

# Agriculture

A way of living: What we eat and how we raise it





## Plant diversity:

~400,000 species of plants,

3,000 tried in agriculture

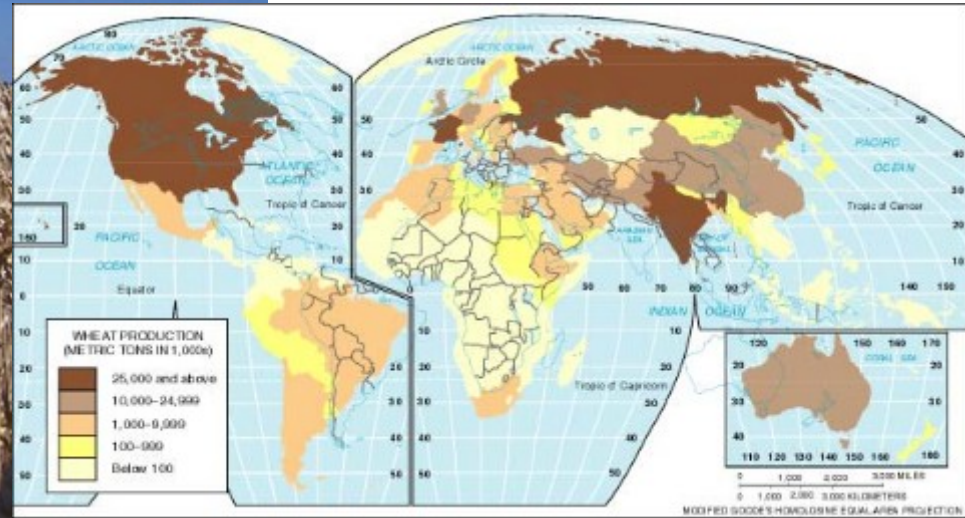
150 cultivated on large scale

14 crops provide most of the world's food - ???



