



Chapter 11

Feeding the World

Farming done “proper”

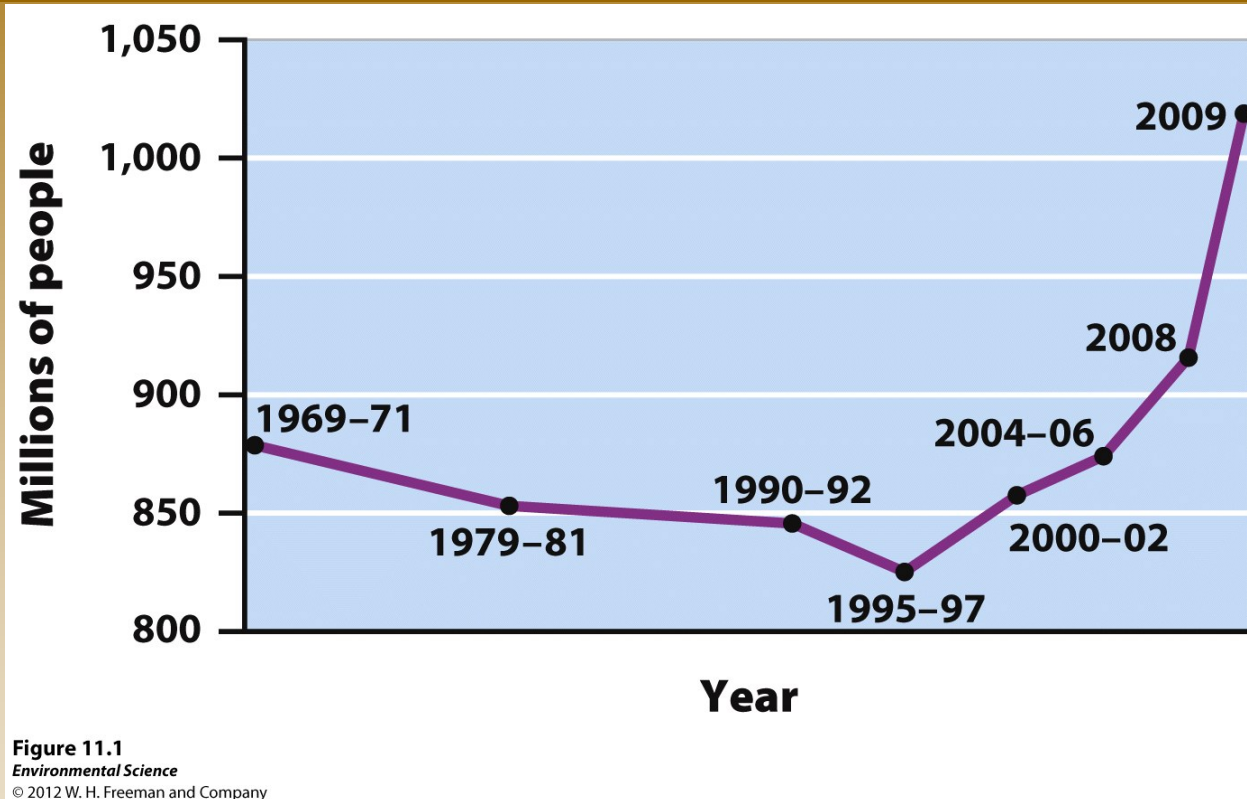
- ▣ Grass to cattle to manure to soil to grass.
- ▣ Chickens as pest control...manure spreaders.
- ▣ Mixing straw and corn with manure in the barn ...decomposition produces heat during winter.
- ▣ In spring, pigs dig thru it and convert it to compost, as they eat.

Some History

- ▣ Agriculture started about 10,000 years ago
- ▣ Farming meant less reliance on nature
- ▣ Industrialization in 20th century

Despite all the advances, 24,000 people starve to death each day

Global Undernutrition



Recent rise due to:

- Decrease in gov't assistance
- Increase in fuel prices
- Global economic downturn

Defining Famine

- ▣ 5 or more deaths per day per 10,000 due to a lack of food.



