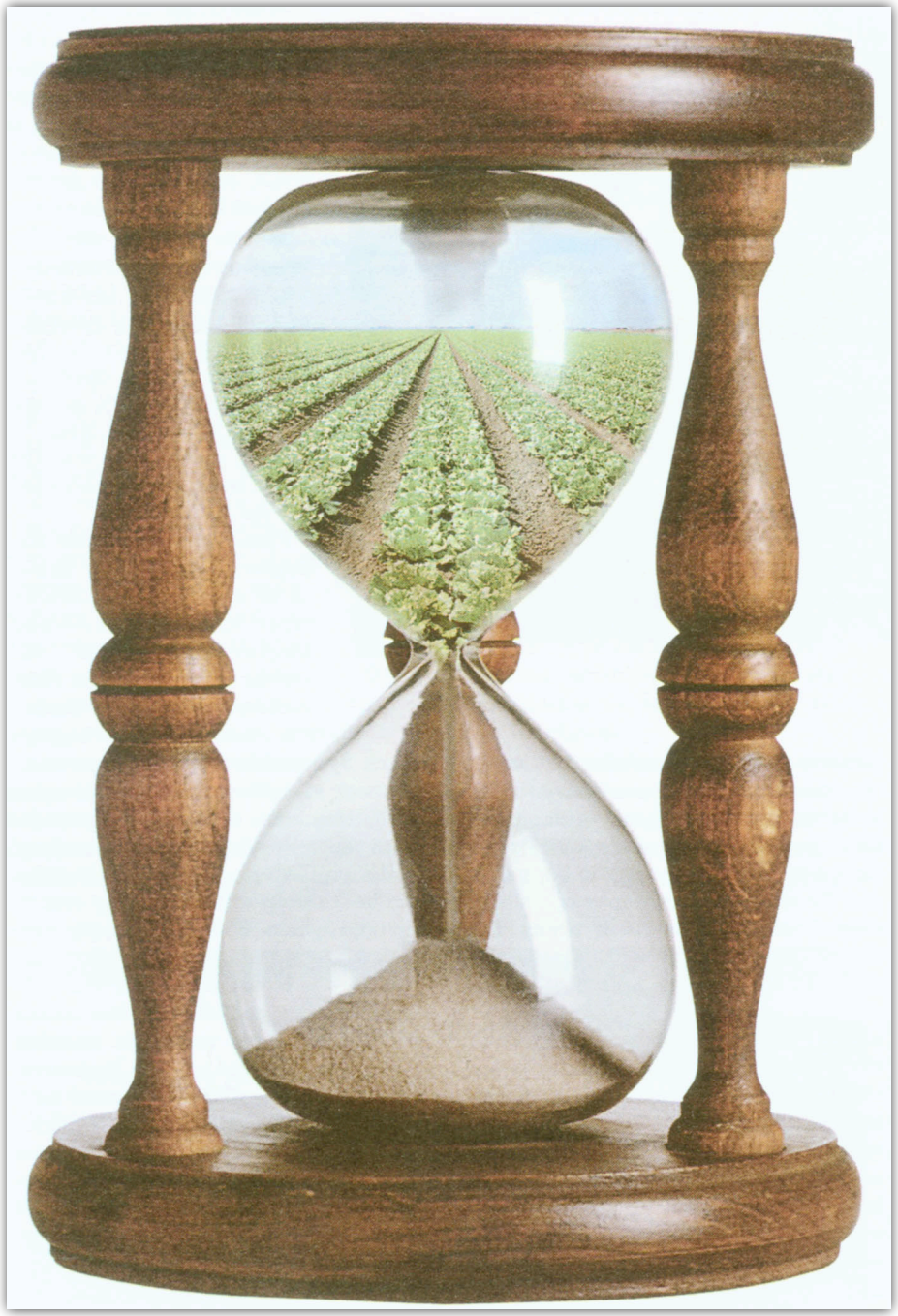
