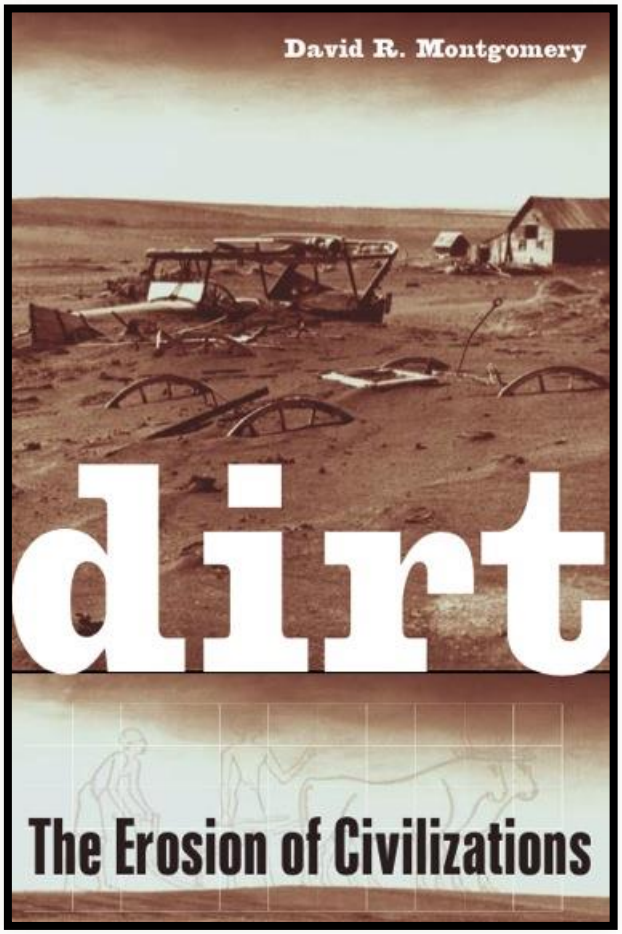

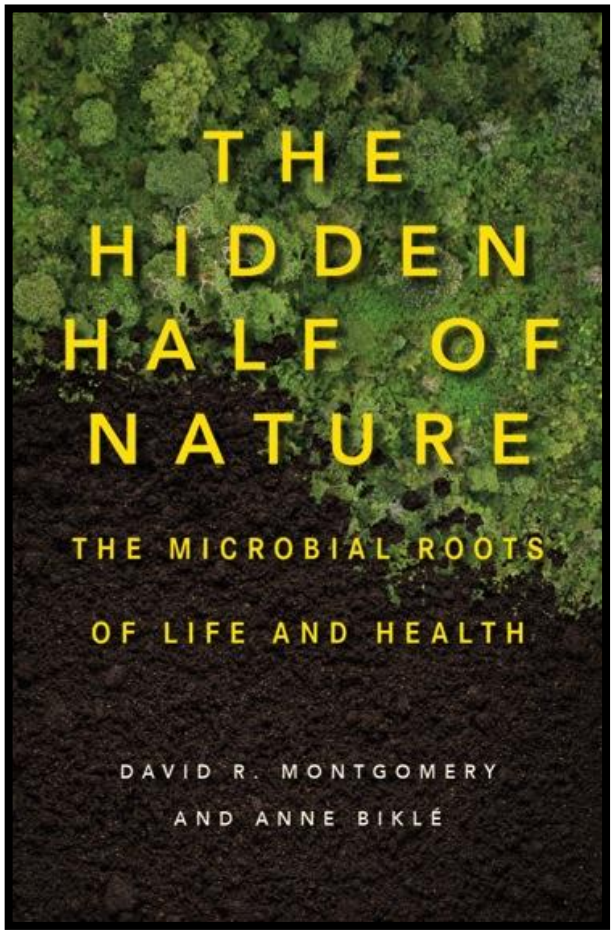

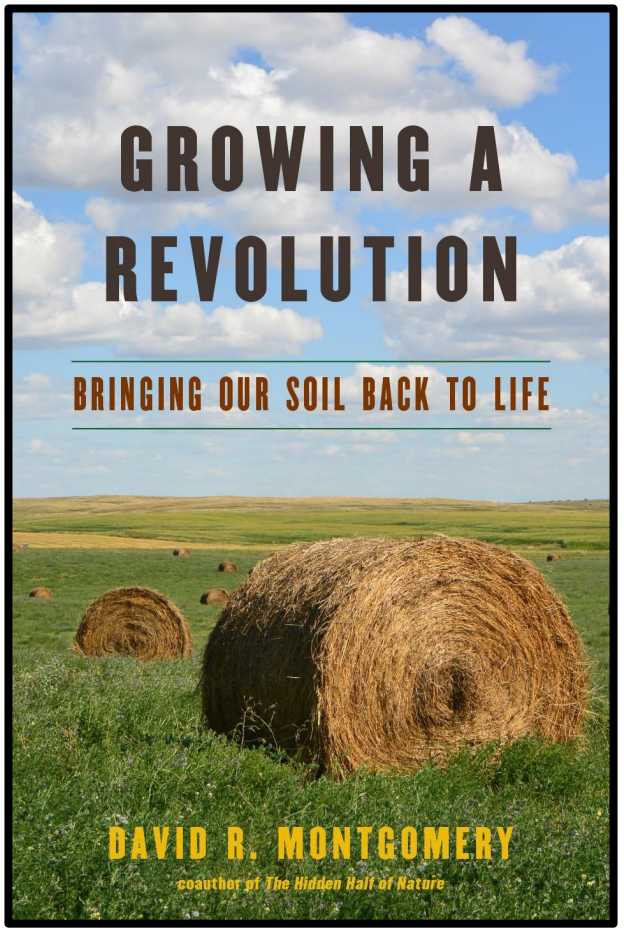

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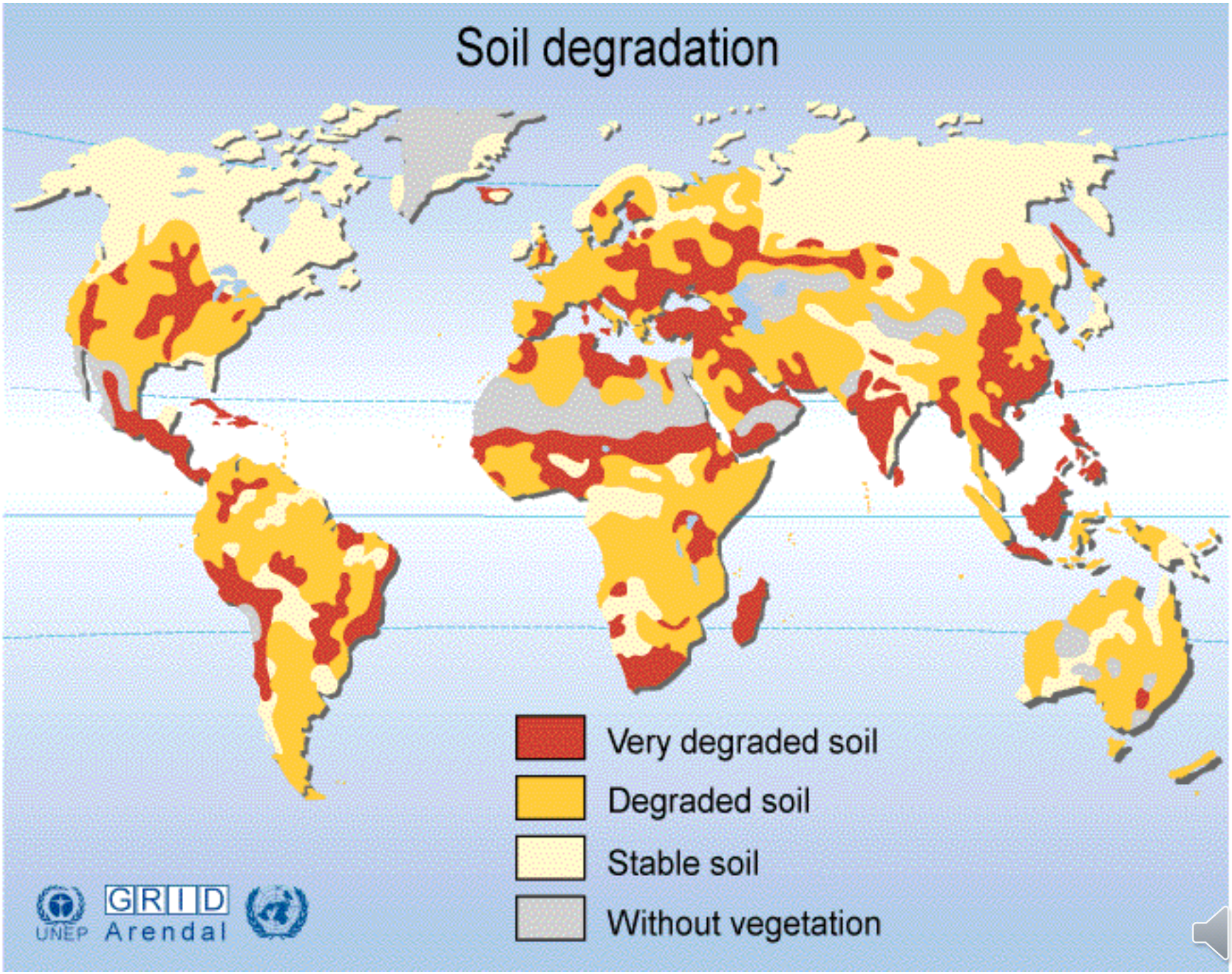
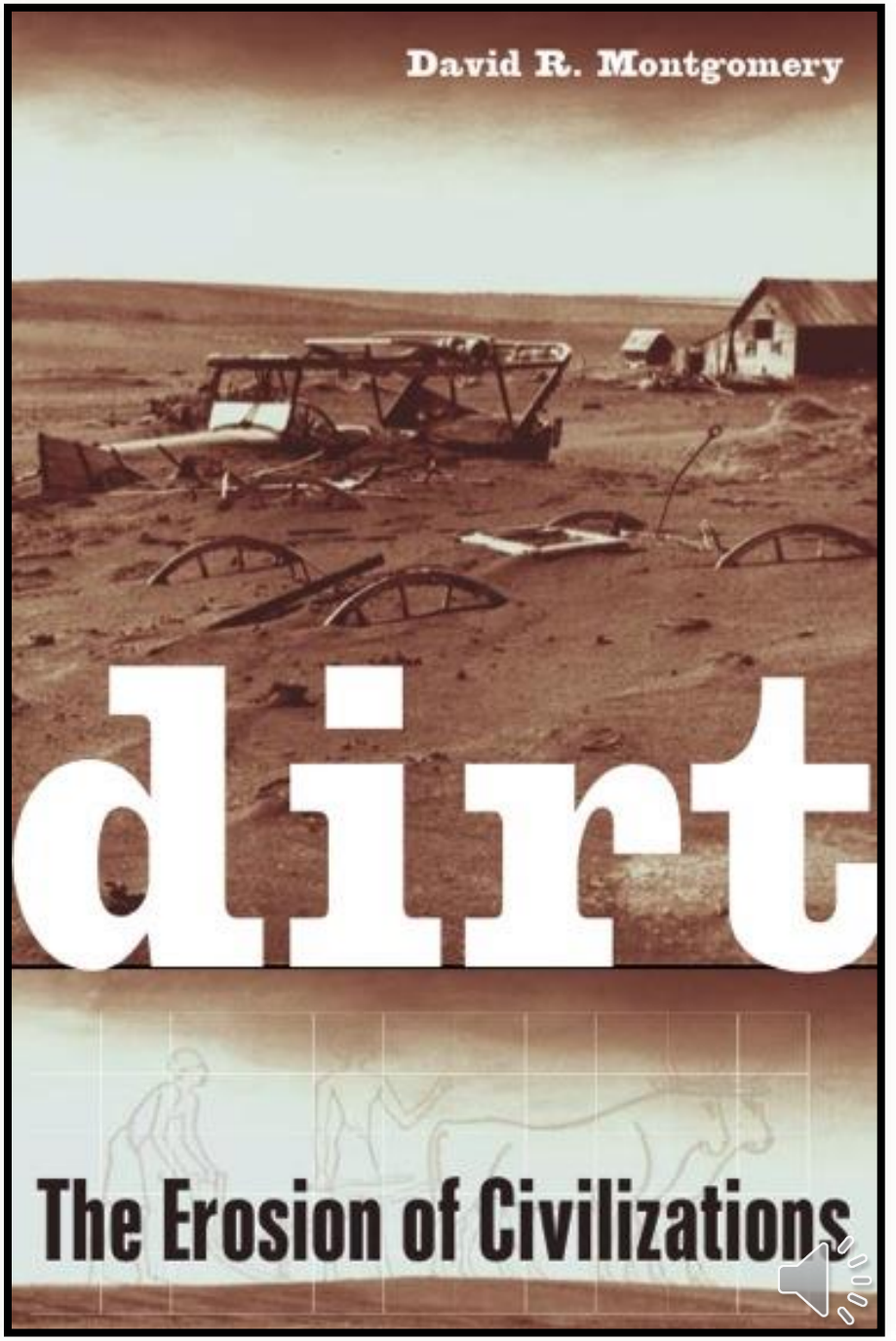
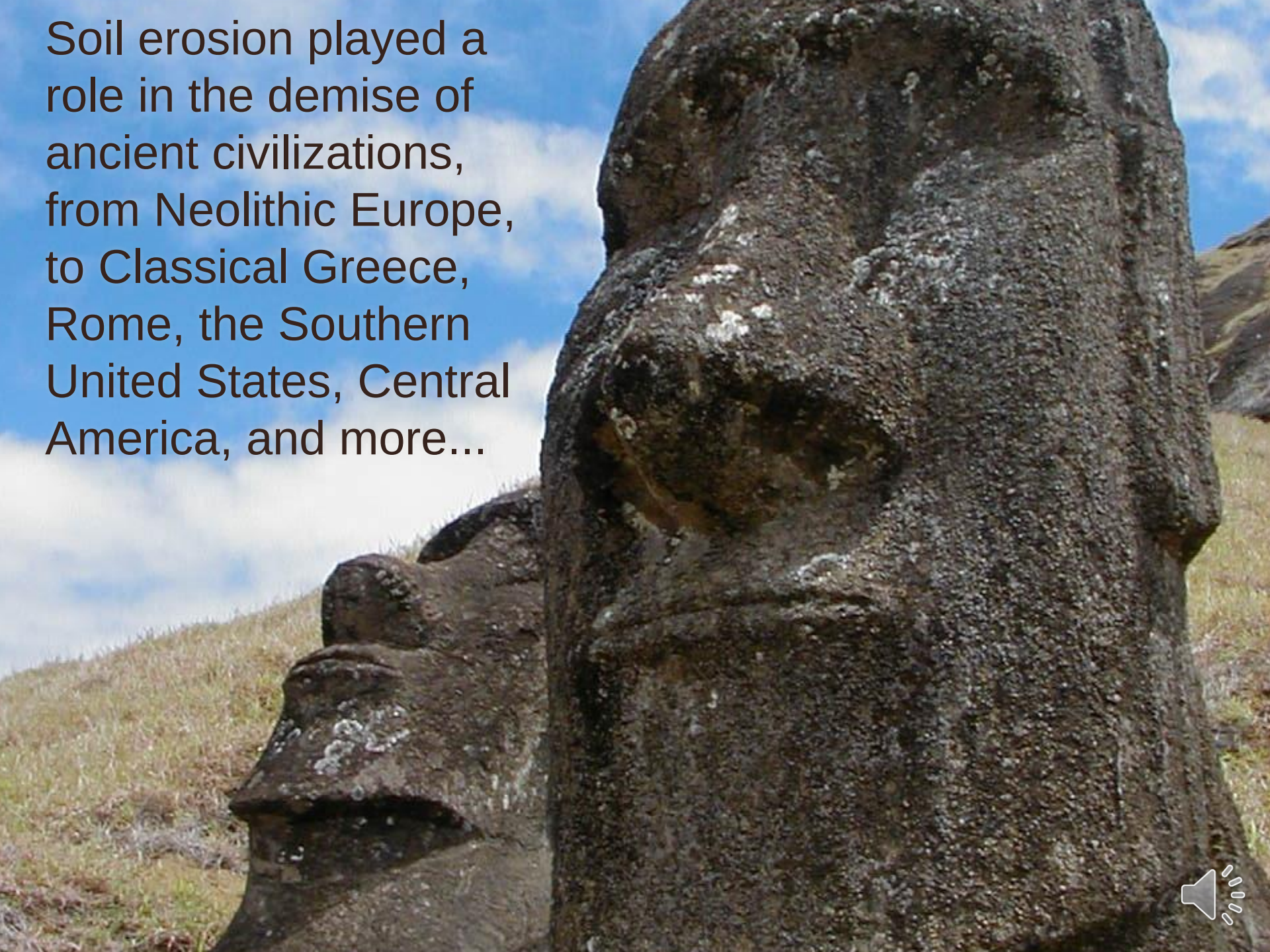

Soil degradation
Very degraded soil
Degraded soil
Stable soil
Without vegetation
UNEP
GRID
Arendal

Humanity loses another 0.3% of our global food production capacity each year to soil erosion and degradation.

UN Global State of the Soil Assessment, 2015


David R. Montgomery
dirt
The Erosion of Civilizations


Soil erosion played a role in the demise of ancient civilizations, from Neolithic Europe, to Classical Greece, Rome, the Southern United States, Central America, and more...

Invention of the plow fundamentally altered the balance between soil production and soil erosion, dramatically increasing soil erosion…