Nutritional Requirements

- ▣ Undernutrition- not consuming enough calories to be healthy.
- ▣ Malnourished- a persons diet lacks the correct balance of proteins, carbohydrates, vitamins, and minerals even though they get enough calories.
- ▣ Overnutrition- too many calories and improper foods that causes a person to become overweight.
 - Type II Diabetes
 - Hypertension
 - Heart Disease
 - Stroke

Access to Food

- ▣ Food Security- economic, social, and physical access to sufficient, safe, and nutritious food.



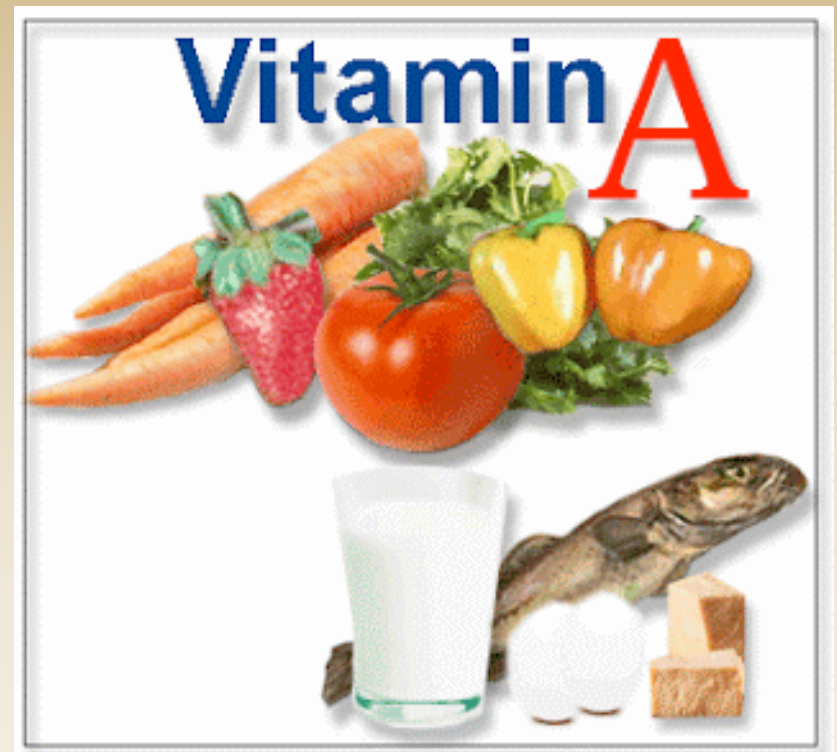
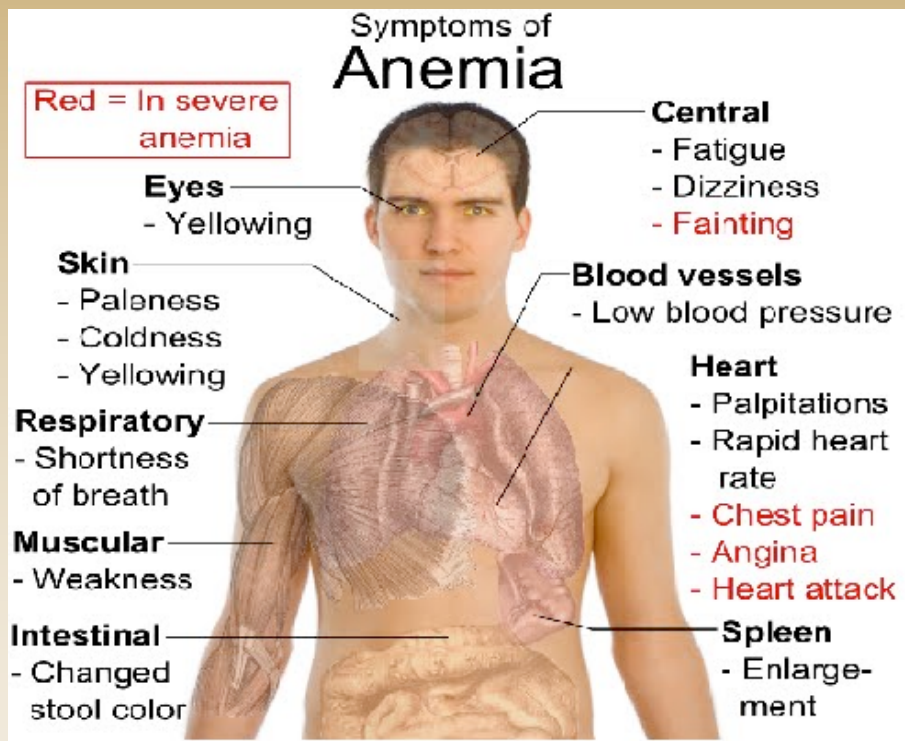
- ▣ Food Insecurity – opposite of that