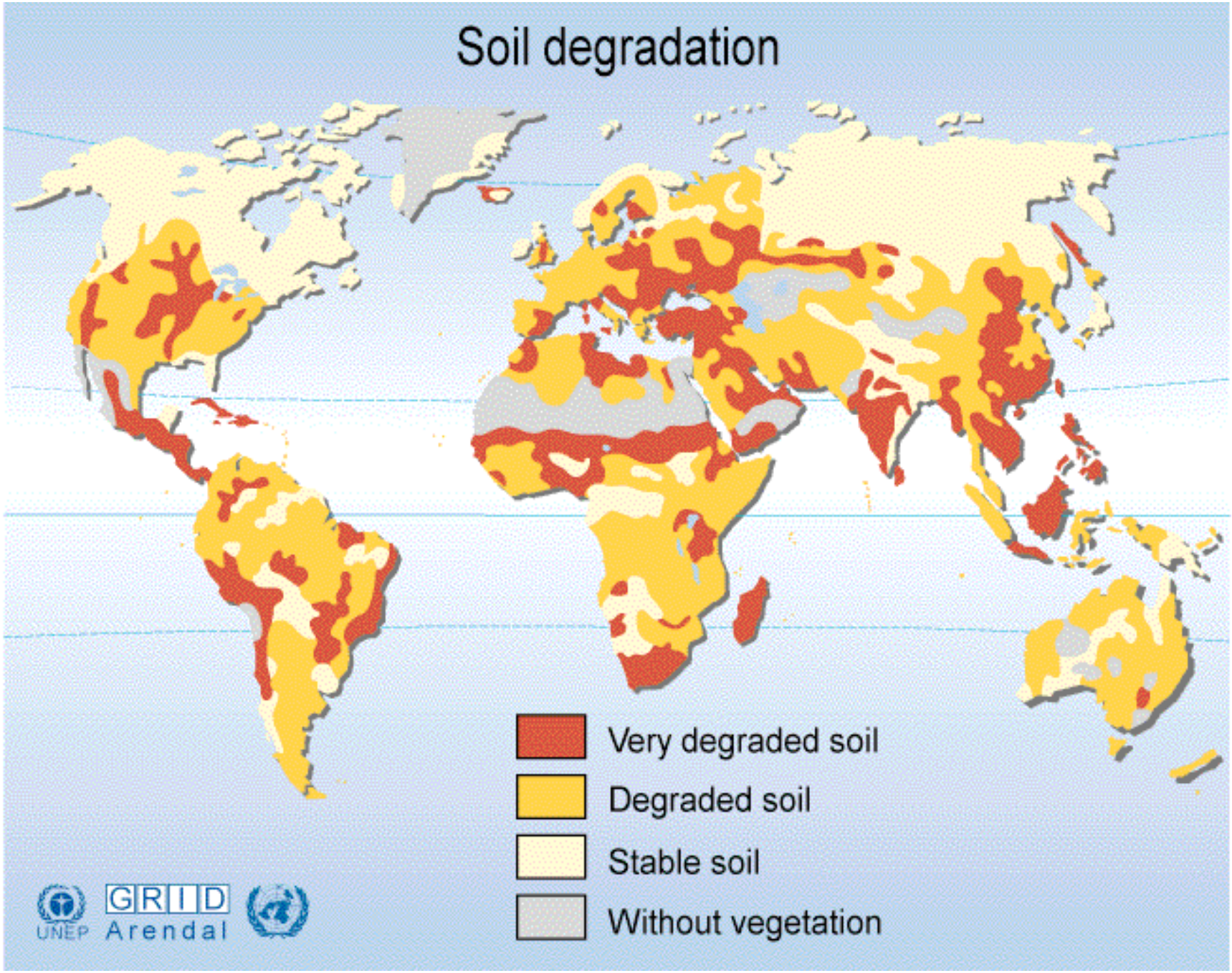

