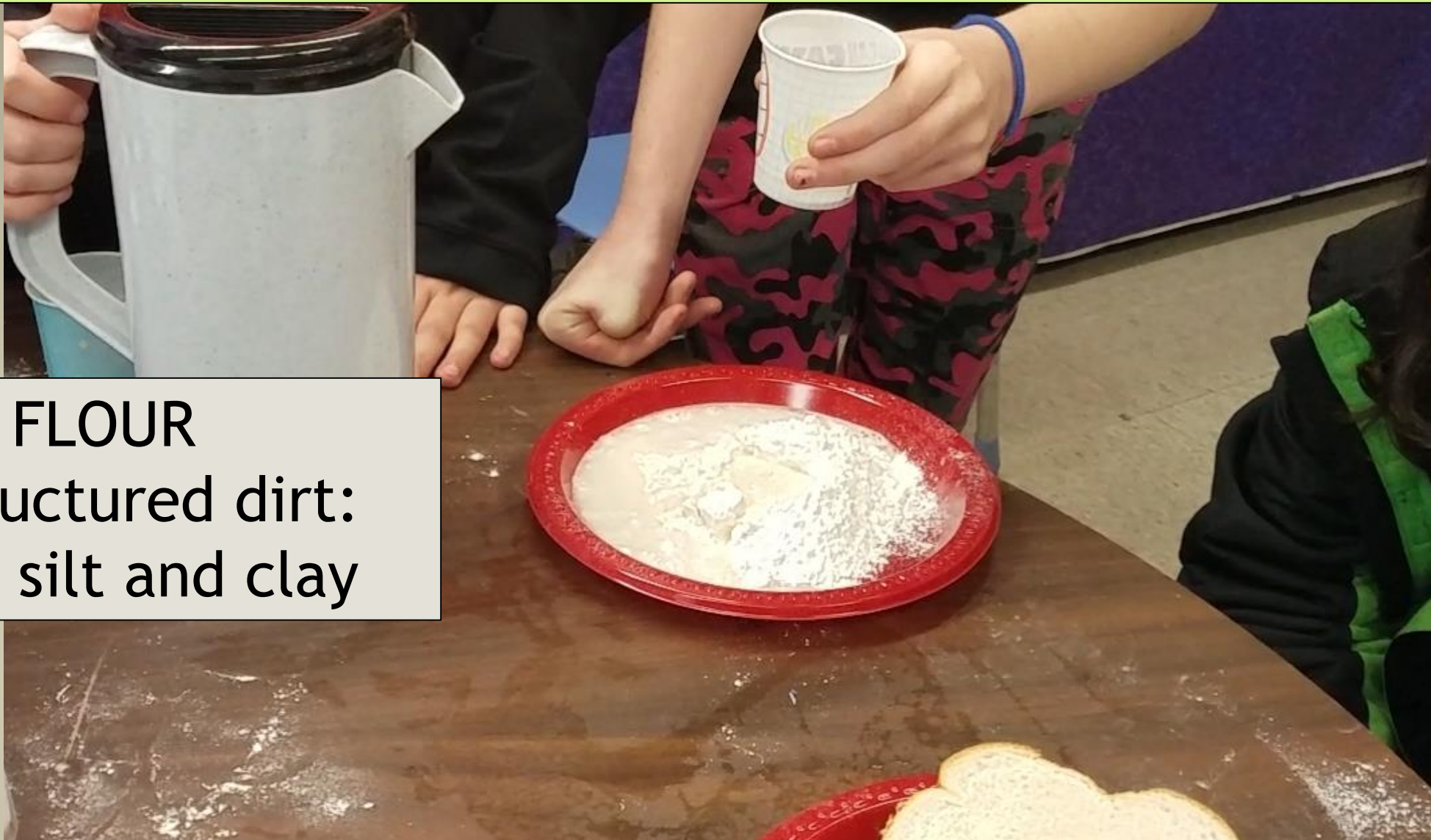


# Soil Sponge: healthy soils for better infiltration and retention

## Harvesting Water and Growing Soil To Keep Our Landscapes in Place



### FLOUR

Unstructured dirt:  
sand, silt and clay

### BREAD

Structured soil:  
biology, soil organic  
matter,  
sand, silt and clay





# The world has 60 years of topsoil left?!

If present rates of degradation continue, all of the world's topsoil could be lost by 2075.

~ Senior UN official. Dec 12, 2014

## Average soil loss

1 bushel corn = 1 bushel soil

1 bushel soy = 1.2 bushels soil

## Loss per acre, per year

5.8 tons

~15 bushels of lost yield \$ potential.

## Loss per 10 years

(given 5.8 tons/year average).

~ 1/3 inches topsoil per 10 years

~ \$12,225 in lost yield and nutrients on 40 acres

~ Corn and soybean digest 2017

Iowa corn 2018





# Is New England any better at holding onto soil than Iowa?



LEFT

Crops and fields destroyed by TS Irene in Waitsfield, VT.

BOTTOM LEFT

Standing floodwater after TS Irene in Pittsford, VT

BOTTOM RIGHT

Schoolyard flooding on July 1 2017  
Thetford VT





# Soil Loss (runoff) from Tropical Storm Irene, 2011

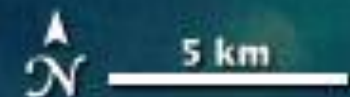
**\$800 million in infrastructure damage**

[climatechange.vermont.gov](http://climatechange.vermont.gov)

Connecticut River—

—Thames River

*Long Island Sound*





# Holding Landscapes AND Water in Place

Creating conditions for healthy soil will decrease flooding and drought and increase transpiration and global cooling.

Soil carbon is the living (soil organic matter [SOM] including plants & animals), the dead (decaying SOM) and the very dead (stable humus, glomalin, fossil fuels, coal).

SOM holds 18-20 times its weight in water and recycles nutrients for plants to use.

The first meter of soil contains three times as much carbon (in SOM) as is found in either the atmosphere or in living plants.