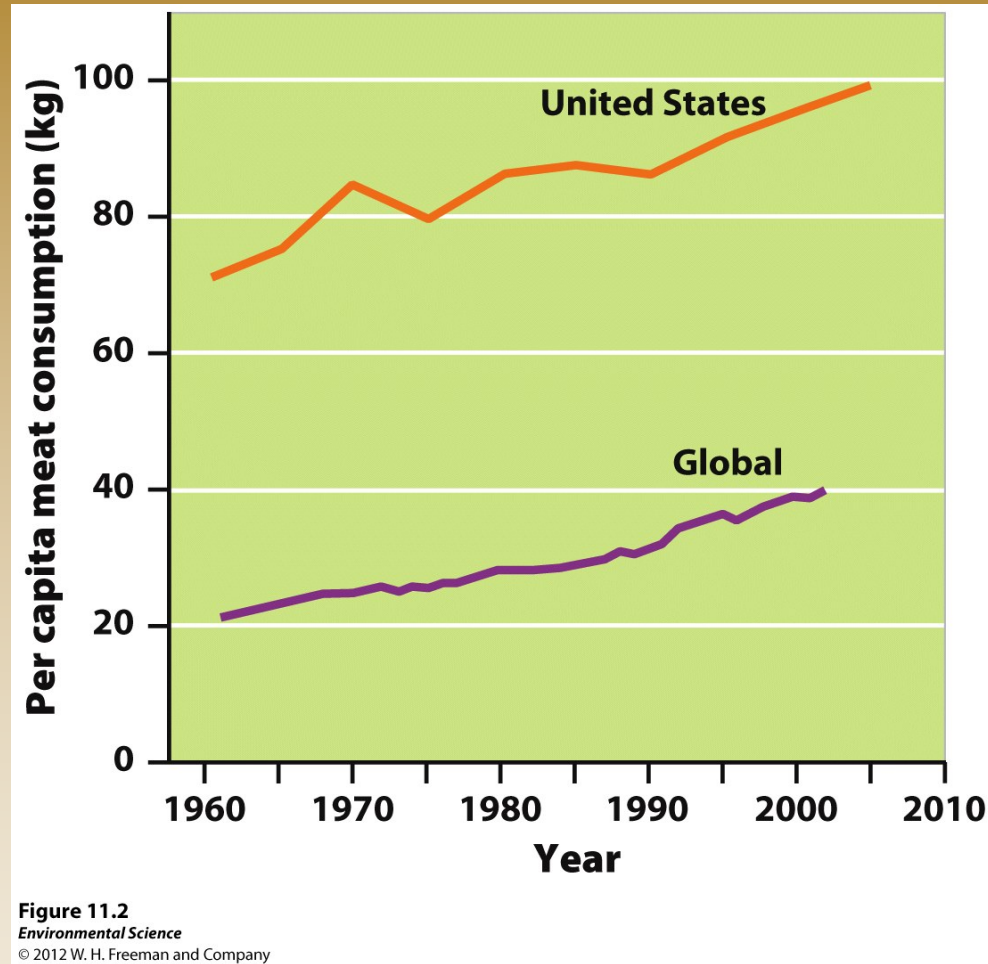
Food Vitamin Issues

- ▣ Anemia – Iron deficiency.

