How Do We Raise Abundant, Healthy Food

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Many Hands Organic Farm

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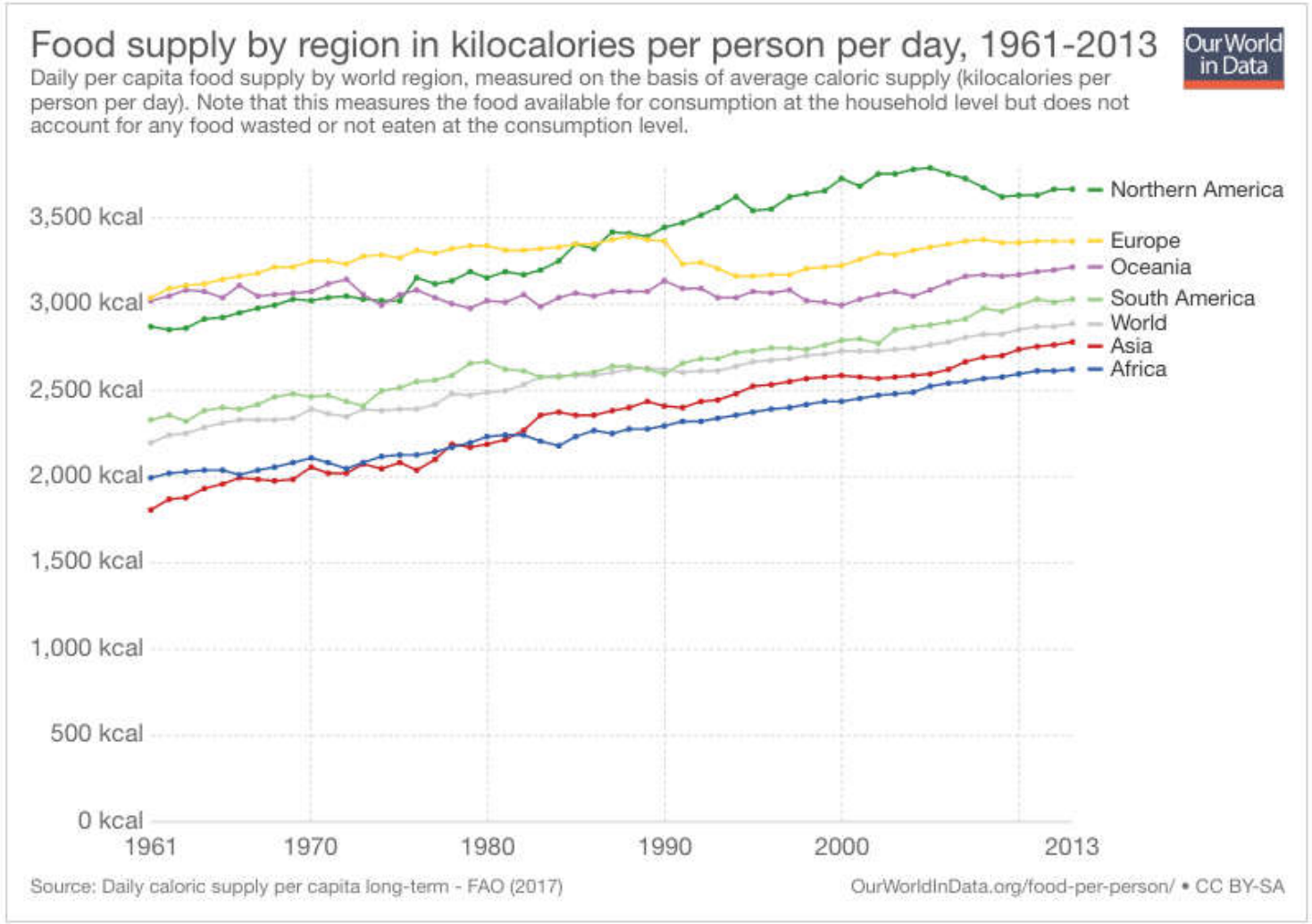
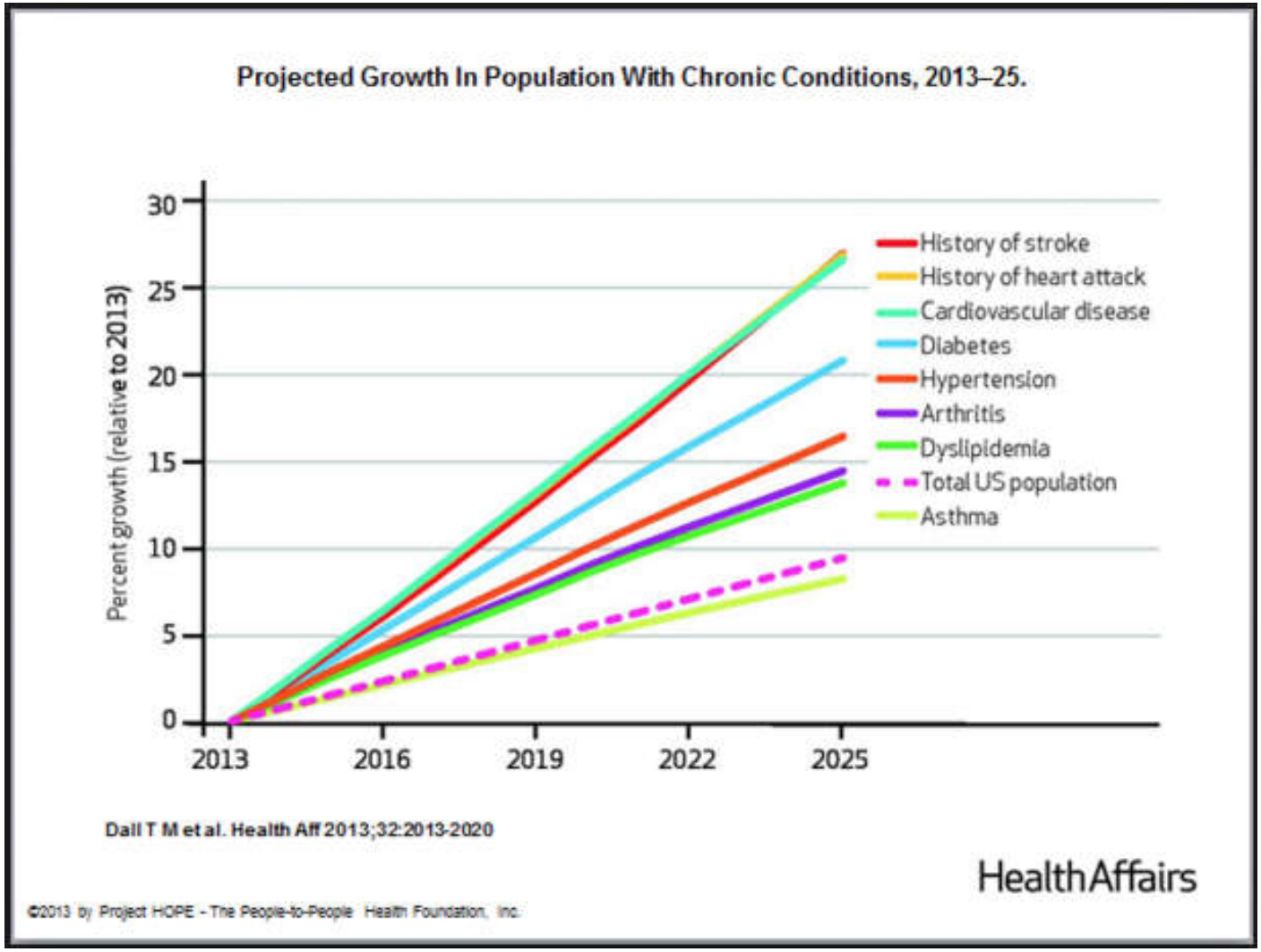
American Agriculture is Good at Raising Crops



But Perhaps it is Not So Good at Raising healthy Food?



Is That Why We Have Epidemics of These?