David R. Montgomery
dirt
The Erosion of Civilizations



Soil is a Strategic Resource


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

Over the last 40 years soil erosion has caused farmers to abandon about 430 million ha of arable land, an area equivalent to about one-third of all present cropland.

The estimated rate of world soil erosion in excess of new soil production is 23 billion t yr, or about 0.7% loss of the world's soil inventory each year.

Pimental et al., 1992, BioScience

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

Net soil loss of ≈ 1 mm/yr implies that erosion of a typical 0.5 - 1 m thick hillslope soil could occur in roughly 500 to 1000 years; approximately the lifespan of most major civilizations outside of major river floodplains…

A nation that destroys its soils, destroys itself.
– President Franklin D. Roosevelt, Feb. 26, 1937.

National Archives: 114 SC 5089

Is Soil Restoration Possible?

Can we reverse the historical pattern?

Rebuilding Soil

We can make soil surprisingly fast — faster than nature does…

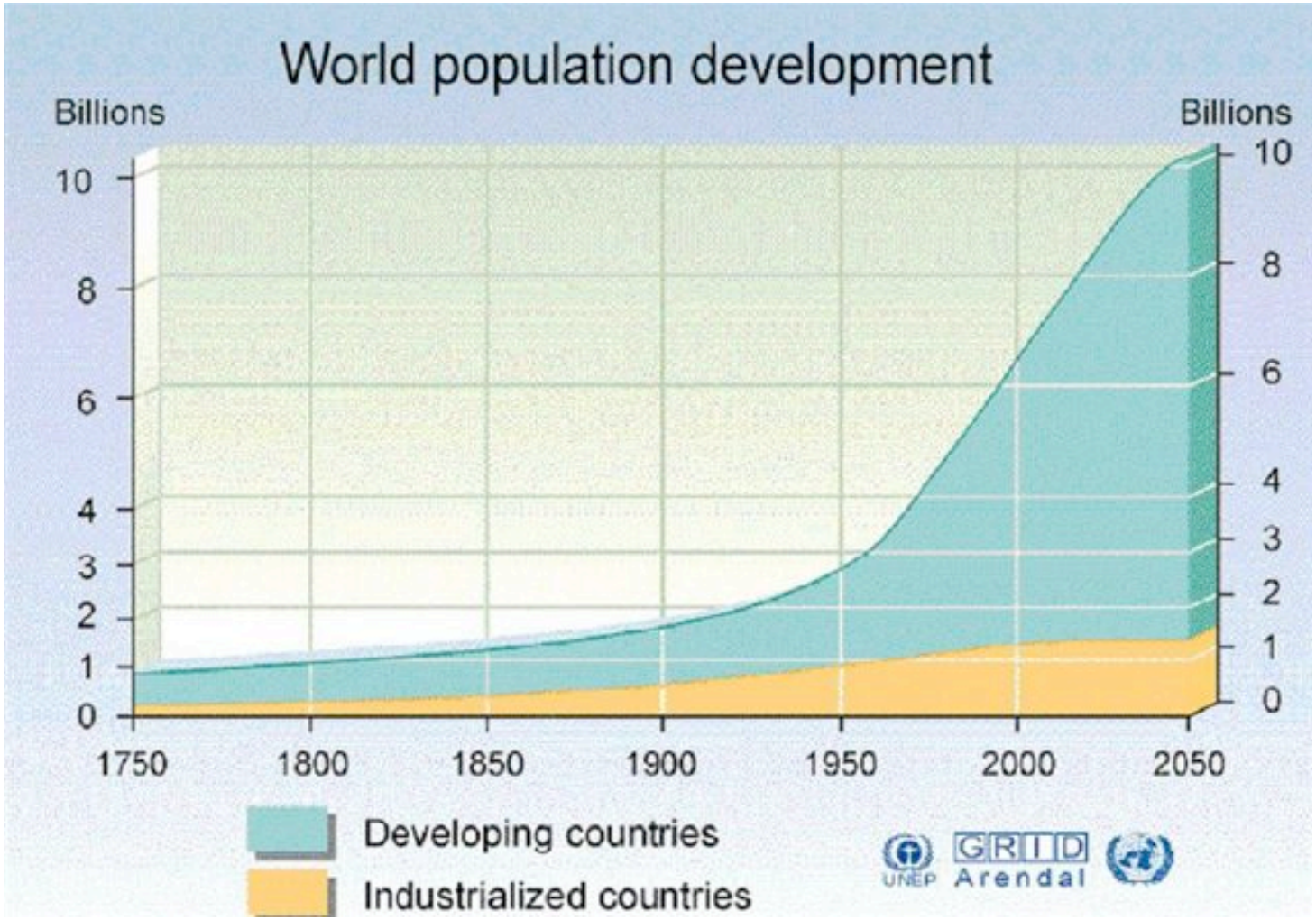
It takes organic matter and labor — what we have in cities (organic waste and people).