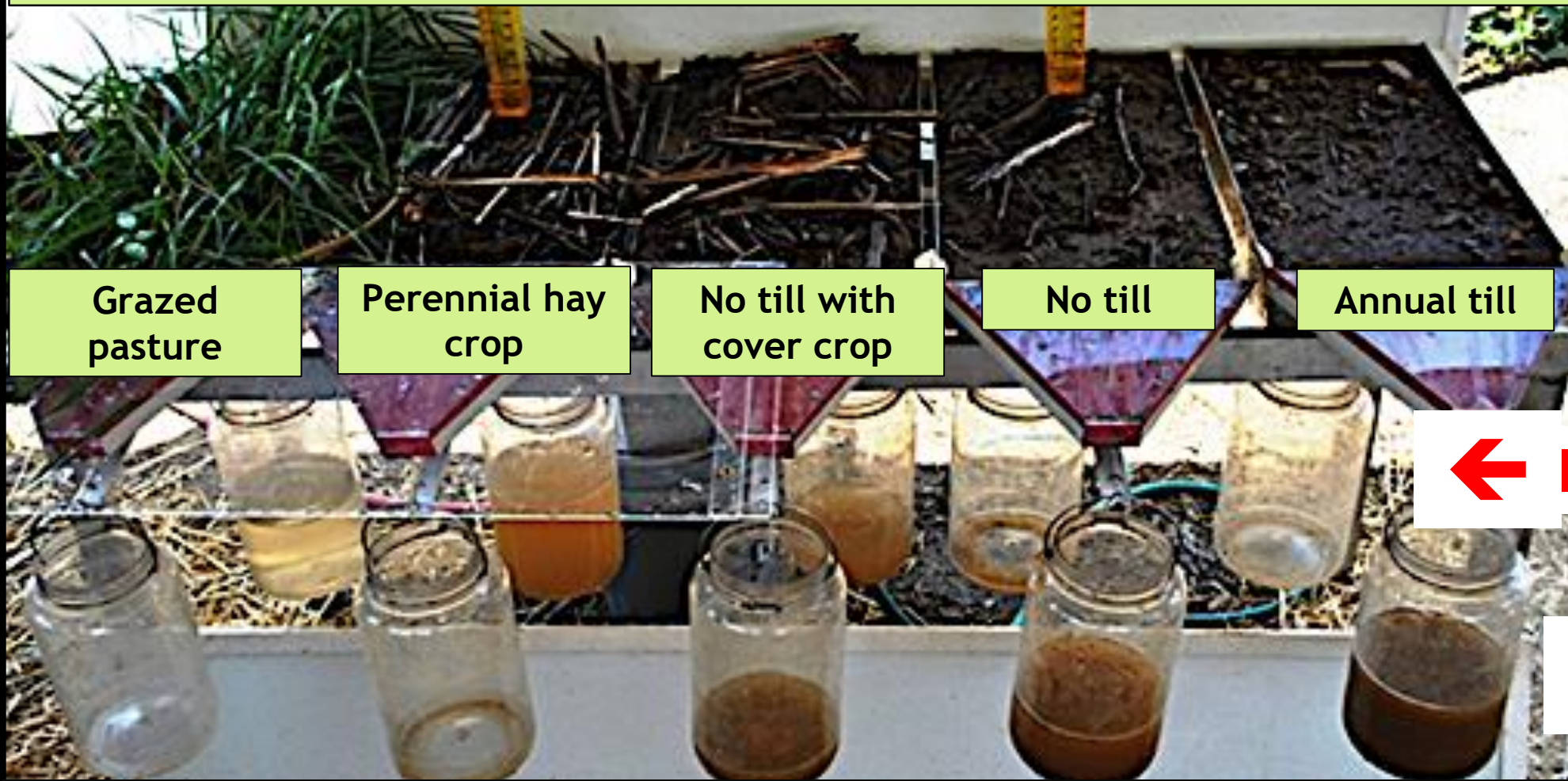
Living soil can absorb and store greenhouse gases AND retain and cycle water.

A 1% increase of organic matter in the top 6 inches of soil per acre can hold over 20,000 gallons of water.