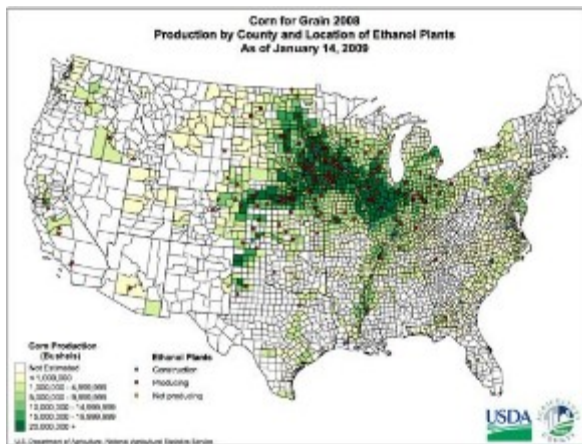


# Wheat





# Corn







Rice

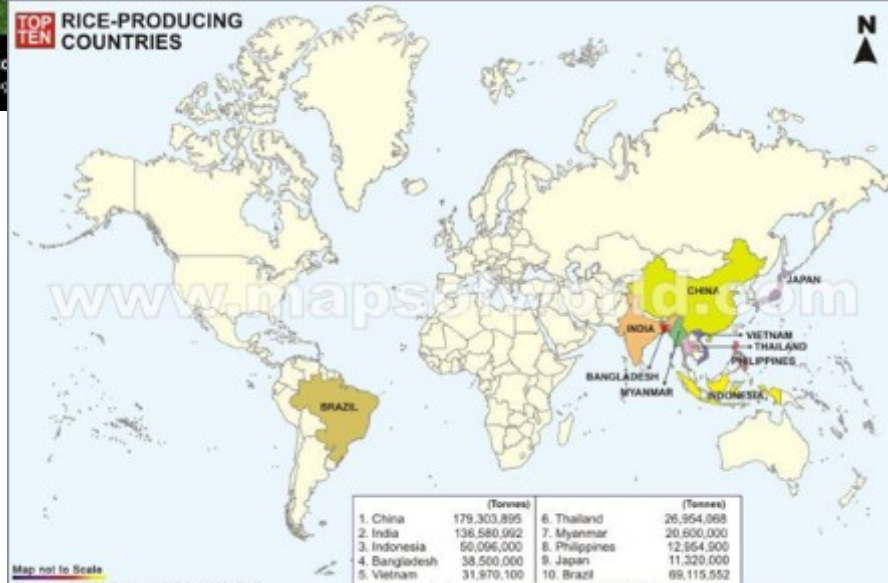




NATIONALGEOGRAPHIC.COM

Photo © 2005 National Geod

**TOP TEN RICE-PRODUCING COUNTRIES**



Map not to Scale  
Copyright © 2006 Compare Infobase Limited



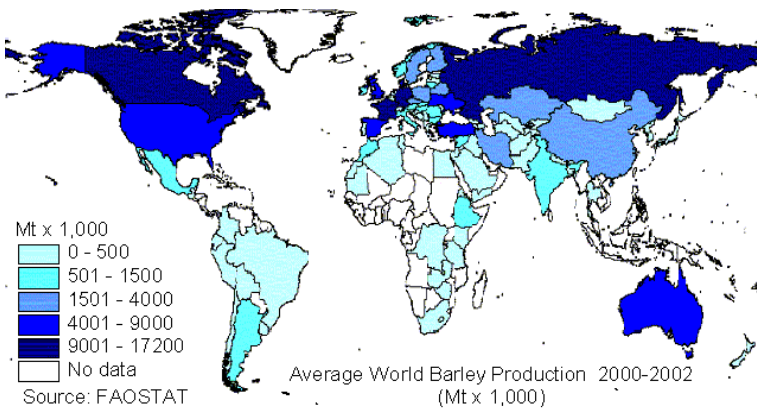






L48-324801 - © - Soren Breiting

### Barley



FreeFoto.com





Sorghum







Soy Beans

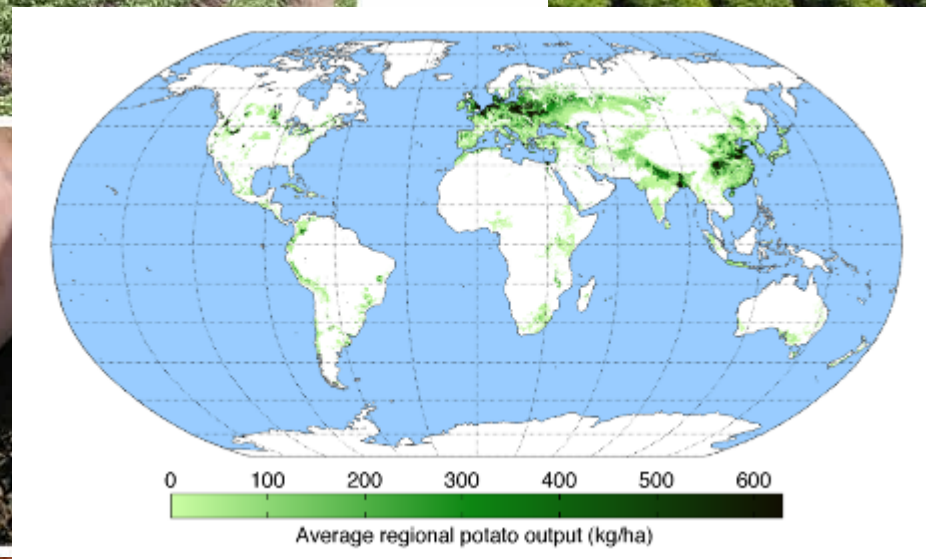




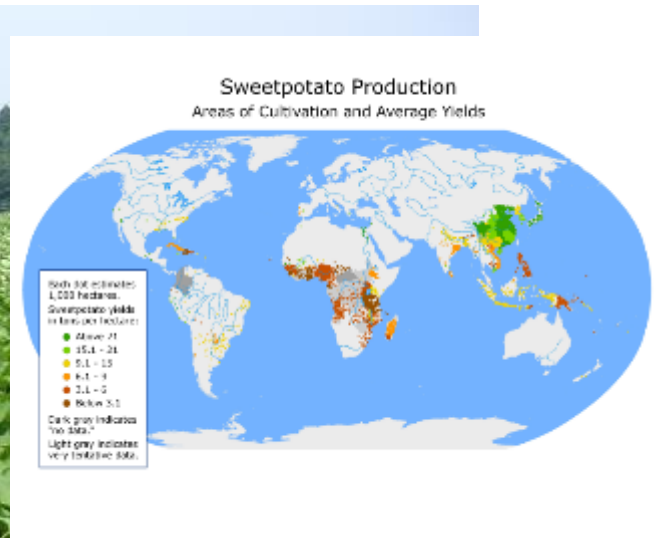
Beans



# Potatoes



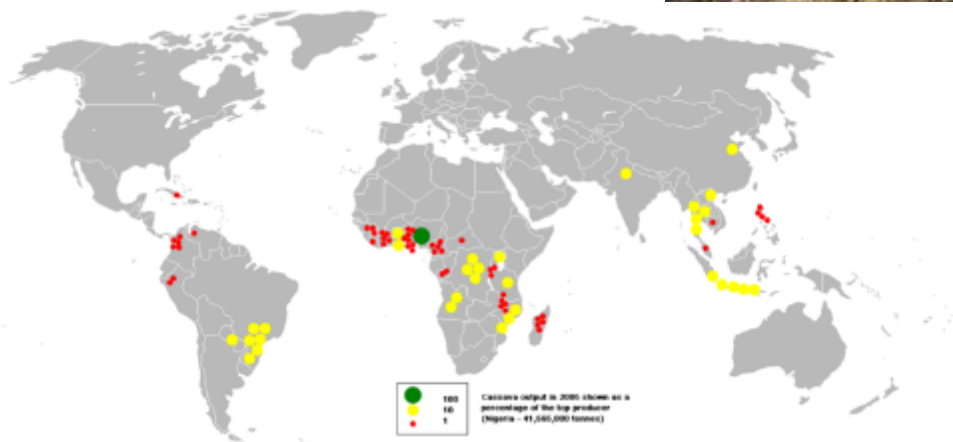
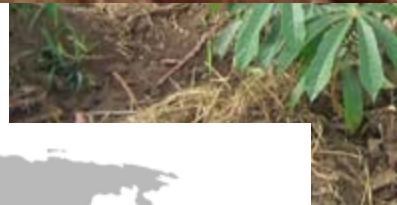




