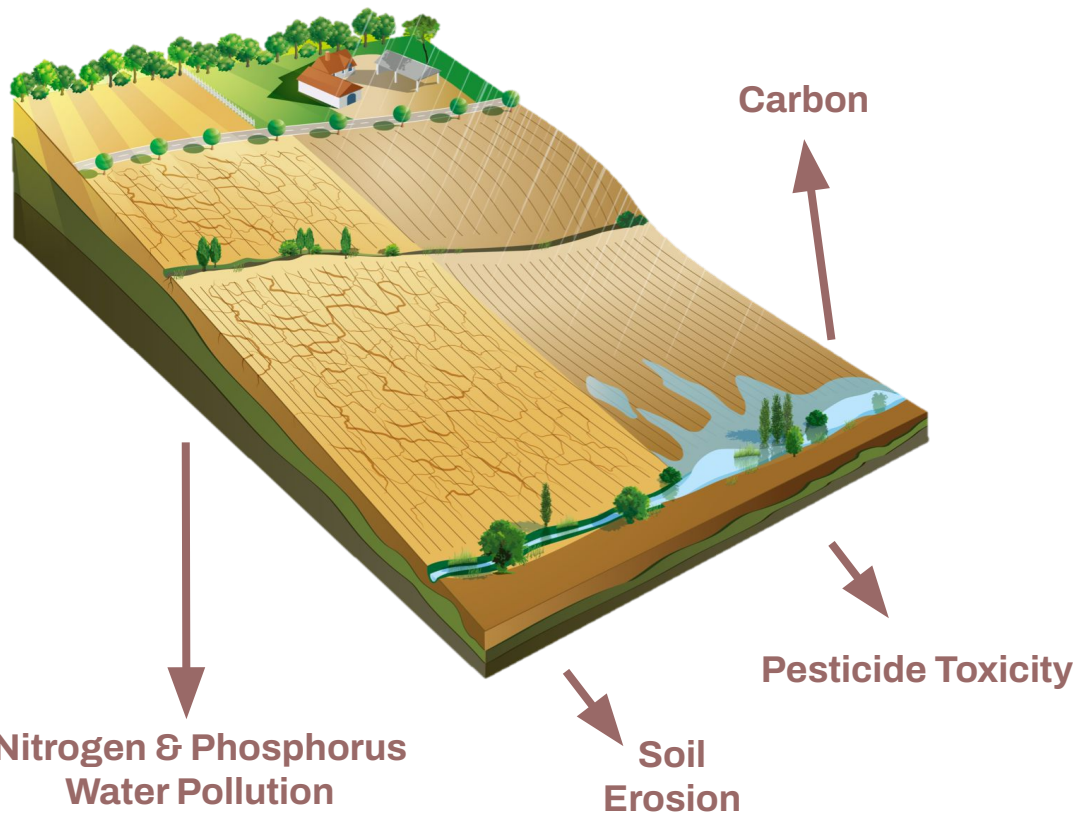


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# The Root of the Matter

Source: ©Association Française d'Agroforesterie

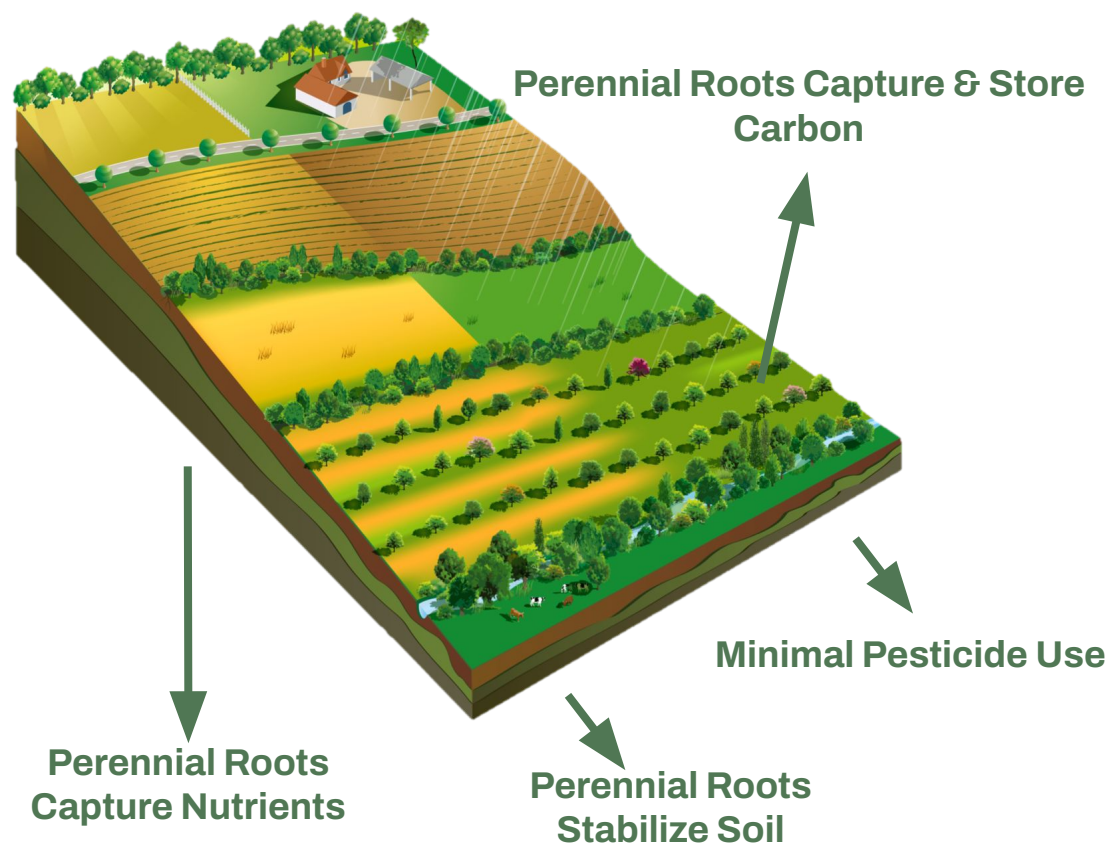


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# Roots Matter

Source: ©Association Française d'Agroforesterie



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**Okay, but what do trees have to do with this? How can they help?**

