

A World Without Soil

NRCS USDA

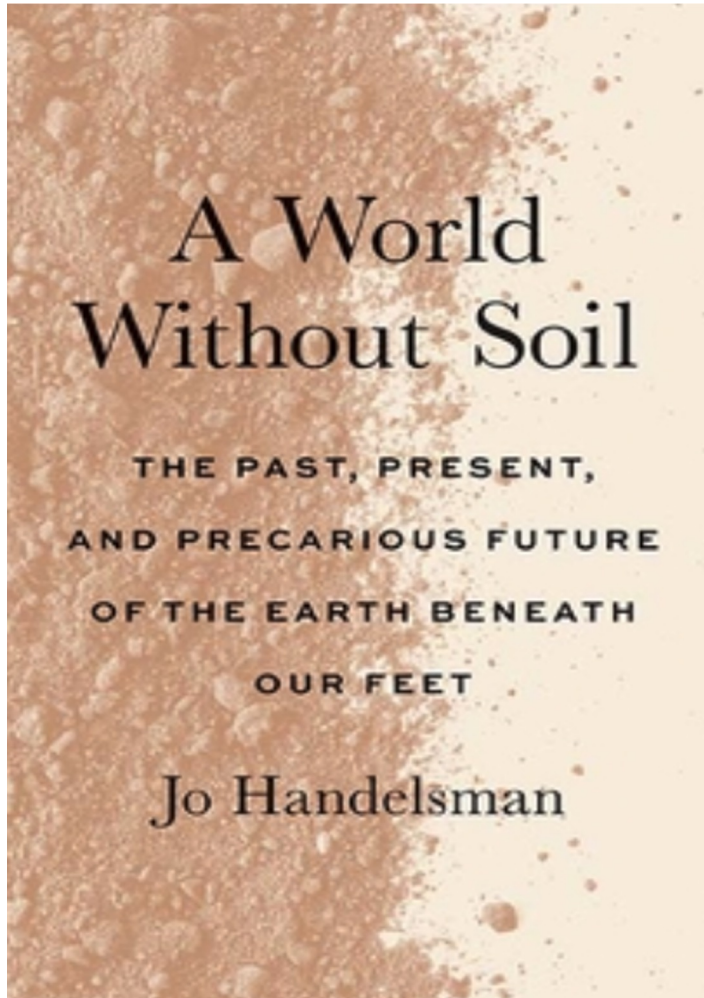
5-10-22

Jo Handelsman
Wisconsin Institute for Discovery and
Department of Plant Pathology
University of Wisconsin – Madison

@jo44atWID
#SOILROCKS!
www.soilrocks.org



A World Without Soil



<http://soilrocks.org>



Soil Under Threat

- What is soil?
- Soil's contributions
- Losing soil
- Consequences of losing soil
- Soil protection