# Infiltration and runoff by variety of management on agricultural land

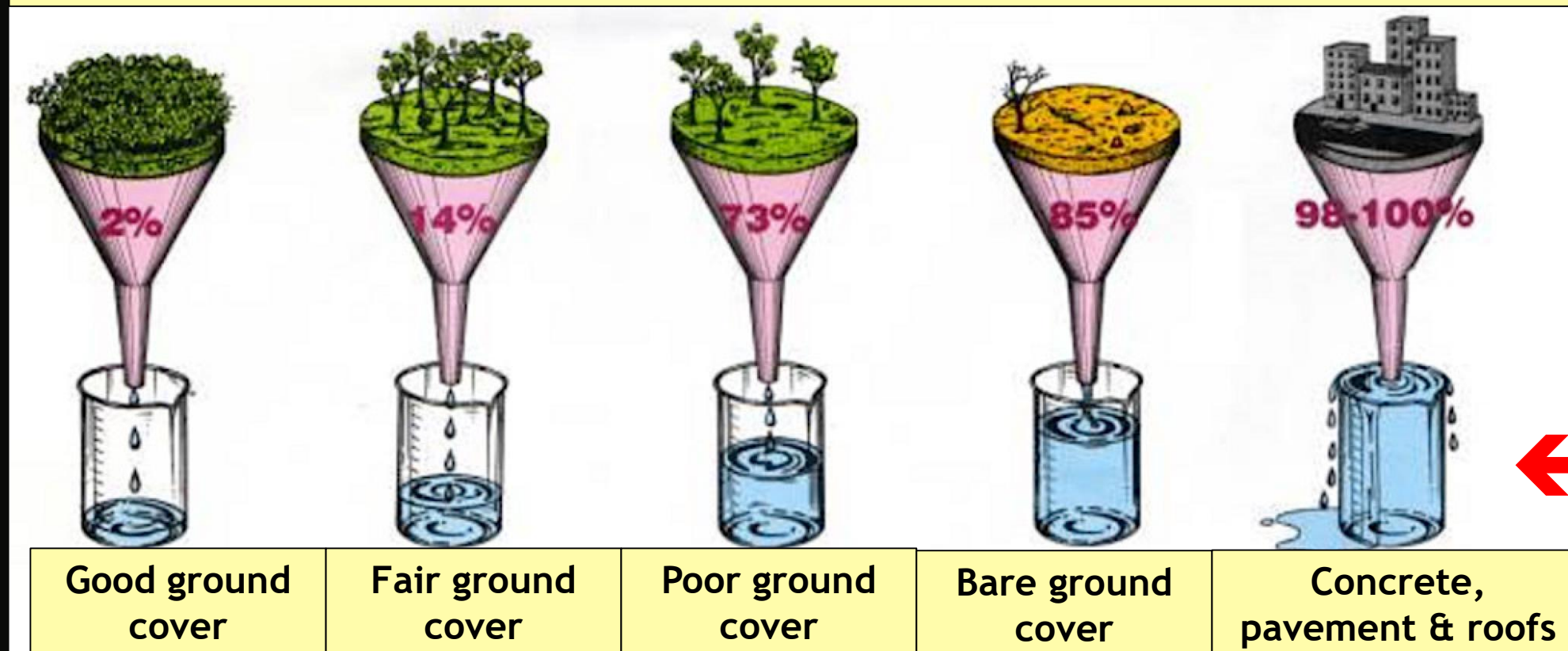


Can we improve land management?

← INFILTRATION

← RUNOFF

## Percent of runoff on a variety of environments and surfaces



Can we improve community Planning?