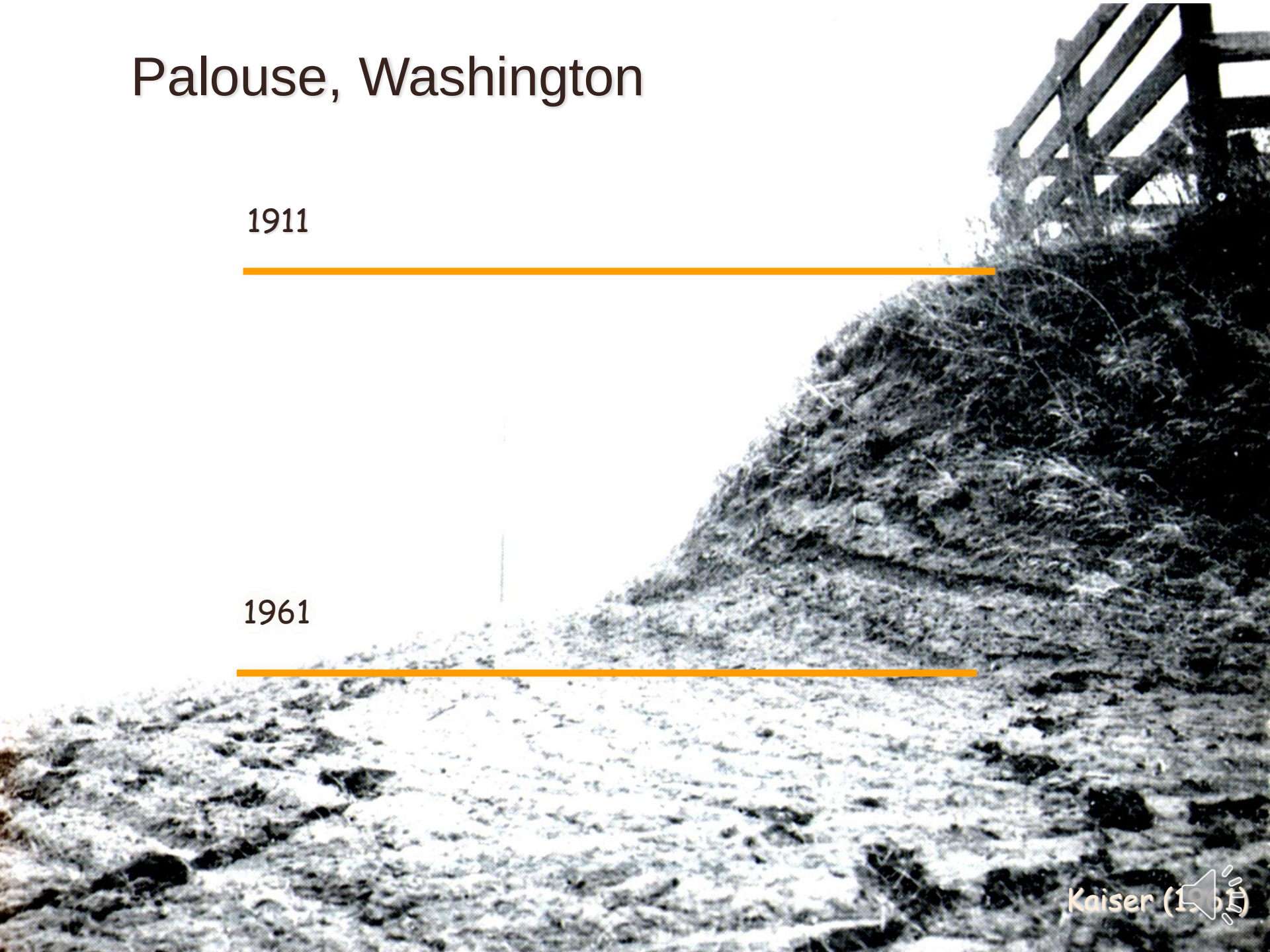
Palouse, Washington

1970

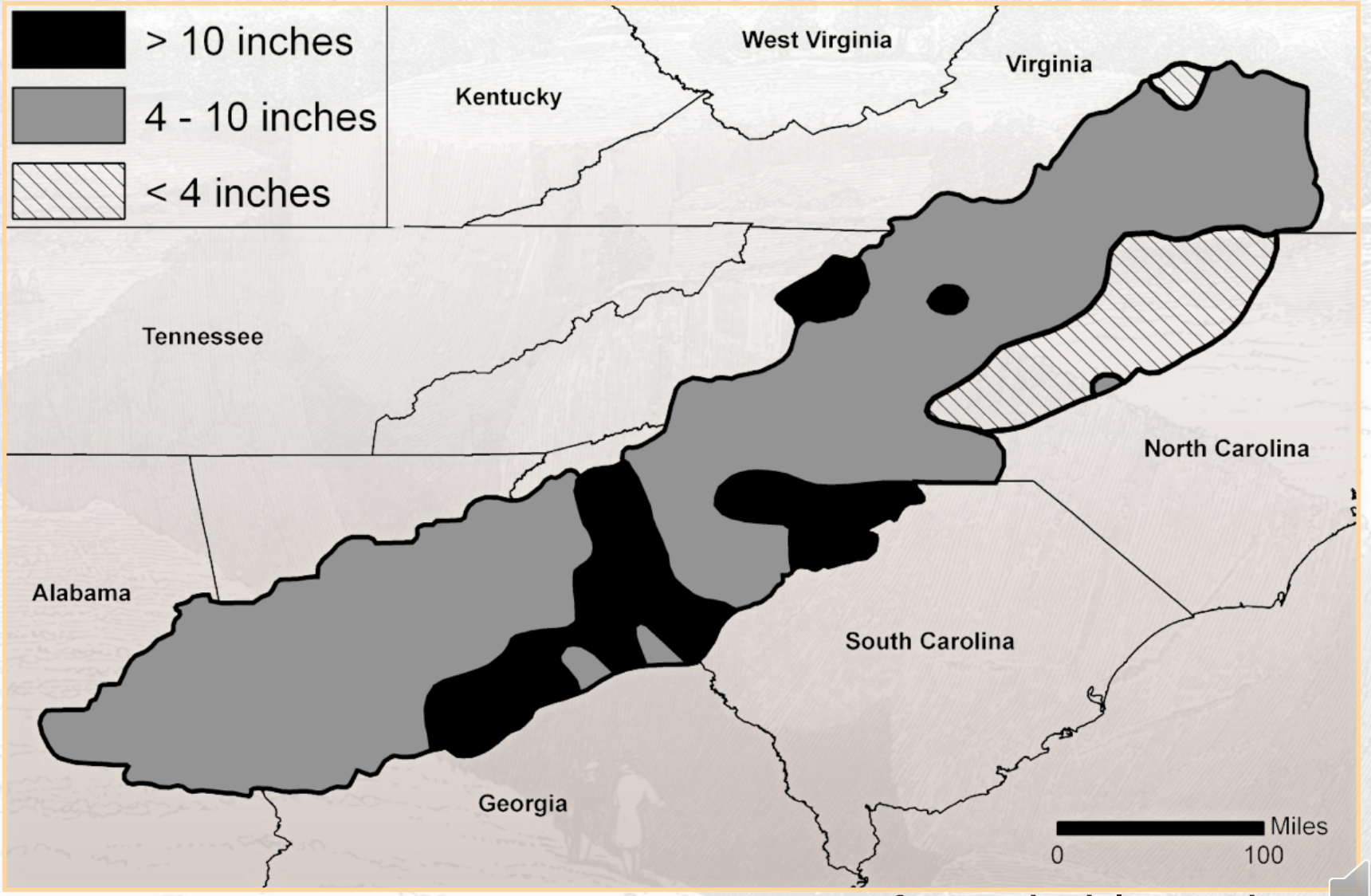
Palouse, Washington

1911

1961

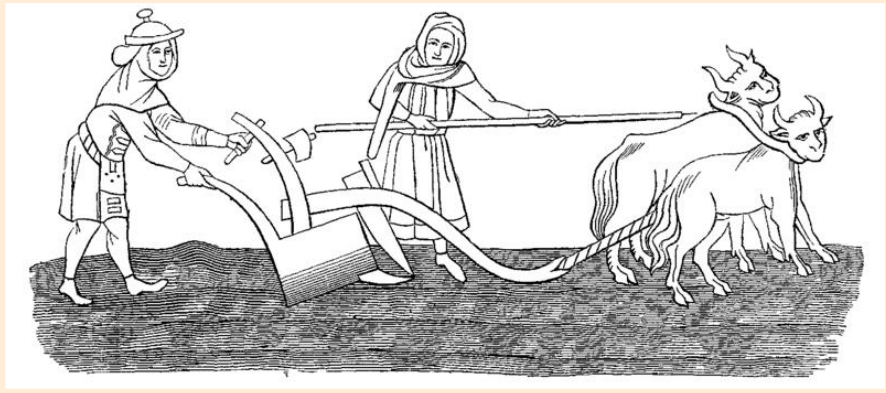


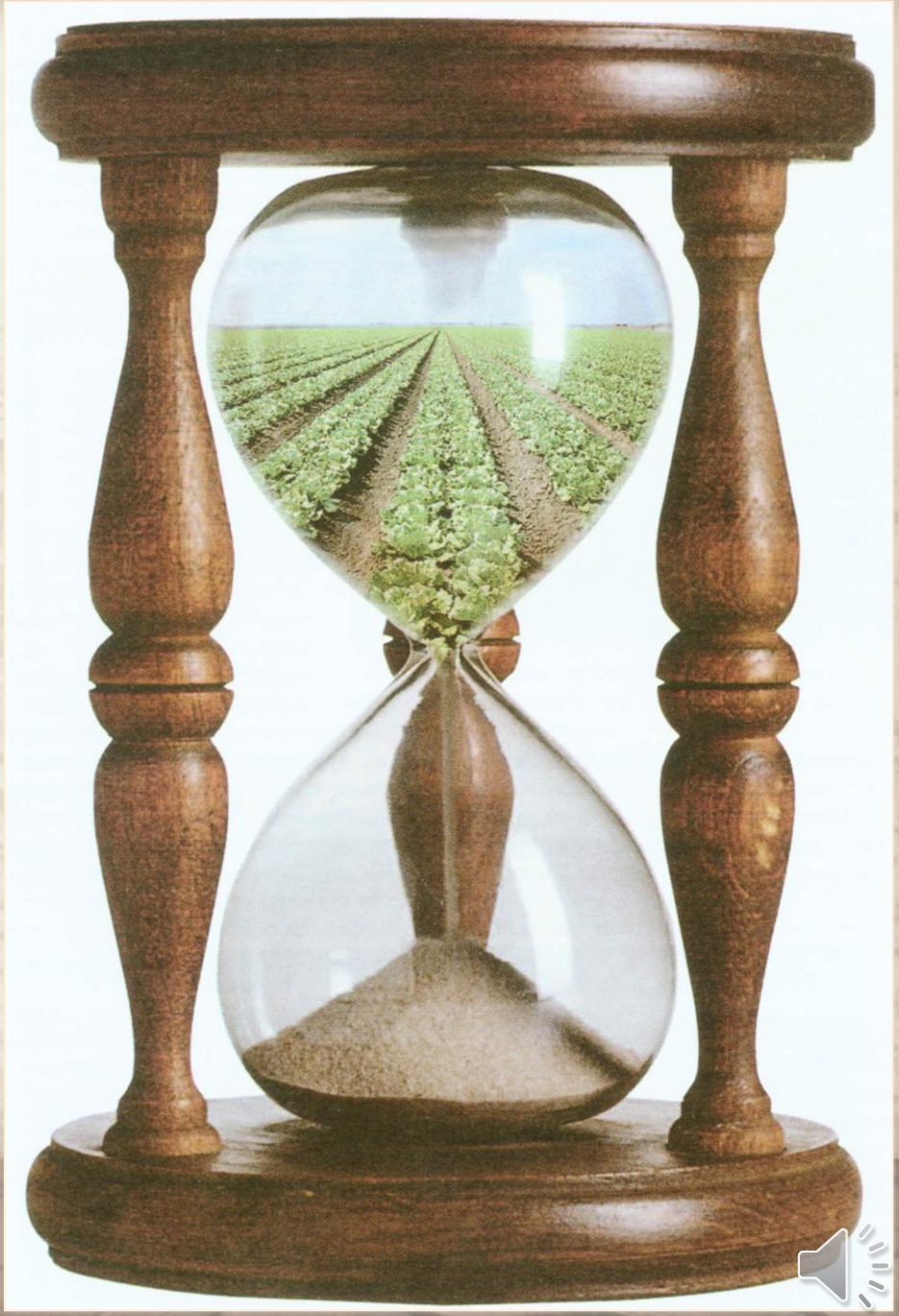
Historical soil erosion in the Piedmont region



after Trimble and Meade

In researching *Dirt*, I compiled data on both contemporary and long-term (geological) erosion rates—and agricultural erosion rates.