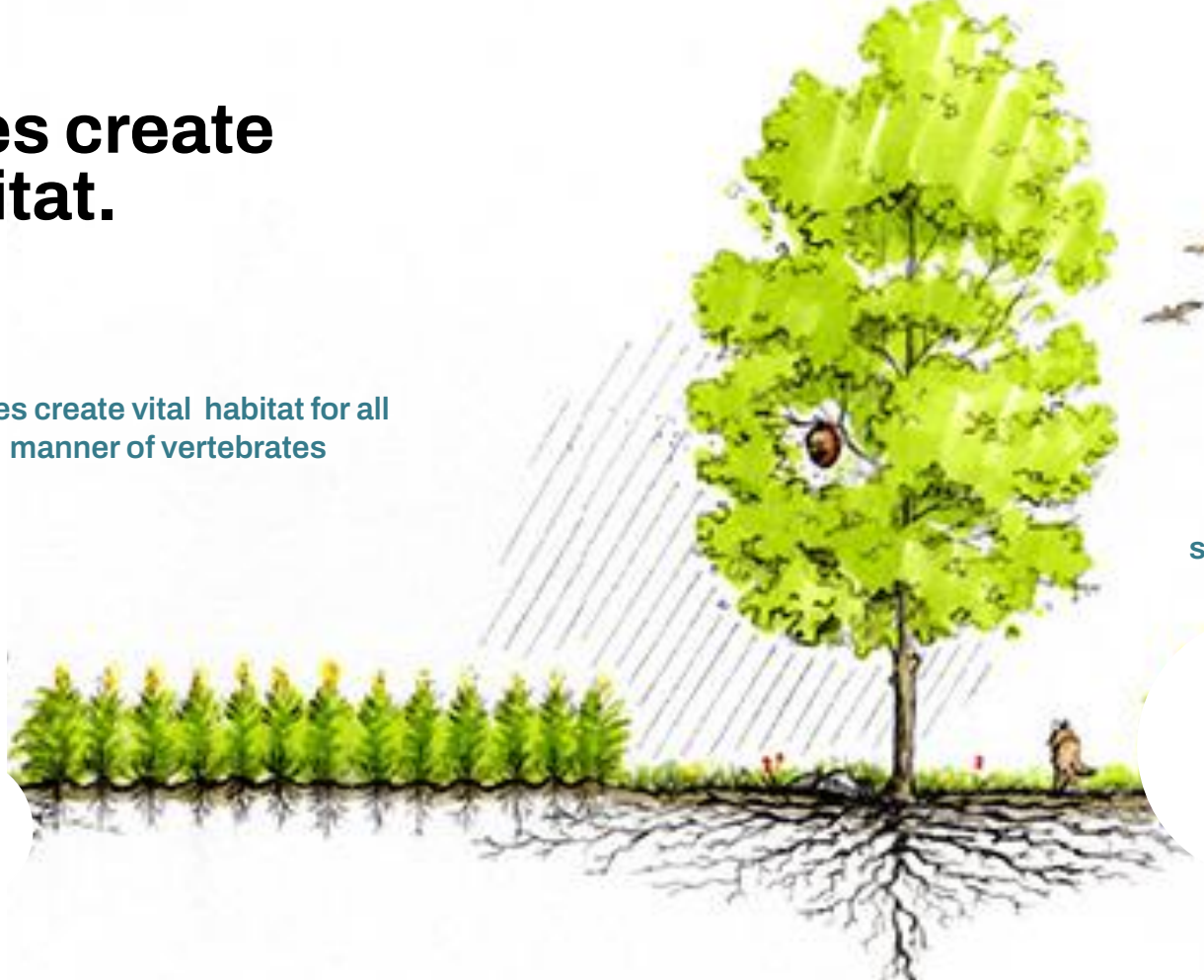




# Trees create habitat.



Trees create vital habitat for all manner of vertebrates

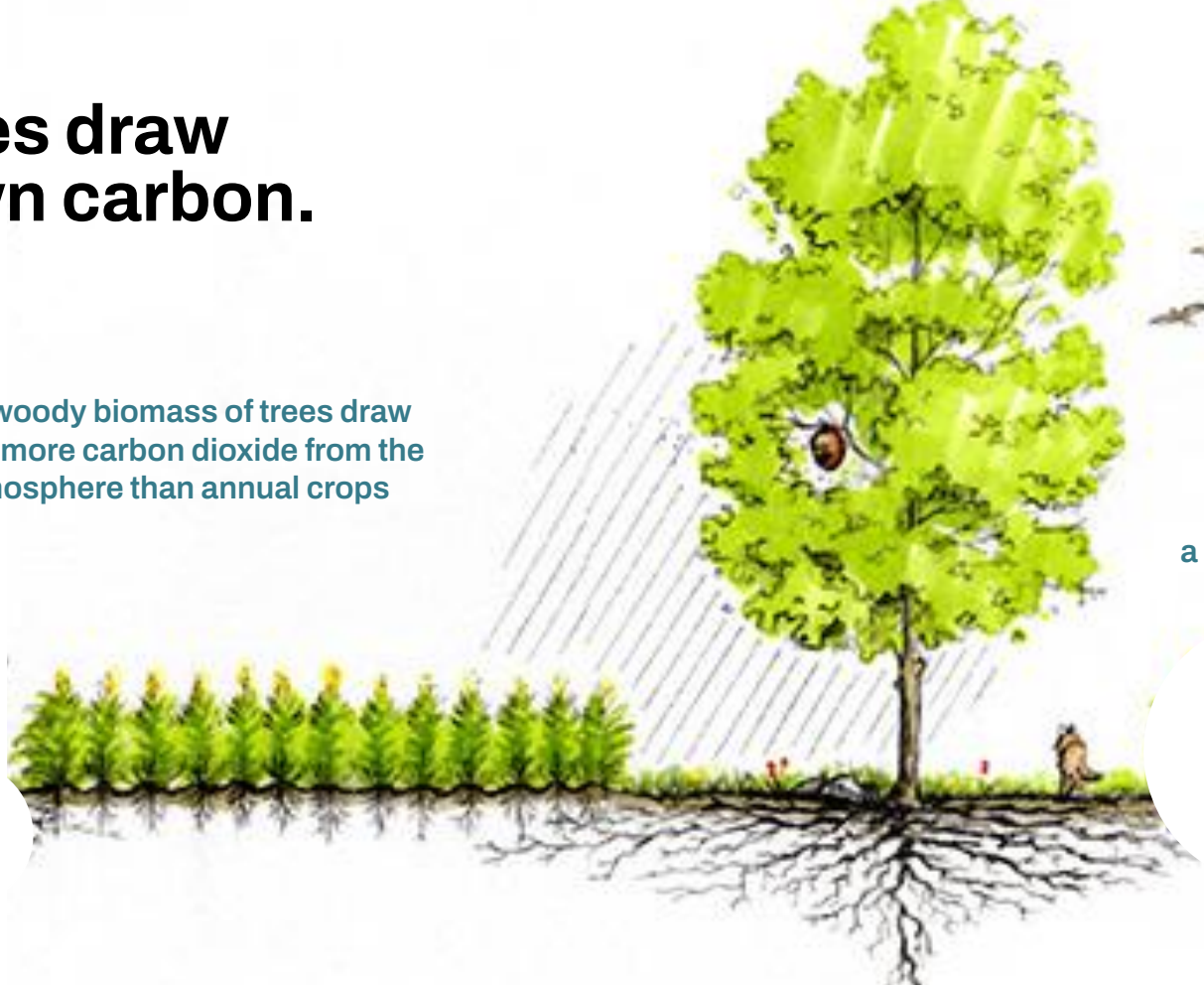


Trees increase biodiversity and supports both above ground and below ground communities of life

Trees support increased pollinator populations

# Trees draw down carbon.

The woody biomass of trees draw down more carbon dioxide from the atmosphere than annual crops

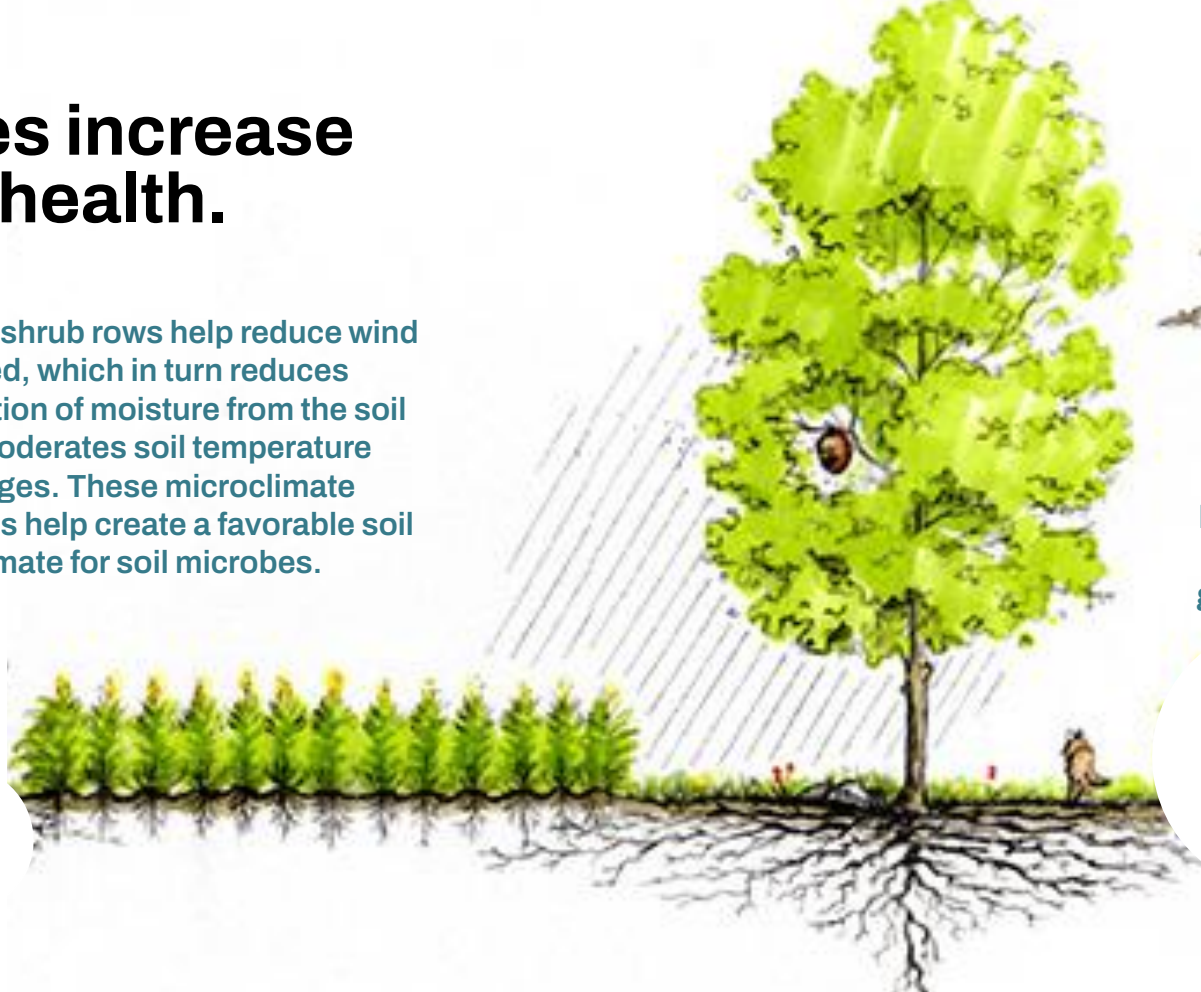


Forests and trees release less nitrous oxide, a greenhouse gas contributing to climate change

Deep tree roots sink more carbon into the soil at a deeper level

# Trees increase soil health.

Tree and shrub rows help reduce wind speed, which in turn reduces evaporation of moisture from the soil and moderates soil temperature changes. These microclimate influences help create a favorable soil climate for soil microbes.



Agroforestry systems create beneficial microclimates that help improve crop growth, yield and quality. This increased growth helps produce additional organic matter in the soil.