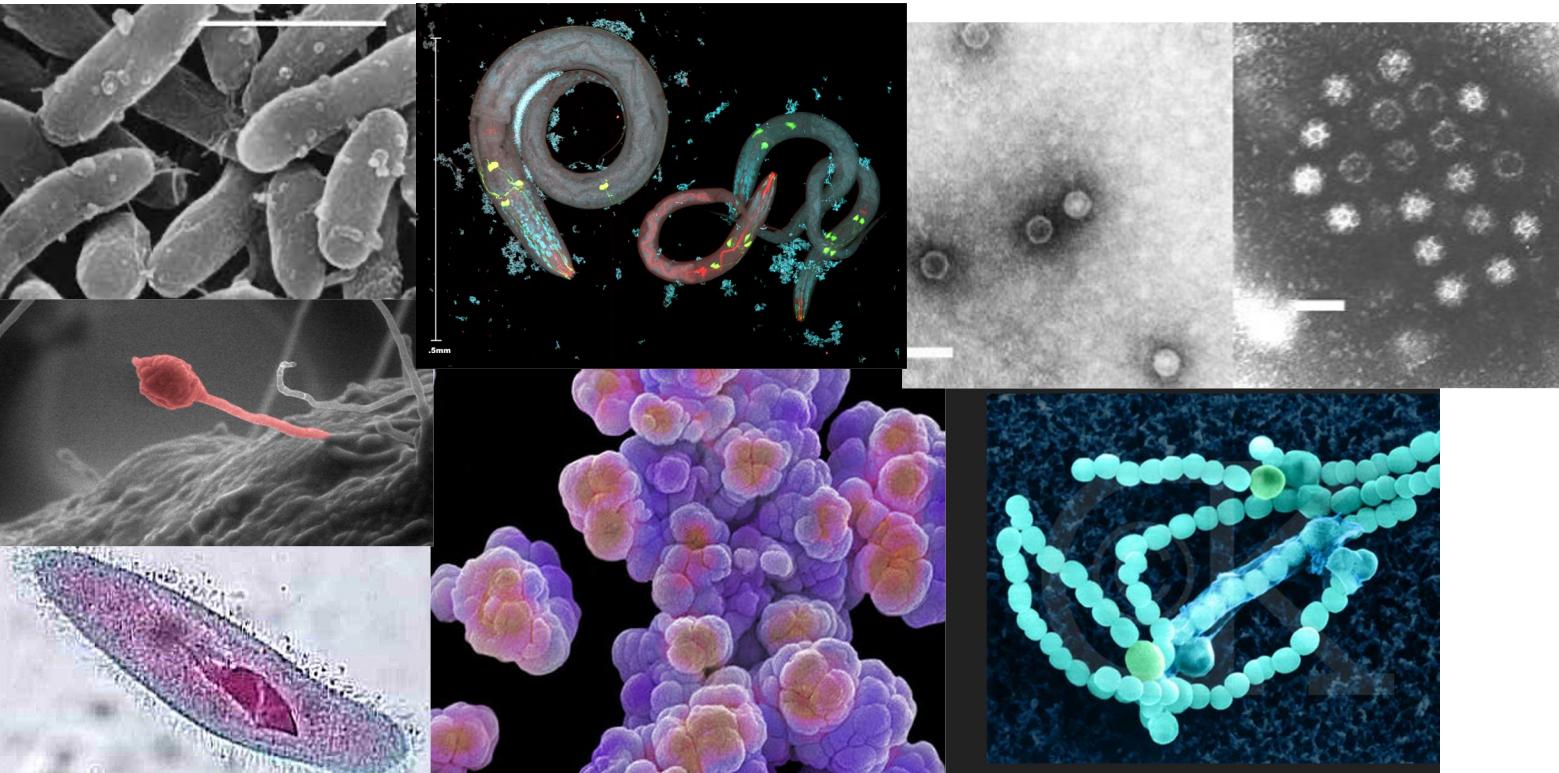
What is Soil?

- Soil contains a heterogeneous mixture of
 - weathered rock
 - geologic and mineral material (sand, silt, and clay particles)
 - living and decomposing plants, animals, and microorganisms



What is Soil?

- Microorganisms dominate in soil
- Contains more than 1 billion bacteria per gram