Erosion Rates

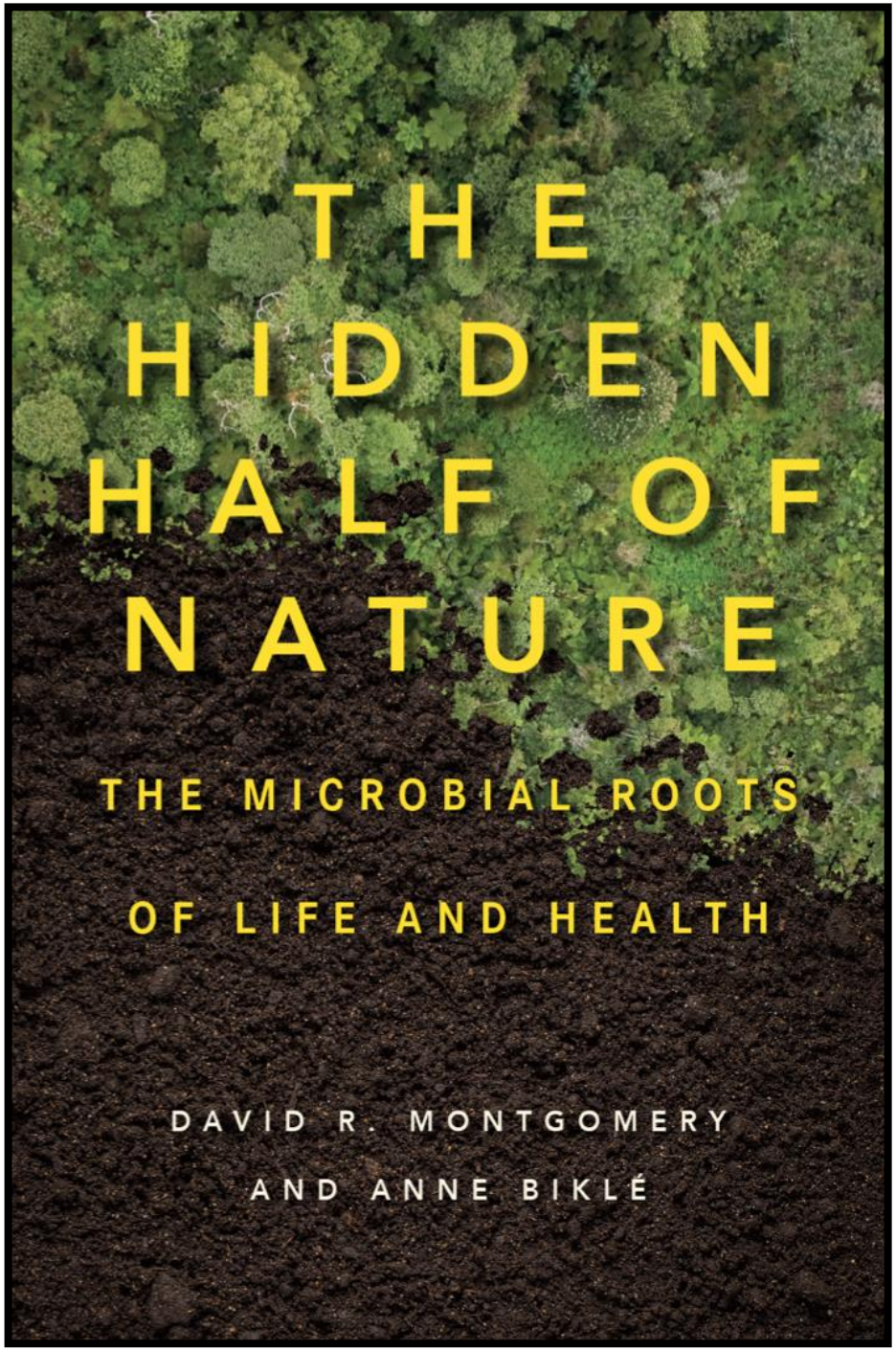
Measurement type	median (mm/yr)
Conventional (448)	1.54
No-till (47)	0.08
Native Vegetation (65)	0.01
Soil Production (188)	0.02
Geological (925)	0.03

Net soil loss of ≈1 mm/yr implies that erosion of a typical 0.5 to 1 m thick hillslope soil could occur in roughly 500 to 1000 years.

This is approximately the lifespan of most major civilizations outside of major river floodplains…

Is Soil Restoration Possible?

Can we reverse the historical pattern?