Fertile carbon-rich soils built by anthropogenic activity in the Amazon and reclaimed sea beds in northern Europe.

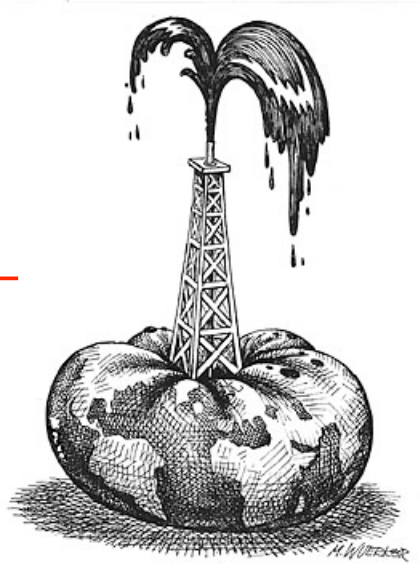

Why bother restoring soils?
To Address Global Challenges of the 21st Century
Climate Change
Feeding a Post-Oil World
Public Health / City Livability
Biodiveristy / Environmental Degradation

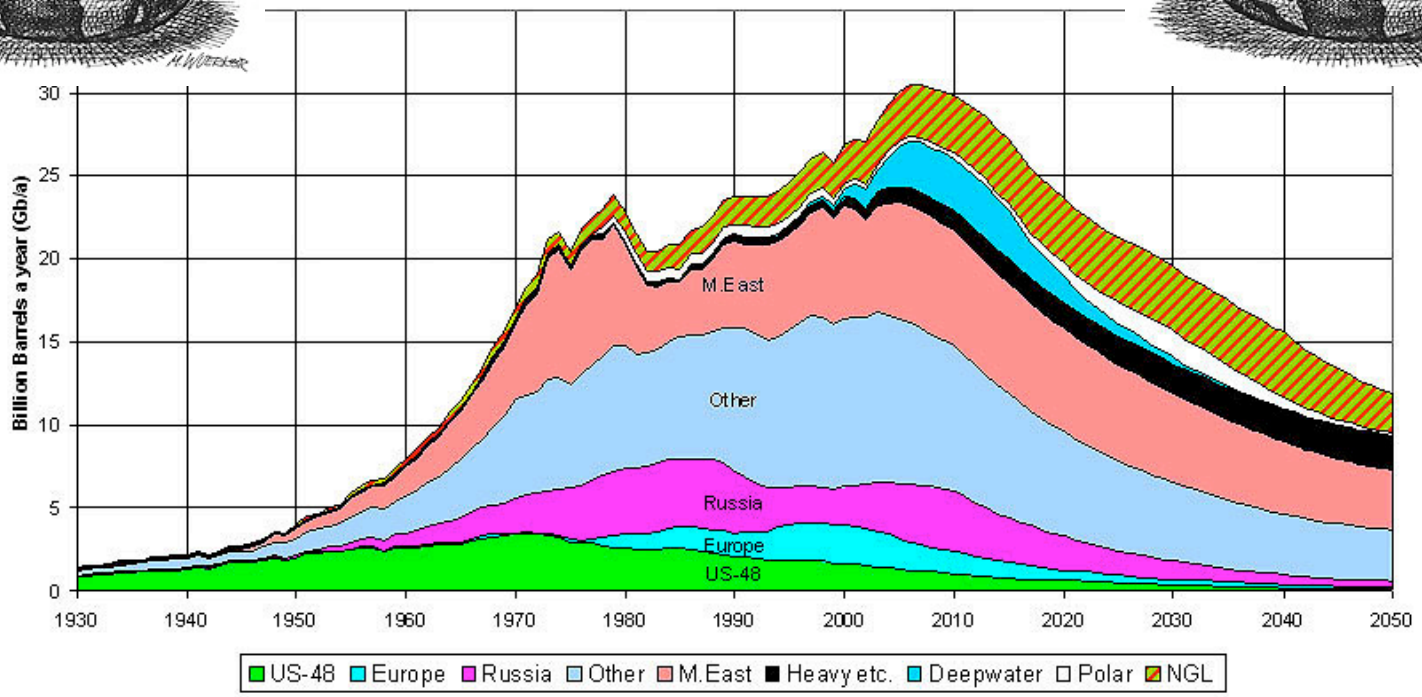

Restoring soil could be
the foundation for partial
solutions to all of these
problems…