← RUNOFF

# Soil Health Principles

## 1. Optimize photosynthesis

*(Green, growing plants with living roots in the ground)*

## 2. Maximize diversity

## 3. Minimize disturbance

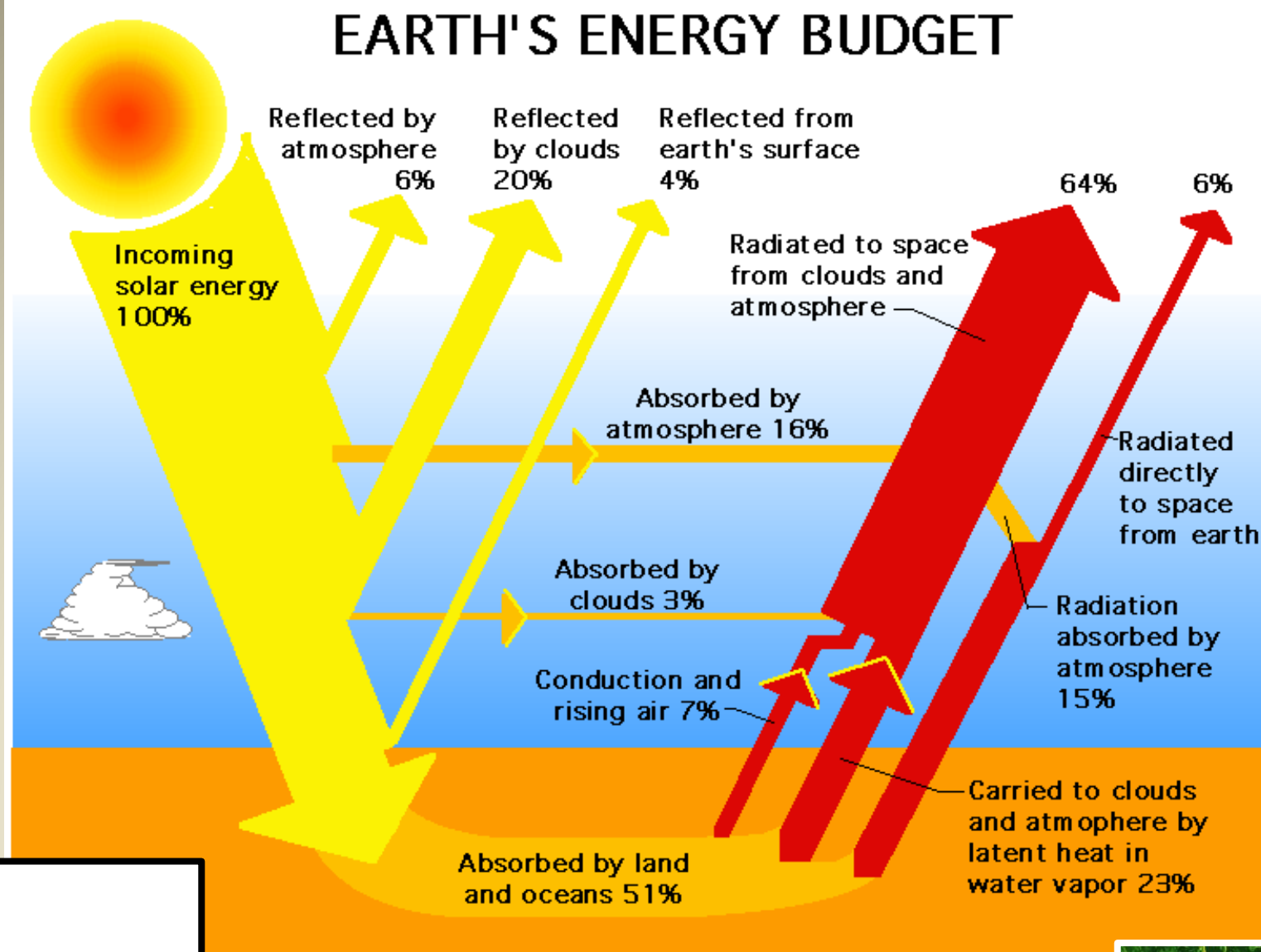
## 4. No bare soil *(minimize)*

## 5. Animal contact with soil

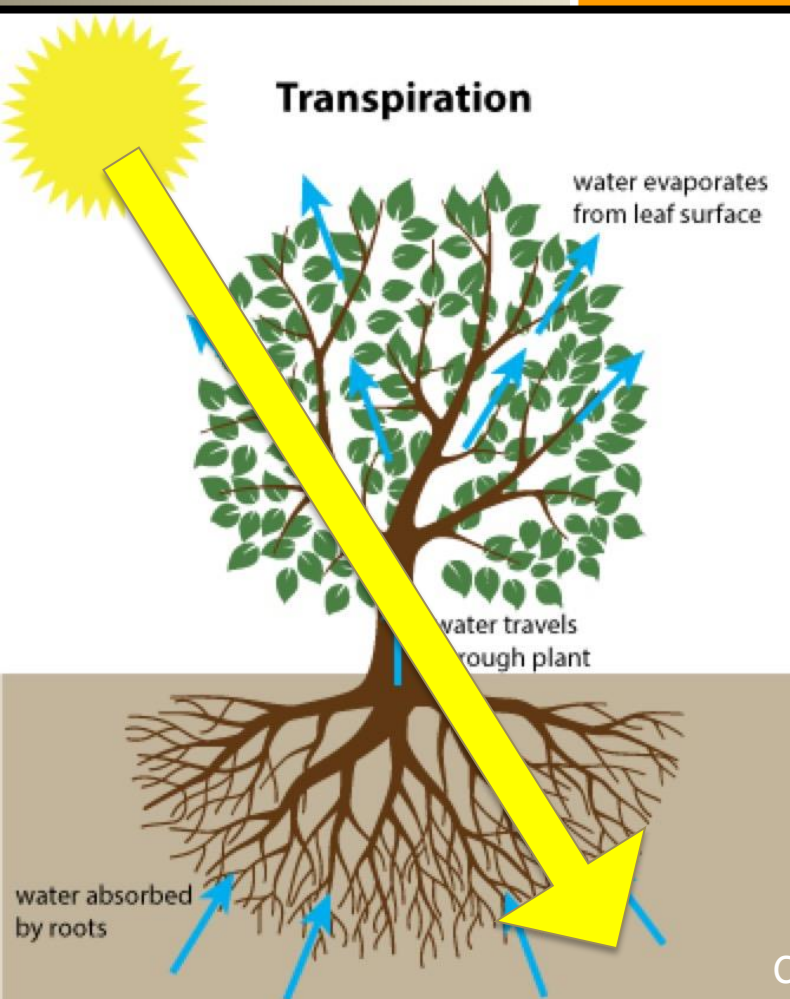
*(microbes, beetles, voles, deer, livestock, humans ... )*



# EARTH'S ENERGY BUDGET



**Champlain Basin**  
average length of green season from 2014 through 2017  
Normalized difference vegetation index (NDVI), is an indicator of the work of photosynthesis.

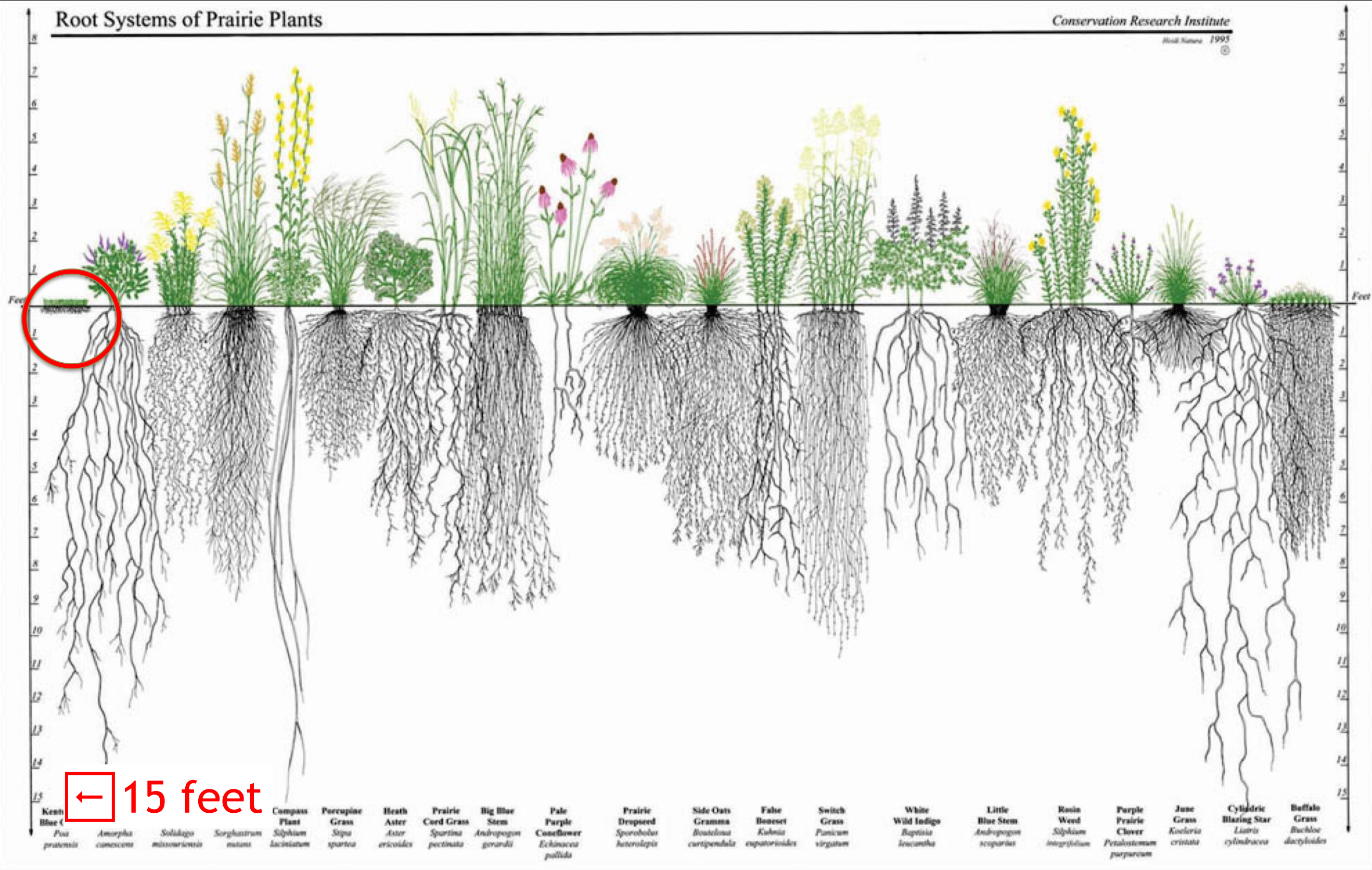


Can we harvest more sunshine?