- Autism 1:36
- Asthma 1:10
- Attention Deficit 1:8 (70% medicated)
- Allergy 1:4
- Diabetes 1:4
- Obesity 1:3
- Major Depression 1:2
- Cancer 1:2

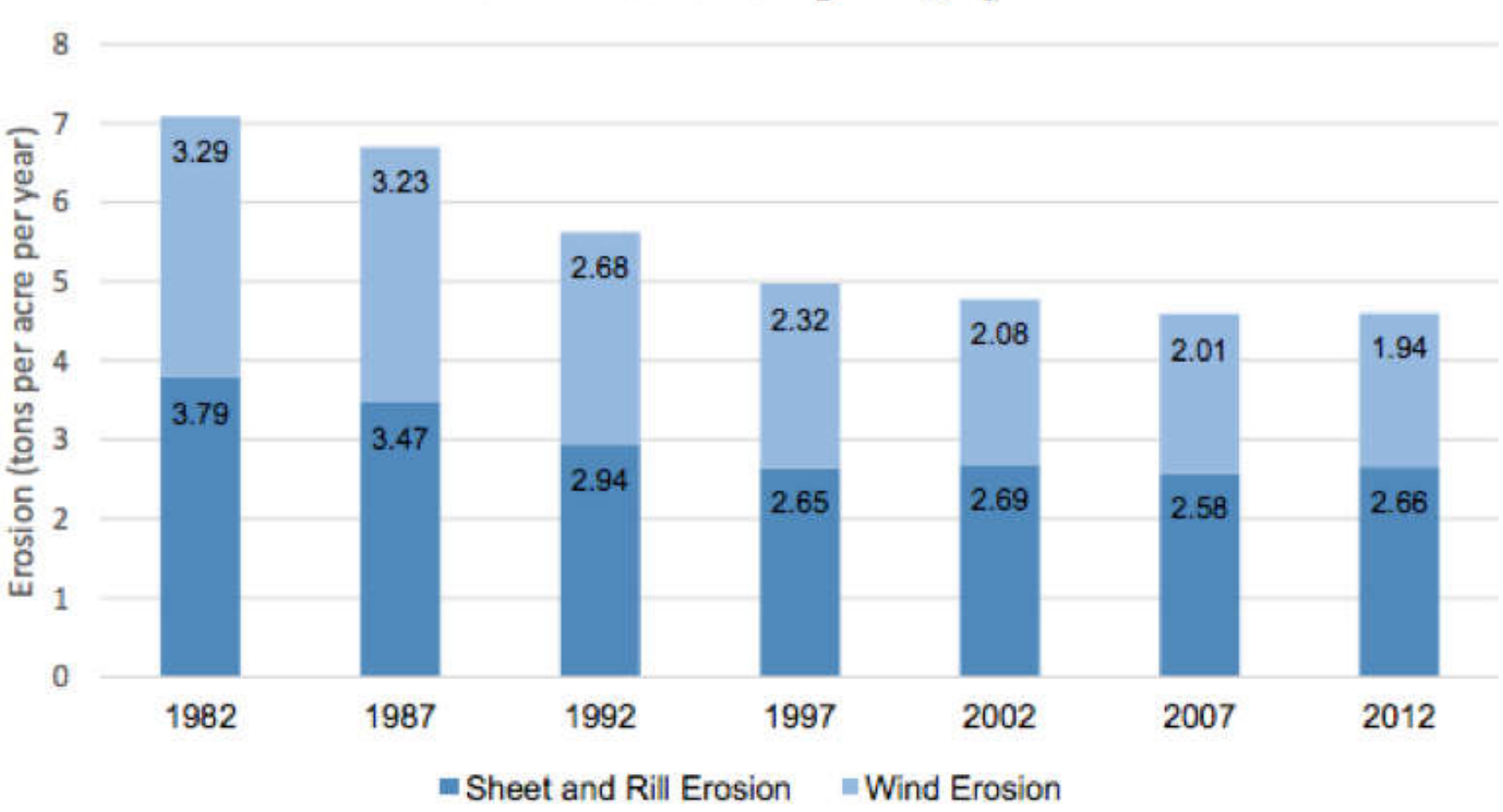
What Has Changed About US Agriculture since 1945?

- Loss of Topsoil
- Loss of Minerals
- Use of Chemicals
- Scale of Mechanization

Topsoil Erosion – by water

Topsoil Erosion – by wind

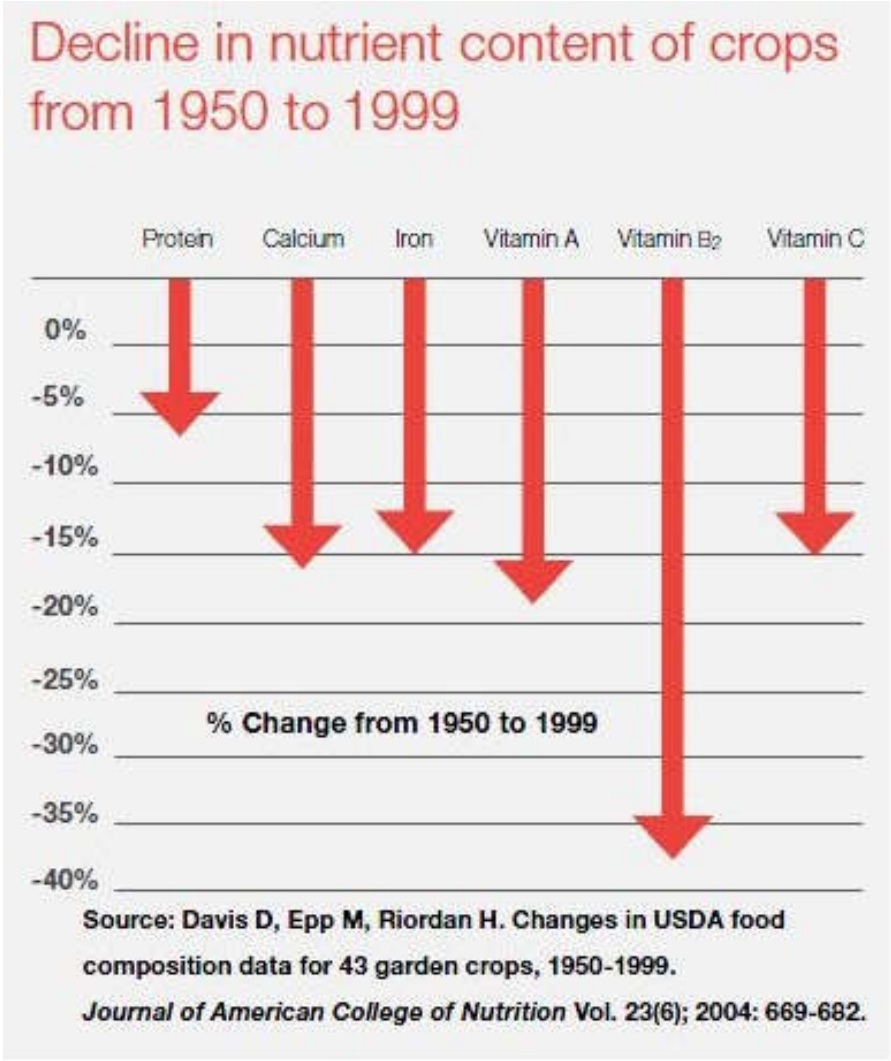
Cropland Erosion of US Agriculture by year (tons per acre)