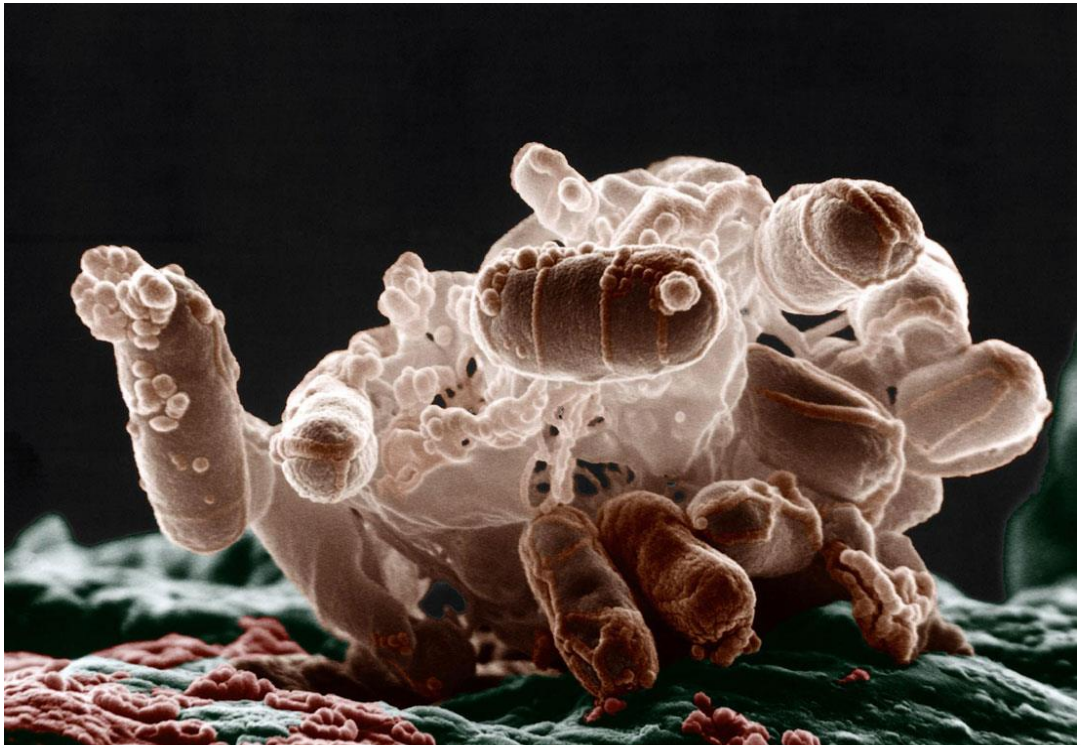

THE HIDDEN HALF OF NATURE
THE MICROBIAL ROOTS OF LIFE AND HEALTH
DAVID R. MONTGOMERY
AND ANNE BIKLÉ

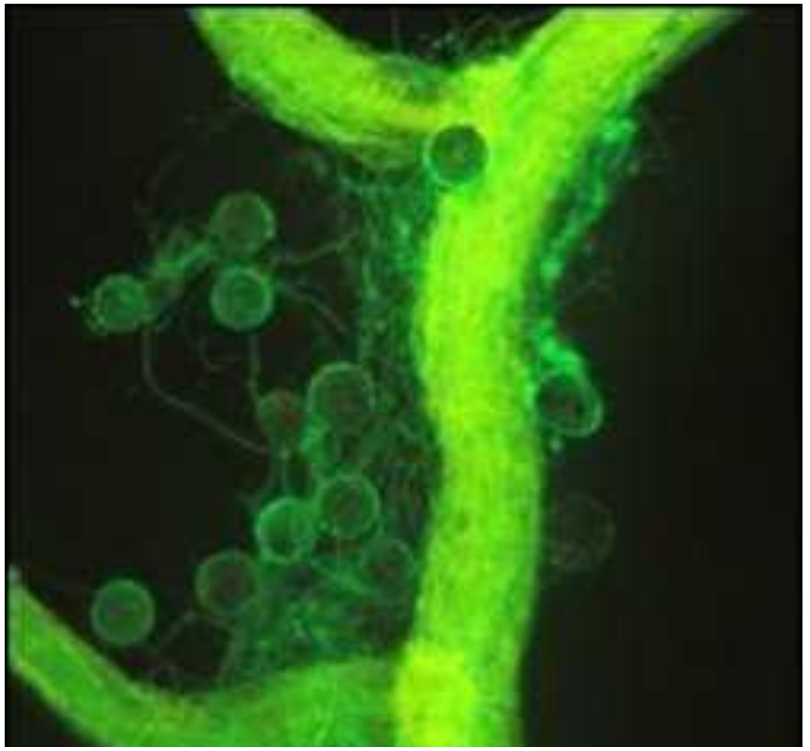
The Brown Goods

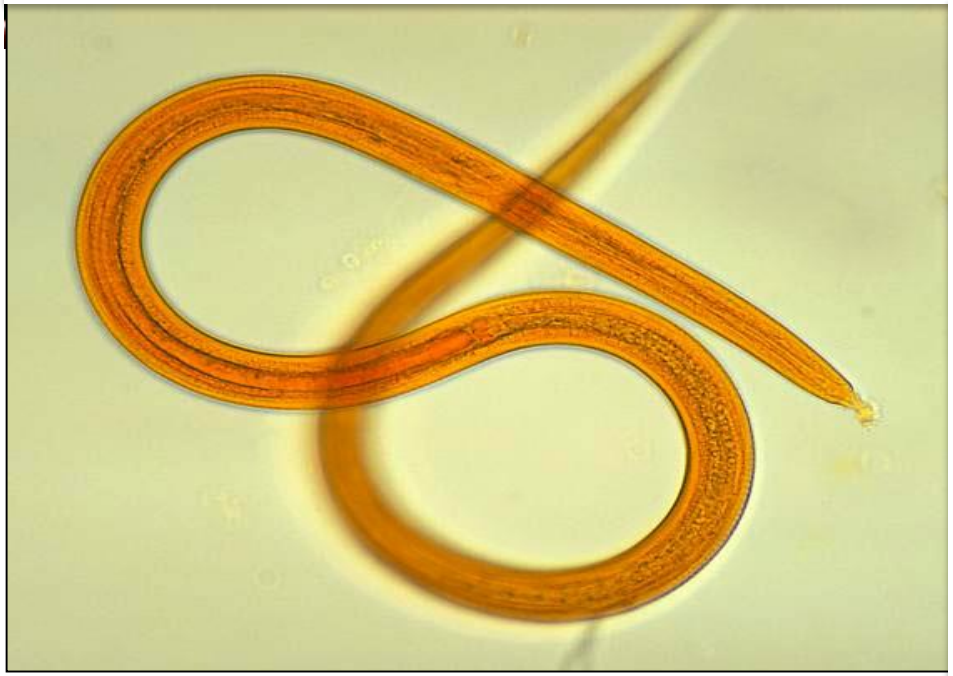
The Green Goods

The LIVING Goods

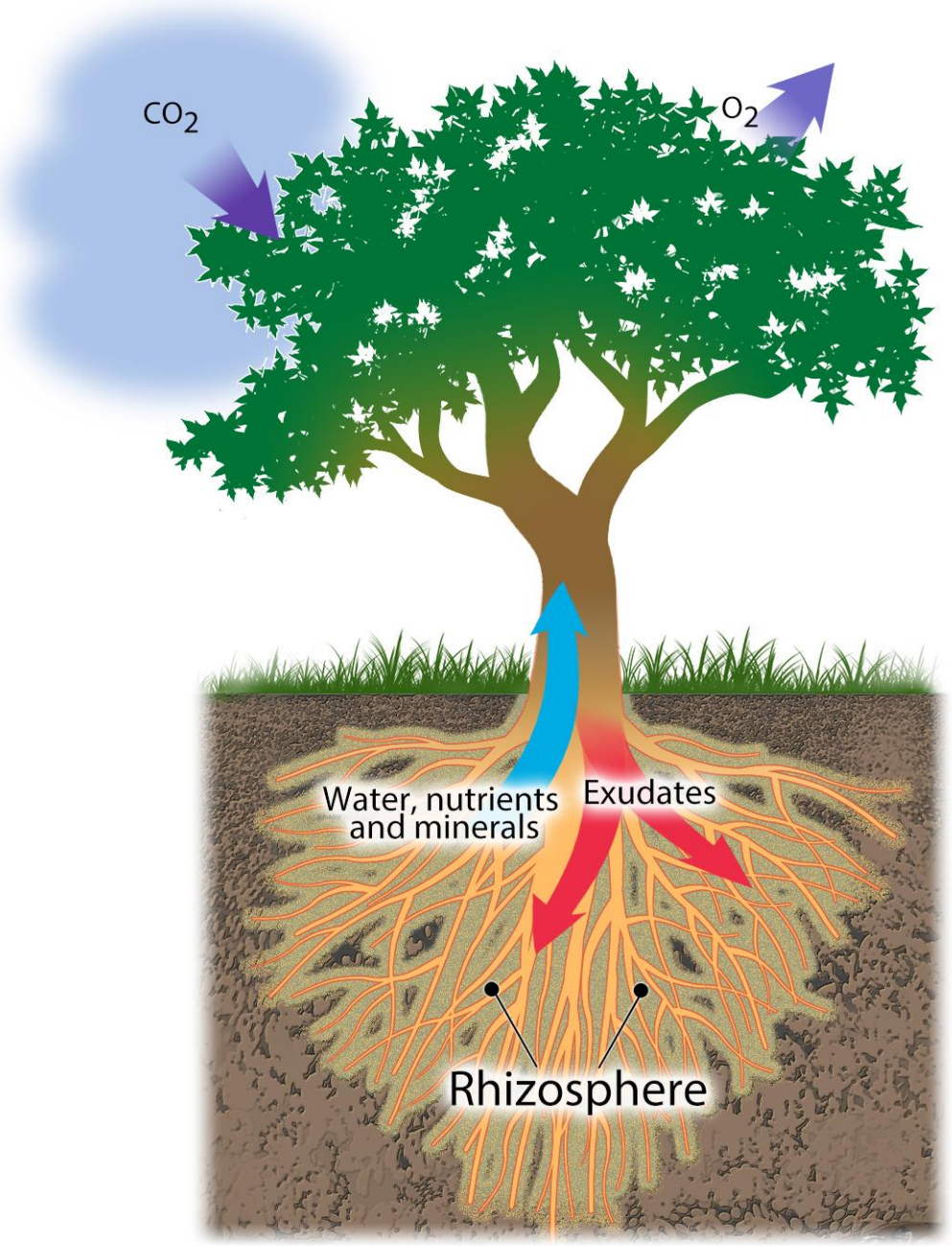