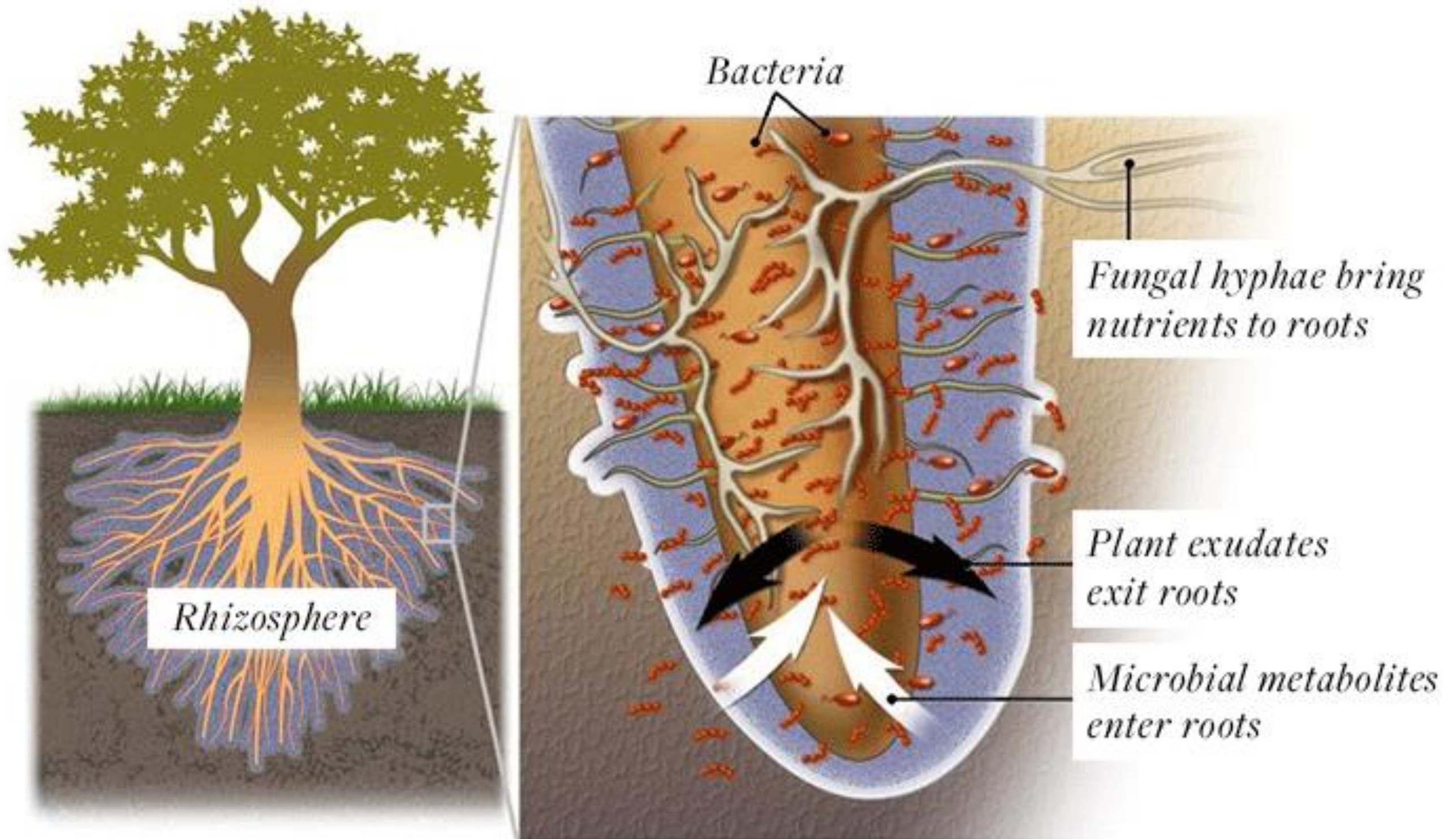
# DEEP Living roots in the ground for as long as possible



Standard lawn

USA: 32 million acres of lawns (residential, commercial, and institutional lawns, parks, golf courses and athletic fields)