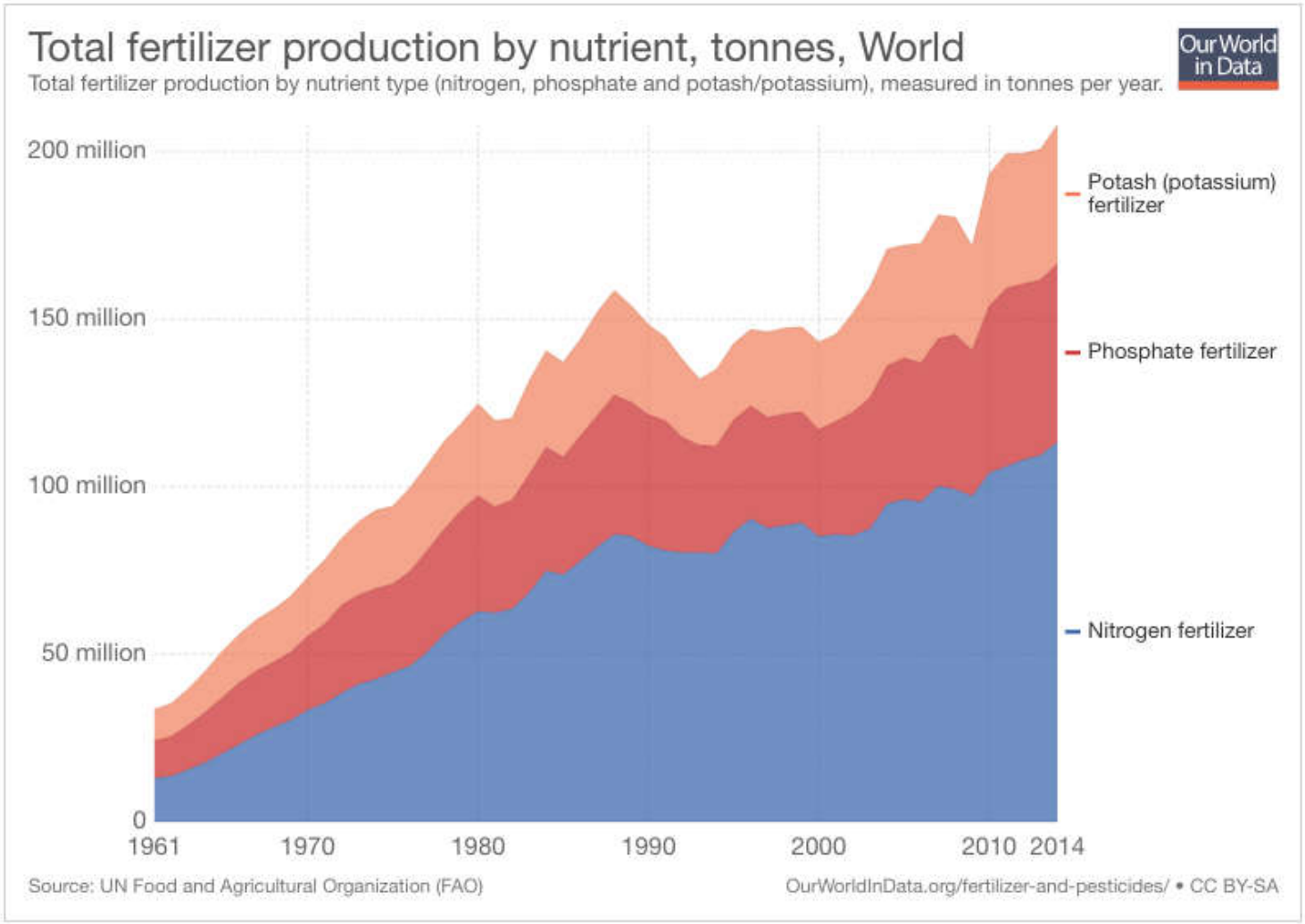
Degradation of Soil Nutrients

Table 1. Selected Nutrients in Broccoli*			
	1975	1997	Change
Calcium	103 mg	48 mg	Down 53.4%
Iron	1.1 mg	0.88 mg	Down 20%
Vitamin A	2500 IU	1542 IU	Down 38.3%
Vitamin C	113 mg	93.2 mg	Down 17.5%
Thiamin	0.10 mg	0.07 mg	Down 35%
Riboflavin	0.23 mg	0.12 mg	Down 47.8%
Niacin	0.9 mg	0.64 mg	Down 28.9%
*Based on 100 Grams, Edible Portion. *Source: USDA food composition tables*			

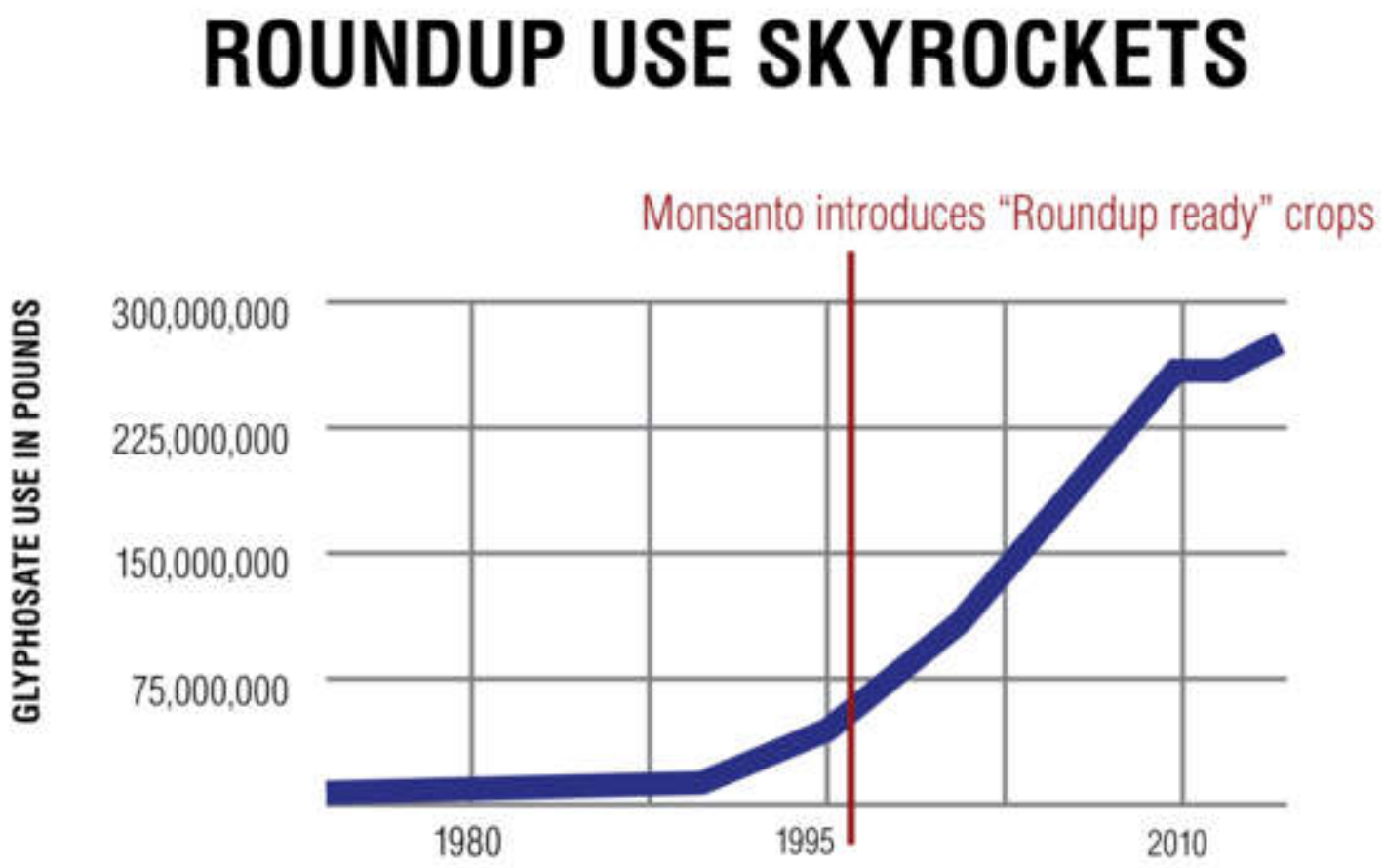
Loss of Minerals in Soil



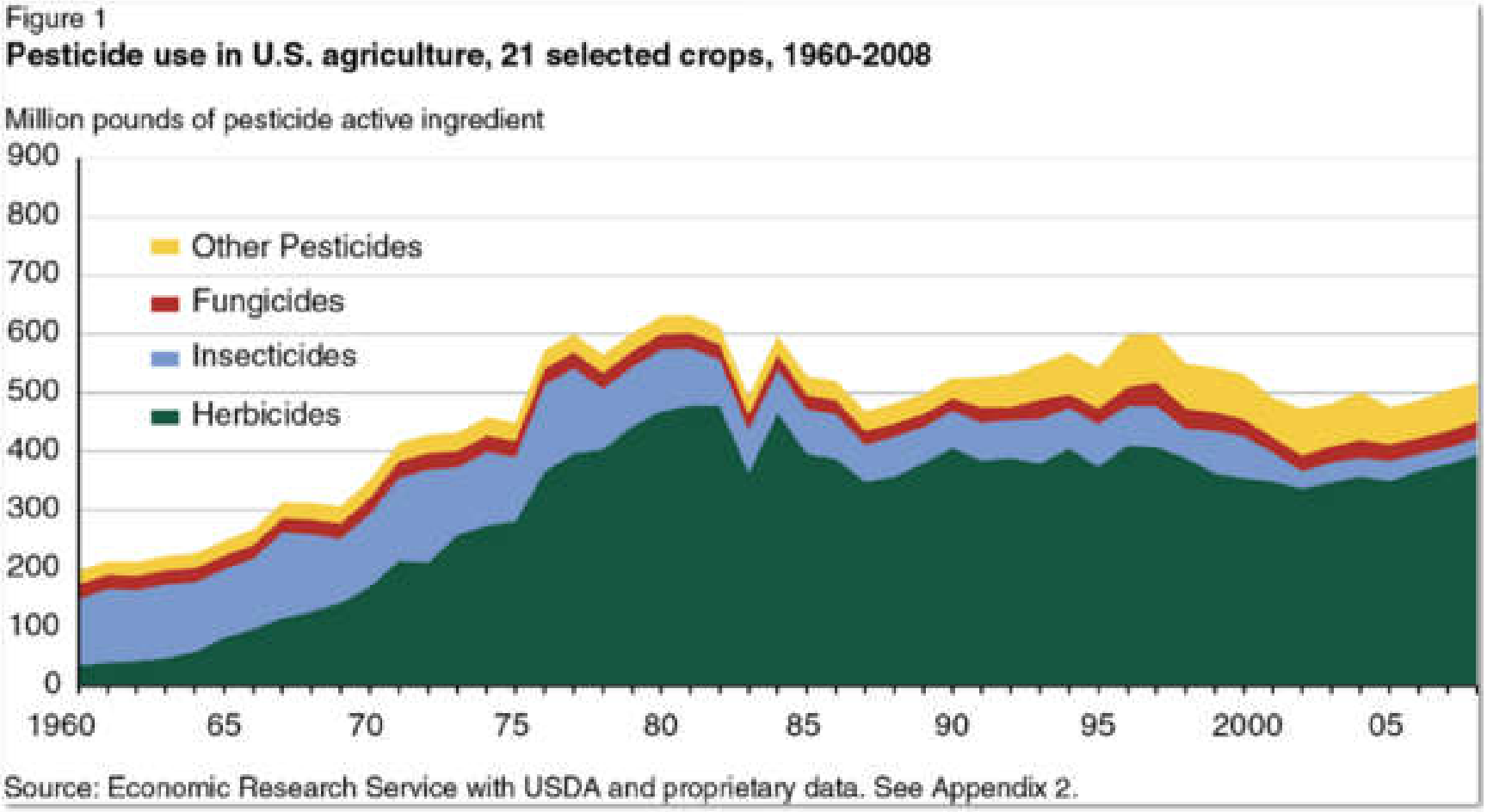
Use of Chemicals -- Fertilizer



Use of Chemicals -- Herbicides



Use of Chemicals -- Pesticides



Mechanization Exposes Soil

Every Year Machines Get Bigger, Soil Exposure is Worse

What Do All These Changes Mean?