We can build soil surprisingly fast — faster than nature





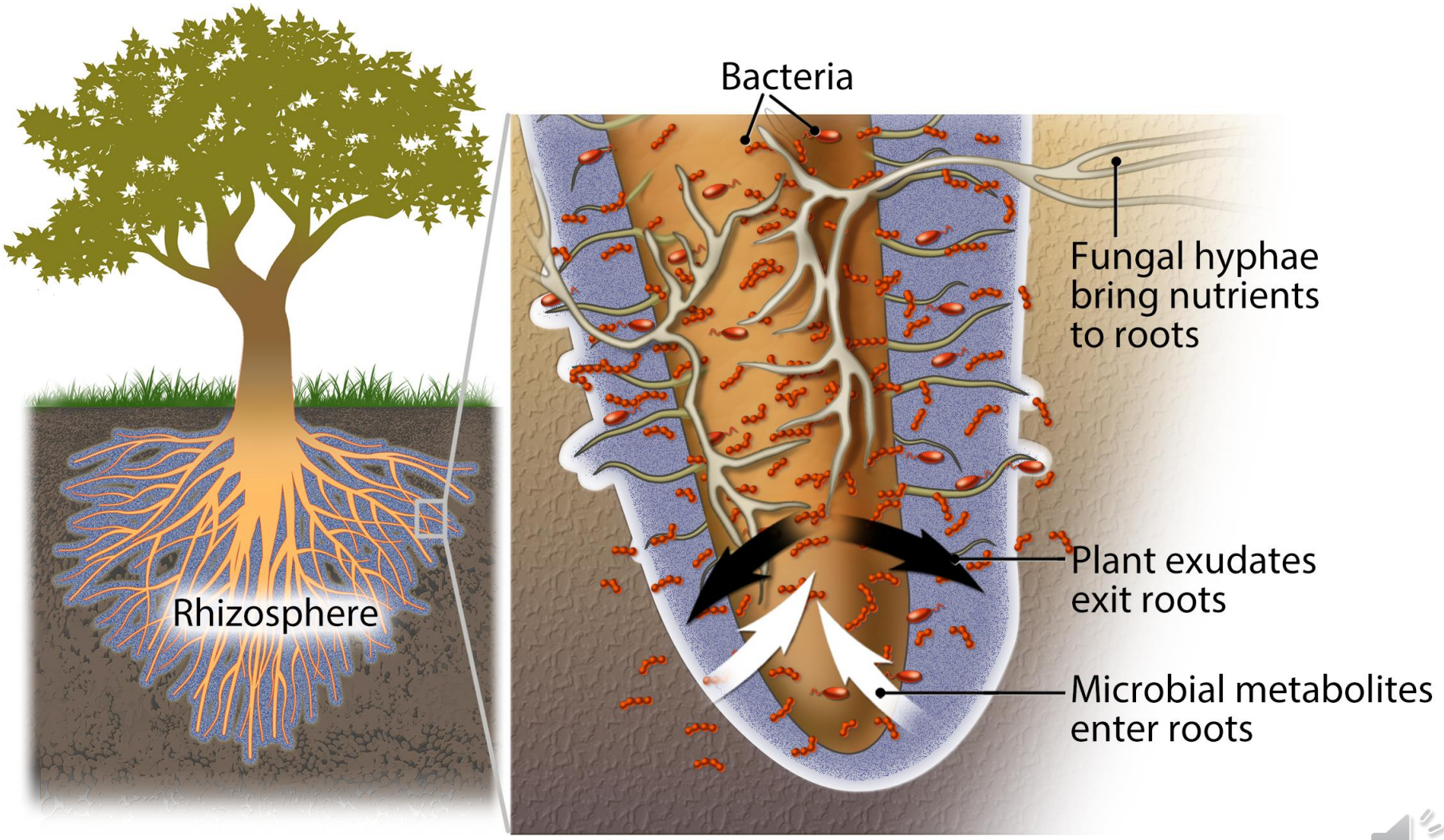



© Pavel Krásenský
www.naturfoto.cz



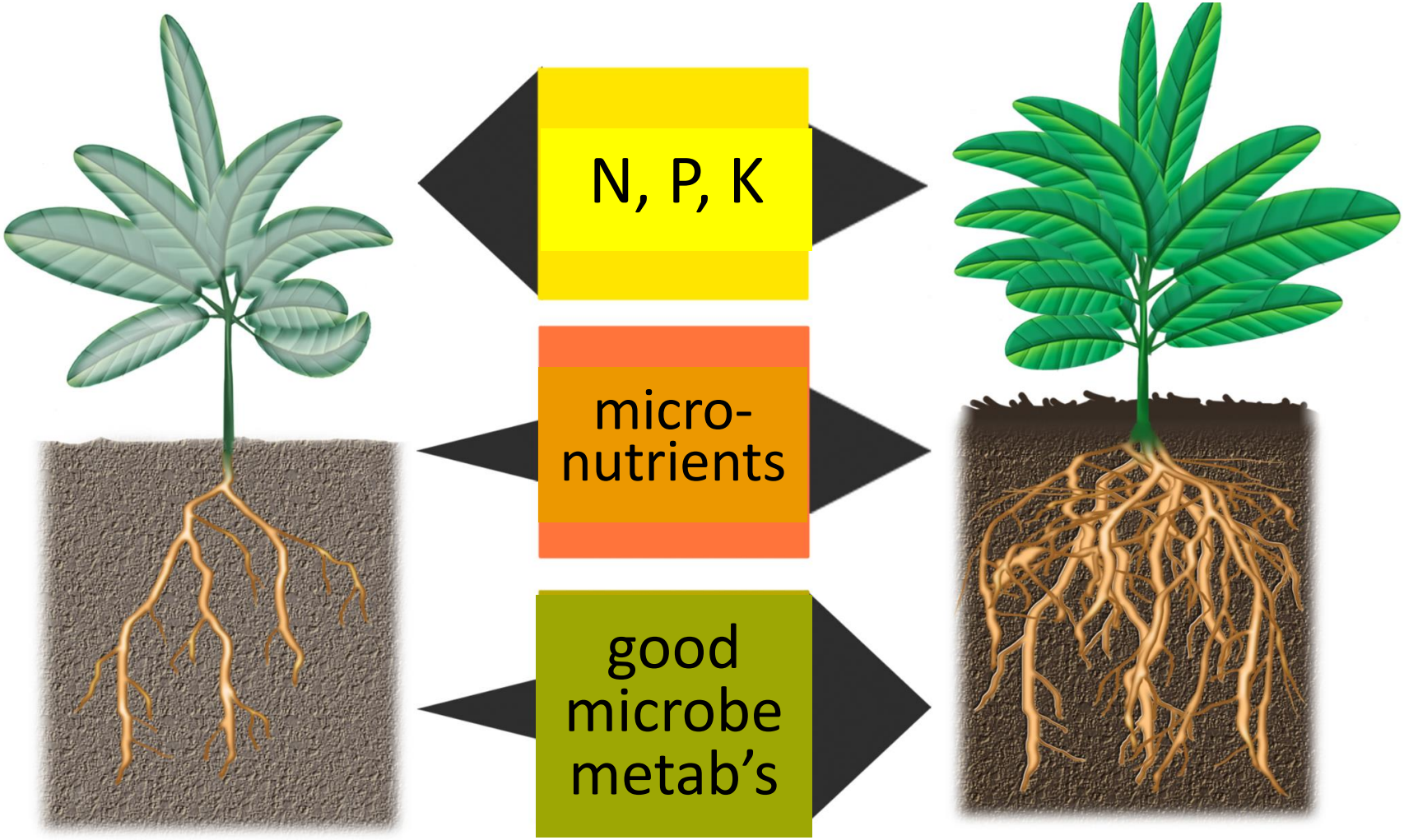
The rhizosphere is a zone rich with microbial life, a living halo that surrounds plant roots