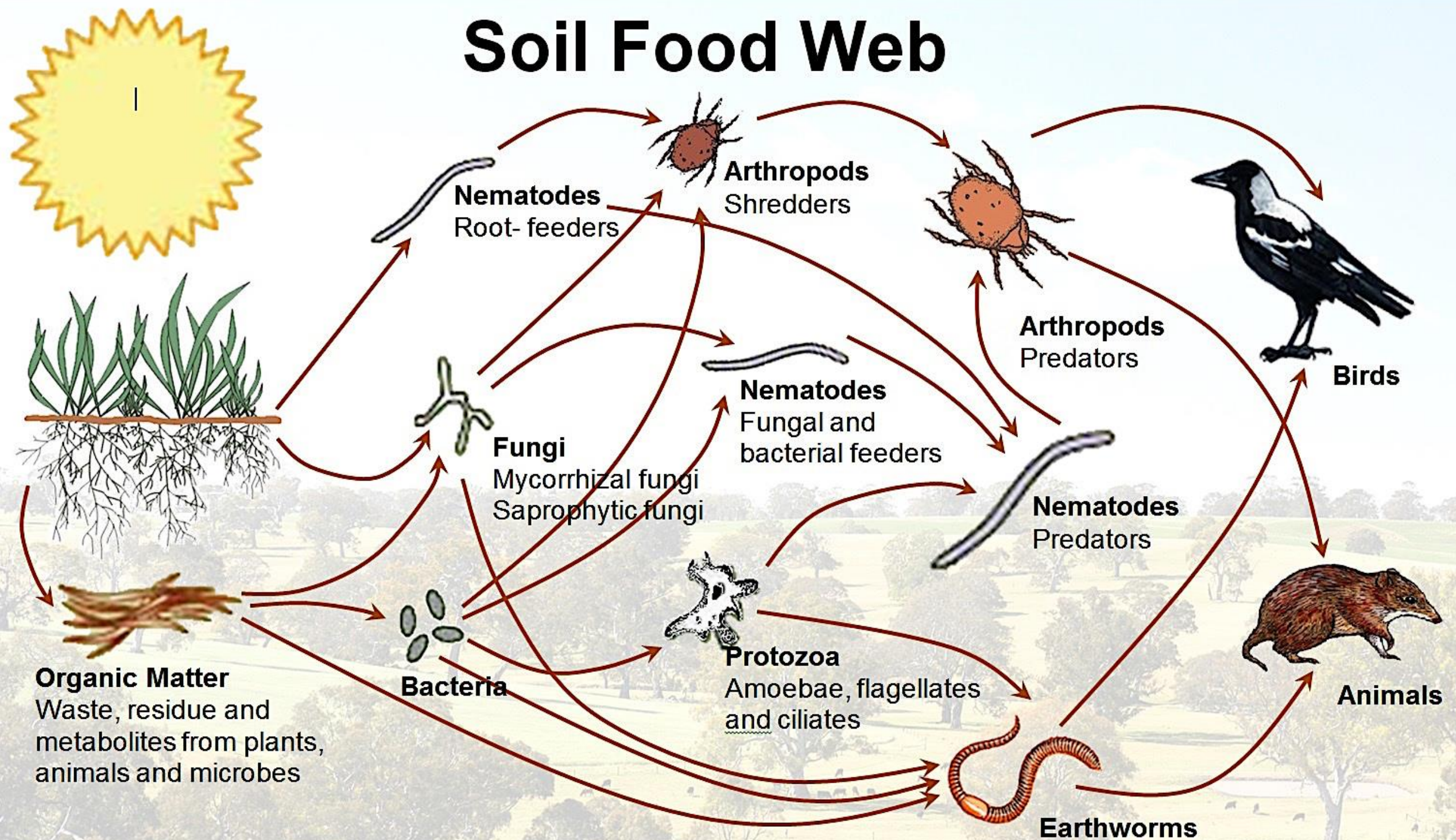




The rhizosphere houses billions of microorganisms



# Soil Food Web



First trophic level	Second trophic level	Third trophic level	Fourth trophic level	Fifth trophic level
Photo synthesisers	Decomposing Mutualists, Pathogens, Parasites, Root-feeders	Shredders Predators Grazers	High level predators	Higher level predators

These underground biological workers are building the glue that holds our landscapes in place.



# Glues, snots and slimes are the structure of the Soil Carbon Sponge.

Turn this



and this!

and this!

After 2 months  
of drought 2018



Jack and Anne Lazor's perennial pasture Butterworks Farm, Westfield VT

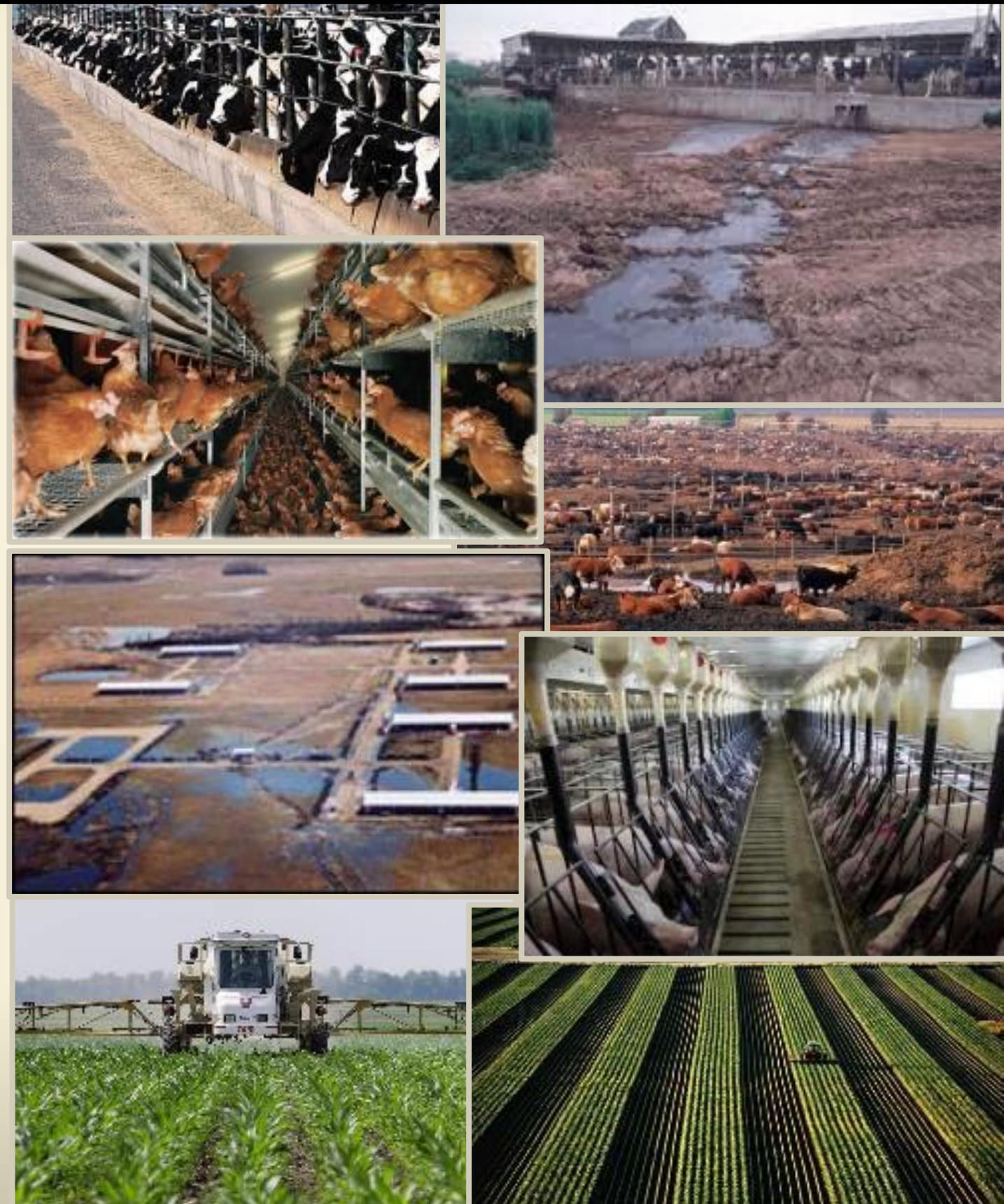
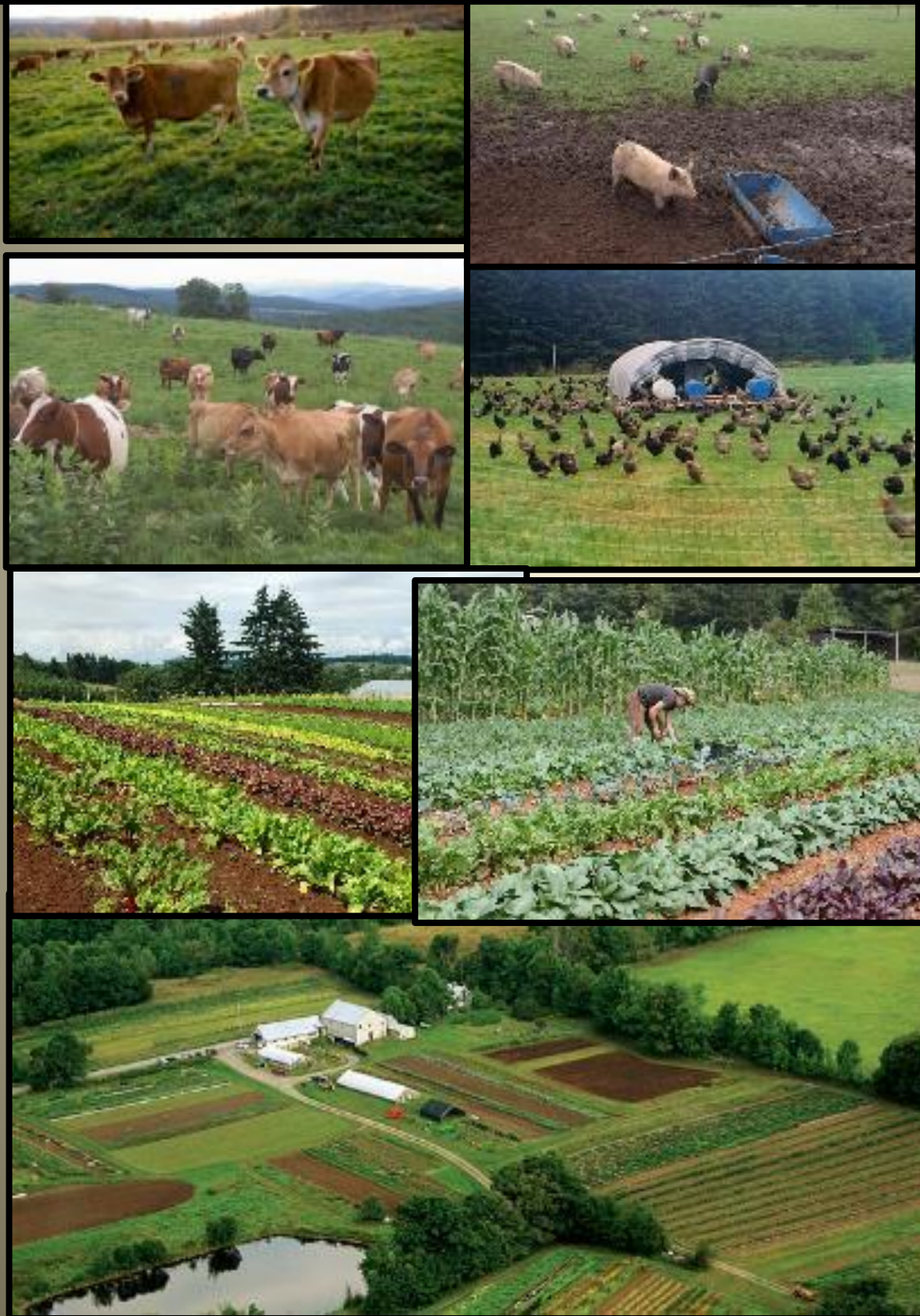
To this!