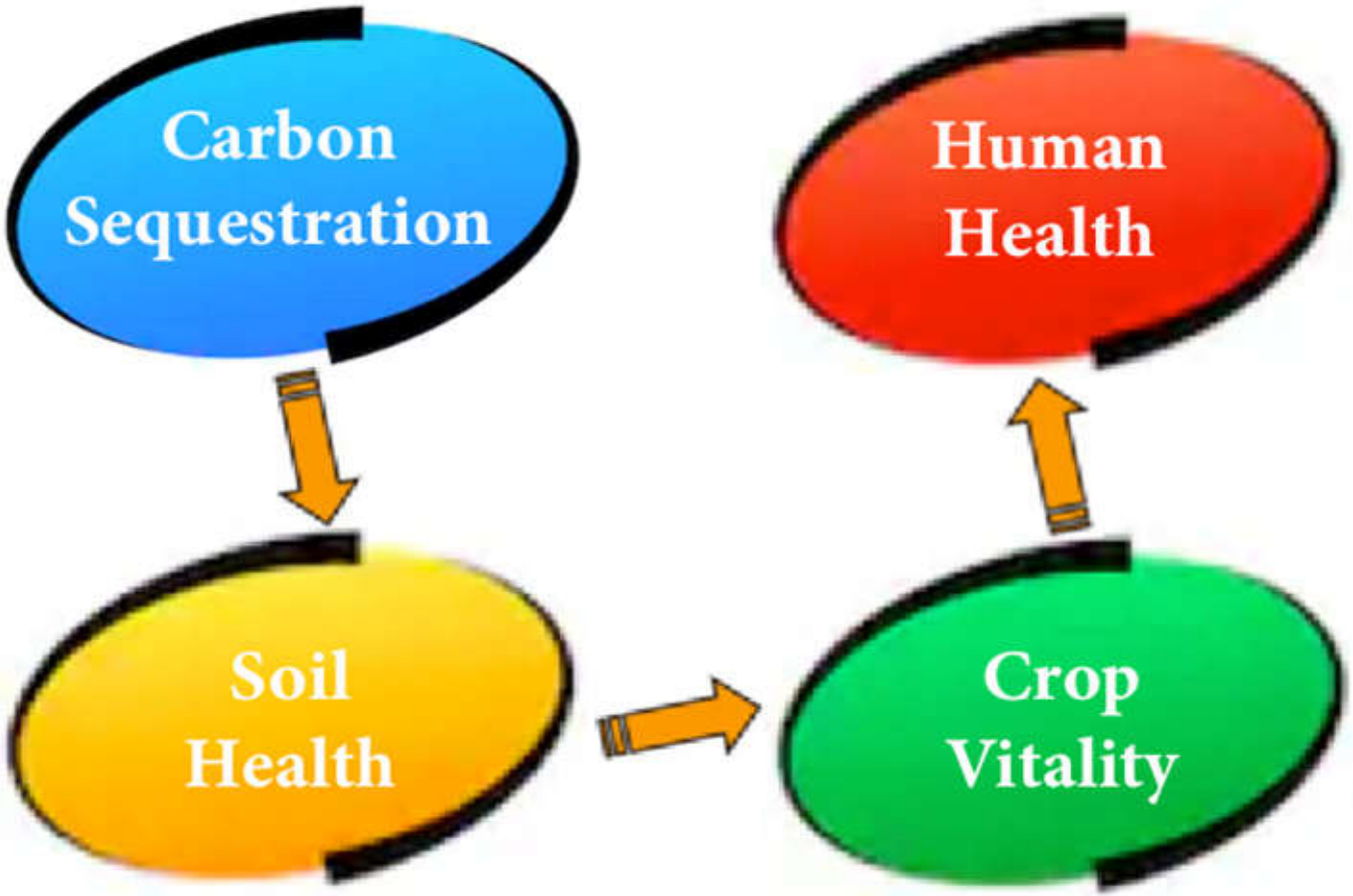
Why Is It Dead?

- Lost to wind and water erosion
- Degraded of nutrients after years of farming
- Soil life killed by toxic chemicals
- Exposed to air by tillage, carbon becomes CO_2

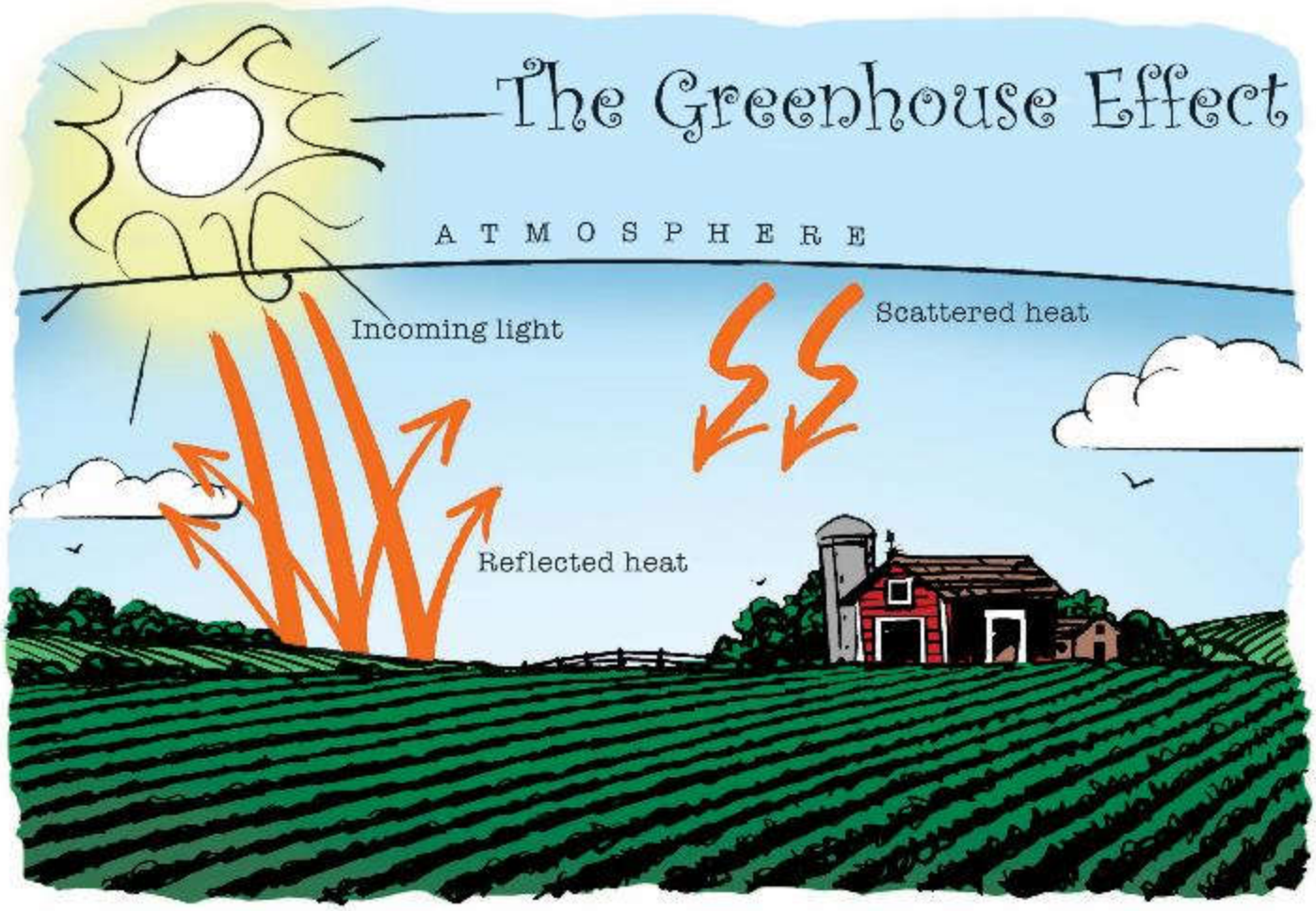
What Needs to be Done?