Feeding A Growing Population …



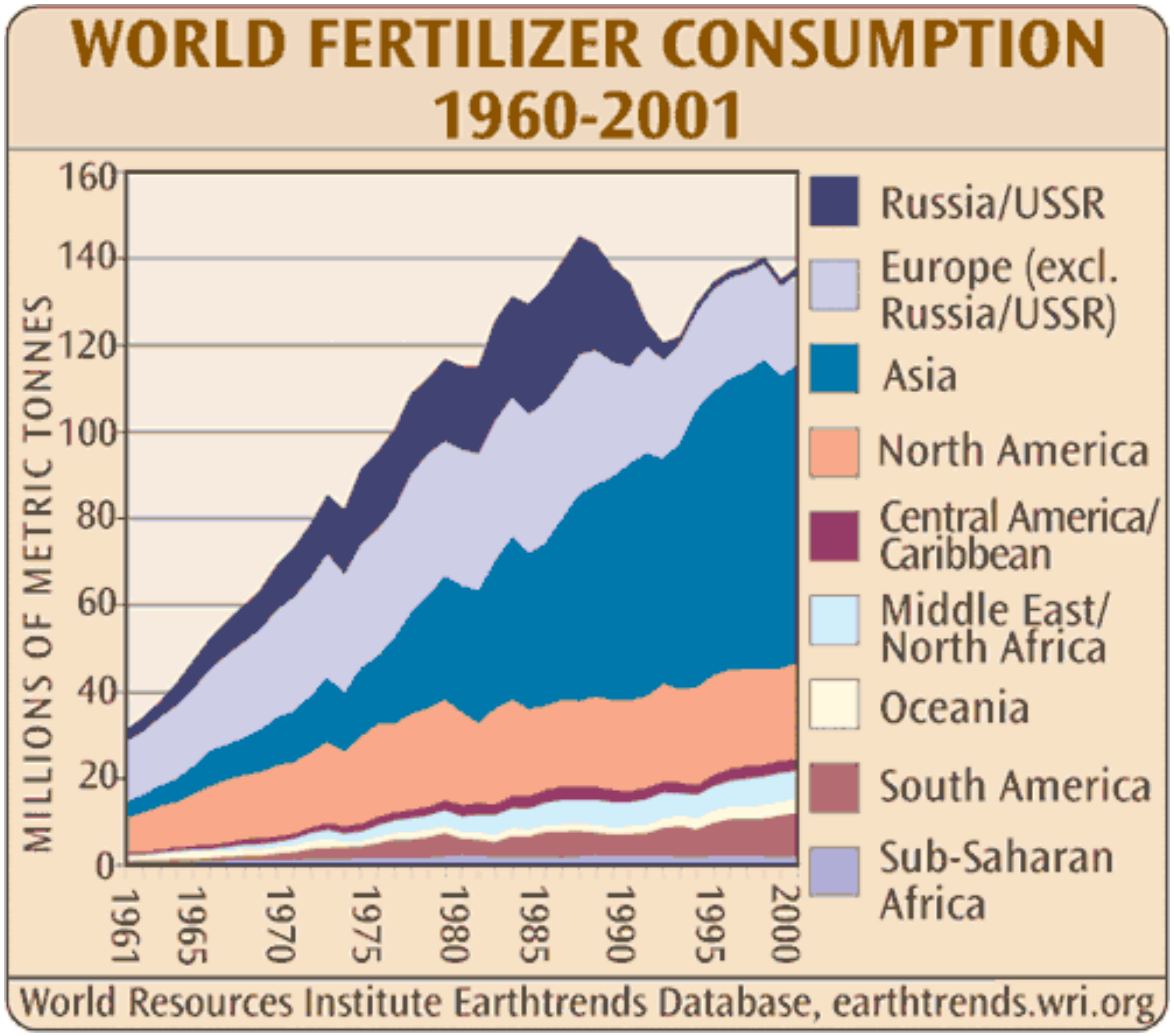
Peak Oil
A Question of When





20th Century Strategy
Intensification of Fertilizer Use

Can we maintain this strategy in the long run as oil supplies dwindle and prices rise dramatically later this century?