Deep tree roots support more robust nutrient cycling to support both tree and crop growth

# Trees improve water quality



Trees slow runoff, encouraging deposition and infiltration



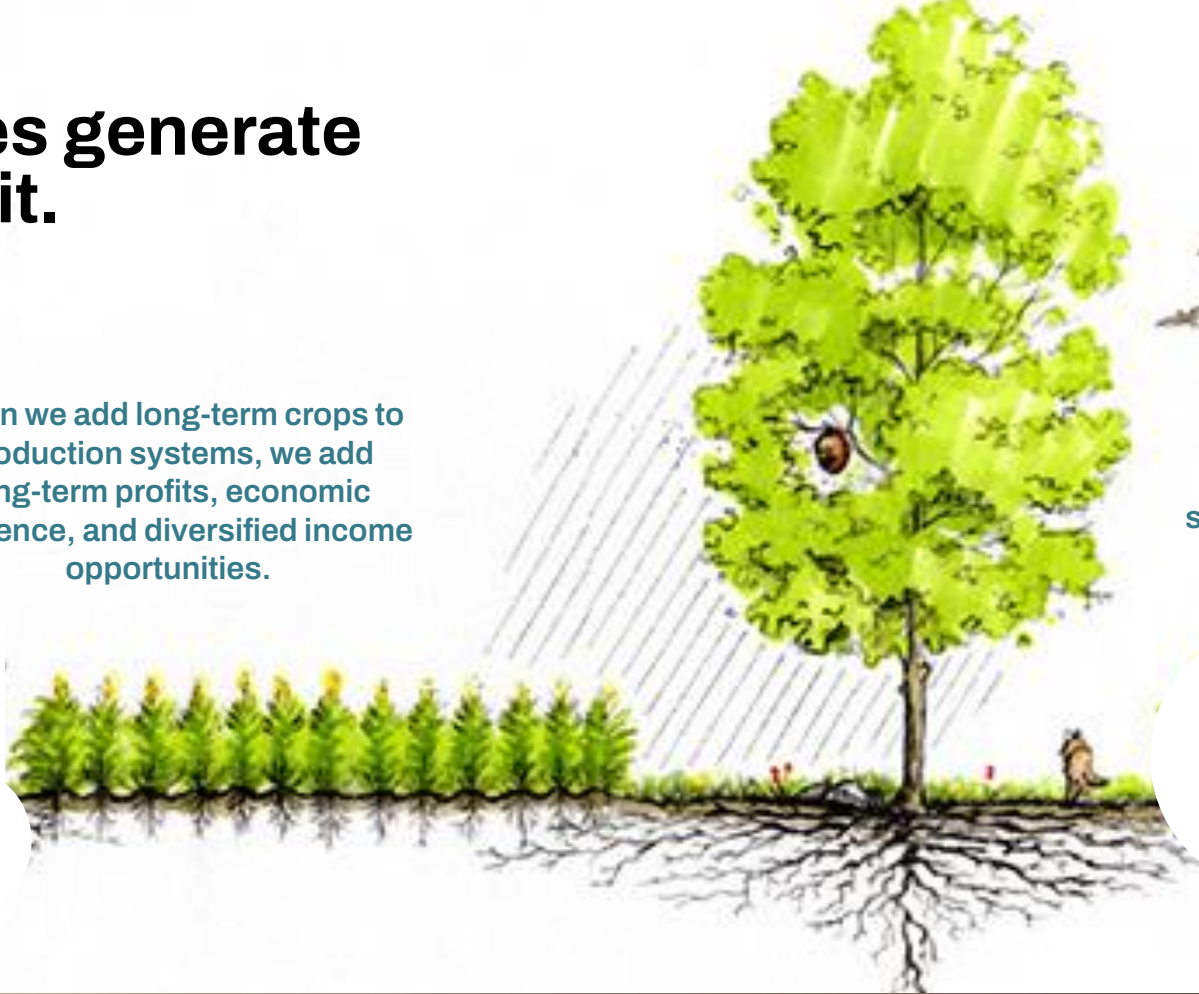
Nutrients from runoff are taken up by woody plants. Water and oxygen are released into the atmosphere

Contaminants and nutrients are processed by plants and microbes

# Trees generate profit.



When we add long-term crops to production systems, we add long-term profits, economic resilience, and diversified income opportunities.



Tree based agricultural systems allow farmers to stack multiple enterprises on one landscape and open opportunity for multi-party systems and family succession.

There are multiple paths to fund establishment and cash flow the large upfront cost of perennial systems.

# AGROFORESTRY



An integrated approach to farming with trees and livestock that can produce many benefits for people and the land.

Healthy, local food

Clean air

Provides wildlife habitat

Diversifies farm income

Sustainable communities



Improves livestock comfort

Prevents erosion

Purifies water

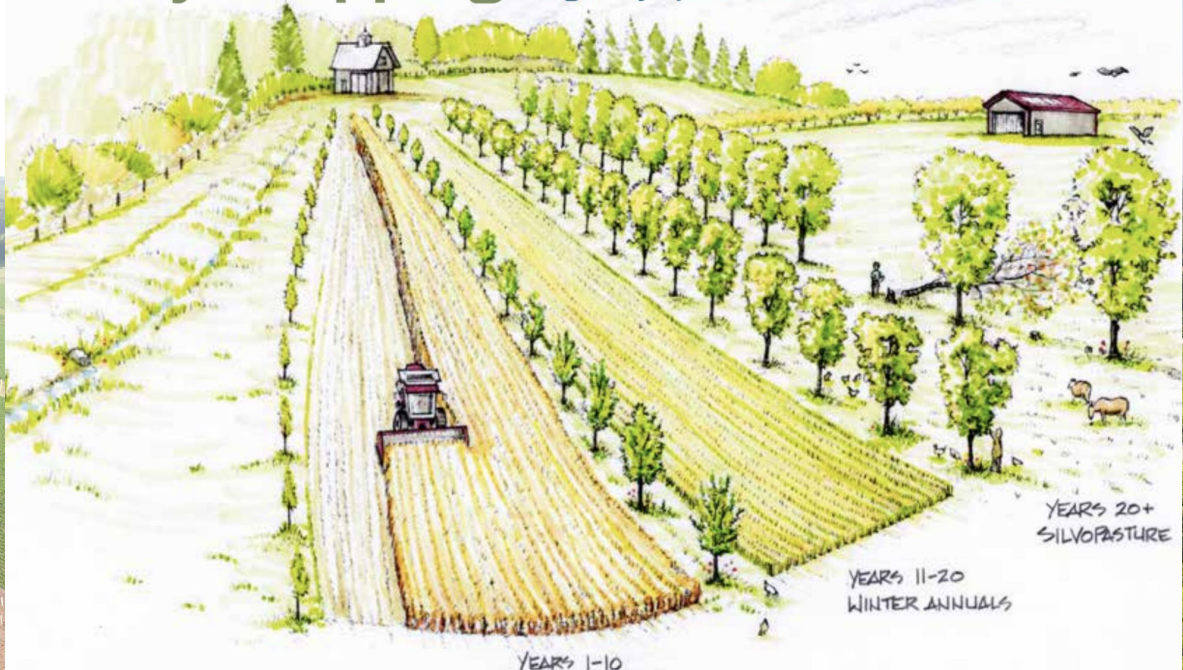
Sequesters carbon

Captures fertilizer and pesticide

# What is agroforestry?

## Alley Cropping

The cultivation of crops in the alleys between regularly spaced rows of trees or shrubs.



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What is  
agroforestry?

## Silvopasture

The intentional integration of trees, pasture, and livestock, managed as a single system.



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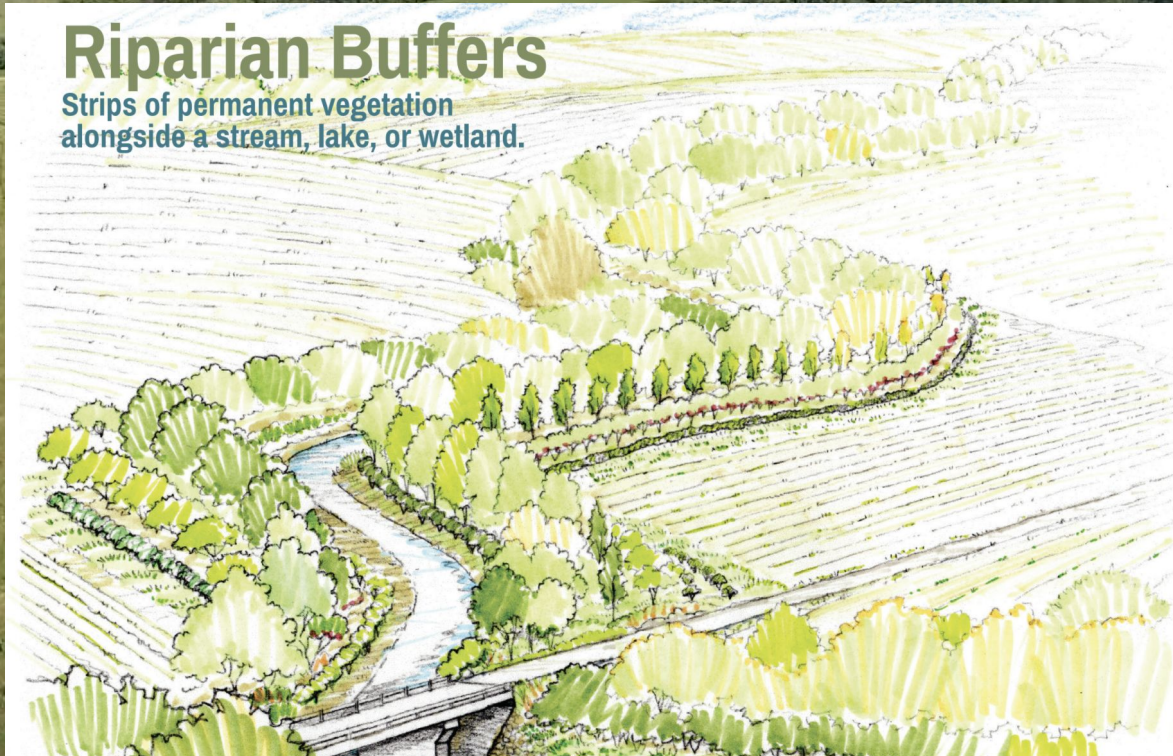
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What is  
agroforestry?