Bacteria
Fungi
Protists
Nematodes
Viruses

Soil Forms Slowly



Geologic material
rock and minerals

+

Plants
Animals
Microorganisms

+

Climate

+

TIME



SOIL



<0.5 ton/acre/year

Soil and Food Production



Value of Soil for Human and Planetary Health

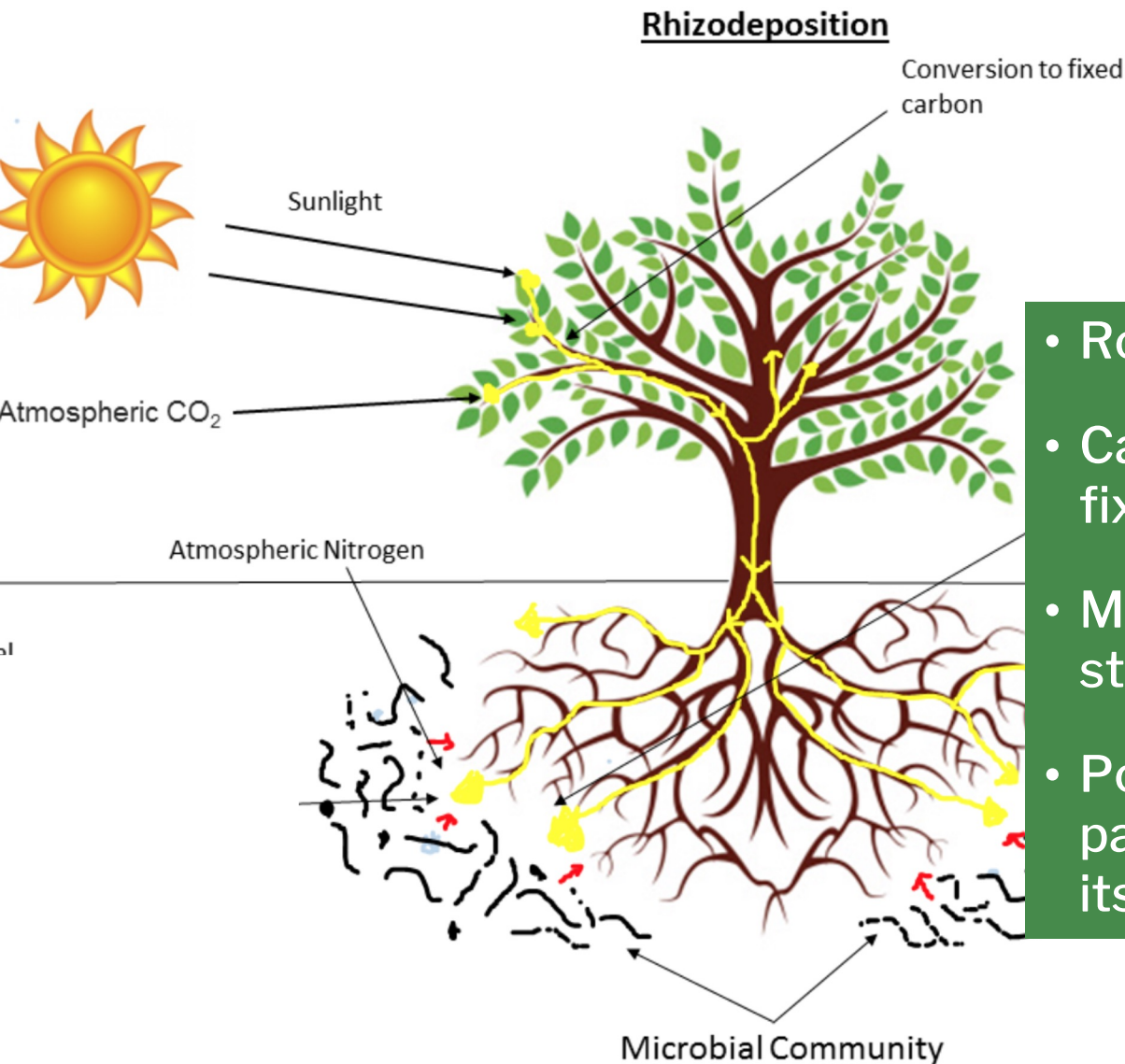
- Food Security
- Water quality
- Biodiversity
- Antibiotic discovery
- Carbon storage



<https://www.scidev.net/global/news/soil-based-filter-bricks-clean-up-water-for-moroccan-farmers/>



Carbon: From atmosphere to soil



- Roots release carbon into soil
- Can be as much as 1/3 of C fixed through photosynthesis
- Microbes eat carbon, produce sticky polysaccharides
- Polysaccharides glue soil particles together, giving soil its structure and reducing

Soil and Climate Change Mitigation

Top 2 meters of soil contains

- 2,500 billion tons of carbon
- >3x the amount of carbon in the atmosphere
- >4-5x the carbon in all plant biomass on Earth