How will we feed a post-oil world without fertilizer-intensive agriculture?
EXXON

A Greener Revolution?

In some cases, crop yields from no-till and organic agriculture appear able to match those from conventional agriculture…

No matter how one looks at it restoring native soil fertility will be important for sustaining agriculture in a post-oil (and post-cheap fertilizer) world.

Soil and Climate Change

By the late 20th Century, a third of carbon added to atmosphere since the Industrial Revolution came from degraded soil organic matter.

We can put that much (and more) back in the ground through:

(1) increasing soil organic matter

(2) biochar

Global Agriculture, Land Use and Carbon Emissions

Lal (2004) estimated that changes in agricultural practices could sequester 0.4 to 1.2 Gt C per year, enough to offset 5-15% of global fossil fuel emissions.

Amundson (2001) noted that cultivation and deforestation releases >4 Gt C per year, equivalent to more than half global fossil fuel emissions.

Biochar:

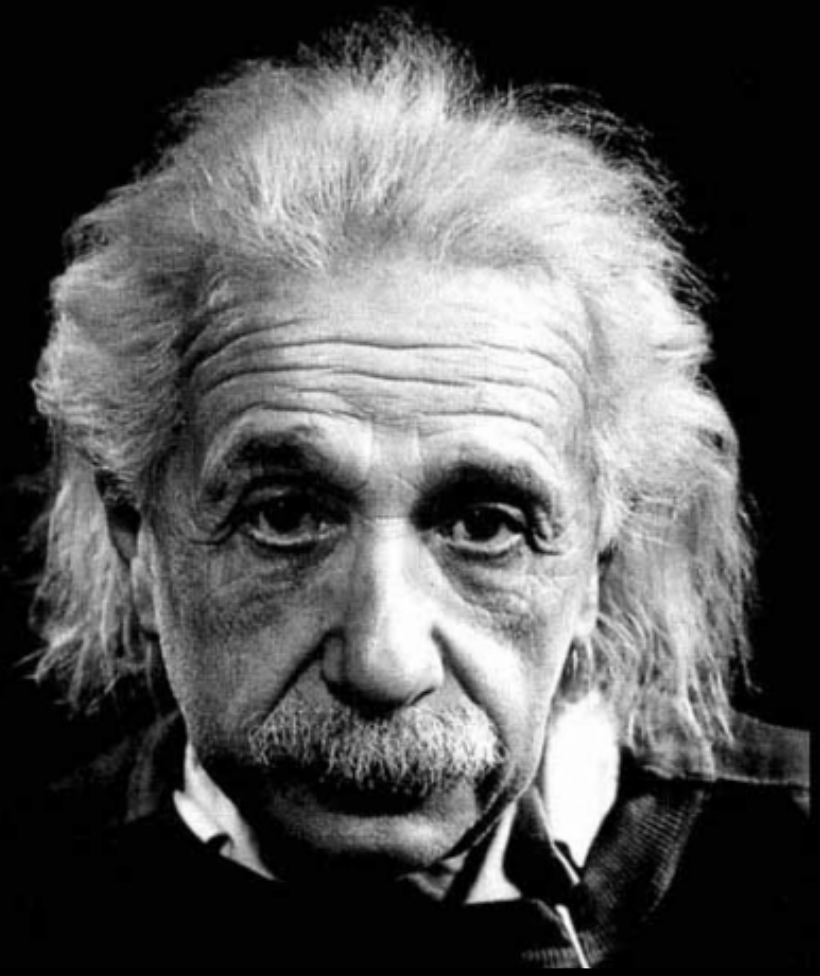
Global soil C≈1500 Gt
Global atmospheric C≈760 Gt

Average residence time for SOC globally is less than 2 decades.