## Riparian Buffers

Strips of permanent vegetation  
alongside a stream, lake, or wetland.



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# What is agroforestry?

## Windbreaks

Strips of trees and shrubs designed to enhance crop or livestock production while providing conservation benefits.



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# What is agroforestry?

## Forest Farming

The cultivation of specialty crops under existing forest canopies.



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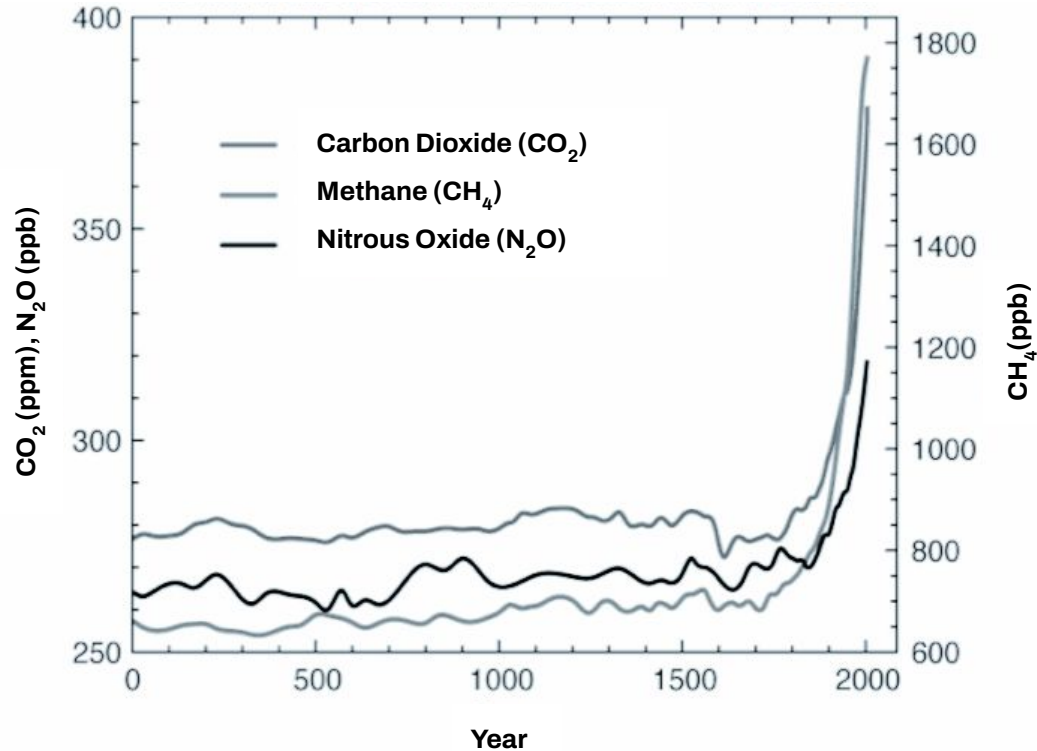
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**What does that have to do with climate?**

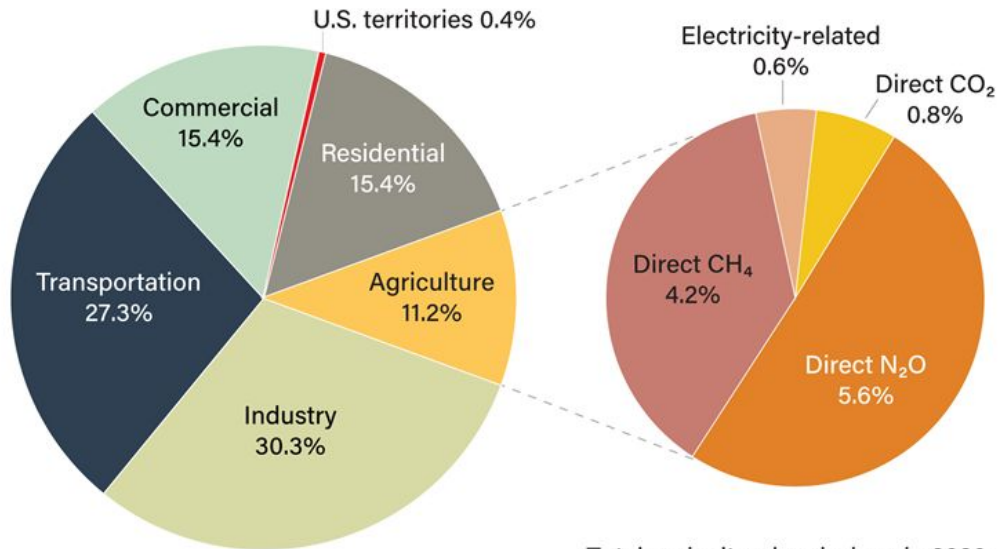




# Concentration of Greenhouse Gases from 0 to 2005



# Estimated US Greenhouse Gas Emissions by Sector, 2020



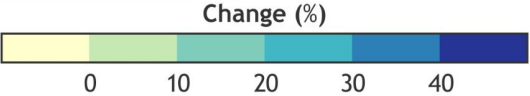
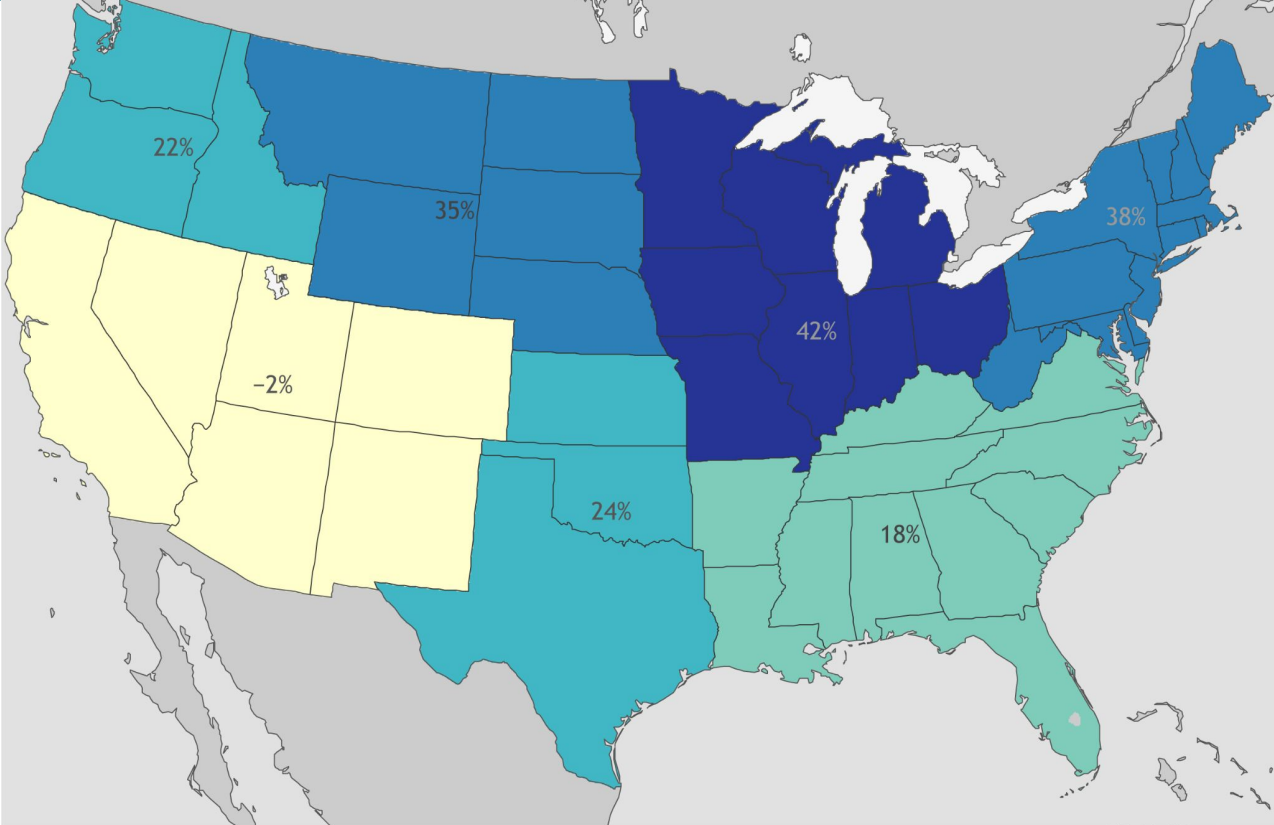
Total U.S. emissions in 2020  
= 5,981 million metric tons of  
carbon dioxide equivalent

Total agricultural emissions in 2020  
= 670 million metric tons of carbon  
dioxide equivalent

Notes: CH<sub>4</sub> = methane. N<sub>2</sub>O = nitrous oxide. CO<sub>2</sub> = carbon dioxide. Carbon dioxide emissions associated with electricity consumption are allocated to each end-use sector in the left pie chart.