Sweet potato

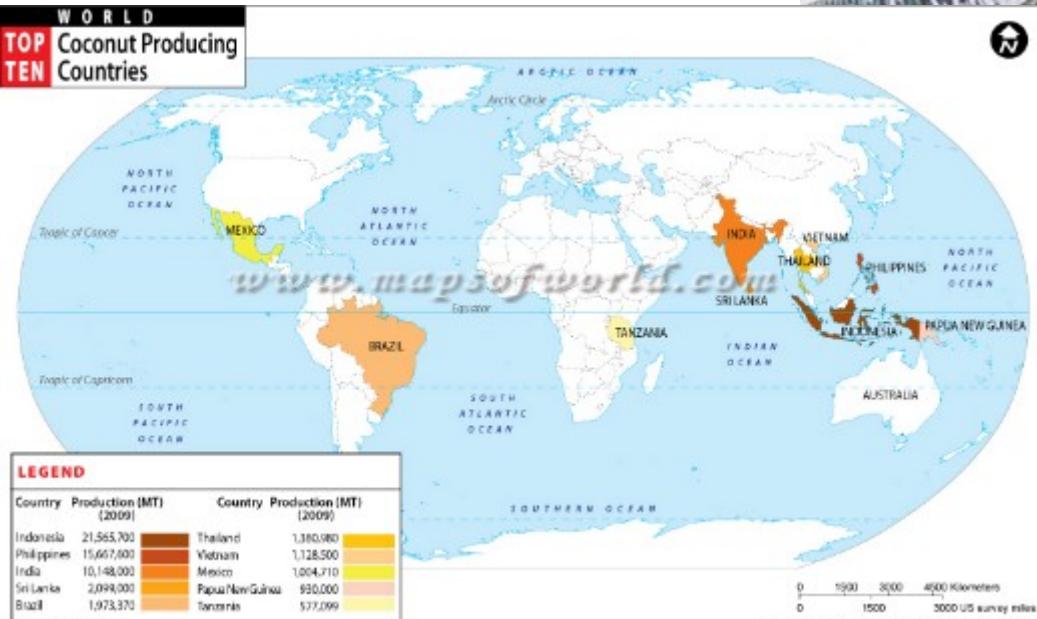


# Manioc (cassava, yuca)



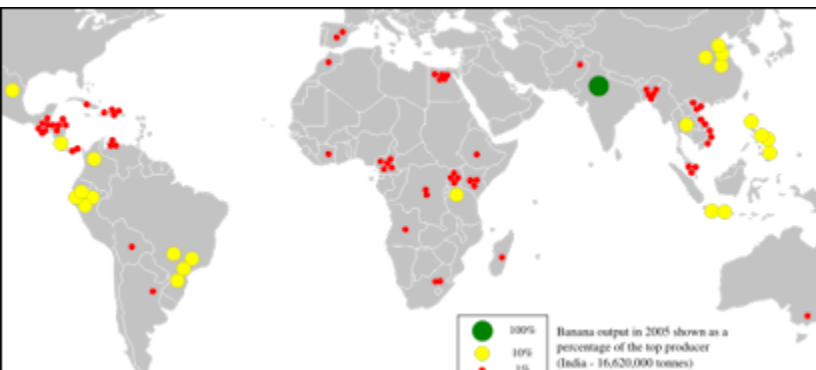


# Coconuts



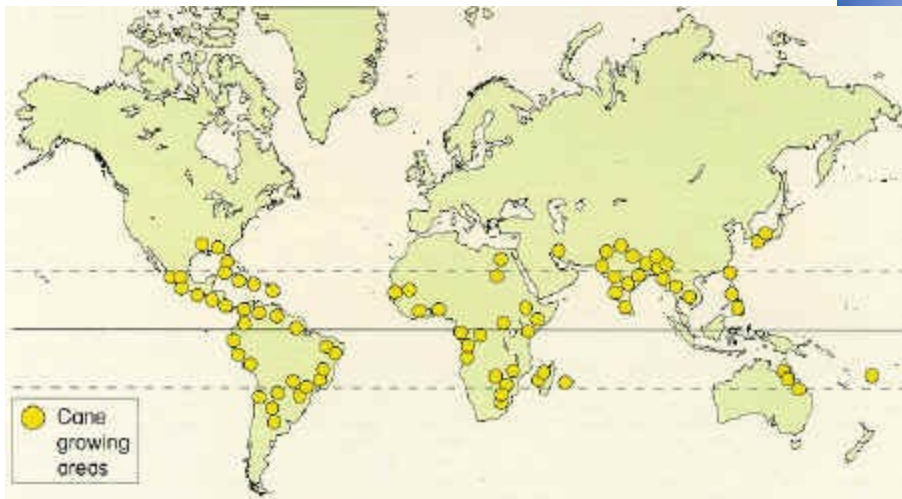


# Banana



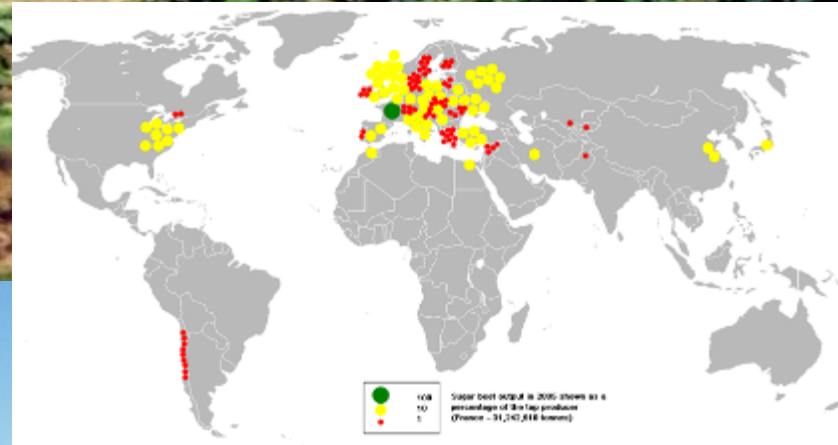


# Sugar Cane

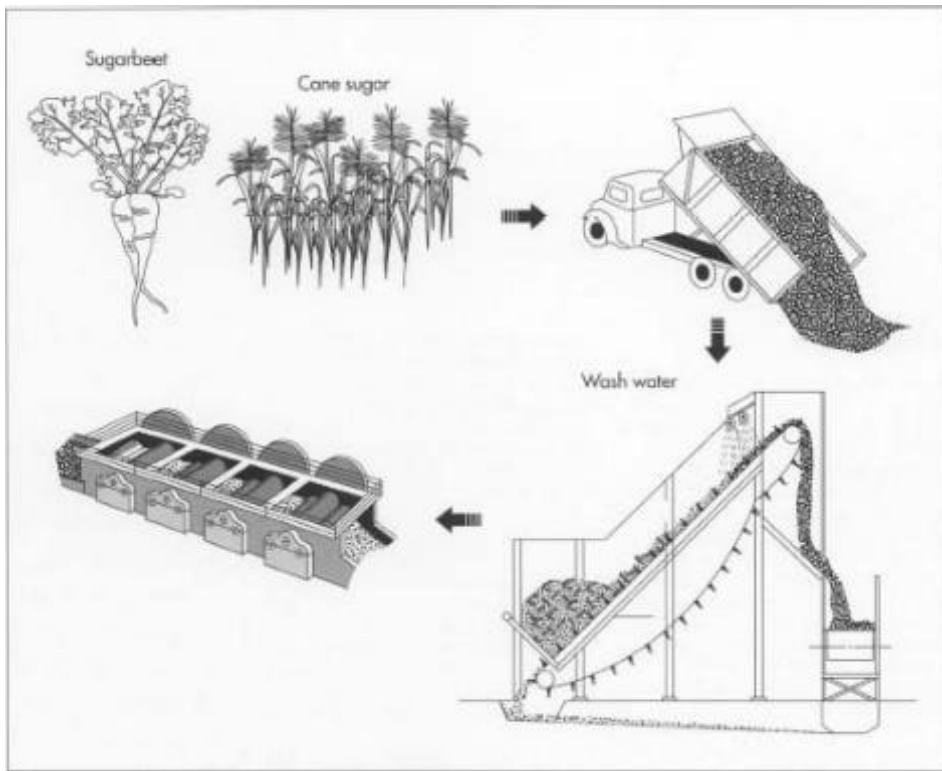




# Sugar Beets

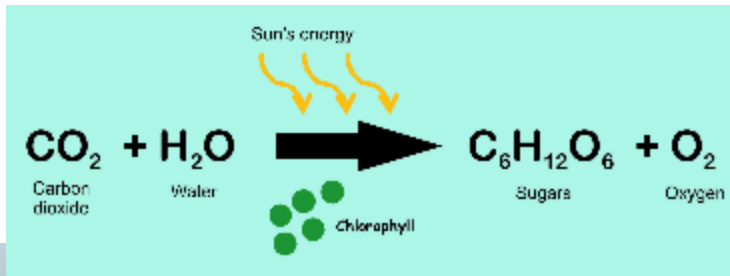








Food supply is mostly based on **annual plants** – early successional species that produce an amazing amount of biomass in a short time by capturing the sun’s energy through photosynthesis. The sun’s energy is stored in the chemical bonds of the plant material and is both structural and functional (both in terms of plant processes and energetics).



before



after

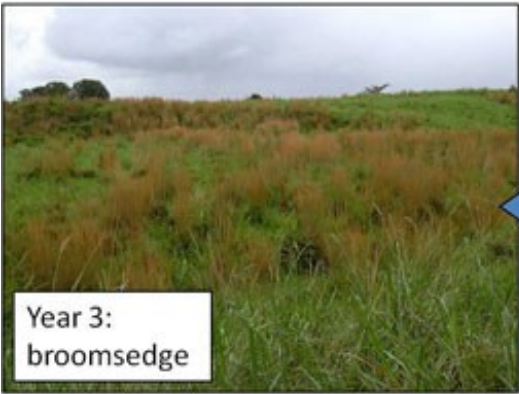
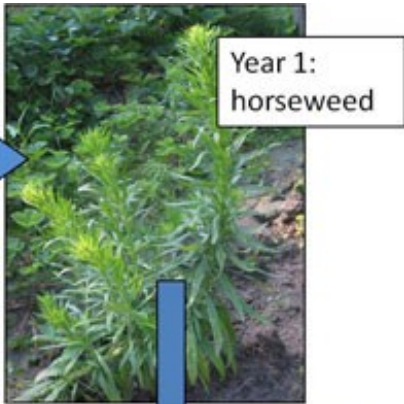
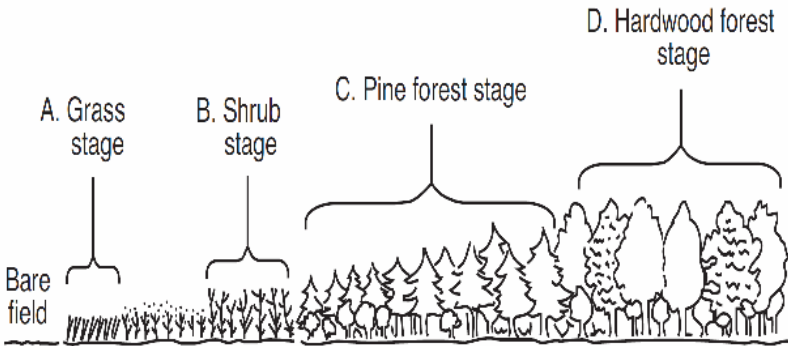


# 5 ways that agro-ecosystems differ from ecosystems



# Agro-ecosystems

## 1. Stop ecological succession – requires energy





## Agro-ecosystems

2. Large areas of a single species – monoculture, reduces soil fertility because the specific requirements of that species





## Agro-ecosystems

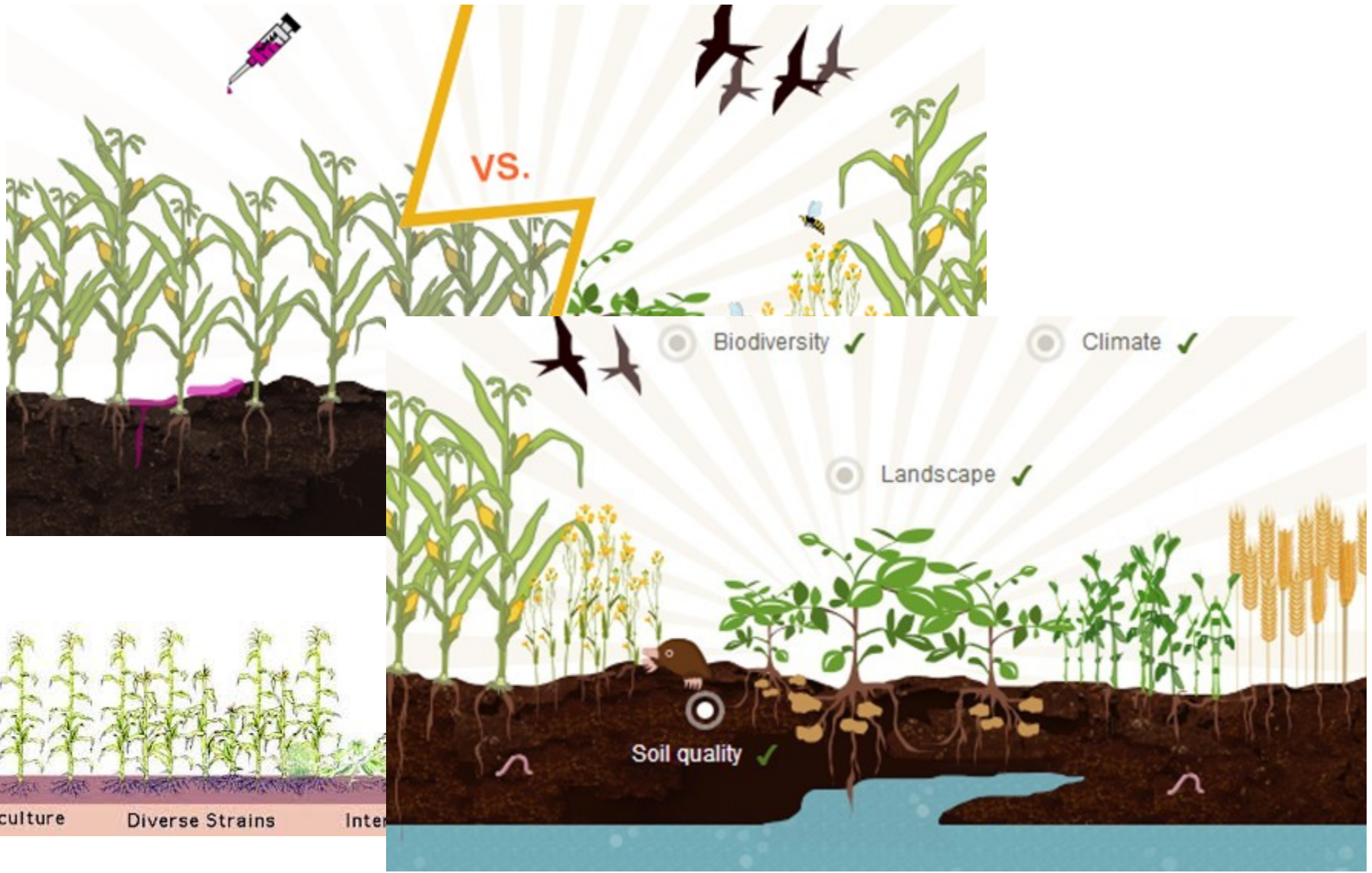
3. Planted in neat rows makes it easier for pests (real systems are complex)





# Agro-ecosystems

4. Food chains are greatly simplified – competitors and pests eliminated box and arrow





# Agro-ecosystems

## 5. Plowing – erosion, damage to the physical structure of the soil









**Food waste**: Forty percent of the food in the United States is never eaten.

Roughly 50 percent of all produce in the United States is thrown away—some 60 million tons (or \$160 billion) worth of produce annually, which is about \$1,600 per four person family.