- Stop Tilling
  - Prevents loss of carbon to atmosphere
- Provide continual soil cover
  - Prevents erosion
- Avoid Farm Chemicals
  - Prevents killing worms and soil microbes
- Keep adding soil organic matter (carbon)
  - Mulch, compost, cover crops

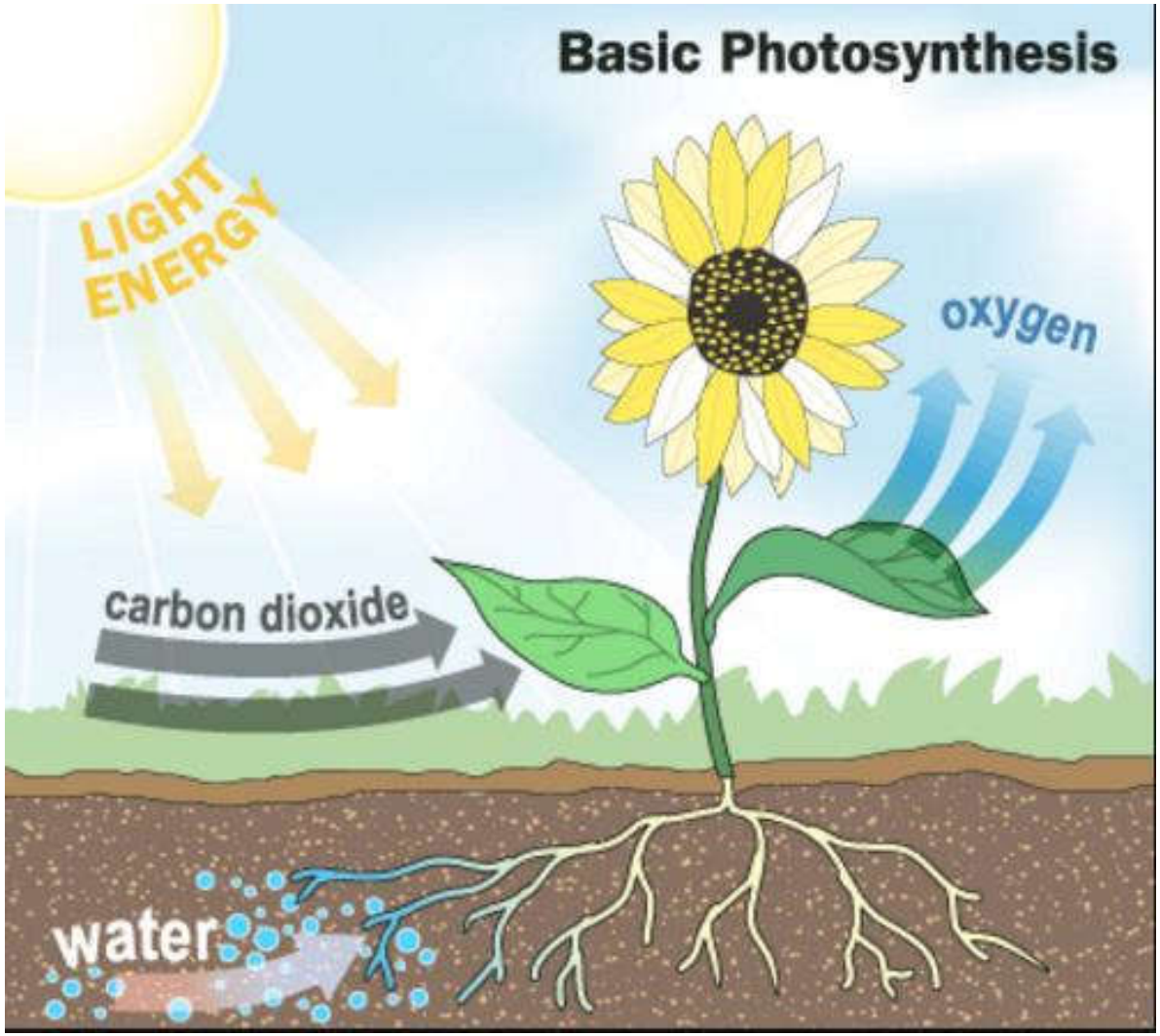
What Happens When We Add Carbon?



The Atmosphere has too much Carbon Dioxide



Here's how Nature Deals with Carbon



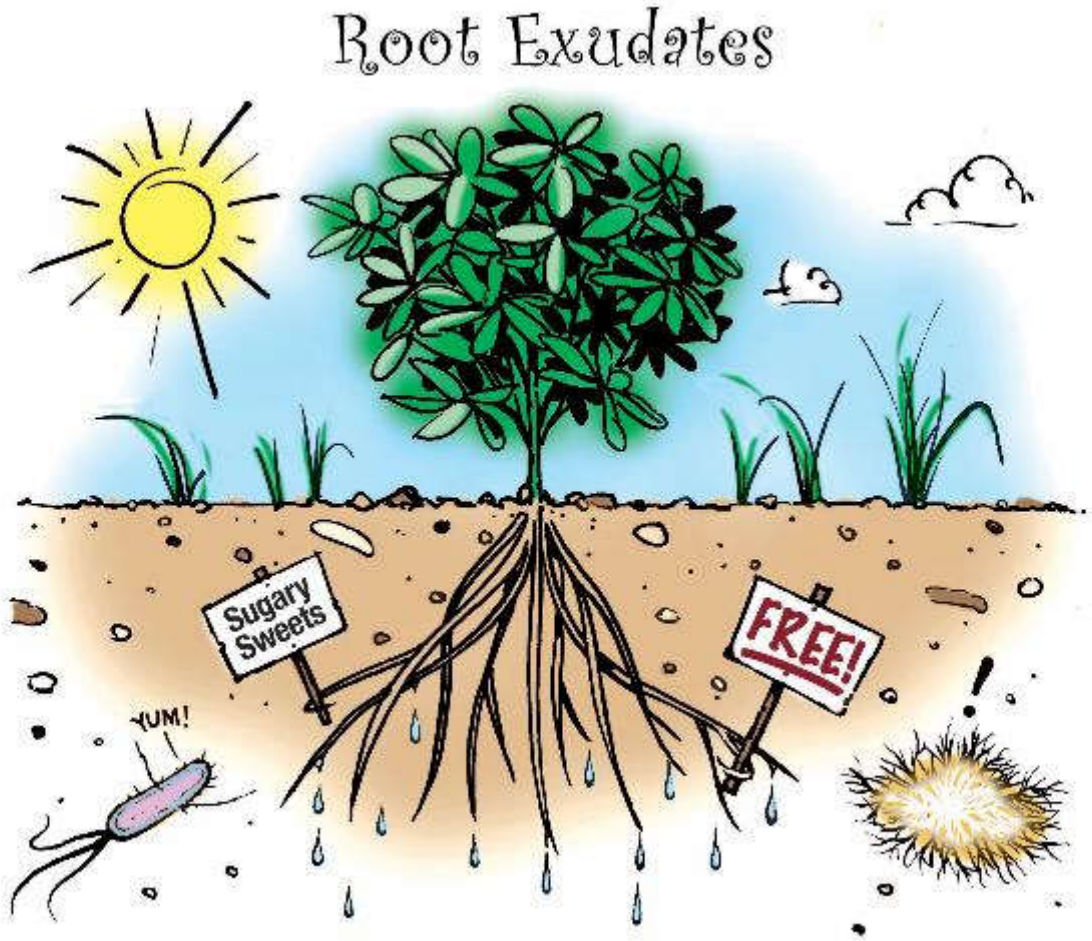
How much Carbon is Photosynthesized?

A lot!

- 15% of all the carbon dioxide in the earth's atmosphere passes through plants each year via photosynthesis

- In less than 7 years it is all taken up through plants and recycled

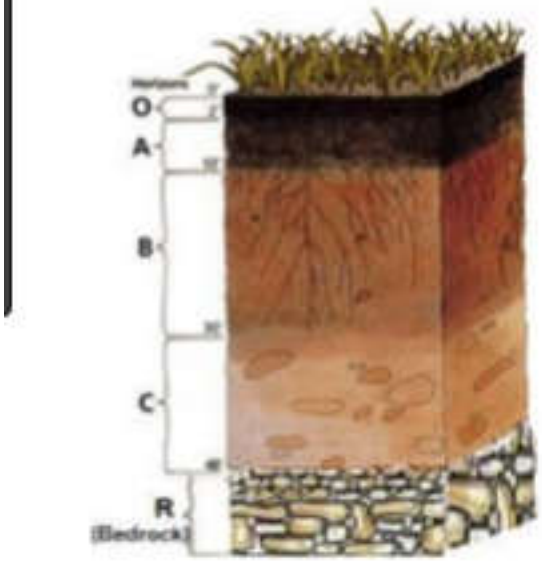
And here's where up to half of that carbon is put: the soil



What can Carbon do in Soil?