# Observed Change in Extreme Precipitation by 1901-2016



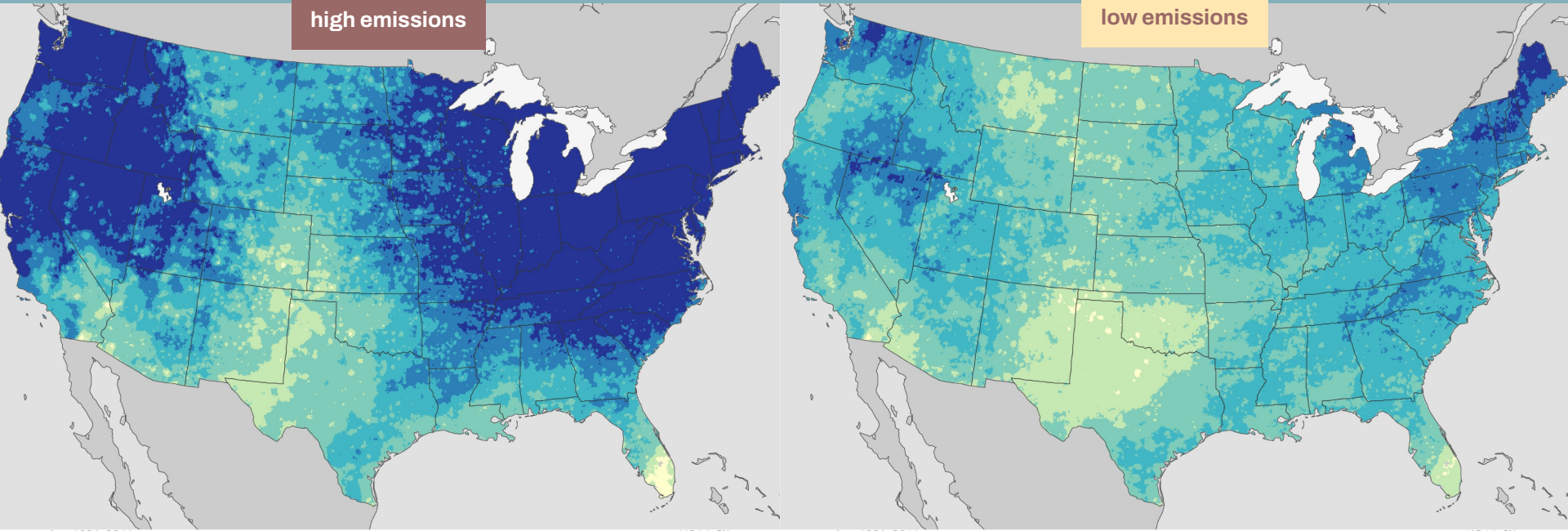
Source: NOAA Climate.gov, Data: NCA4



# Predicted Extreme Precipitation Change by 2100

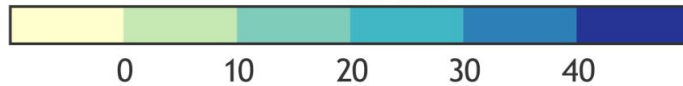
high emissions

low emissions



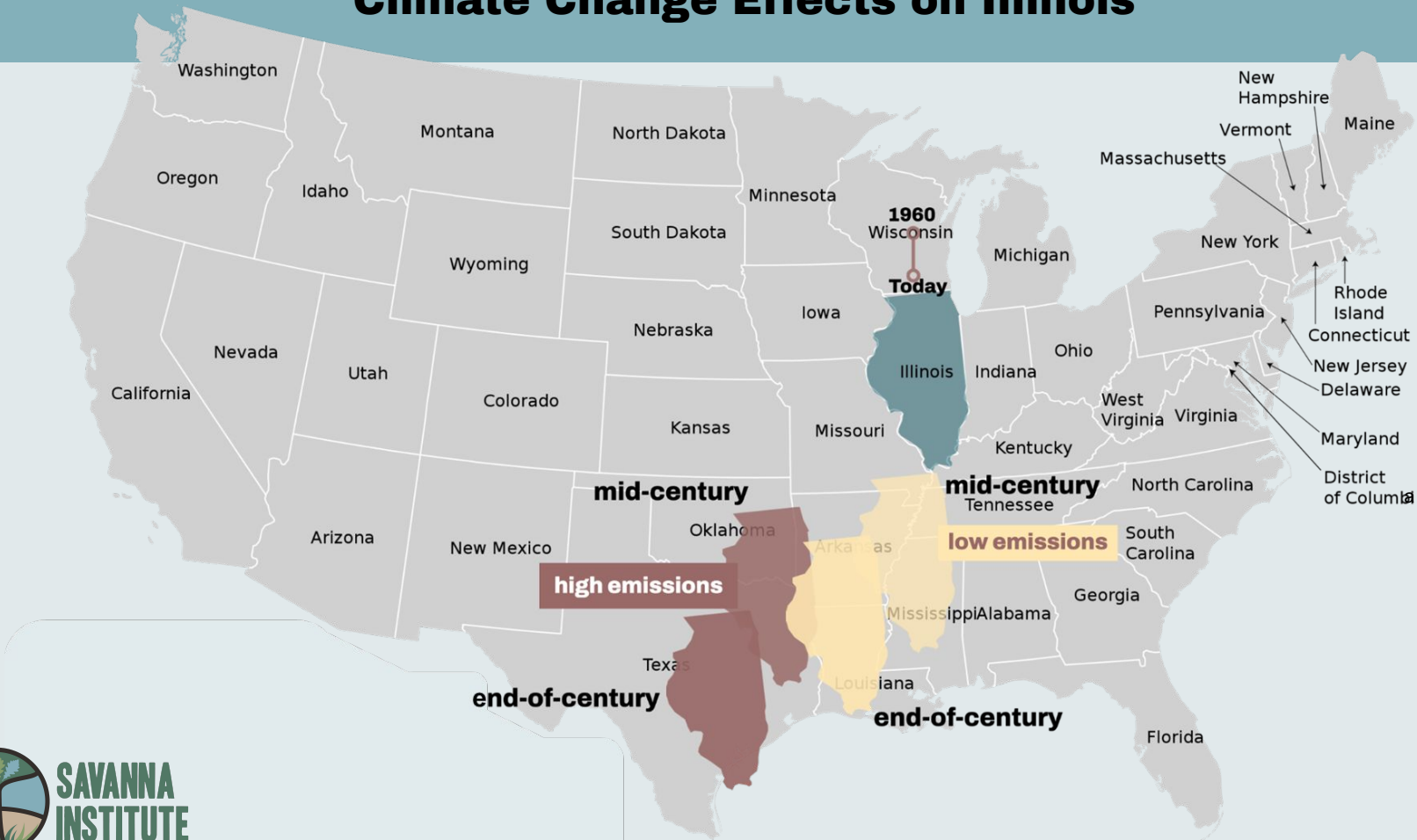
compared to 1986-2016

Change (%)



Source: NOAA Climate.gov, Data: NCA4

# Climate Change Effects on Illinois

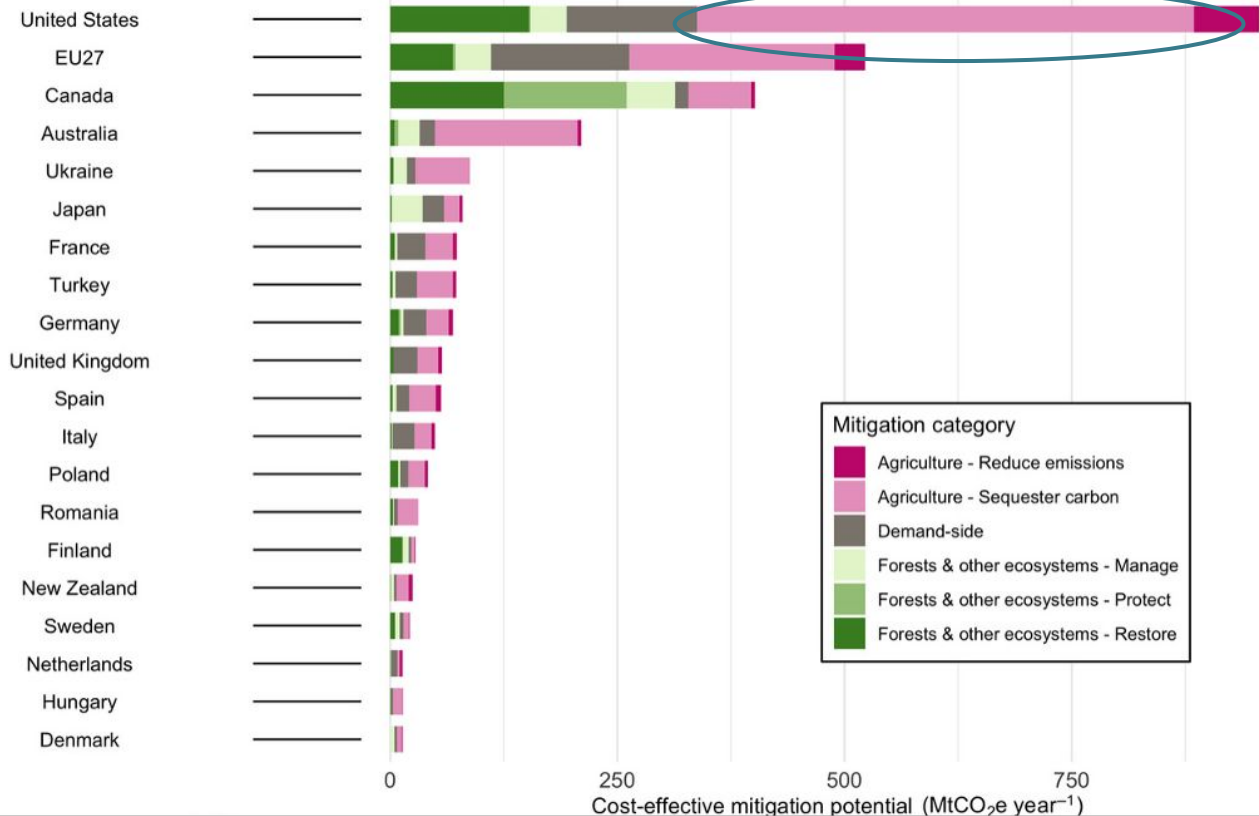


Source: United States Global Change Research Program (2009)

# Climate Potential

US agriculture has the potential to capture massive amounts of carbon from the atmosphere.