**WHY?**

**We are conditioned to only buy perfect looking produce**

**We can afford to throw food away**

**We are not self-aware**

people should sort their trash to find out how much they waste

**We don't know a lot about food safety**

[Expiration dates are not tied to food safety](#)



## Food waste solutions

- Consumer education that leads to behavioral changes
- Systemic changes that make food waste less likely/more expensive

[France to force big supermarkets to give unsold food to charities](#)

[Germany Has An Ambitious Strategy To Halve Food Waste By 2030](#)

[USDA and EPA Join with Private Sector, Charitable Organizations to Set Nation's First Food Waste Reduction Goals](#)



# Role of livestock in agriculture

- Synergy between the plants, animals, and humans
- Animal manure fertilizes, hooves aerate soils
- Ruminants can consume plants we can't
- Can survive on areas not amenable for row crops
- Extra food source, available all year
- Where there is grassland there is hoofed mammal – co-evolved together
- *Gun, Germs, and Steel* – Jared Diamond





# Ways of farming meat

Pastureland



# Ways of farming meat

Rangeland





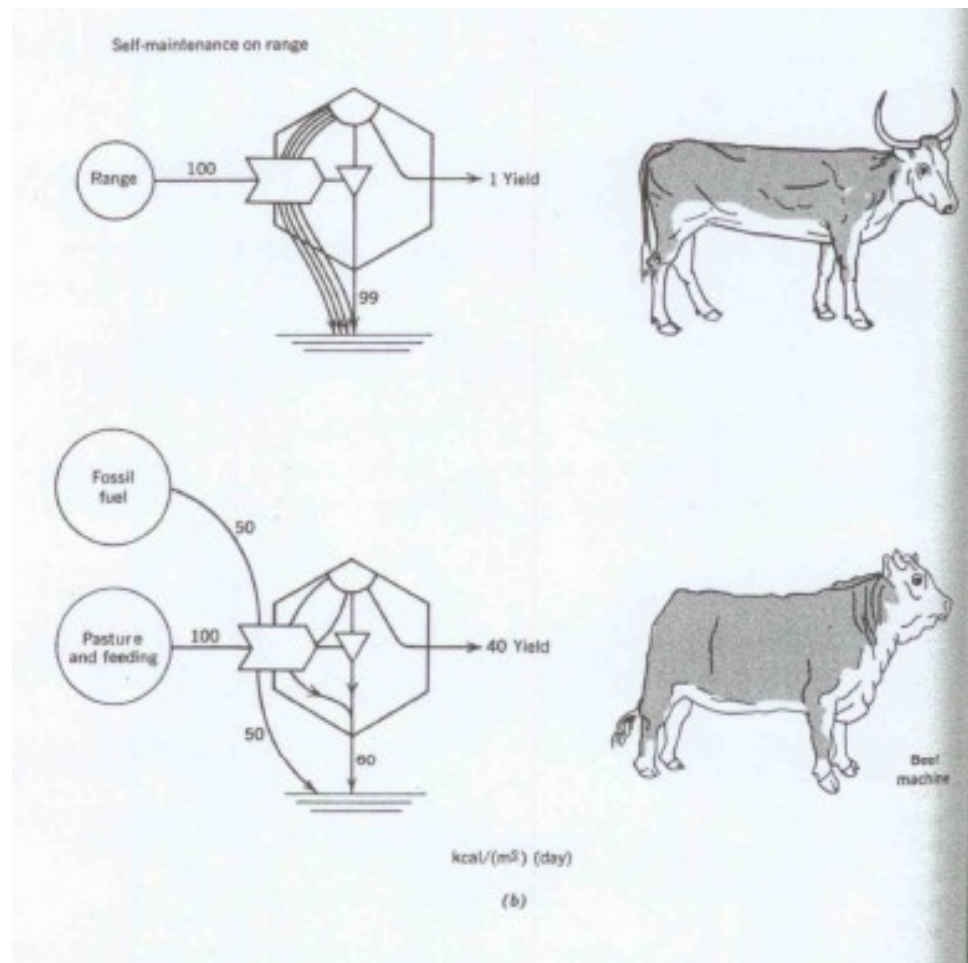
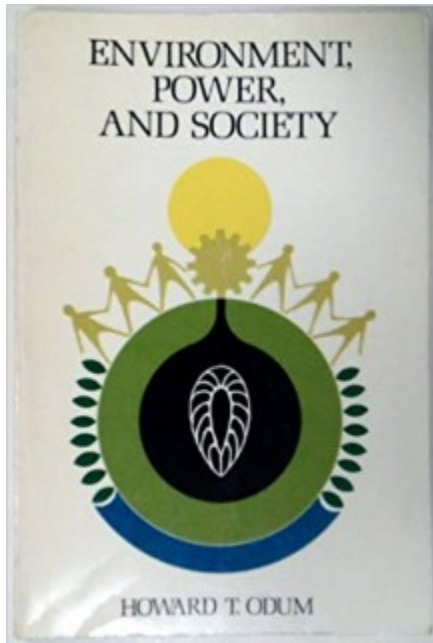
# Ways of farming meat

Factory farming



# Environment, Power, and Society

Role of thermodynamics and energetics in human society (HT Odum, 1971)





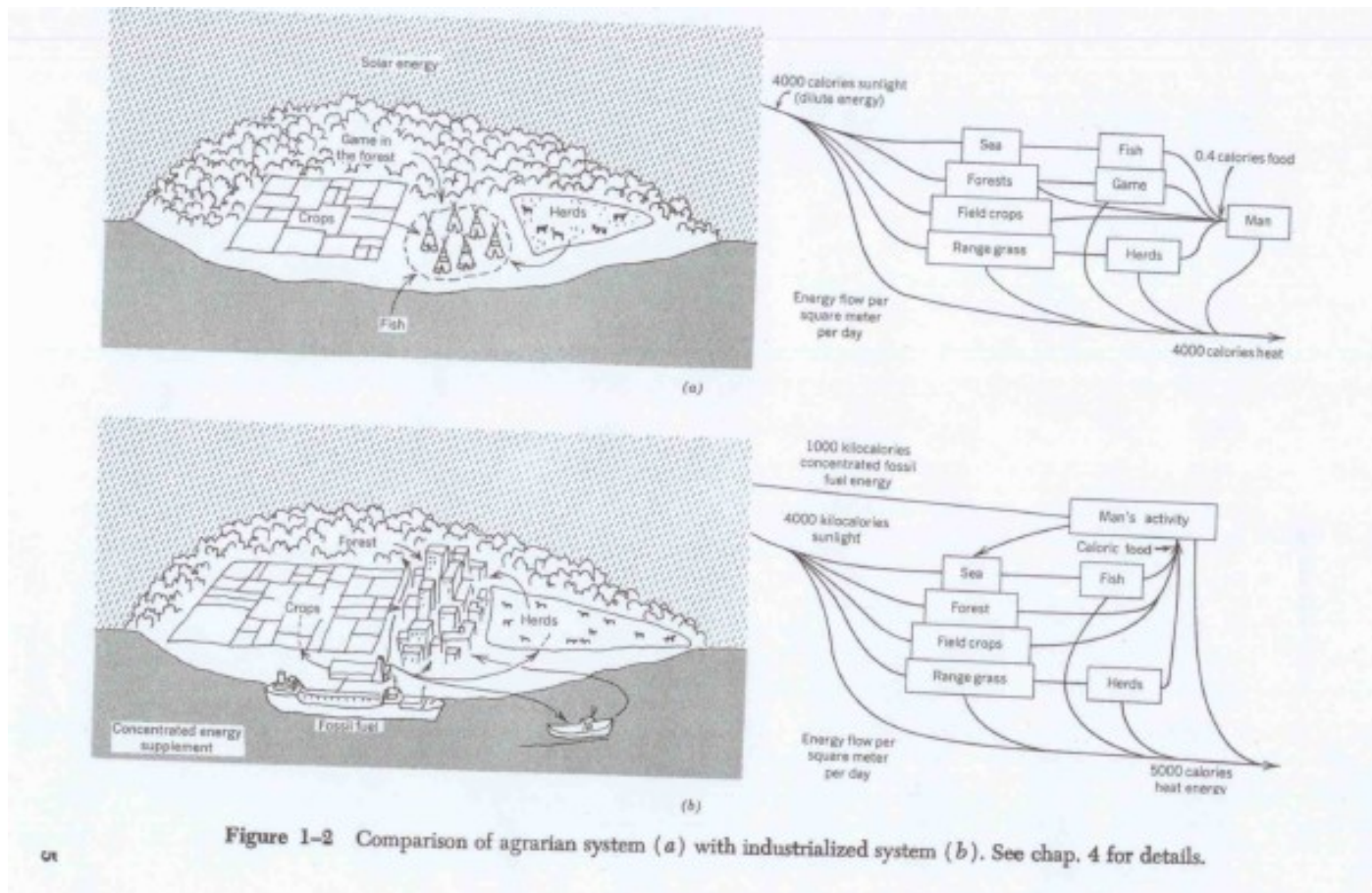


Figure 1-2 Comparison of agrarian system (a) with industrialized system (b). See chap. 4 for details.