We have lost 50% of soil's carbon since 1850



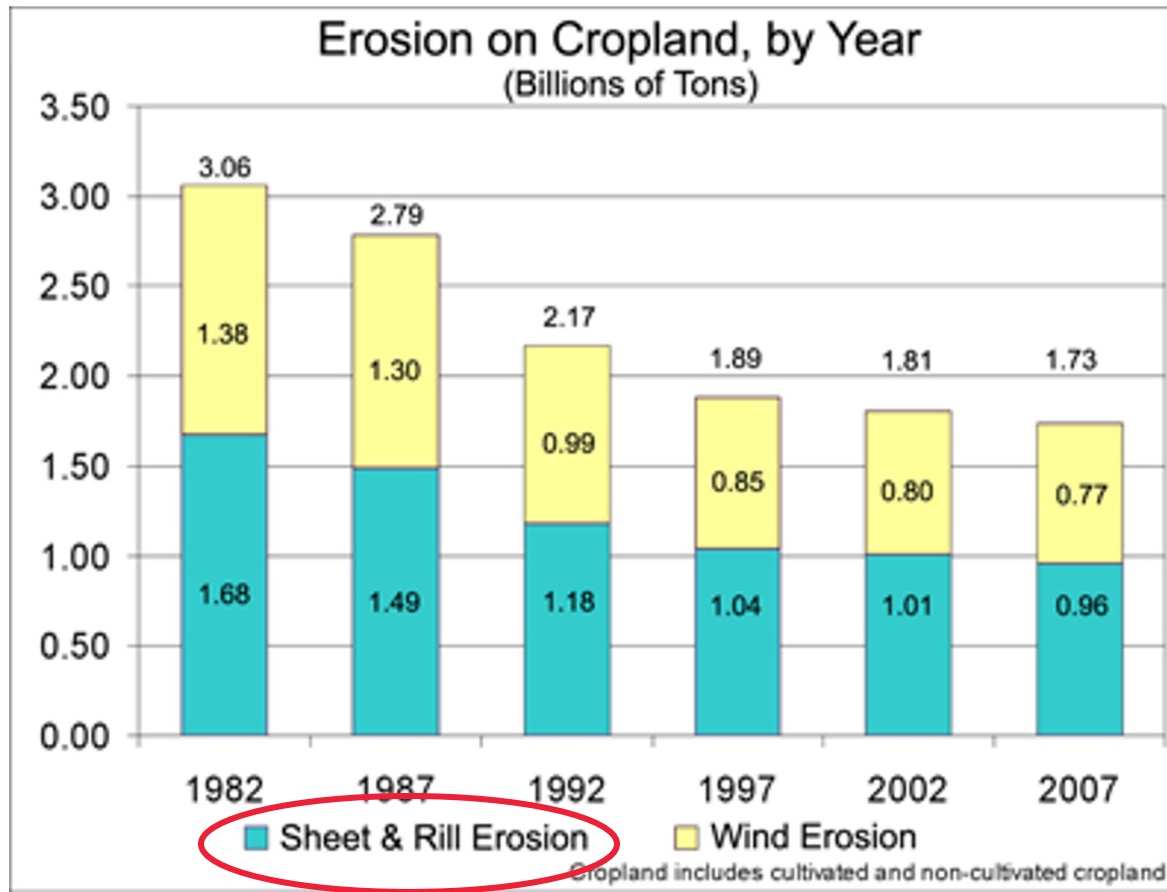
Soil is Eroding Rapidly



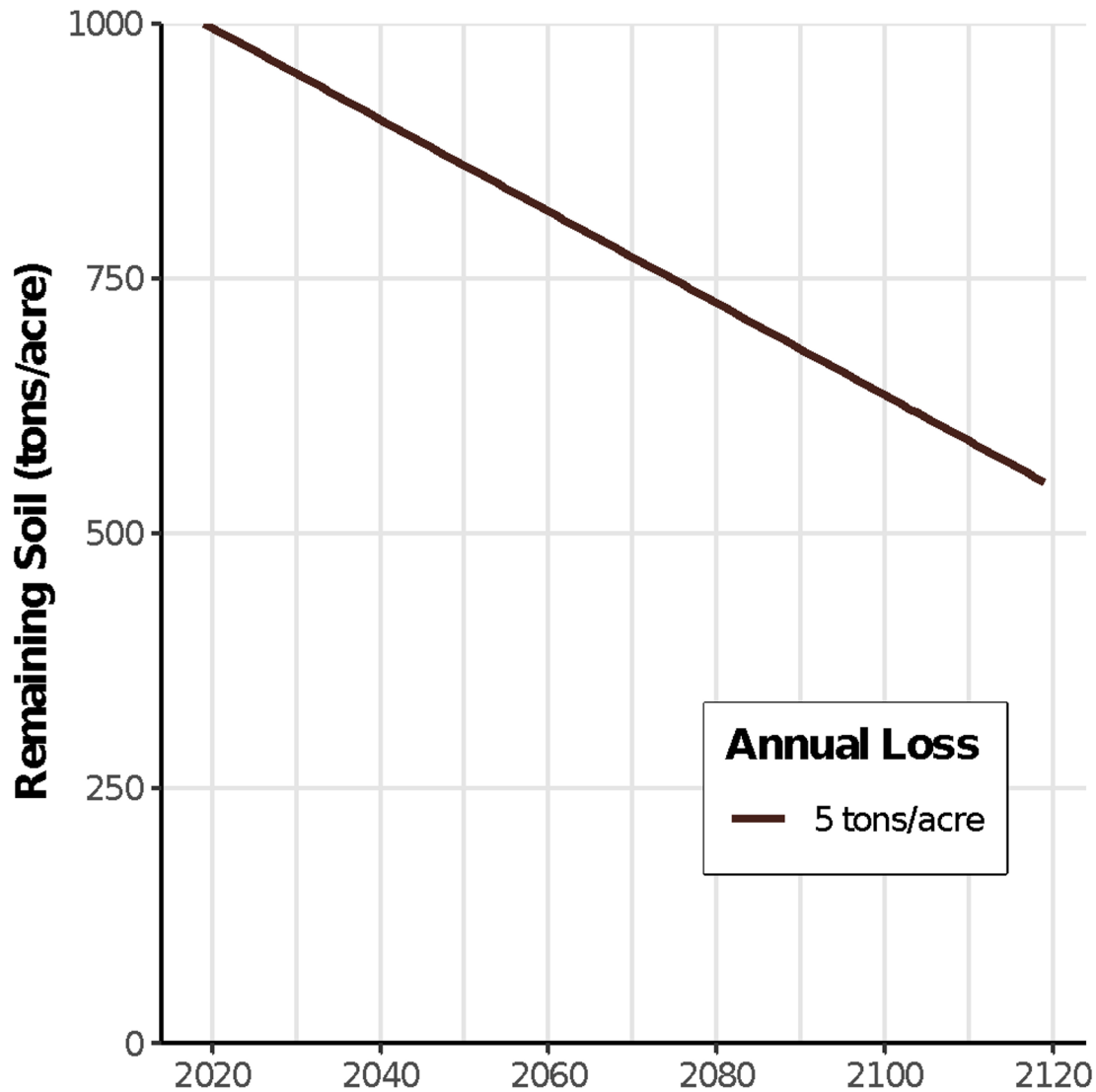
<https://www.pinterest.com/pin/322922235755208265/>