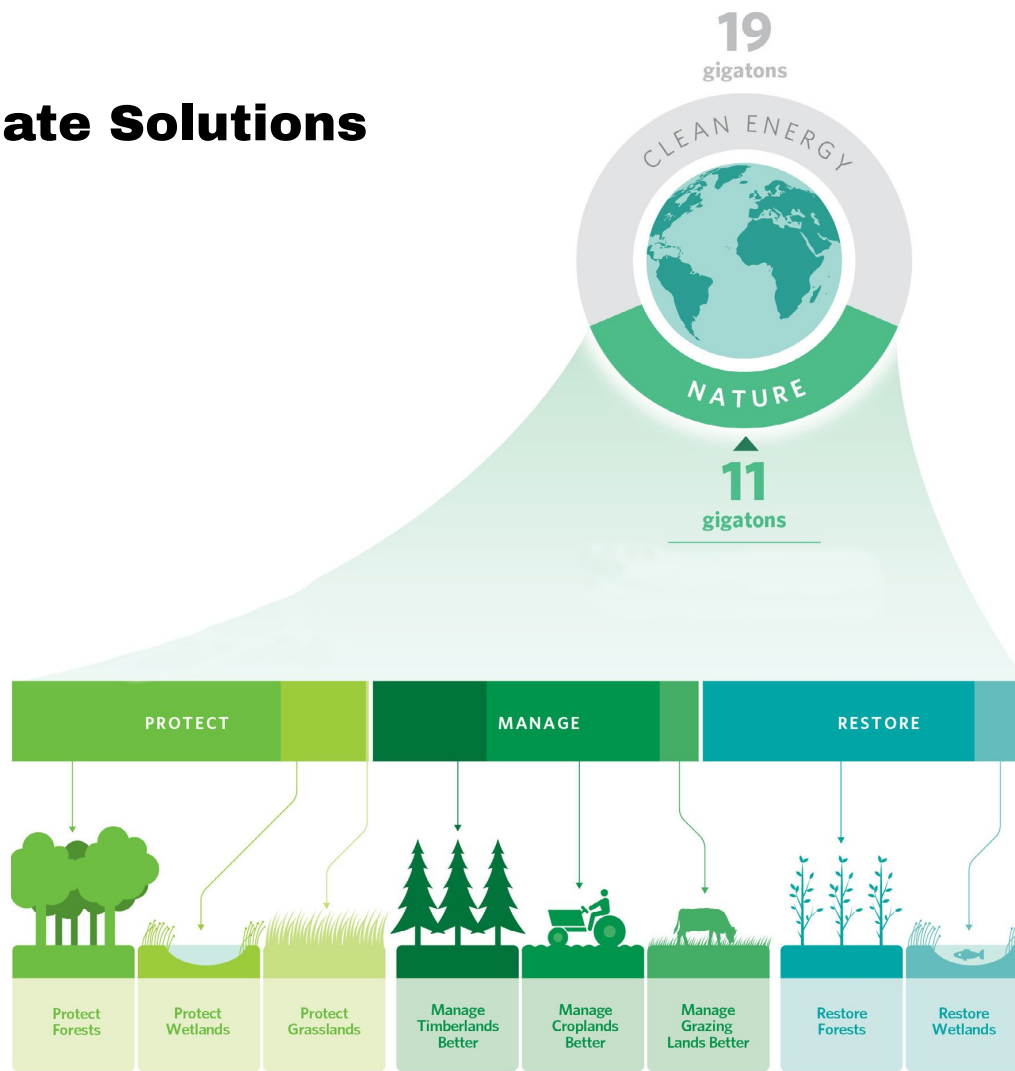
Source: Land-based measures to mitigate climate change: Potential and feasibility by country, Global Change Biology, Volume: 27, Issue: 23 Pages: 6025-6058, First published: 11 October 2021, DOI: (10.1111/gcb.15873)



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# Natural Climate Solutions are key



US Nature  
4Climate



Source: Griscom et al (2007)

## USA Farms & Ranch NCS Pathway Mitigation Potential

<b>Carbon Sequestration Activities</b>	<b>Millions of tons of CO<sub>2</sub>/ year</b>	<b>Million Acres</b>
<b>Cropland Strategies</b>		
Cover crops <sup>1</sup>	86 to 113	323
Cropland nutrient management <sup>1</sup>	46 to 144	396
Trees in cropland <sup>2</sup>	71	39
Biochar <sup>3</sup>	95	NA
<b>Rangeland &amp; Grassland Strategies</b>		
Restoration of marginal croplands to grasslands <sup>3</sup>	9	5
Avoided grassland conversion <sup>3</sup>	107	2 (per year)
Trees in pasture <sup>2,4</sup>	87-188*	69
Improved manure management <sup>3</sup>	24	NA
Grazing optimization <sup>1</sup>	6	383
Rangeland and Pasture Planting <sup>1</sup>	22-44**	53-99
<b>Maximum Additional Potential Tons of CO<sub>2</sub></b>	<b>553-797</b>	



US Nature  
4Climate



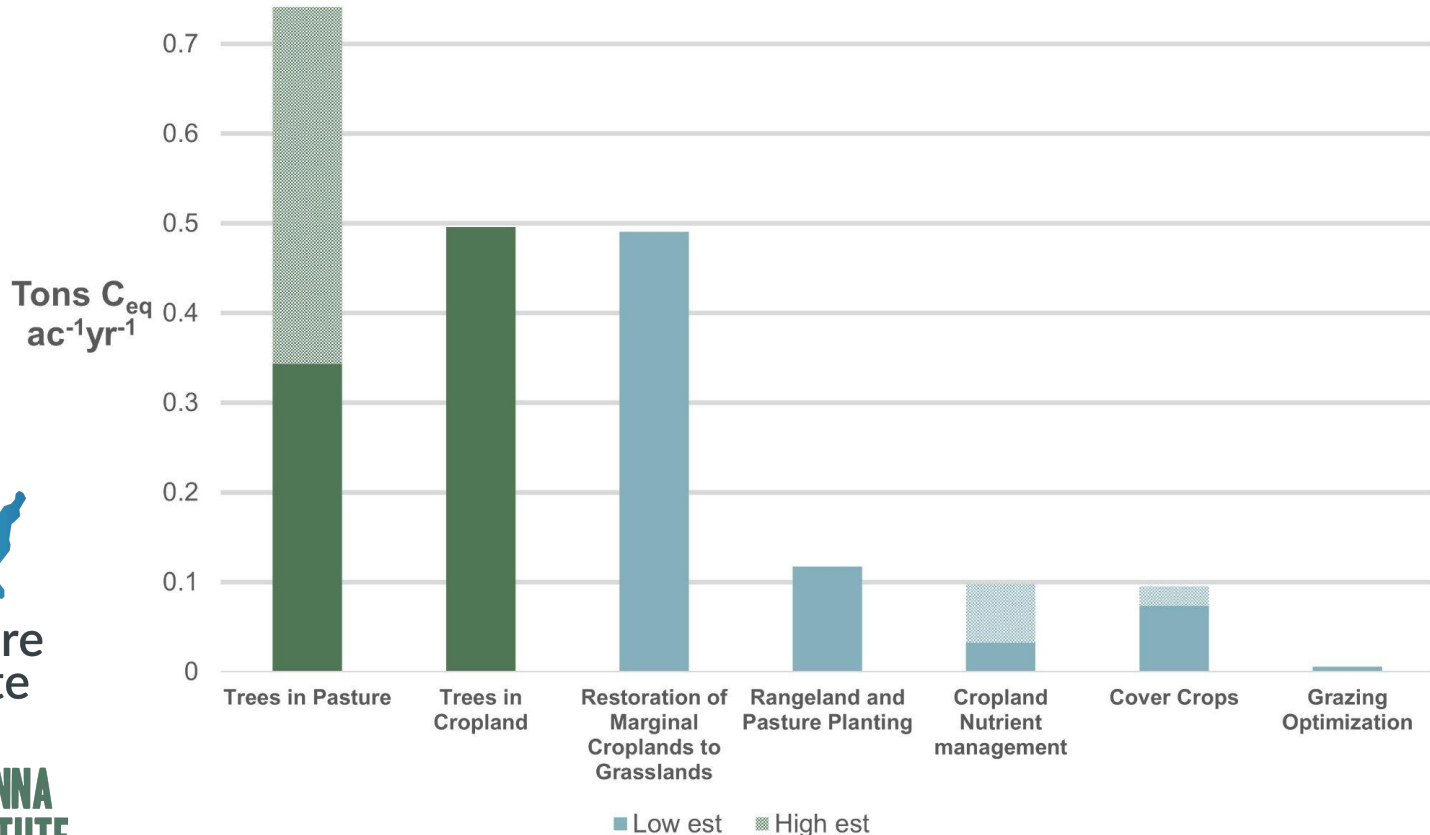
\*Low end of range corresponds to silvopasture systems; the high end corresponds to reforestation of historically forested pasture

\*\*Range based on estimates of the percentage of US rangeland that is degraded and thus in need of supplemental planting (Herrick et al. 2010).