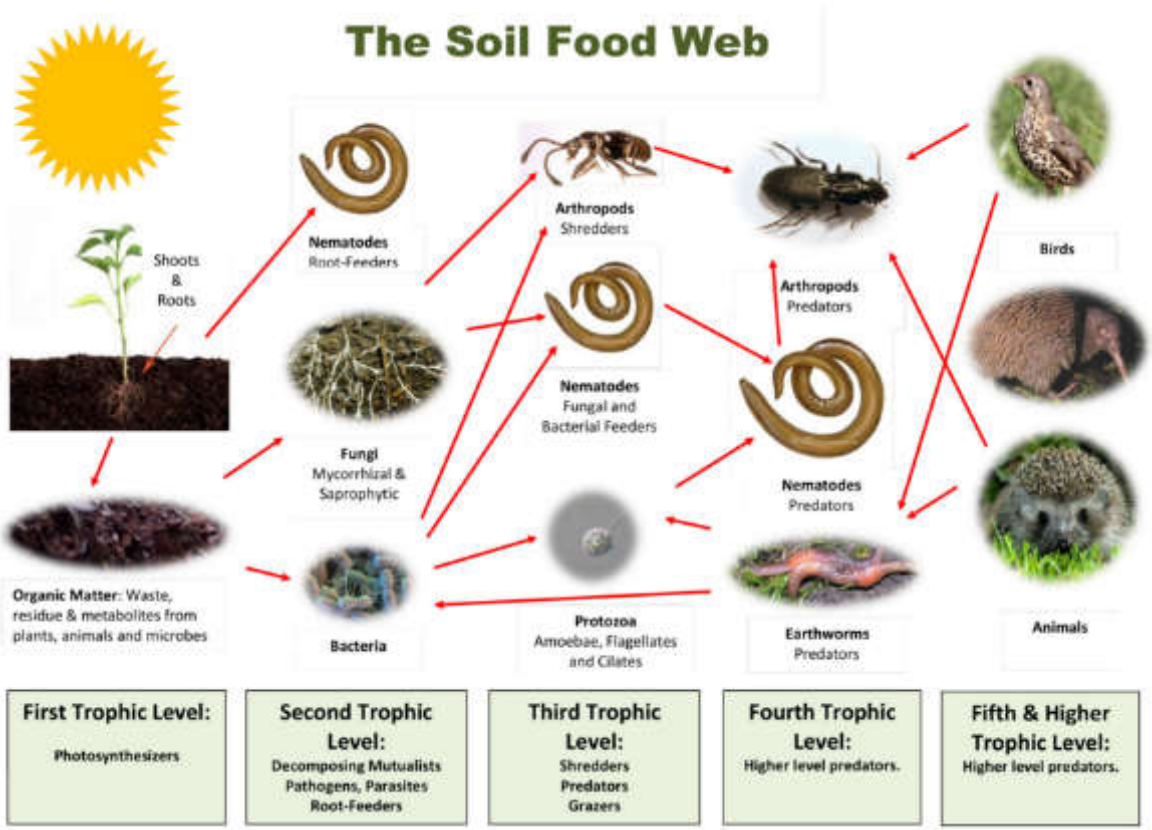
- Store water (1% soil organic matter stores up to 25,000 gallons of water per acre)

- Increasing soil organic matter increases water holding capacity.



What else can Carbon Do in Soil?

- Feed a diverse web of soil organisms



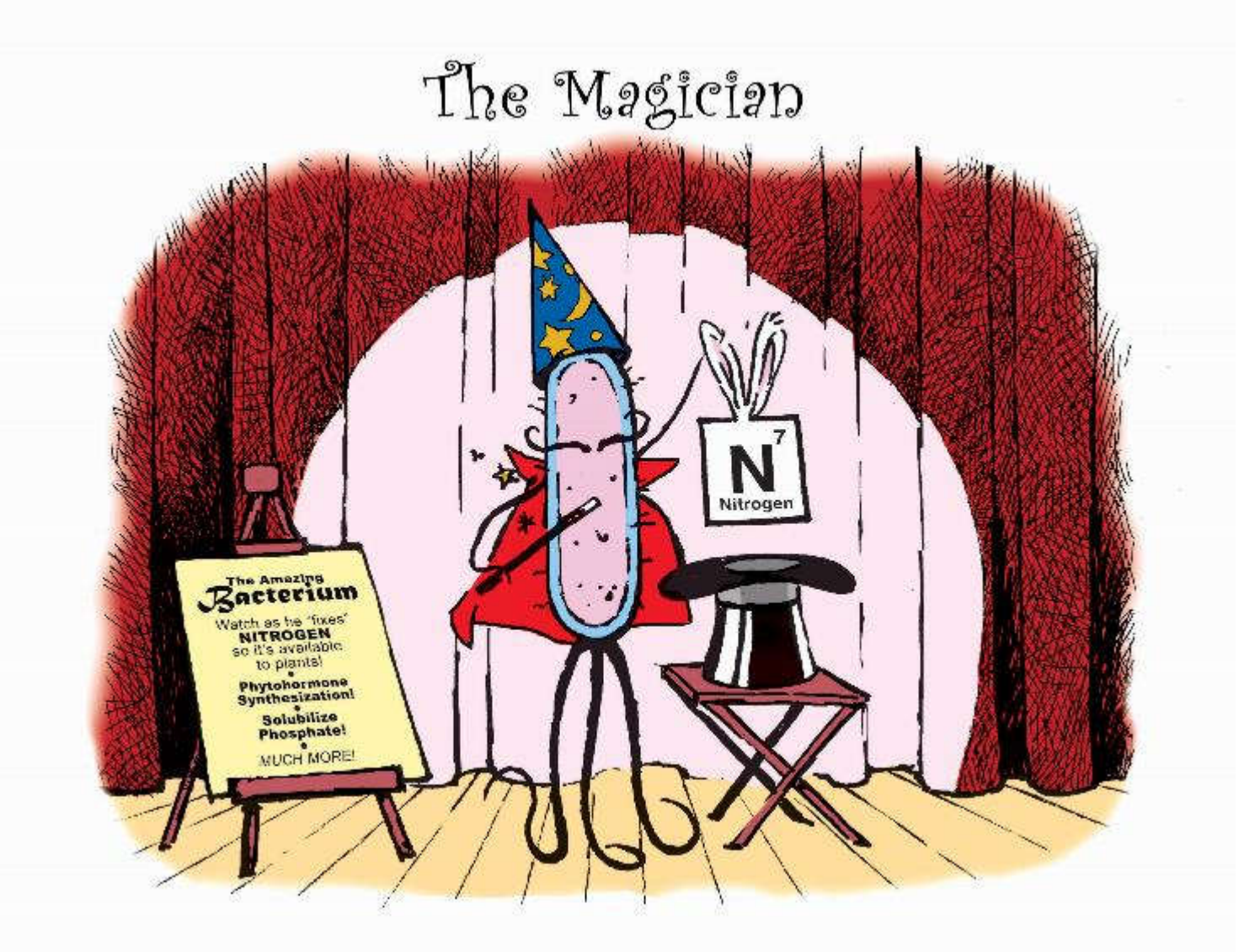
Why do we want a healthy soil with plenty of biodiversity and soil life?