- National average soil erosion 5 tons/acre/year
- In Iowa, some acreage is eroding at 25-50 tons/acre/year
- One year, 50 tons/acre was lost in one rainstorm on thousands of acres in Iowa

Despite 75 years of soil conservation since the Soil Conservation Act was enacted, today soil erodes



Projections of Soil Depletion in Iowa



From White House
OSTP

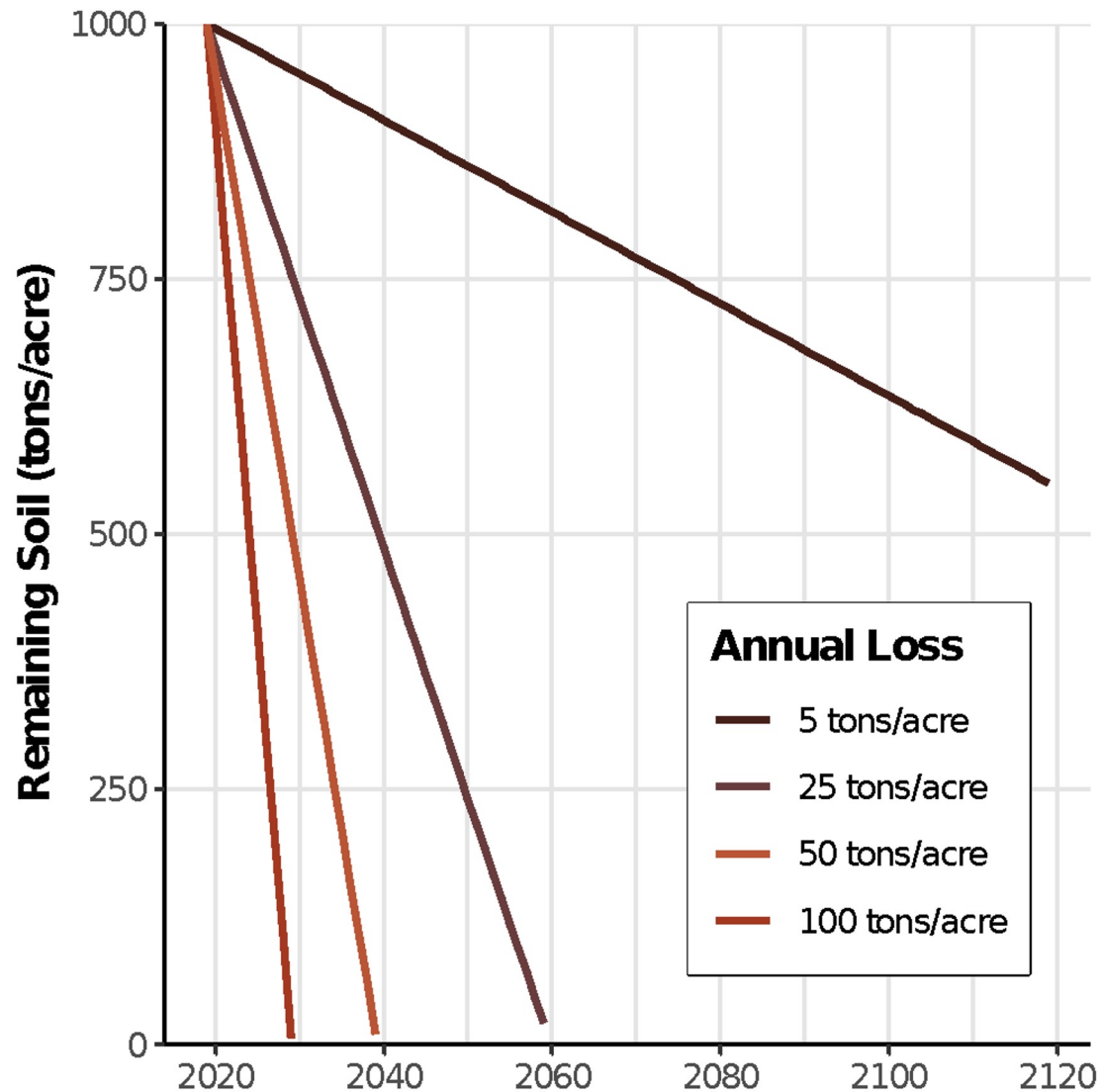
USDA Erosion Estimates Do not Account for Ephemeral Gullies