Nicole Masters photo: New Zealand



# Can we shift our systems to provide Multiple Ecosystem Services vs. Single Services







Agroforestry at New Forest Farm in Southwest Wisconsin

Can we learn  
to mimic functional natural ecosystems?

How can we better work  
**WITH** nature?

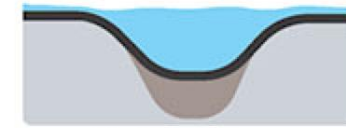


## A stream comes back to life

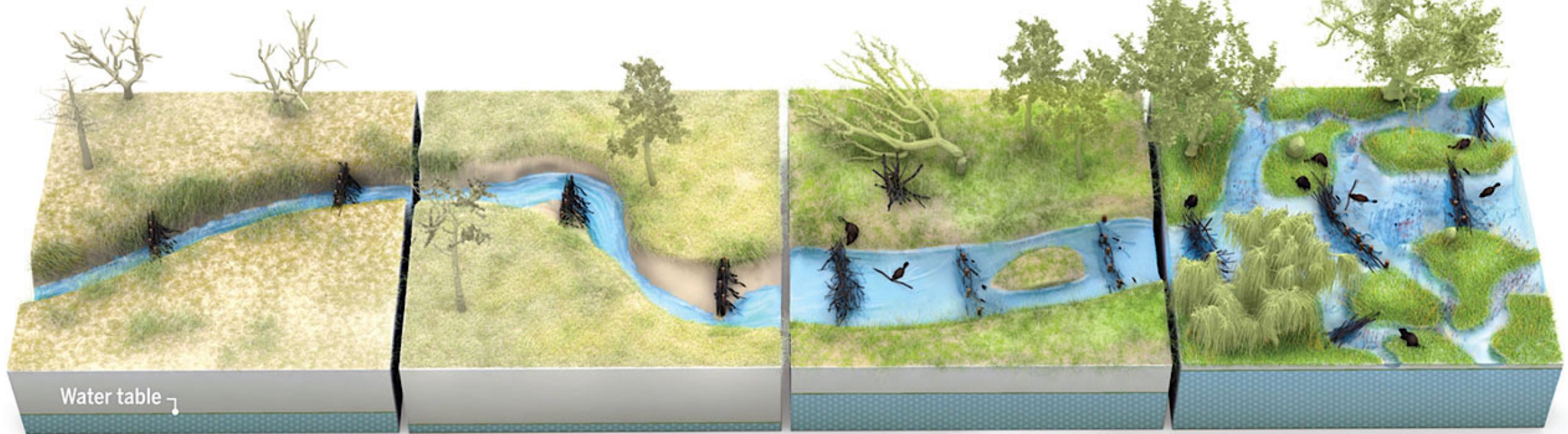
Across the U.S. West, scientists and land managers are using beaver dam analogs (BDAs) to heal damaged streams, re-establish beaver populations, and aid wildlife. In some cases, researchers have seen positive changes in just 1 to 3 years.