## Livestock and poultry production

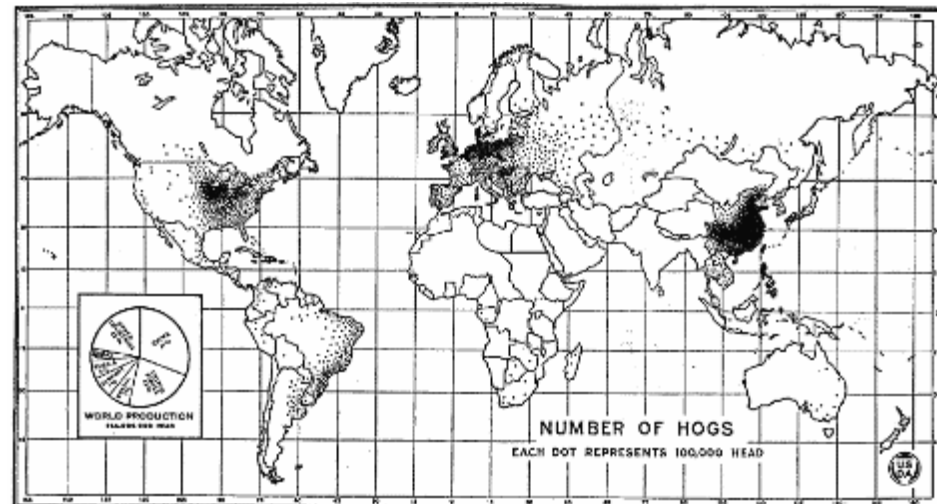






Concentrated/Confined  
Animal Feeding Operations  
(CAFOs)

**What is a CAFO?**  
Agricultural operations where animals are kept and raised in confined situations. CAFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland





2017 Poultry slaughtered: Chickens: 9,050,716,000; Turkeys: 241,677,000; Ducks: 26,628,000

[National Agricultural Statistics](#)





U.S. egg production in 2017: Total 105.7 billion; 92.1 billion table eggs and 13.6 billion hatching eggs







## Poor agricultural practices lead to:

- soil erosion (potentially desertification),
- nutrient depletion,
- biodiversity loss (habitat loss and introduced chemicals),
- overuse of fertilizers (eutrophication),
- high energy use,
- unhealthy labor conditions,
- animal abuse,
- high use of antibiotics (leading to resistant strains),
- climate change,
- ...



## What that Mud in Our Rivers Adds up to Each Year



"the top soil which goes swirling by in our rivers at flood stage may look like mud to you but it is beefsteak and potatoes, ham and eggs and homemade bread with jam on it."

Erosion and soil loss



# Alternatives to conventional agriculture

## Ways to reduce erosion

Contour plowing

Terracing

Strip cropping

No till farming

## Ways to maintain soil fertility

Strip cropping

Crop rotation

Cover crops

Leaving land fallow

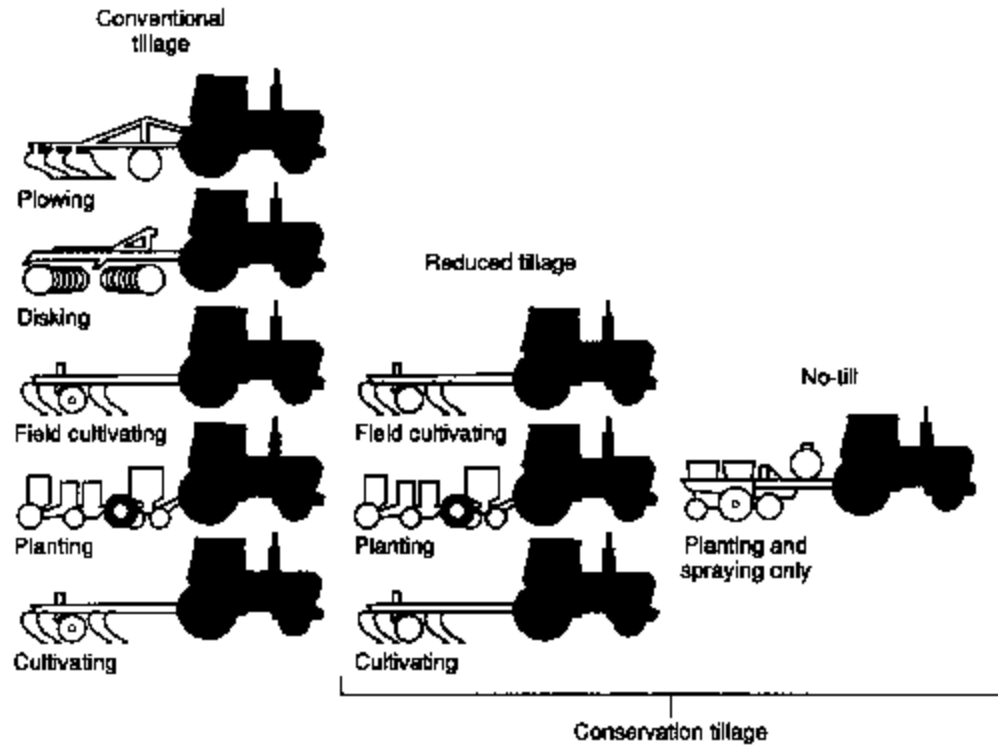
Polyculture

Permaculture

## Urban farming

## Organic farming





No till farming







## Contour planting and strip cropping

Farming with row patterns nearly level around the hill—not up and down hill.







Landscape terracing



Urban farming

Vegetables and greens





Organic Farming is a system to produce agricultural products to:

- maintain long-term soil fertility
- increase soil biological activity (decomposers)
- recycle wastes to return nutrients to the land
- ensure effective pest management
- provide attentive care to farm animals, and
- create conditions that do not require extraneous synthetic additives.

It relies on [crop rotation](#), [green manure](#), [compost](#), and [biological pest control](#) to maintain soil productivity and control pests, excluding or strictly limiting the use of synthetic [fertilizers](#) and synthetic [pesticides](#), [plant growth regulators](#), livestock feed additives, and [genetically modified organisms](#)

Free range – organic chickens and pigs

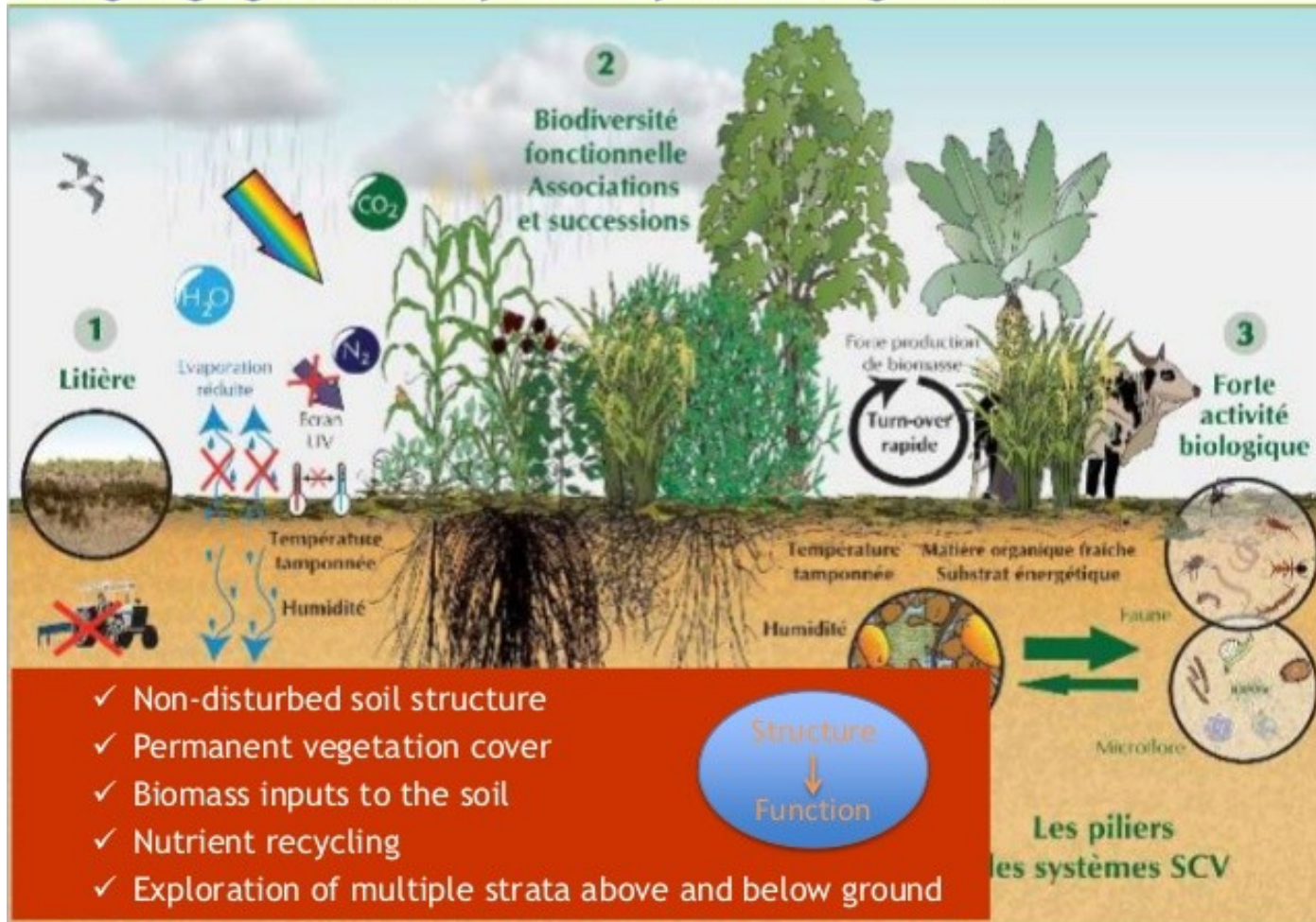






Agroecology is the study of ecological processes applied to agricultural production systems.