<https://iowalearningfarms.wordpress.com/2014/01/21/combating-ephemeral-gully-erosion/>

<https://indianapublicmedia.org/earthheats/government-underestimating-farmland-erosion.php>

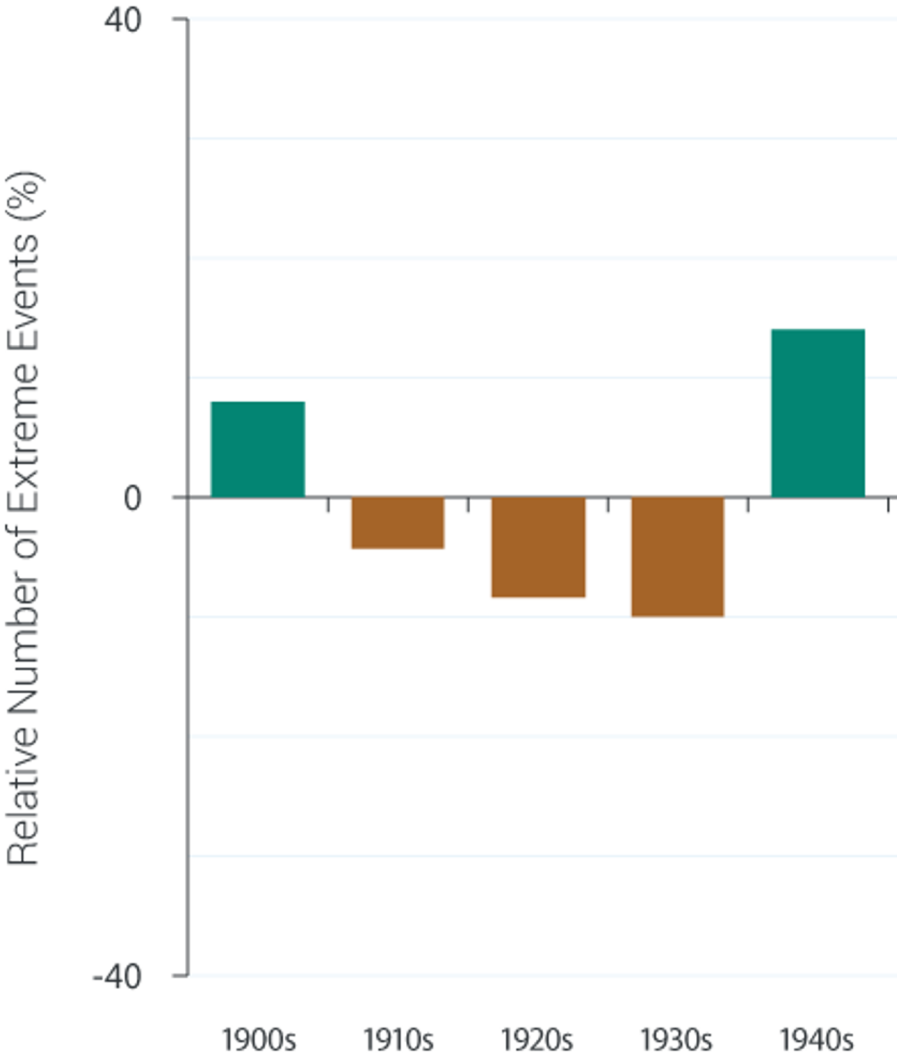
Projections of Soil Depletion in Iowa



From White House
OSTP

Climate Change Threats to Soil

Observed U.S. Trend in Heavy Precipitation



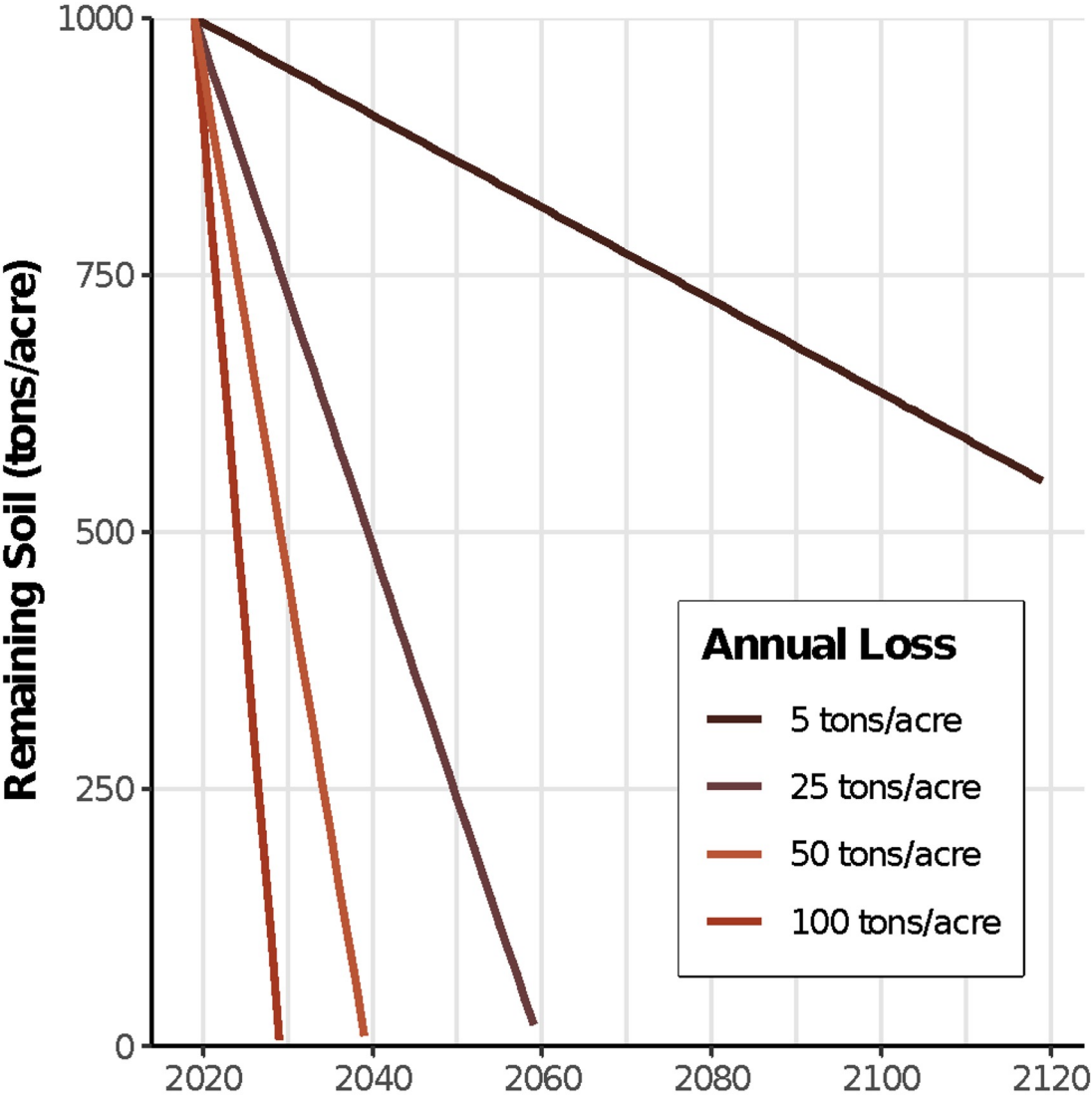
Climate Change Threats to Soil

Observed U.S. Trend in Heavy Precipitation



<https://science2017.globalchange.gov/chapter/7/>

Projections of Soil Depletion in Iowa



From White House
OSTP

25% of Iowa
cropland
has no topsoil—
2019

Consequences of Soil Loss: Agriculture

- Crop yield reduction
- Less buffering floods and droughts
- Less land to feed a hungry, populated world
- Lose resilience and beauty of the landscape
- Lose the most powerful water filter on Earth

Consequences of Soil Loss: Climate

- We have already lost 133 billion tons of carbon from the Earth's soil – equivalent to 25 years of U.S. fossil fuel emissions
- Some soils emit greenhouse gases when disturbed

There are consequences where soil ends up...



<https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/august-2009/gullies-supply-most-sediment-to-major-east-coast-river-systems/>

Why does soil erode?

Plowing Destroys Soil Structure



Prairies Covered 1/3 of Wisconsin Land Before European-Americans Arrived



Many Highly Bred Crops Have Diminutive Root Systems



14 ft.
Switchgrass



5.8 ft.
Average height man



The Perfect Storm

Extensive use of plowing

+

Monocropping with annual crops

+

Small root systems

+

Severe weather events

=

EROSION

How to save soil?