Sources:

1) American Farmland Trust - estimates made using 2017 Census of Agriculture data & COMET-Planner Emission Reduction Coefficients - see [www.farmland.org/carpetool](http://www.farmland.org/carpetool) for more information. 2) Cook-Patton, et al. in review 3) Fargione et al. 2018 4) Mulligan et al. 2020

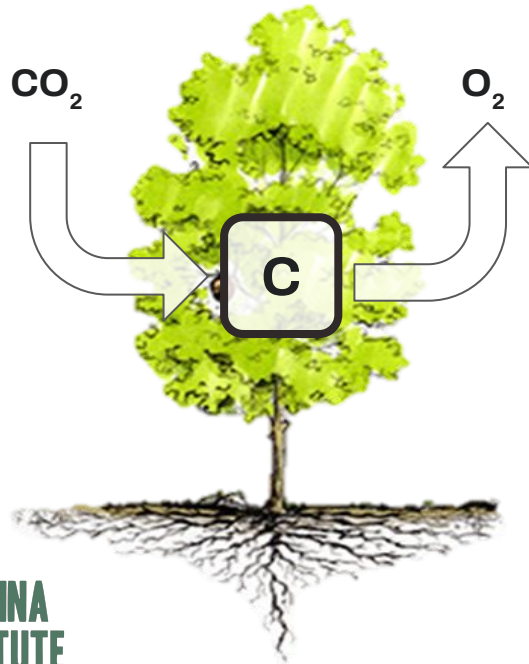
# US Farm & Ranch Natural Climate Solutions



Compiled with data from COMET Planner Emissions Reduction Coefficient by American Farmland Trust. Fargione et al. (2018), Mulligan et al. (2020)

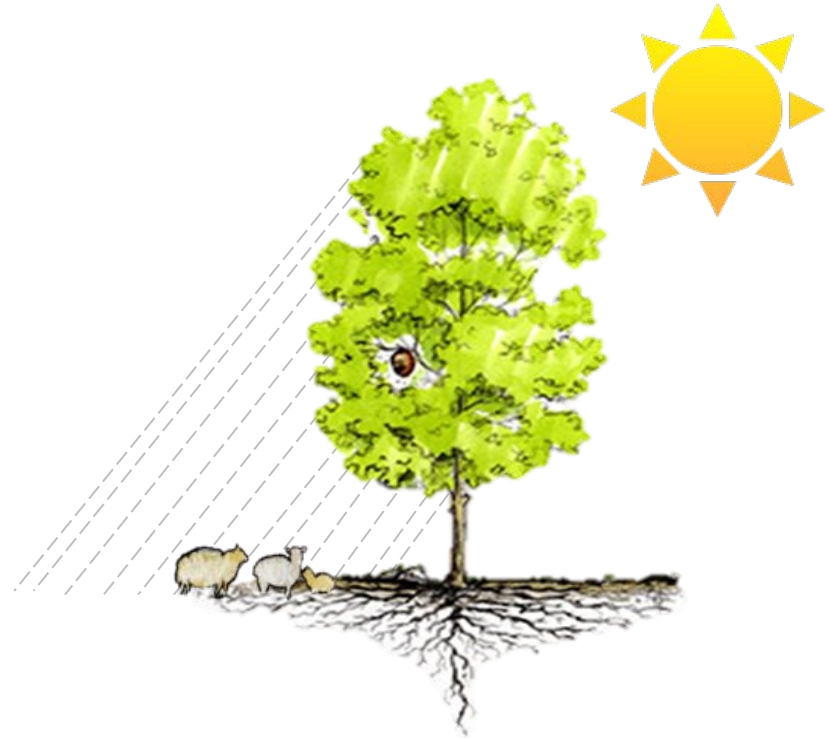
## Mitigation

Action to limit climate change by reducing greenhouse gas emissions or removing these gases from the atmosphere



## Adaptation

Adjusting or preparing for current or expected impacts of climate change





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**Don't forget the soil!**

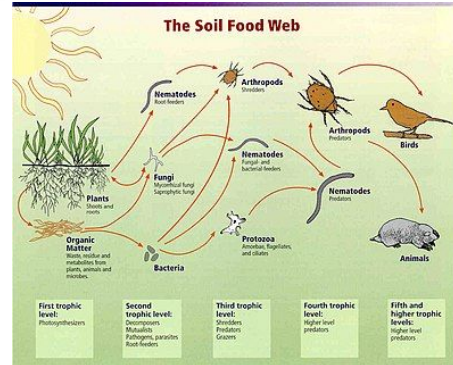




# Soil Health is key for carbon sequestration



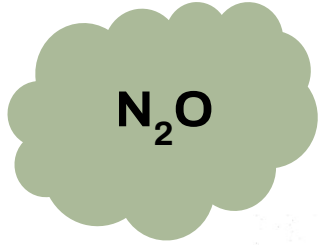
Encourage Soil Biology!!



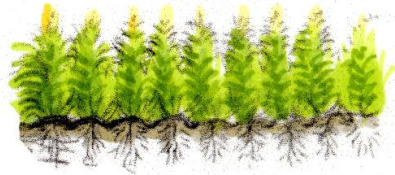
Relationships between soil food web, plants, organic matter, and birds and mammals  
Image courtesy of USDA Natural Resources Conservation Service  
[http://soils.usda.gov/topsoil\\_quality/soil\\_biology/soil\\_food\\_web.html](http://soils.usda.gov/topsoil_quality/soil_biology/soil_food_web.html)

# Why Trees? On Farms?

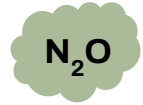
Tree crops sequester more carbon dioxide and release less nitrous oxide than annual crops.