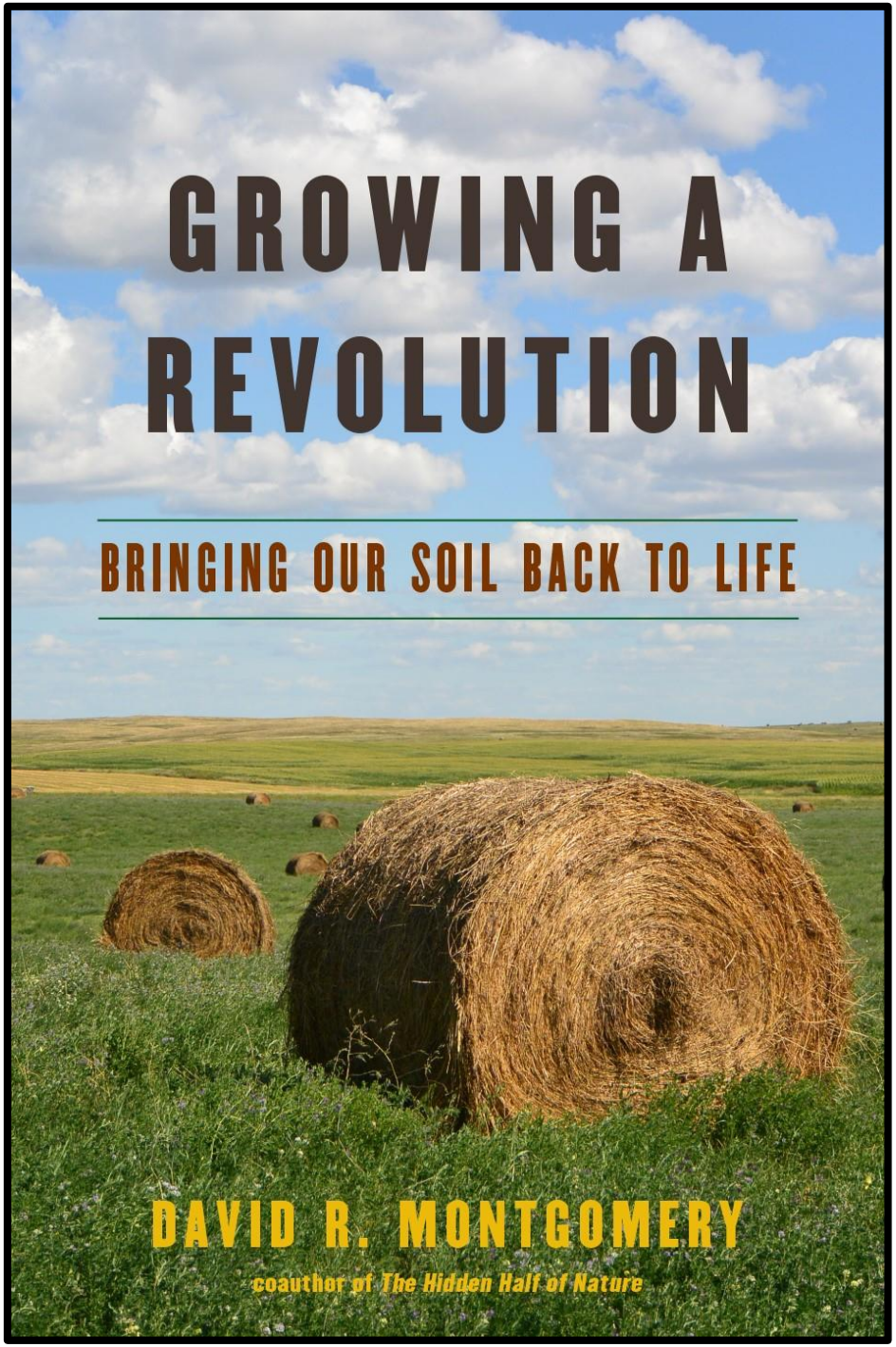
The rhizosphere is a biological bazaar where microbes and plants trade nutrients, metabolites, and exudates



Fertilizer Diet

Soil Life Diet

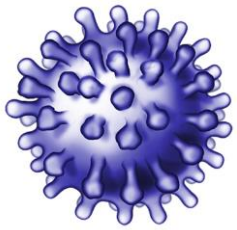


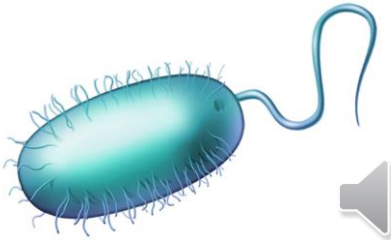

GROWING A REVOLUTION
BRINGING OUR SOIL BACK TO LIFE
DAVID R. MONTGOMERY
coauthor of The Hidden Half of Nature

Visiting farms around the world that had rebuilt soil health I saw how adopting Conservation Agriculture principles could match conventional yields using far less oil and chemical inputs.

Principles of Conservation Agriculture

- minimal or no disturbance / direct planting of seeds (e.g., no-till)
- permanent ground cover (retain crop residues and include cover crops in rotations)
- diverse crop rotations (to maintain soil fertility and break up pathogen carryover)



Cover Crops

Adopting no-till, cover crops, and complex rotations reduced inputs of diesel, fertilizer and pesticide by more than half.

Traditional Yield
soybeans: 63 bushels/acre
corn: 217 bushels/acre

Complex Rotation Yield
soybeans: 79 bushels/acre
corn: 235 bushels/acre


Got Dirt?
Get Soil.

Traditional (slash and burn)
vs. no-till with cover crops

Erosion
Traditional: 1787 kg/ha/yr
No-till: 77 kg/ha/yr

Traditional Yield
corn: 1.5 tons/ha
cowpeas: 0.8 tons/ha

No-till Yield
corn: 4.5 tons/ha
cowpeas: 1.5 tons/ha


OHIO
No-Till
Council

County Average
Full tillage, 200 lbs N & 2.5 quarts Roundup / acre

Total cost ≈ $500/acre
Corn yield ≈ 100 bushels/acre
At $4/bushel = - $100 / acre

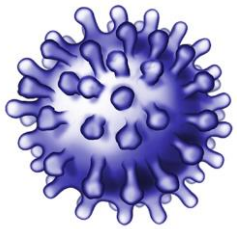
44-year no-till with cover crops
No tillage, 24 lbs N & 1 quart Roundup / acre

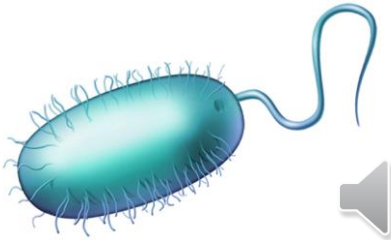
Total cost ≈ $320/acre
Corn yield ≈ 180 bushels/acre
At $4/bushel = + $400 / acre


Ditch the Plow,
Cover Up &
Grow Diversity

Benefits of Conservation Agriculture

- comparable or increased yields
- greatly reduced fossil fuel and pesticide use
- increased soil carbon and water retention (crop resilience)
- higher farmer profits & less pollution



This is not really a question of low tech organic versus GMO & agro-tech…

… but how to apply an understanding of soil ecology to the applied problem of increasing — and sustaining — crop yields in a post-oil environment.

Carbon Sequestration Potential

Rattan Lal conservatively estimated that conservation agriculture could put enough carbon back into soils to **offset 5 to 15% of global fossil-fuel emissions**.

The Rodale Institute (and others) have suggested that carbon sequestration in soils could **fully offset fossil fuel emissions**.


TACOMA


FREE
TAGRO
MIX
AMES
PRO LIFE

The First Revolution

Cultivation

The Second Revolution

Husbandry / Crop Rotations / Grazing

We know more about the movement of celestial bodies than about the soil underfoot.