Incised stream



Restored stream



### Adding dams

Beaver trapping and overgrazing have caused countless creeks to cut deep trenches and water tables to drop, drying floodplains. Installing BDAs can help.

### Widening the trench

BDAs divert flows, causing streams to cut into banks, widening the incised channel, and creating a supply of sediment that helps raise the stream bed.

### Beavers return

As BDAs trap sediment, the stream bed rebuilds and forces water onto the floodplain, recharging groundwater. Slower flows allow beavers to recolonize.

### A complex haven

Re-established beavers raise water tables, irrigate new stands of willow and alder, and create a maze of pools and side channels for fish and wildlife.

Ben Goldfarb,  
Eager: The  
Surprising, Secret  
Life of Beavers  
and Why They  
Matter,





Can we measure impacts and outcomes?

Can we hire land managers to produce the outcomes we want?

How do we create value for ecosystem services?

### IMPACTS/loss/liabilities

Drought  
Flooding  
Erosion  
Infrastructure damage  
Riverbank scouring  
Sedimentation  
Atmospheric carbon  
Nutrient runoff  
Nutrient leaching

### OUTCOMES/gains/assets

Plant available water  
Stream base flow  
Stream purity  
Groundwater quality  
Groundwater recharge  
Surface water temperature  
Soil carbon  
Soil fertility  
Pollination  
Wildlife habitat

The above are a focus of Abe Collins' work with Landstream.



# Take Action to Build the Soil Sponge! Grow More, Waste Less!

1. Buy Read labels. Know your food. Vote with your food dollars
2. Gardens Less disturbance. Living roots. No bare ground.
3. Hire farmers, foresters and land managers to deepen watersheds.
4. Home Aerobically compost all food scraps and yard waste.
5. Harvest Water Catch, slow and sink water everywhere.
6. Landscapes Swales. More deep-rooted perennials and trees.
7. Lawns Mow less. Mow higher. Add more species.
8. Community Planning Avoid impervious surfaces. Manage all water to keep it around; don't waste it! More green spaces with rain gardens, especially uphill!
9. Learn Get involved with community resilience initiatives. Become a Soil Carbon Coalition Land Listener and gain skills for monitoring changes over time in landscape function.
10. Connect with your community to work together to build our future.

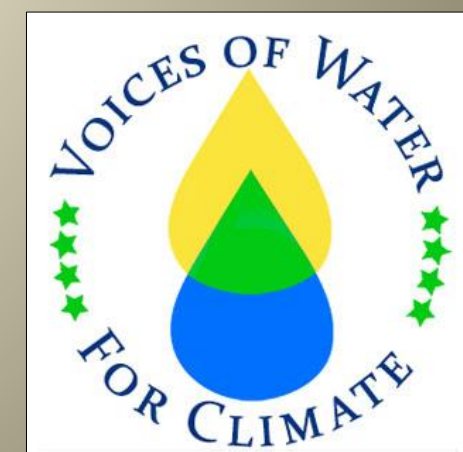
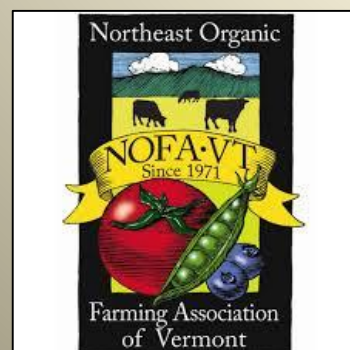
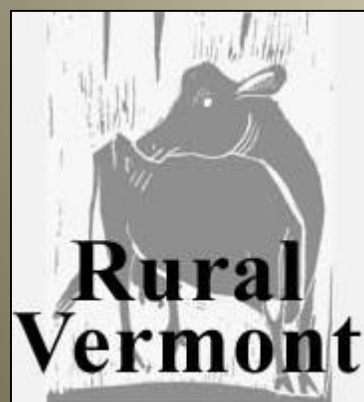
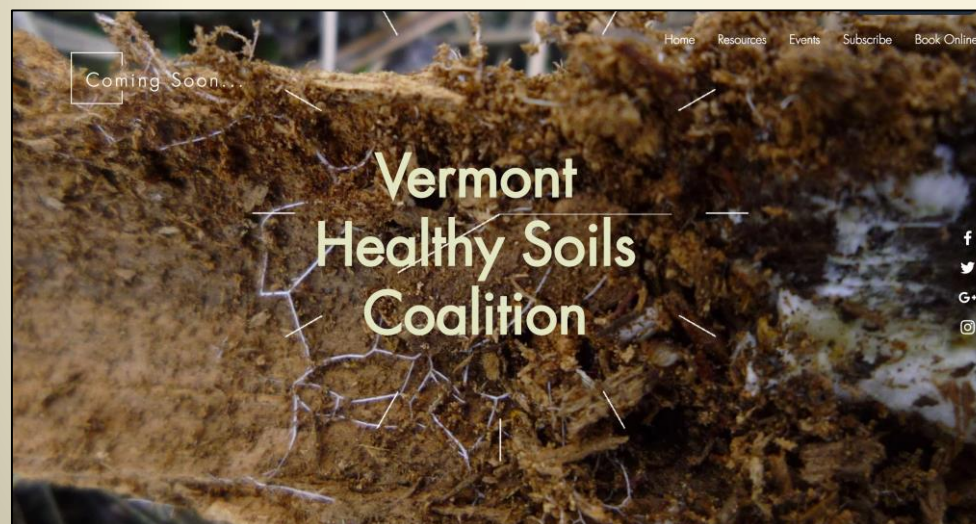






Cat Buxton  
 Grow More, Waste Less  
 Food Systems Consulting, LLC  
 Sharon VT 802.359.3330  
[www.growmorewasteless.com](http://www.growmorewasteless.com)

*Connecting communities to affect positive food system change from the ground up.*





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