## Designing agricultural systems by mimicking nature







Community Supported Agriculture consists of people who buy shares from a farm operation, sharing the risks and benefits of food production. In return, they receive produce throughout the growing season, as well as satisfaction gained from reconnecting to the land and participating directly in food production.



[onestrawfarm](http://onestrawfarm.com)

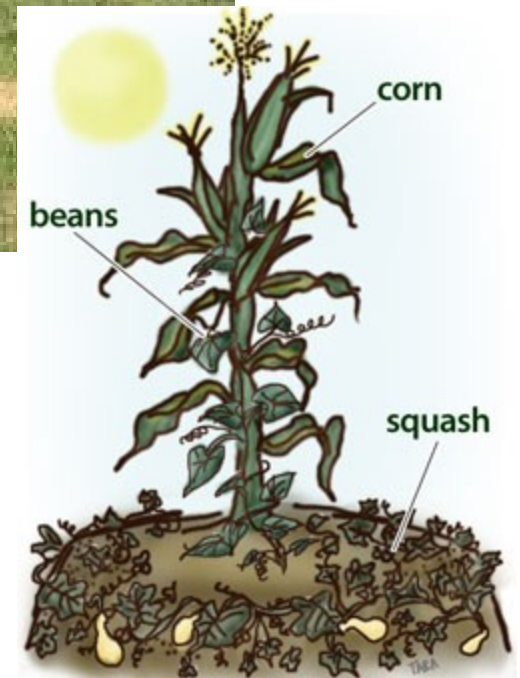


[realfoodfarm](http://realfoodfarm.com)





Three sisters planting - combines corn, squash, and beans



*Direct-Sow, Easy-to-Grow:  
The Ancient **Three Sisters** Method*

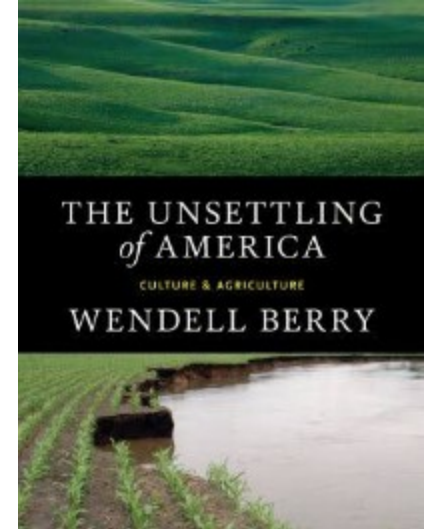


# Cultural and Ecological aspects of Agriculture

# Fragmentation

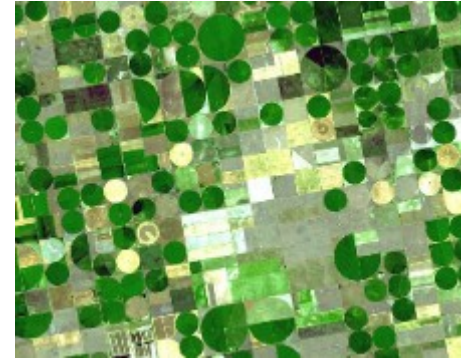
- “The concept of country, homeland, dwelling, place becomes simplified as ‘the environment’—that is, what surrounds us. Once we see our place, our part of the world, as *surrounding* us we have already made a profound division between it and ourselves.”  
p.24

- Berry 1977





# Crisis of agriculture



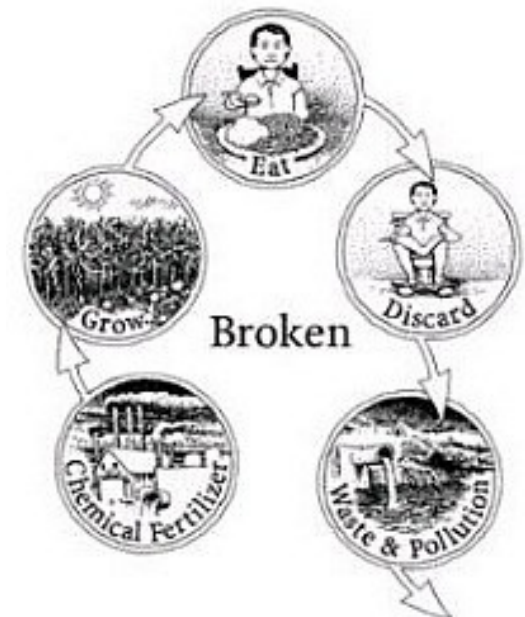
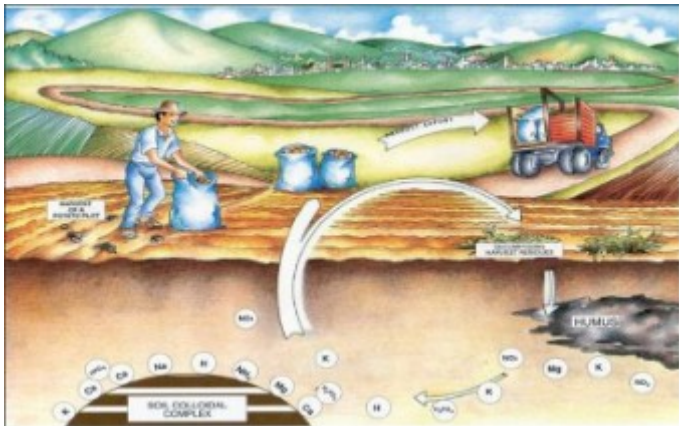
- With pressure from growing urban populations and in a losing effort to keep up with the city, the countryside abandoned its connection to cycles of growth and decay and turned the land into a production machine.

This left both the land and the people poorer



# Isolation of food and body

- “Our system of agriculture, by modeling itself on economics rather than biology, thus removes food from the *cycle* of its production and puts it into a finite, linear process that in effect destroys it by trans-forming it into waste.” p.142
- “By regarding [ourselves] merely a consumer of food, we reduce the function of the body to that of a conduit which channels the nutrients of the earth from the supermarket to the sewer.” p.141



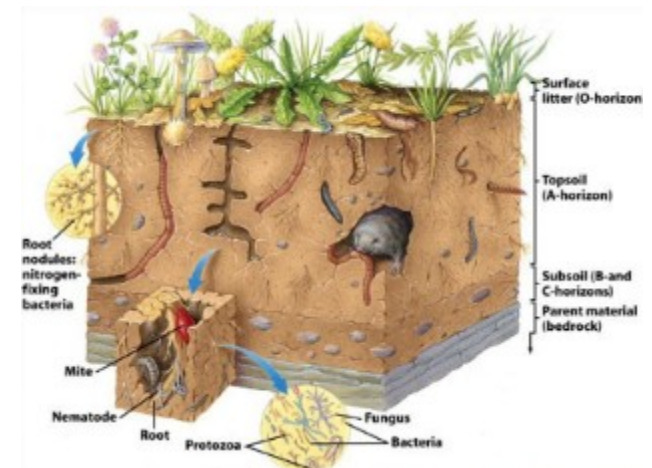


# Agricultural revolution



- “Establish agriculture upon the same unifying cycle that preserves health, fertility, and renewal in nature by which ‘Death supersedes life and life rises again from what is dead and decayed’ ”
- “Soil is the great connector of lives, the source and destination of all. ... It is alive itself. It is a grave, too, of course.” p.90