- Leonardo da Vinci

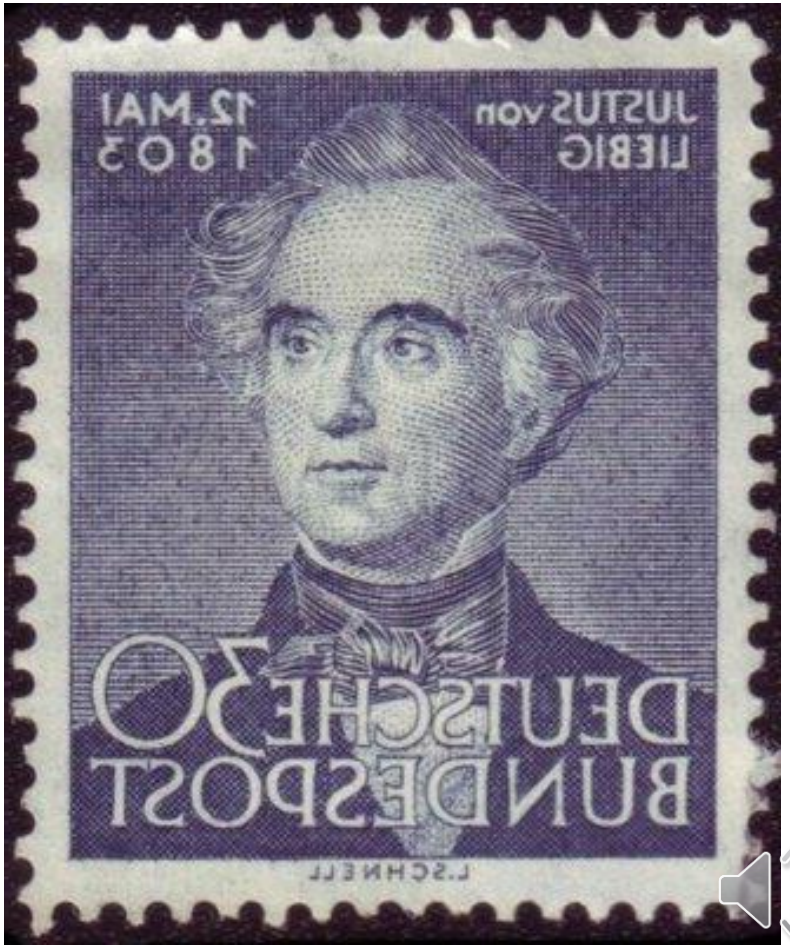
The Third Revolution

Mechanization and Industrialization

Sidebar…

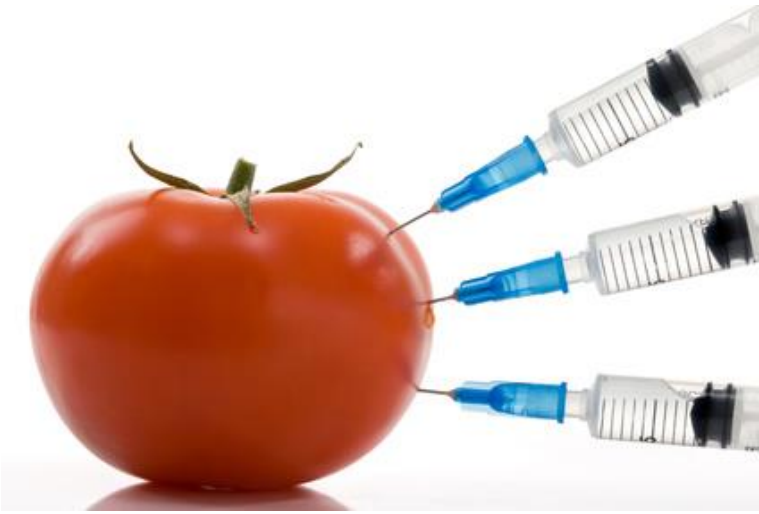
Liebig's change of heart

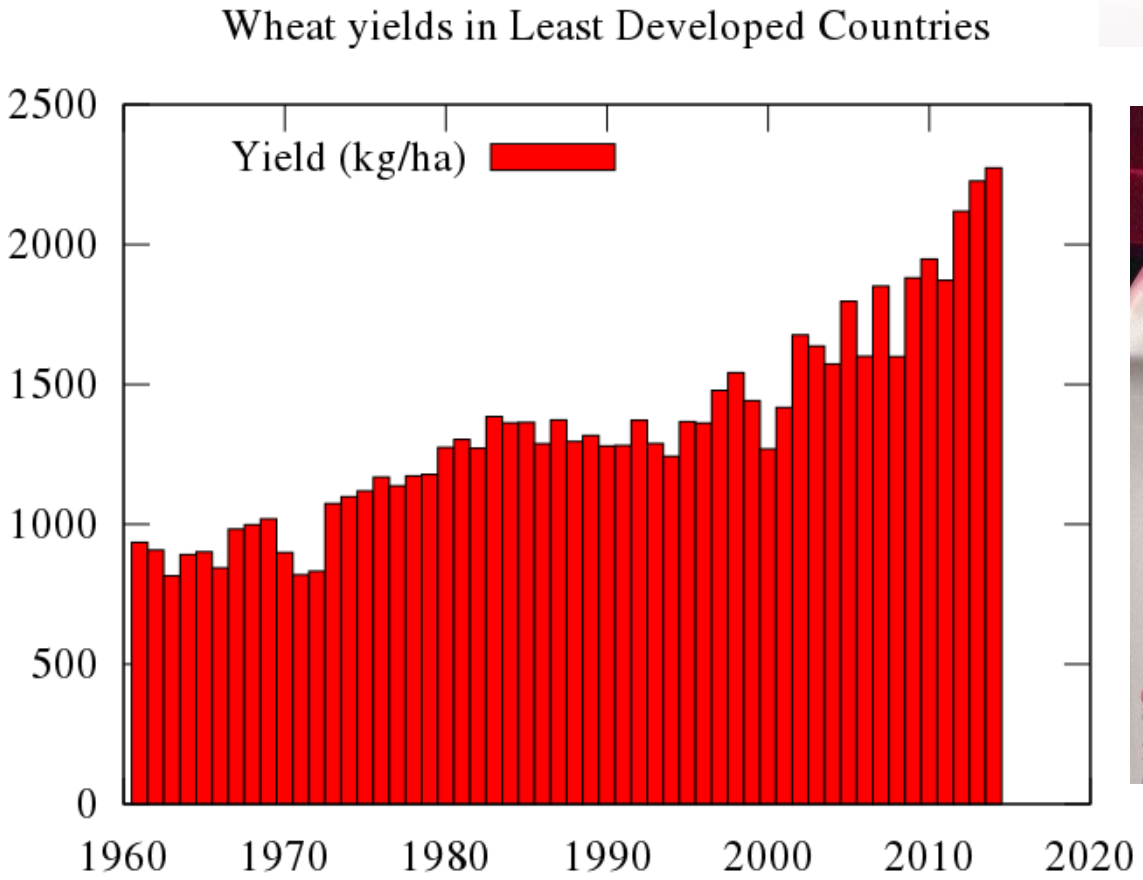
In his 1863 book, *The Natural Laws of Husbandry*, the father of fertilizers recommended returning organic matter to the fields to provide crops with a full complement of nutrients.