Soil organisms perform many useful functions

in exchange for the

carbohydrates that plants exude

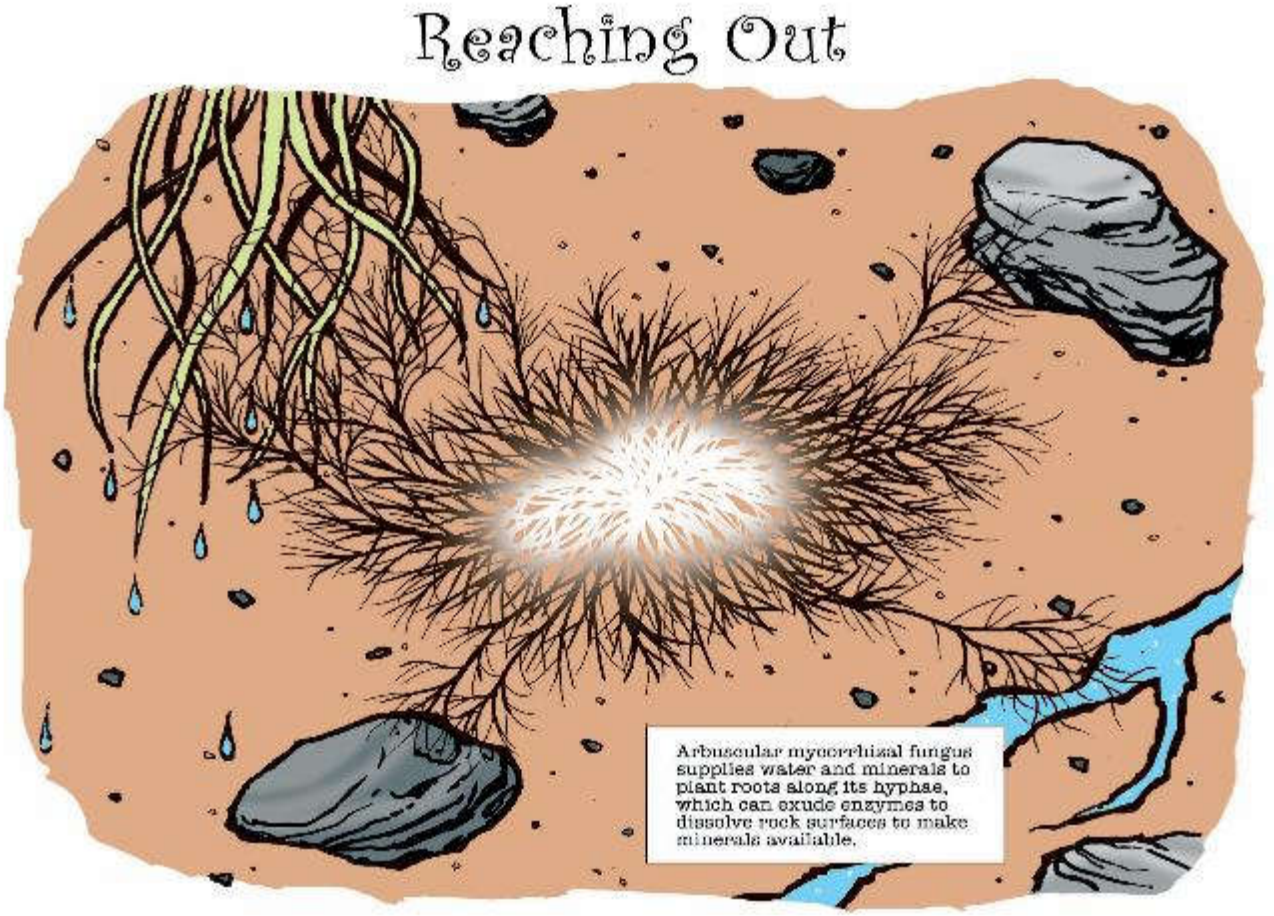
Bacteria, for example, are chemical wizards



Some of the things bacteria do for plants

- Fix Nitrogen from the atmosphere
- Make phosphorus and sulfur more available
- Produce glycoproteins and polysaccarides to help soils aggregate
- Synthesize antibiotics needed by plants to protect against pathogens
- Create ‘plant growth promoting hormones’ like auxins, gibberellins and cytokinins

And fungi are miners and transport engineers



Some of the things fungi do for plants

- Exude enzymes to solubilize phosphorus and other minerals from rocks
- Find available soil water
- Transport nutrients in solution via fungal hyphae to plant roots
- Enable plants to communicate their needs and stresses via ‘earth’s natural internet’-- the hyphal network
- Filter plant nutrients through living membranes
- Produce proteins like glomalin to glue together soil aggregates

This help from microbes produces larger, stronger crops

- West coast tomatoes grown with *Paenibacillus* bacteria are immune to Salmonella
- *Rhizobium etli* bacterium in soil improves Mexican bean yield by 50%
- A Yellowstone fungus enables grasses to withstand extreme heat, cold, drought, and salinity
- Inoculation with fungal gel enables cassava to access soil phosphate, increasing yield 20%

-- *Scientific American, 9/2013*

- The bacterium Streptomyces thermoautotrophicus, which can fix nitrogen in the presence of oxygen, can allow corn, wheat or rice to thrive without fertilizer N.

  -- National Geographic, 9/2014

- Iowa State University is investing in researching the microbial biome of crop plants in order to double food production by 2050.

  -- Southeast Farm Press, 11/2016

- Several genera of nematodes are effective in biocontrol of insect pests such as grubs, weevils, armyworms, beetles and locusts.

  -- Food and Agriculture Organization (FAO) of the UN

But how do microbes help vital plants deliver health to humans?

Plants can't run away, so they have evolved a huge arsenal of different chemical compounds to protect them. When threatened, they send a chemical message down to their roots, signaling nearby microbes to provide phytochemicals. Many of these have been shown to have beneficial activity in human health.

-- Jennifer Reeve, PhD. Soil scientist, Utah State University

-- Emeran Mayer, M.D., PhD. UCLA

An Example: ERGO

Ergothioneine is an amino acid and an antioxidant produced by soil fungi. It is transferred to oats and other crop plants. It benefits humans for cognitive function, eye health, immune modulation, lung, skin, and reproductive health. We cannot synthesize it and must get it in our diets.

-- Rodale Institute 2017 Farming Systems Trial

Another Example: Lovastatin

This is a metabolite of *Aspergillus terreus*, an endophytic (plant-inhabiting) fungus, that reduces cholesterol in the blood. Lovastatin is found in rice, among other foods. Such phytochemicals are now among the most widely prescribed substances for preventing cardiovascular problems.

-- Pharmacological Reviews, July 2014

Or by Fighting Mineral Deficiencies: Zinc

- Zinc is an essential micronutrient for all living organisms. Zinc deficiency affects an estimated one-third of the world's population, particularly in regions with zinc-deficient soils. Test plants grown in pots of such soils, however, received up to 24% additional zinc via fungal pathways. The relative contribution to plant zinc by fungal uptake was highest when soil zinc was lowest.

  -- Plant and Soil, May 2015

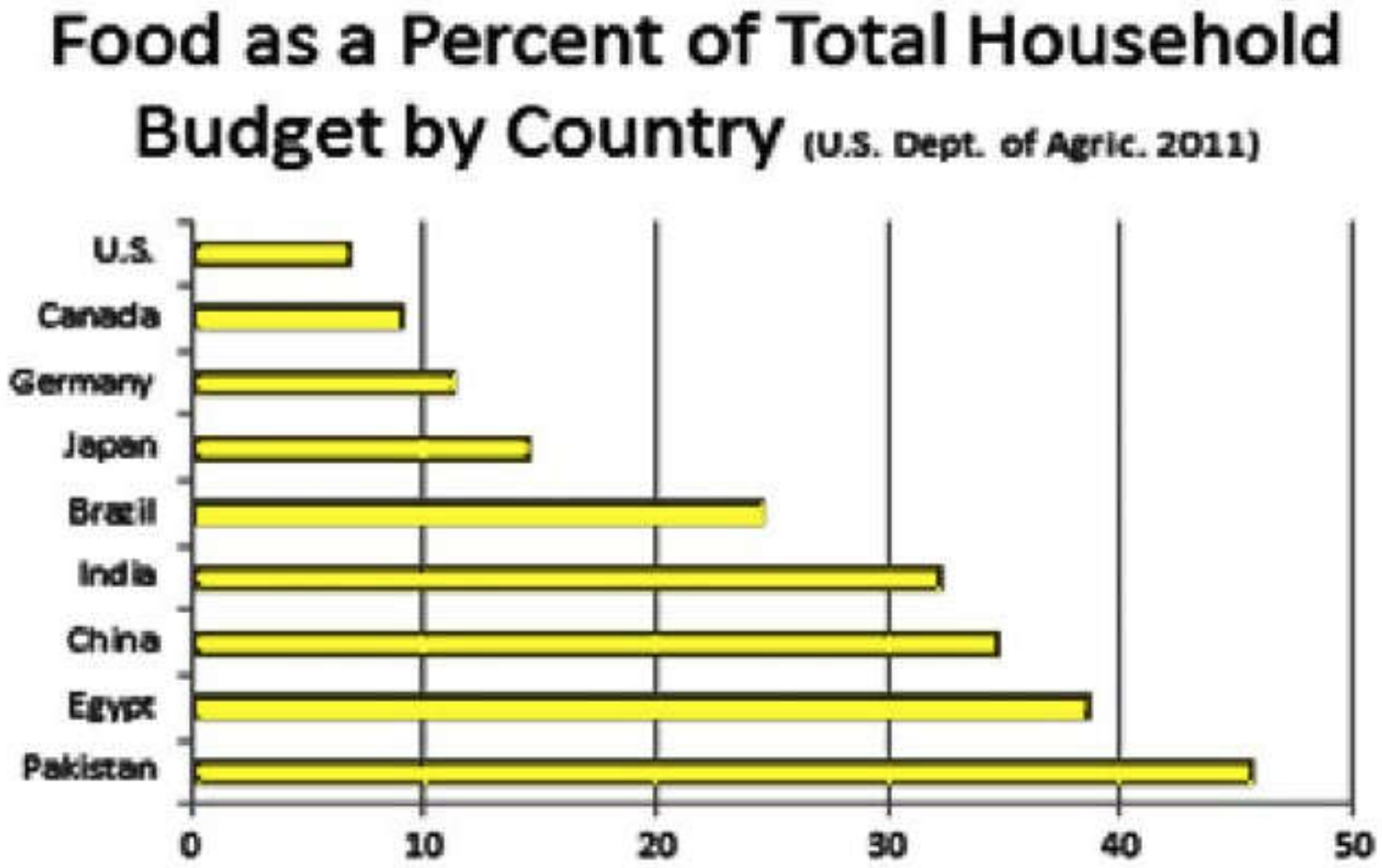
When it comes to soil, if you want its miracles, Don’t Disturb It

Some Thoughts on Affordability

- US Spends Far Less than Rest of World on Food
- Food Industry Externalizes Major Food Costs
  - Environment
  - Human Health
  - Global Stability

Can We Afford High Quality Food?