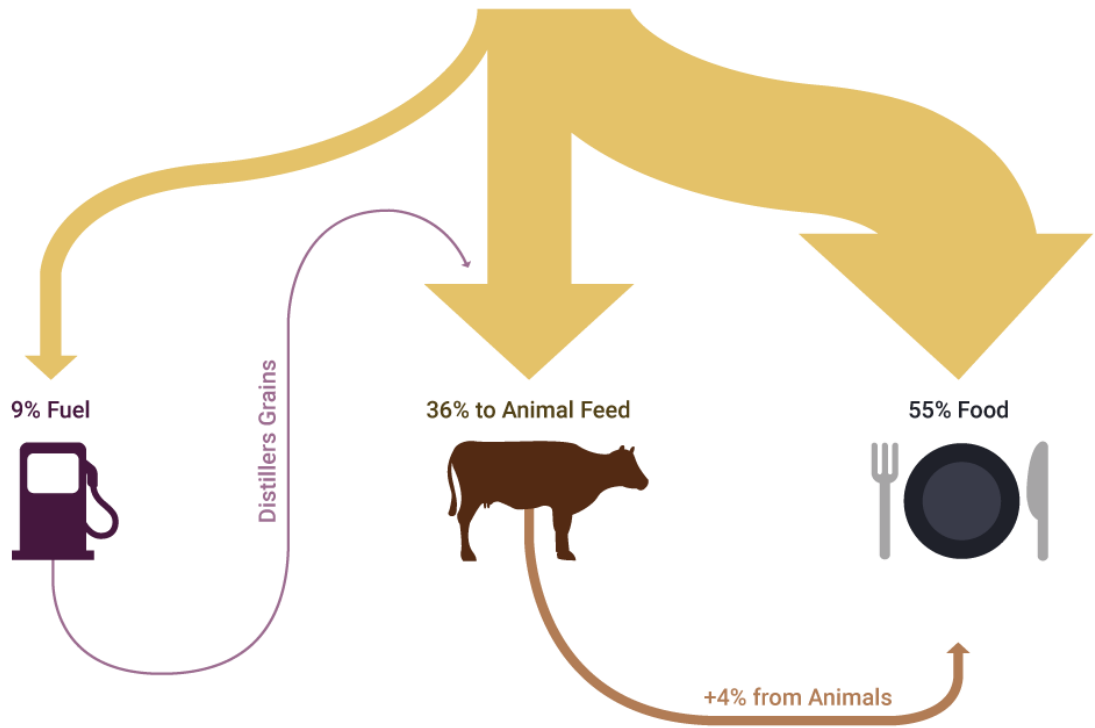
Soil is place



# In the current economic market there is competition for crops

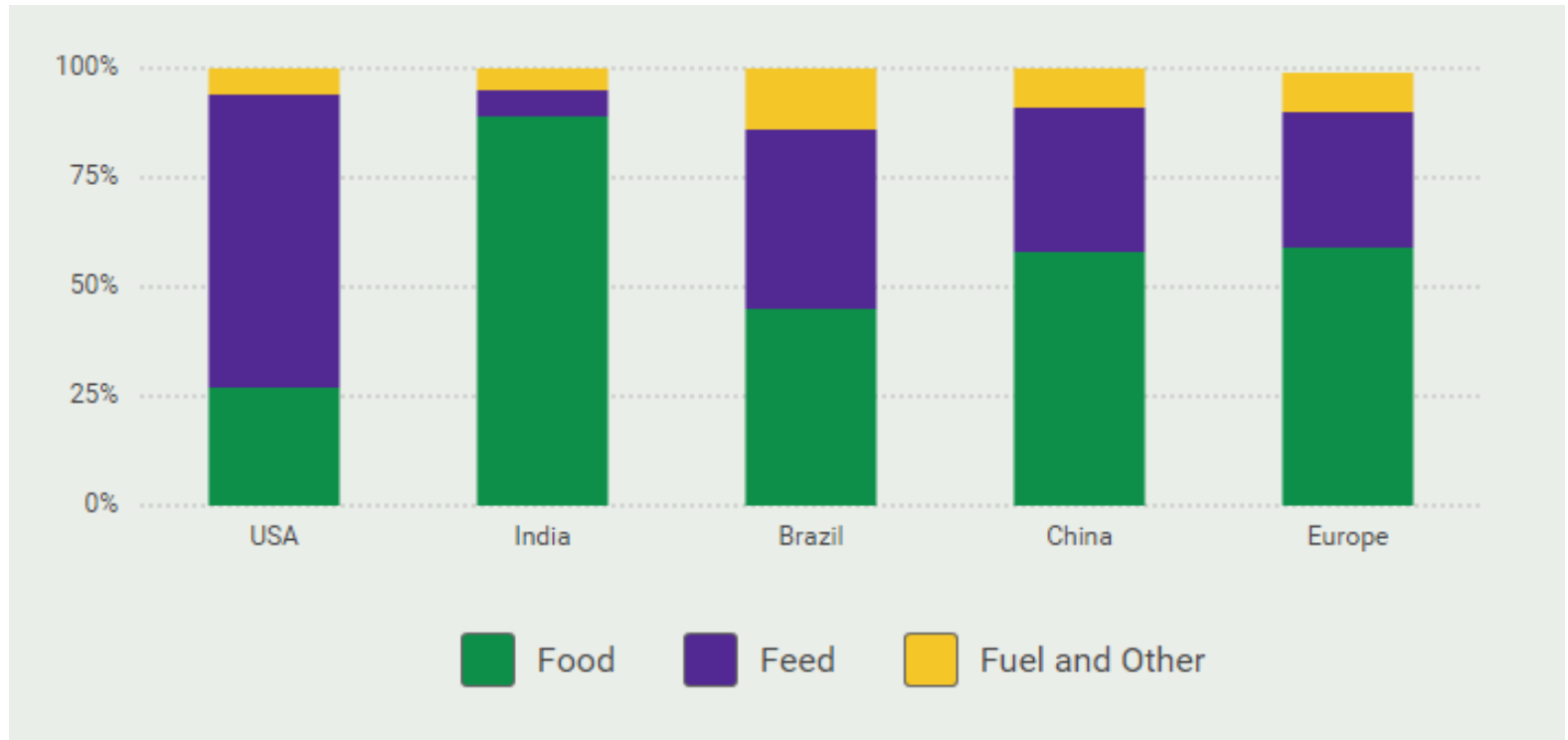


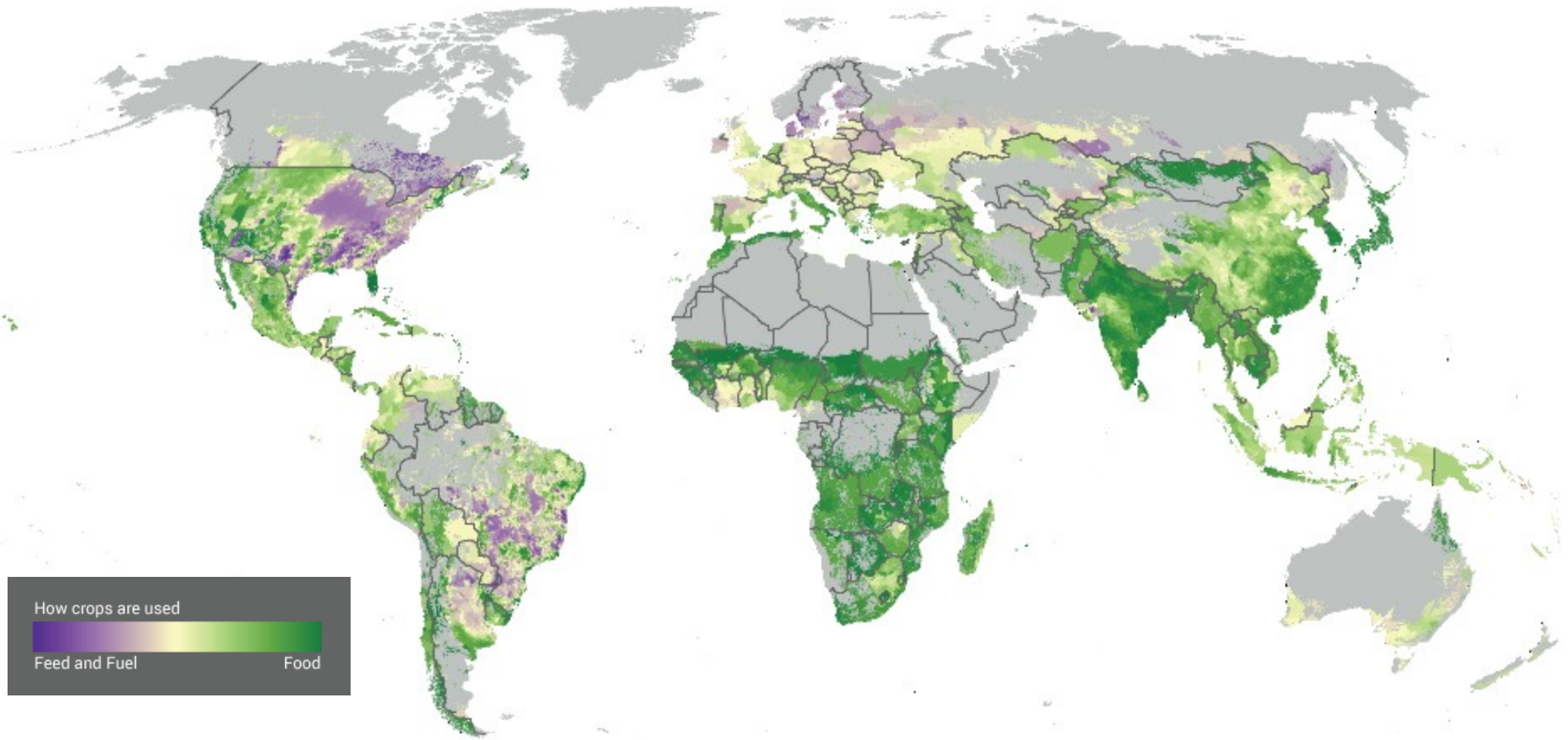
Global Crop Production (kcal)