Biomass decay ≈60 Gt/yr
Fossil fuel emissions ≈7 Gt/yr

Capture of ≈10% of biomass decay as biochar would offset global fossil fuel emissions.

Time For A New View of Soil?



"*The significant problems we face cannot be solved at the same level of thinking we were at when we created them*."

Soil as a mystery, fertility to be personified, deified and revered.

Soil as a decipherable mystery, something to be studied and understood.

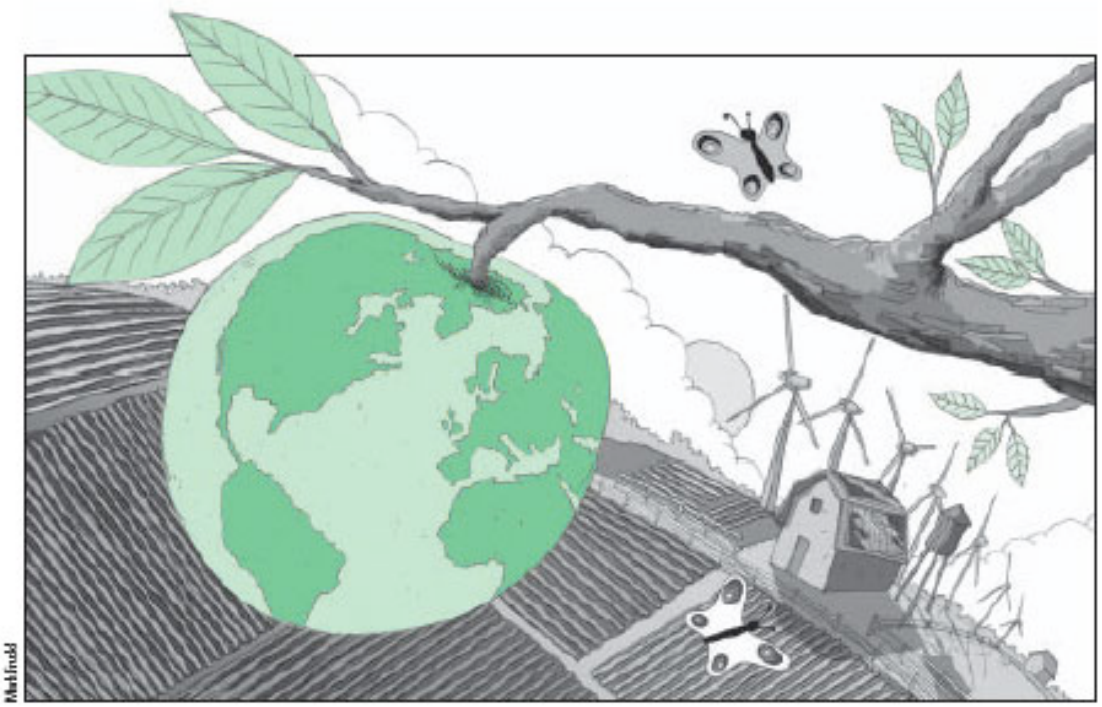
We know more about the movement of celestial bodies than about the soil underfoot.

- Leonardo da Vinci

Soil as a chemical reservoir, a medium to be fertilized as needed.

Soil as an industrial commodity to be used (and used up).

Soil as an ecosystem to be understood and worked with...



Soil Ecology — the Future of Agriculture?

Can we harness the insights of soil ecology to restructure agricultural technology to feed the world based on ecological processes and nutrient cycling?

Soil, Cities, and Public Health

As of 2009, more than half of humanity lives in cities.

Restoring urban soils can improve the quality of the built environment and thereby people's health through:

- Green space/Urban nature
- Physical Activity
- Access to Fresh Food

Emerging areas of research and applications

How to get organic matter back into the soil?

How much can we put there how fast?

Role of ecological (and particularly microbial) processes in governing native soil fertility.

How do we better address linkages between soil and public health?

Can we rebuild soils in cities?