The Fourth Revolution

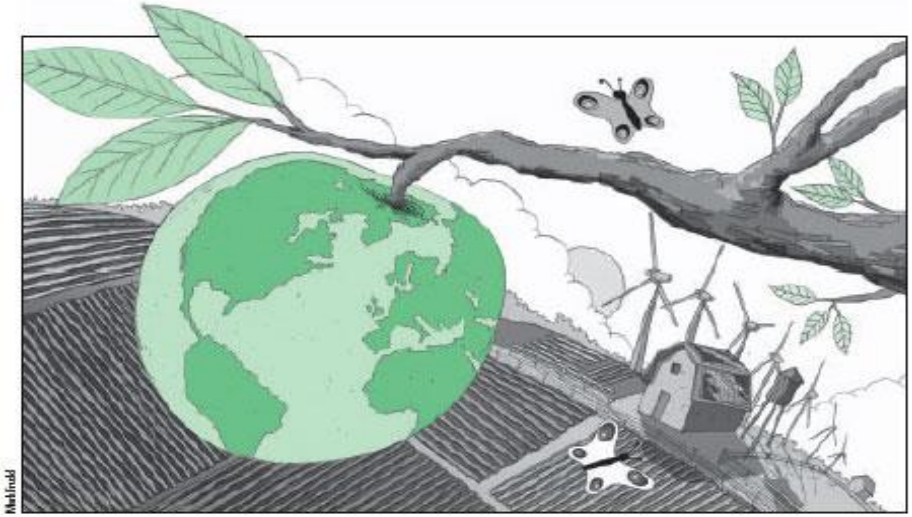
Green Revolution and Biotechnology

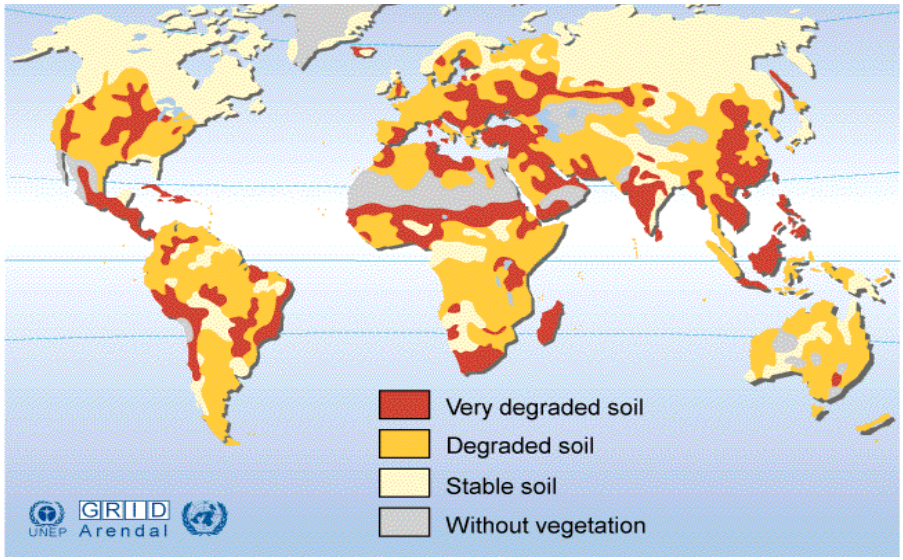


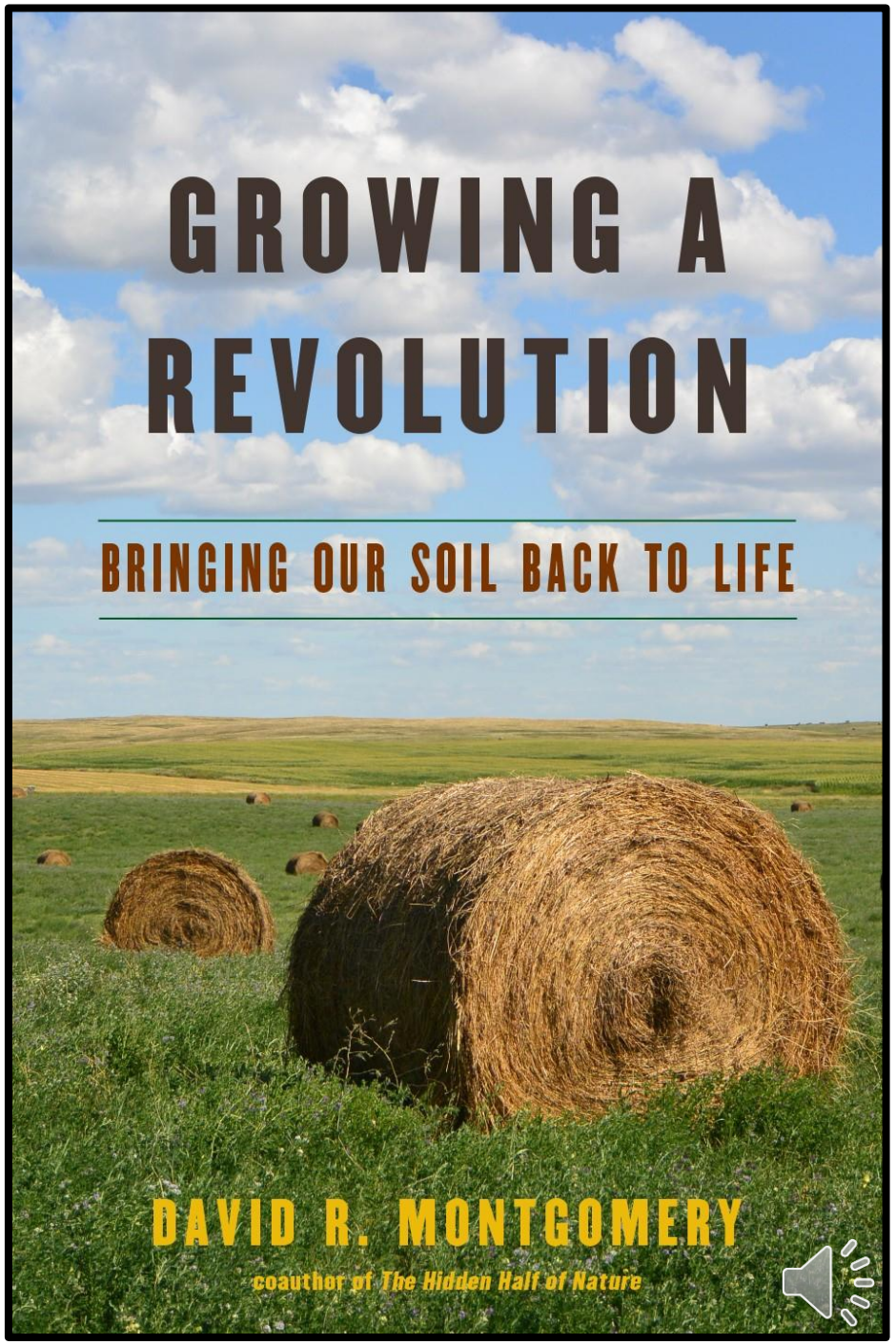


The Fifth Revolution

Soil-Health







Soil Health — the Future of Agriculture

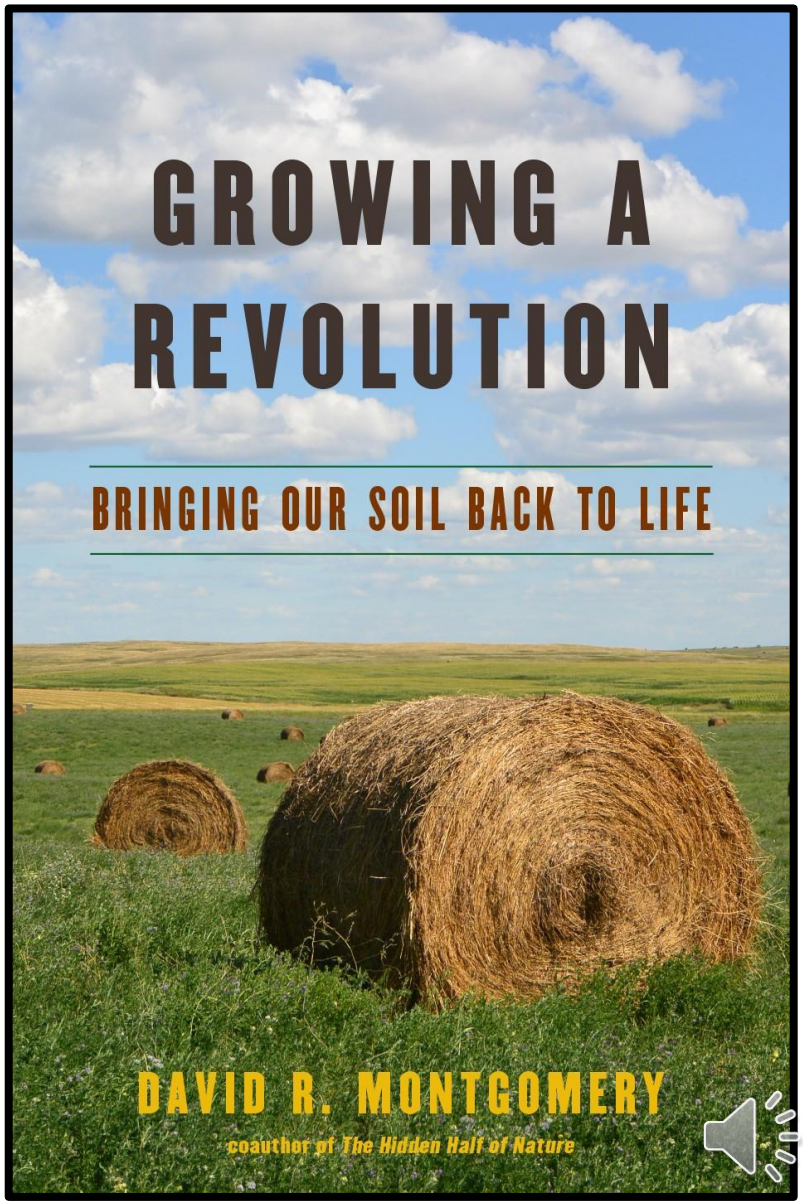
Restoring agricultural soils can help with …

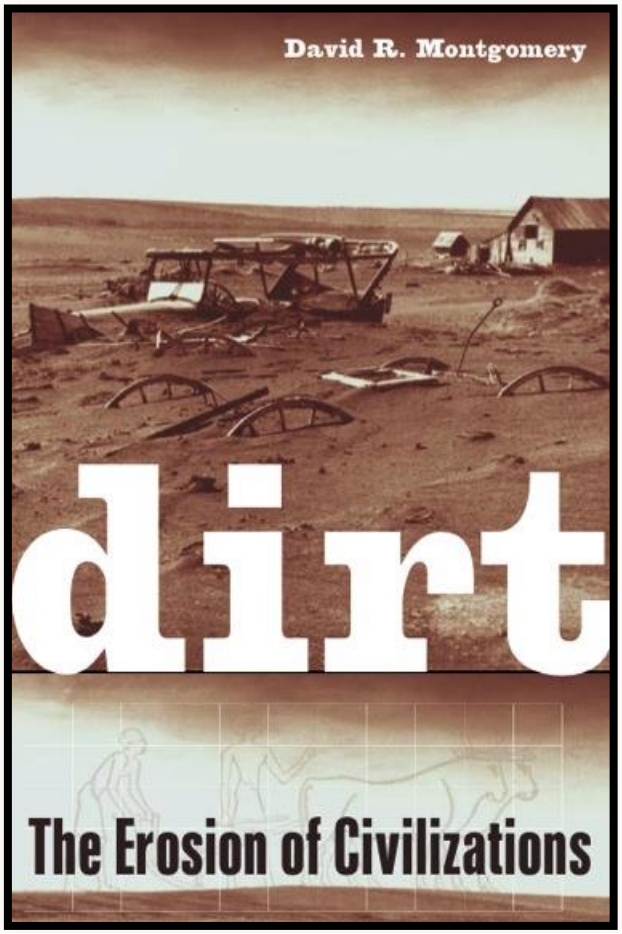
Feeding the world

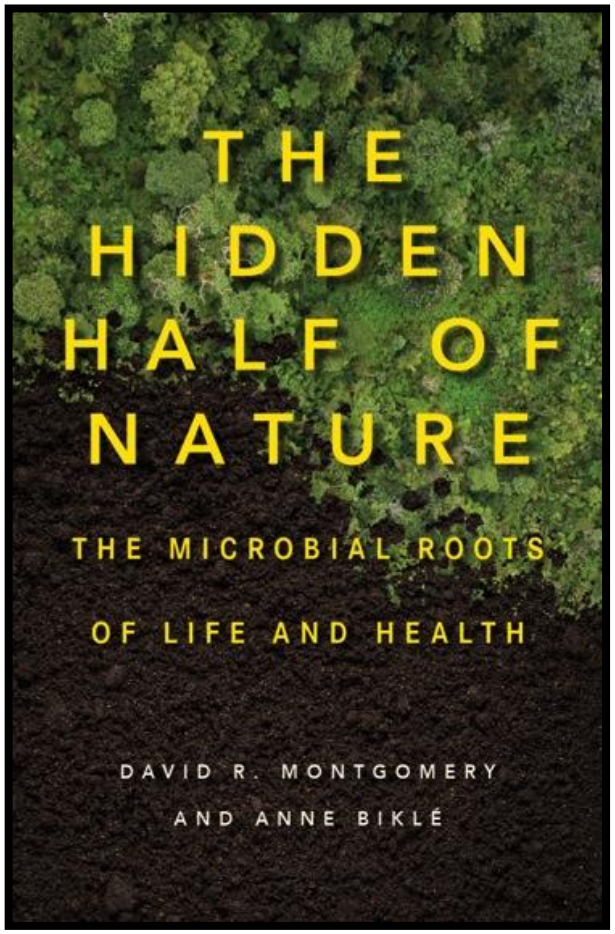
Climate change
(carbon sequestration)

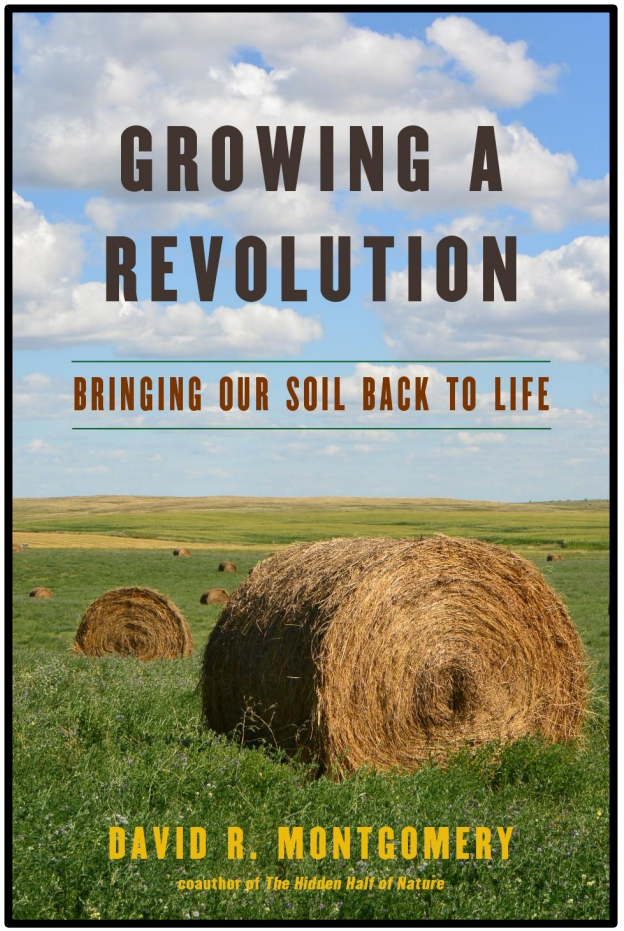
Environmental Degradation

Restoring farm profitability









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