Crop use varies greatly by region



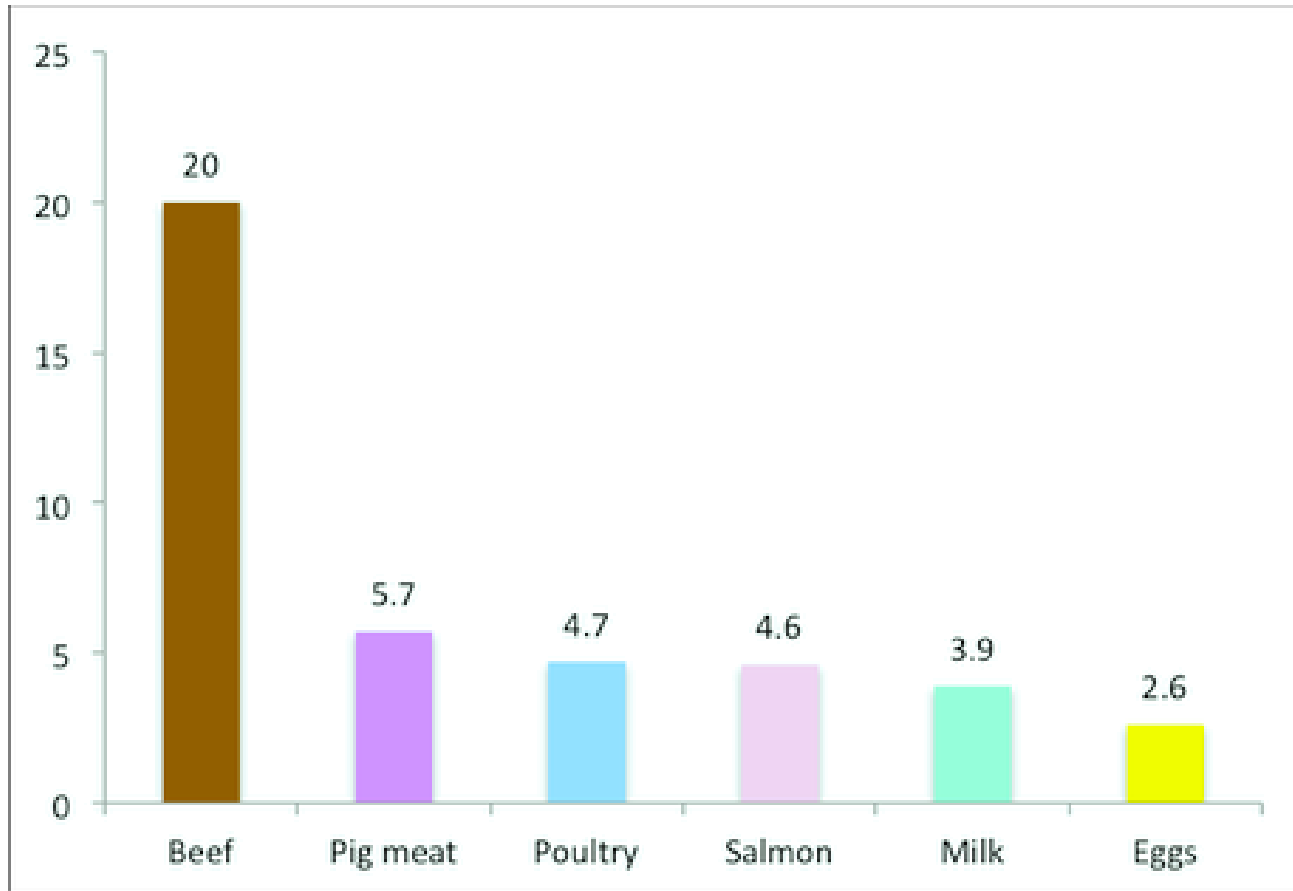


[www.environmentreports.com/change-your-diet-change-our-destiny/#section2](http://www.environmentreports.com/change-your-diet-change-our-destiny/#section2)

## Great global food gap

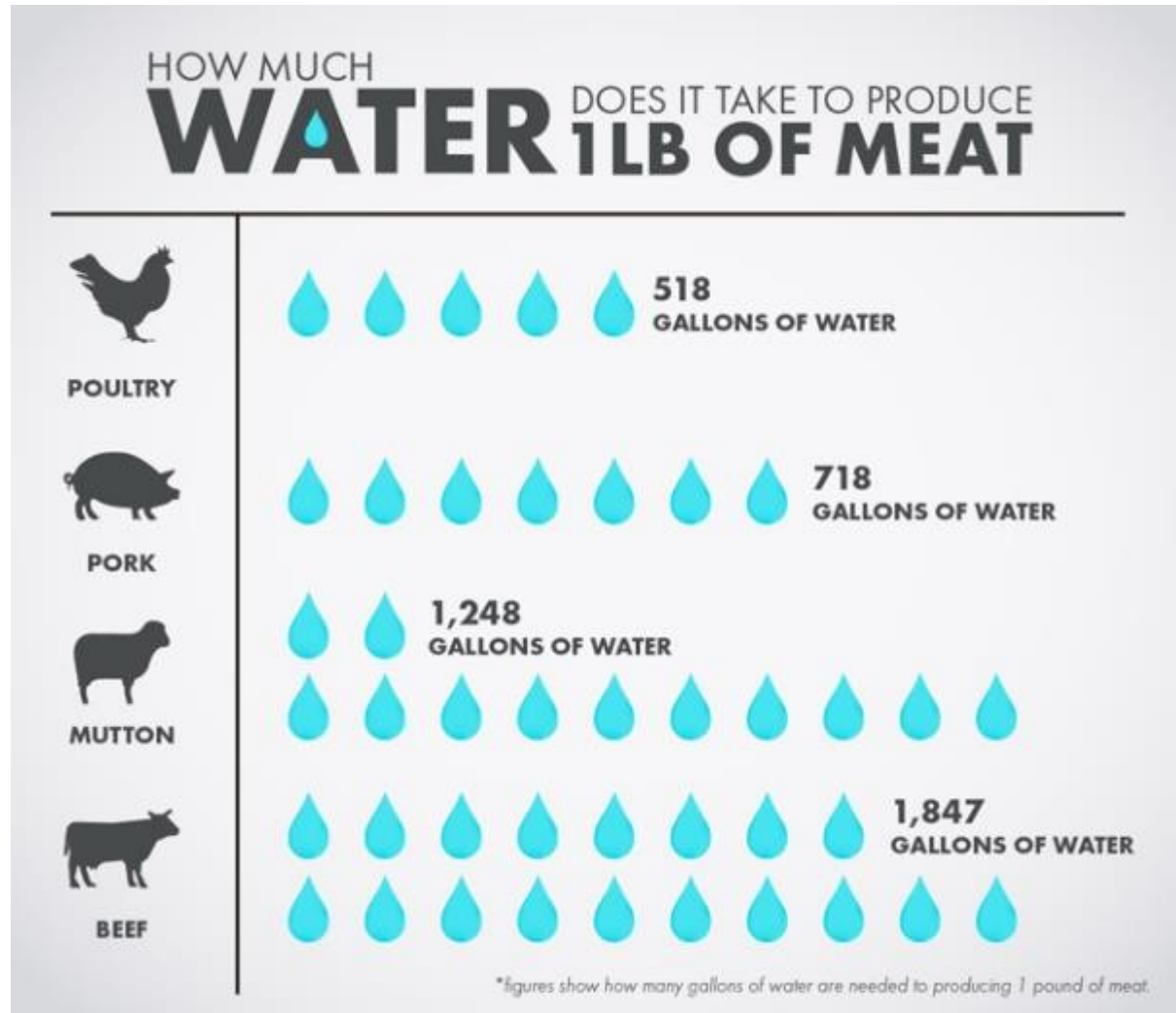


Protein production has different efficiencies in terms of energy  
(more input is less efficient)



Feed conversion ratios (kg feed protein required per kg of animal protein produced)

...and water





# THE Future OF Food



Aquaponics  
GMOs  
Lab grown meat  
Vertical farming  
Detritus farming  
...