Biomass



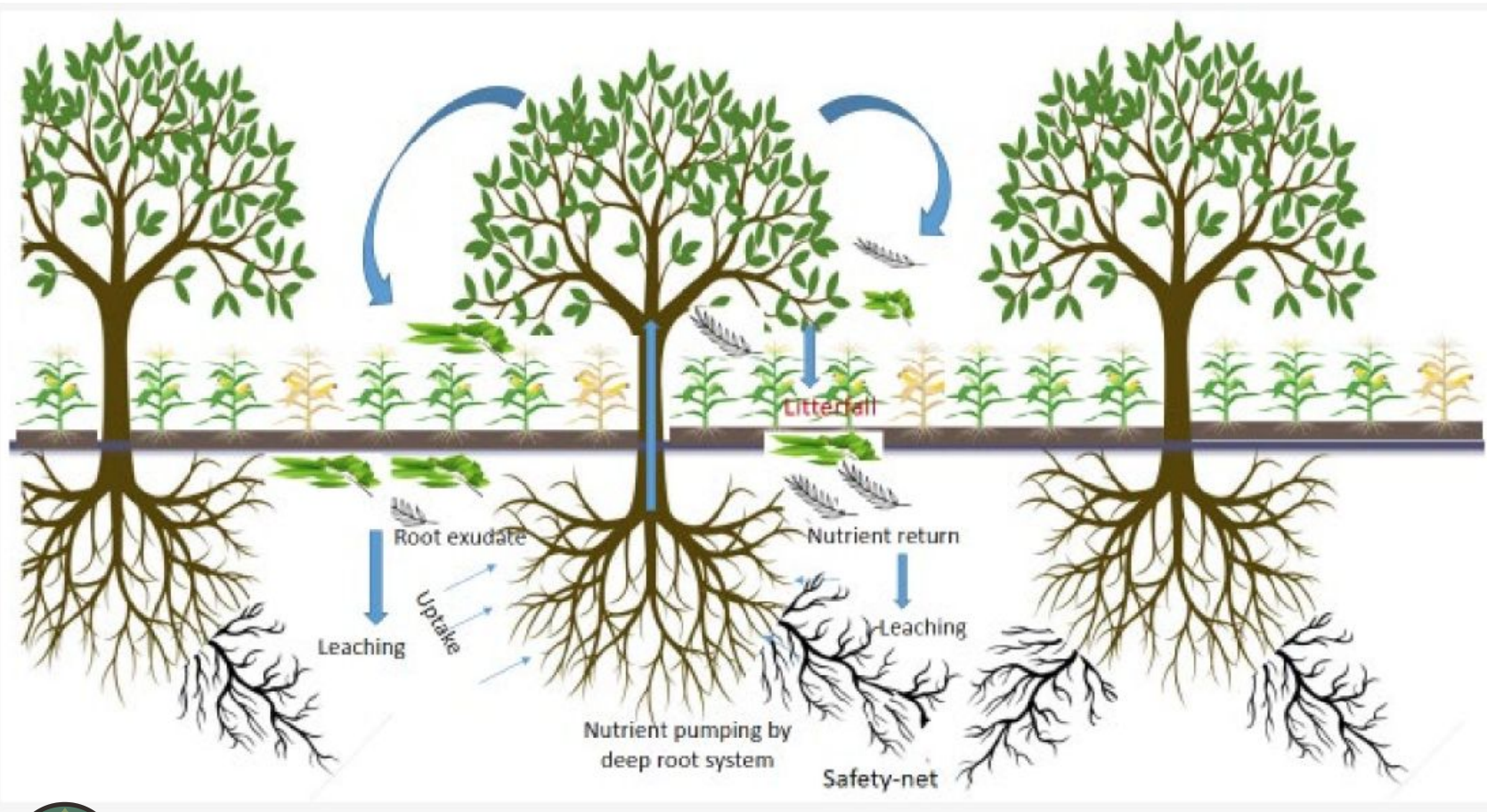
Soil carbon



Biomass

Soil carbon

More carbon content helps regenerate soil



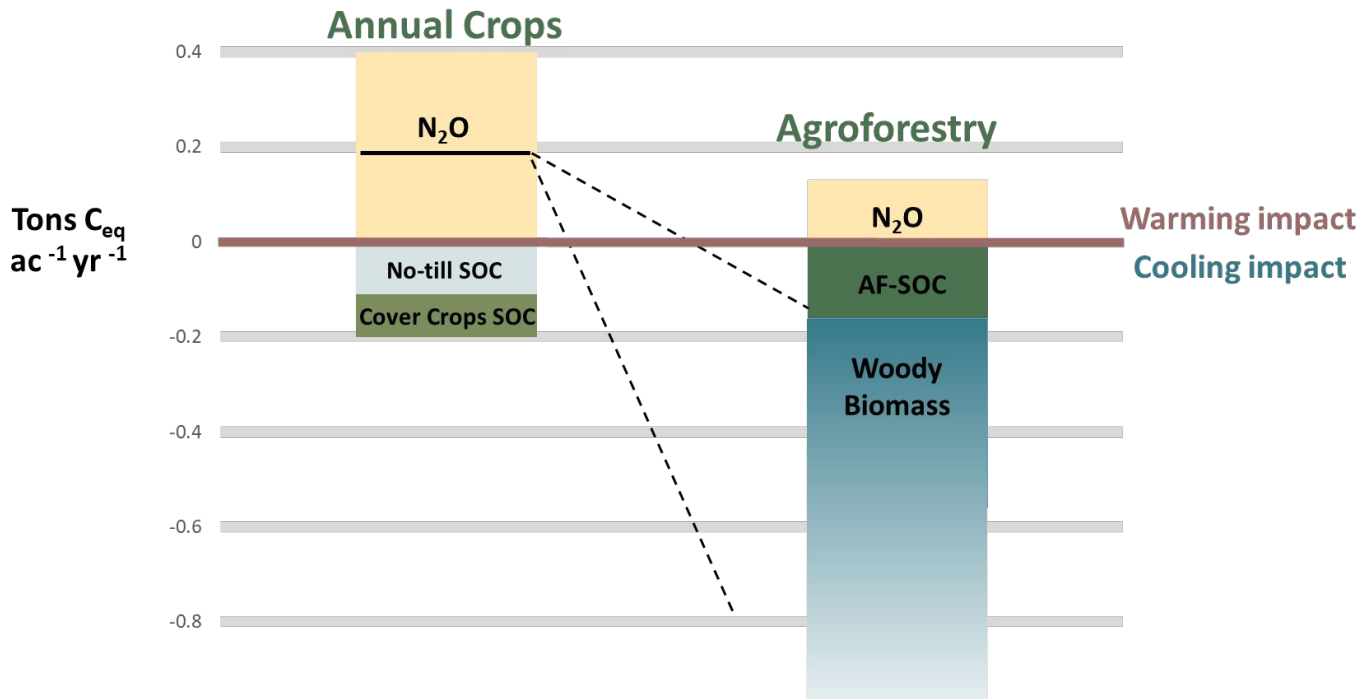


Look at that soil food web!



# Why agroforestry?

Agroforestry has a net-cooling impact on the climate—absorbing more greenhouse gases than it emits.



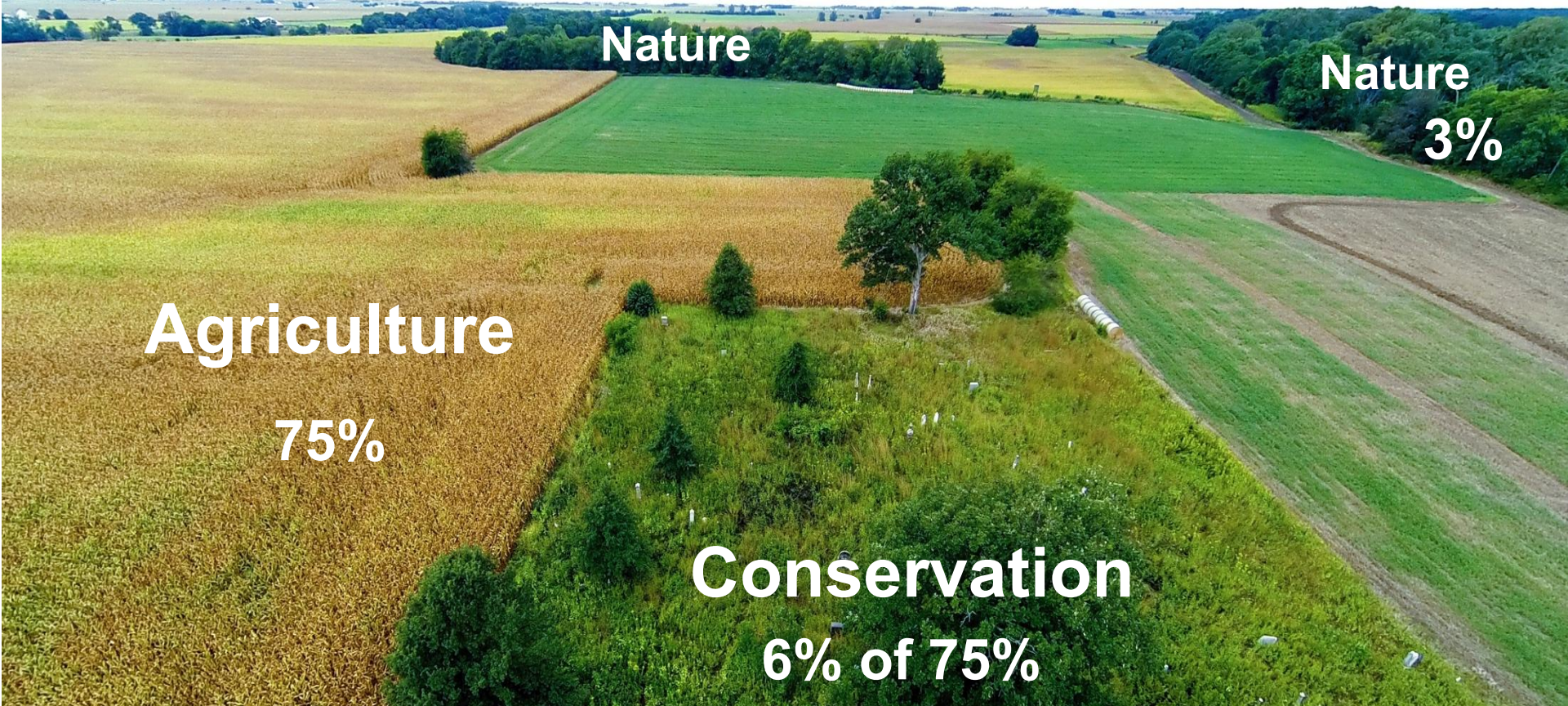
Compiled with data from Lawrence NC, Tenesaca CG, VanLoocke A, Hall SJ (2021), Ogle SM, Alsaker C, Baldock J, et al (2019), McClelland SC, Paustian K, Schipanski ME (2021), Wolz KJ, Branham BE, DeLucia EH (2018), Eddy WC, Yang WH (2022)



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**Okay, so trees are powerful climate allies.  
But where do they go?**





Nature

Nature  
3%

Agriculture

75%

Conservation

6% of 75%



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**Nature**

**Conservation**

**Agriculture  
Conservation**

**Agriculture  
Conservation  
Nature**



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# 4H Memorial Camp Demonstration Farm



Photos courtesy of Canopy Farm Management



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Photos courtesy of Savanna Institute

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Photos courtesy of Canopy Farm Management

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# Hudson Demonstration Farm



Photos courtesy of Canopy Farm Management

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Photos courtesy of Canopy Farm Management

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Photos courtesy of Canopy Farm Management

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**Wow! This seems like a pretty simple idea,  
but it's probably pretty hard in practice.**







**To scale this work,  
it takes us all**

- Stable, long-term funding structures for stable, long-term crops, cropping systems, and ecosystems
- Community and watershed scale social investment throughout our ecosystem
- Support for new, returning, and established farmers and land stewards to make multi-generational investments
- Storytellers to help connect the work of trees to our lands, waters, air, and futures



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# WANT HELP ADDING TREES TO YOUR FARM?

## ONE-ON-ONE SUPPORT FOR FARM PLANNING

The Savanna Institute offers free technical service to landholders in Illinois and Wisconsin who want to integrate trees on their farms.

[SAVANNAINSTITUTE.ORG/TECHNICAL-SERVICE](https://savannainstitute.org/technical-service)



# AGROFORESTRY APPRENTICESHIP PROGRAM

## ON-FARM AGROFORESTRY EXPERIENCE

Each Summer, the Savanna Institute pairs apprentices with ten mentor farms across 6 Midwest states.



[SAVANNAINSTITUTE.ORG/APPRENTICESHIP-PROGRAM](https://savannainstitute.org/apprenticeship-program)

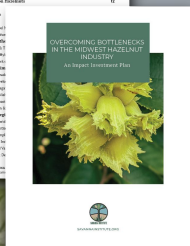


# Tree Crop Development

Our team of scientists develop new and improved cultivars, genomic sequencing, crop reports and ecosystem research.

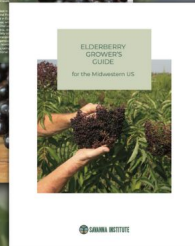
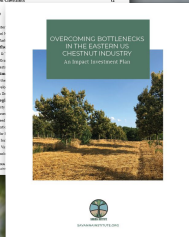
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# SAVANNA INSTITUTE

## Let's Talk More!

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**Director of Demonstration and Education**

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