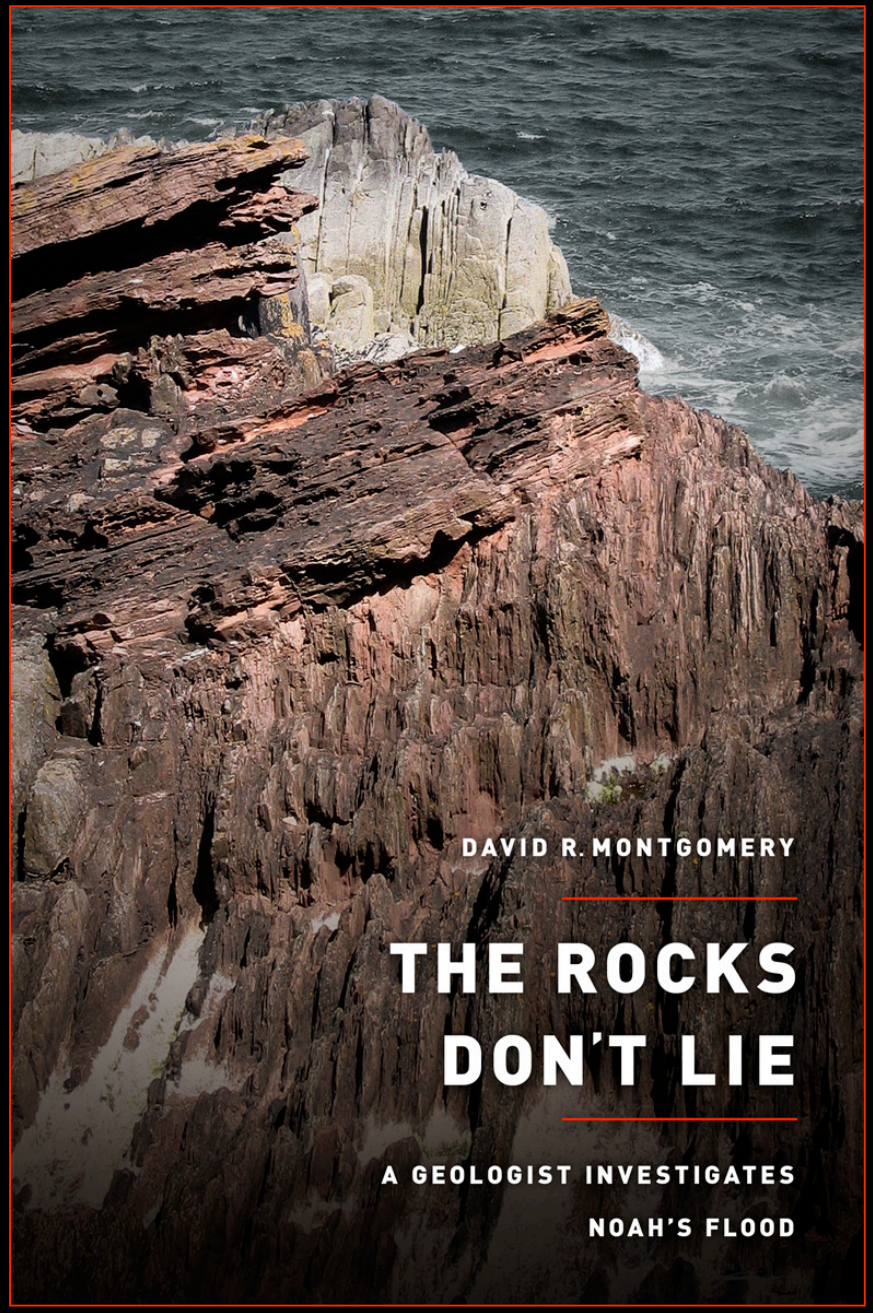
Healthy Soil: No Silver Bullet, But A Secret Weapon?

Restoring soils can help address:

- Climate change
- Feeding the World
- Public health (physical, mental, and social)

First and foremost soil restoration means …

… we can no longer treat soil like dirt!


DAVID R. MONTGOMERY
THE ROCKS DON'T LIE
A GEOLOGIST INVESTIGATES NOAH'S FLOOD