American families don't seem to make food a priority.



But Some Households Choose to Afford it

- It's not about income
- US "organic" households show little price sensitivity

Household income	% food expenditures on organic
under $25,000	56%
$25,000 to $50,000	61%
$50,000 to $100,000	59%
$100,000 and more	60%

- Who expresses a preference for organic? Young and educated people.

Under 35	63%
Bachelor's degree or higher	64%

Externalized Costs:

Environmental Damage

- Contamination
  - Pesticides
    - 983 million pounds/year in US
  - Fertilizers
    - Europe estimates excess N costs $460 billion/year
  - Water
    - Manure lagoon seepage and runoff
  - Air
    - Odors, particulates around CAFOs cause lung disease, depression
  - Soil
    - 7 to 12 tons per year per acre lost to erosion
  - Biodiversity
    - Chemicals destroy microbes, bees, beneficials

Environmental Damage (continued)

- **Food Waste**
  - FAO estimates 1/3 of global food wasted
  - Americans each throw out 106 lbs of food per year
  - This food mostly land filled, not composted

- **Greenhouse Gas Emissions**
  - Petrochemicals for fertility
  - Manure lagoons & methane
  - Exposed soil via tillage, no cover crops.

- **Total Environmental Damage Equals $2.6 Trillion (FAO)**

From FAO

Table 19: Estimated costs of food wastage

Cost categories	Costs (billion USD, 2012)	Cost range (billion USD, 2012)[c]
Atmosphere		
Greenhouse gas emissions (without deforestation/organic soils)	305	45-1500
GHG from deforestation	72	10-350
GHG from managed organic soils	17	3-90
Ammonia emissions	1	
Water		
Pesticides in sources of drinking water	3	
Nitrate in sources of drinking water	1	
Pollution impacts of N eutrophication	3	
Pollution impacts of P eutrophication	17	
Water use (irrigation water)[a]	8	4-17
Water scarcity	164	
Soil		
Erosion (water)	35	7-70
Erosion (wind, very uncertain)	35	7-70
Land occupation (deforestation)	3	
Biodiversity		
Biodiversity impacts of pesticide use	1	
Biodiversity impacts of nitrate eutrophication	3	
Biodiversity impacts of phosphorus eutrophication	3	
Pollinator losses	15	1-25
Fisheries overexploitation	10	
Social[b]		
Livelihood loss	333	
Health damages (well-being loss)	145	
Acute health effects of pesticides	8	
Risk of conflict	396	
Economic		
Value of products lost and wasted	936	
Subsidies (OECD only)	119	
Sub-total environmental costs	696	
Sub-total social costs	882	
Sub-total economic costs	1055	
Total costs (all categories)	**2625**	

[a] The cost of irrigation water is included in the sub-total environmental costs as a proxy for water use; it is excluded from the total costs to prevent double counting as irrigation costs are already covered in the product value.
[b] When excluding children in the population numbers (as the well-being estimates are based on a sample of adults only), the total social costs sum to USD 579 billion (USD 229 billion livelihoods, 101 billion health, 249 billion conflicts). Those numbers more clearly underestimate these costs (as they neglect well-being losses from children) but are more accurate for the sample covered (i.e. for adults).
[c] Where no range is indicated, the numbers are point estimates indicating mid-values.

Externalized Costs:

National Disorders Associated with Diet

- Obesity
- Diabetes
- Hypertension
- Cardiovascular disease
- Food allergies
- Antibiotics
  - Resistance 40% at conventional farms
- Pathogens
  - E. coli, salmonella, campylobacter
- Childhood diseases
  - Autism, Attention deficit disorder, Hyperactivity

Externalized Costs:

International Unrest

- US Subsidies reduce Mexican corn price to 75% of what it was in 1990
- Low commodity prices mean grain snapped up by global traders (Cargill, ADM) who use it for processing (tortillas, tacos, etc.) to undercut prices by Mexican vendors
  - Mexican farmers leave farming
  - Mexican food vendors out of business
  - Mexican drug trade swells
- Taxpayer subsidies enable similar price cuts with similar impact around world

What a Difference Good Agriculture Can Make

- Climate Moderation
- Environmental Stewardship
- Microbial Biodiversity
- Healthier Humans
- Food Justice
- International Peace

Worth Working For!

Many Hands Organic Farm

- 36 years
- 2 ½ acres veg
- 1 acre fruit
- 150 layers, 200 meat birds, 5 pigs, 3 cows, 100 turkeys
- Certified organic since 1987
- No till
- MHSC works with troubled youth and adults

Promote Carbon Sequestration to Ameliorate Climate Change

- Photosynthesis is key to all health – promote it at all junctures and in all formats (forest, plain, field, garden, landscape, corporate campuses)
  - Intimately learn the needs of mycorrhizal fungi – they are the internet underground
    - keep soil covered with green plants all year long
    - Maximize diversity above ground with plants, animals (including earthworms), trees, etc.
    - Use biological inoculants and plant stimulants (seaweed) to ramp up the system
    - Minimally disturb the soil system
    - Learn more at the NOFA Winter Conference – January 12 - WSU

Eat Like Your Life Depended on it – It does; Food as Medicine

- Stop eating glyphosate – it is killing us – all processed food and most things that have an ingredient list
- Eat whole foods that were raised by a carbon sequestering farmer or gardener – ask; read our NOFA literature on this
  - Carbon Sequestering Garden
  - Soil Carbon Restoration: Can Biology Do the Job
  - https://www.nofamass.org/carbon
- Include the prebiotics (herbs and wild foods) and probiotics (fermented foods)

Ban Glyphosate

Join NOFA/Mass and Toxics Action to do a town by town ban of glyphosate and all “cides” on December 13 for our kick off call at noon and again at 7 pm. Work with us as we provide education about how to do this and also how to promote alternatives to biocide use in all aspects of our daily life.

Thank you for expressing interest in our Local Pesticide Action Call happening ***Thursday, December 13th***. Due to lots of interest, we are offering the *same* call TWICE on December 13. The first call will be at 12:00-1:00PM and the second will be from 7:00-8:00PM. See below for call-in info. Please join at whichever time works best for you.

We are using a Zoom Video Conference Platform for each call.

***If you have never used Zoom before, it may take you 5 minutes to log in from a computer for the first time. We HIGHLY recommend joining by computer if you can! There is also a phone call-in line if that is what works best for you or if you have any technical difficulties :)*

Local Pesticide Action Call (Lunch-Time! 12:00-1:00PM)

Join by Computer (recommended!): https://zoom.us/j/718609911

Join by Phone: +1 646 558 8656 US / Meeting ID: 718 609 911

Local Pesticide Action Call (Evening! 7:00-8:00PM)

Join by Computer (recommended!): https://zoom.us/j/389238234

Join by Phone: +1 646 558 8656 US / Meeting ID: 389 238 234

We're excited to connect with you soon!

Mary (and Marty from NOFA!)

PS: If you cannot make either of these call times, please feel free to shoot me an email and we will follow up with you separately in the near future.

Mary Jones – mary@toxicsaction.org

Marty Dagoberto – marty@nofamass.org

Let’s Change Our Worldview

- Nature Bats Last - Domination and tinkering with and “improving” natural systems has not worked – some say we have 60 more harvests
- We must be partners (junior partners) with nature – we now need to move toward collaboration
- Celebrate the orderliness of nature – not the orderliness of humans – change our perception of what is beautiful and then actualize it in gardens, soccer fields, lawns, college and high school campuses
- Get dirty and hug animals and other human beings
- Honor the biology that feed the plant microbiome and that feed our microbiome – they pretty much run the show. Ask, what would my microbiology want me to do today (we are 90% them and 10% us according to some)?
- Build our immunity – don’t kill disease; they will take care of that for us