Indigenous People Have Been Preserving Soil for Thousands of Years



Ifugao of the Phillipines
Māori of Aoetearoa New
Zealand



Maya of Central America and
Mexico
Zuni Indians of SW United States

Practices to Improve Soil Health

- No-till planting—protects soil structure and preserves crop residue
- Cover cropping—avoid 8 months of bare soil, increase organic matter



"Prairie strips transition from research to reality"



- STRIPS program teaches farmers to replace 10% of corn with strips planted with deep-rooted prairie plants
- Can reduce run-off by 37%
- Can reduce erosion by 90%



Key Actions to Improve Soil Health

- Sustainable farming practices
 - no-till, cover crops, STRIPS, rotational grazing
- Research
 - weed control without plowing
 - breed plants for yield under sustainable conditions
- Policy
 - Provide incentives for farmers to protect soil
 - Join “4 per 1000” — International coalition to increase soil carbon by 0.4%

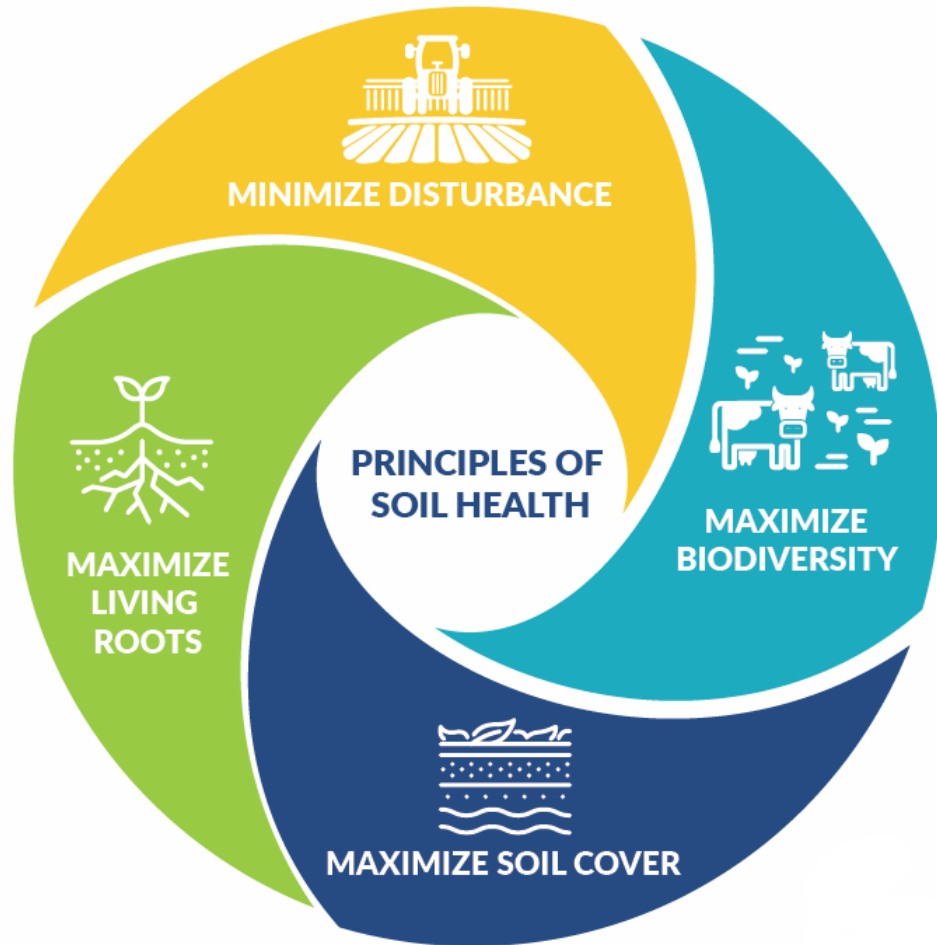
More support for NRCS!!!!

NRCS Soil Movement



www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/

Save Our Soil



<https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>



FRANKLIN D. ROOSEVELT

XXXII *President of the United States: 1933-1945*

40 - Letter to all State Governors on a Uniform Soil Conservation Law.

February 26, 1937

My dear Governor:

The dust storms and floods of the last few years have underscored the importance of programs to control soil erosion. I need not emphasize to you the seriousness of the problem and the desirability of our taking effective action, as a Nation and in the several States, to conserve the soil as our basic asset. The Nation that destroys its soil destroys itself.

In the Act of Congress approved April 27, 1935 (Public No. 46 of the 74th Congress), the Federal Government, through the Soil Conservation Service of the Department of Agriculture, initiated a

“The Nation that destroys its soil destroys itself.”



Decision Moment

Will we have a world with soil?



photograph by Anton Petrus

@jo44atWID
#SOILROCKS!

www.soilrocks.org

jo.handelsman@wisc.edu