- ▣ Blindness – Vitamin A deficiency..250,000 children per year.

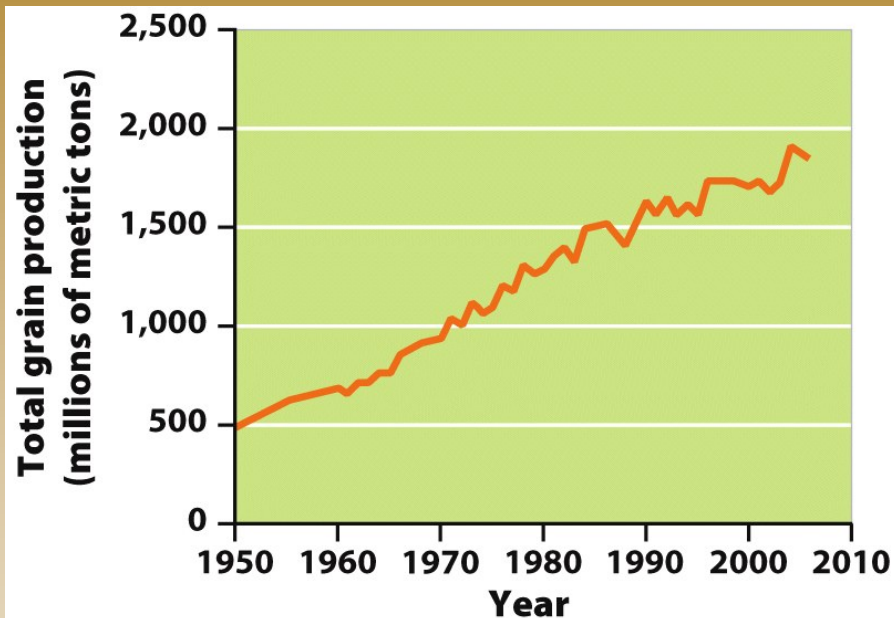


Annual Meat Consumption

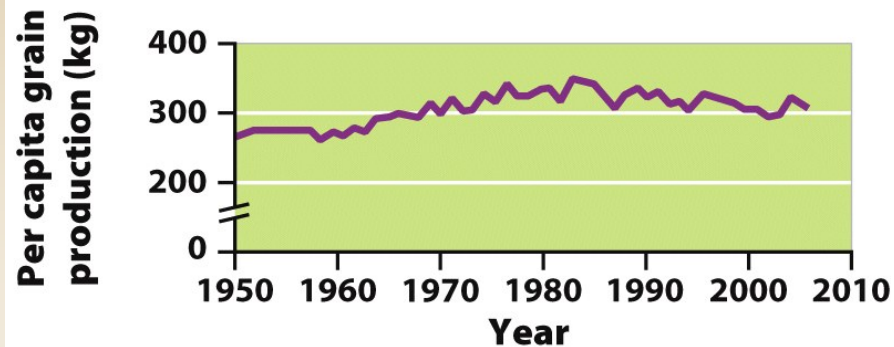


As income increases, meat consumption _____?
“Have” and “Have nots” become apparent.

Global Grain Production, 1950-2006



(a) Total grain production



(b) Per capita grain production

Figure 11.3

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What is the largest portion of the human diet?

Corn, rice and wheat make up 60% of our calories.

Reasons for Undernutrition and Malnutrition

Farmers grow enough grain for 8 billion people, why is it not enough?

- ▣ Poverty in **developing** nations → Unequal distribution
- ▣ Political and economic factors
- ▣ Agricultural resources being diverted to feed livestock and poultry rather than people
 - Feed less people
 - More land required per calorie consumed
 - Grain cost increased due to competition

The Green Revolution

- ▣ New management techniques and mechanization as well as the triad of fertilization, irrigation, and improved crop varieties. This has increased food production dramatically.

Energy Subsidy – the energy that goes in to the energy you get out

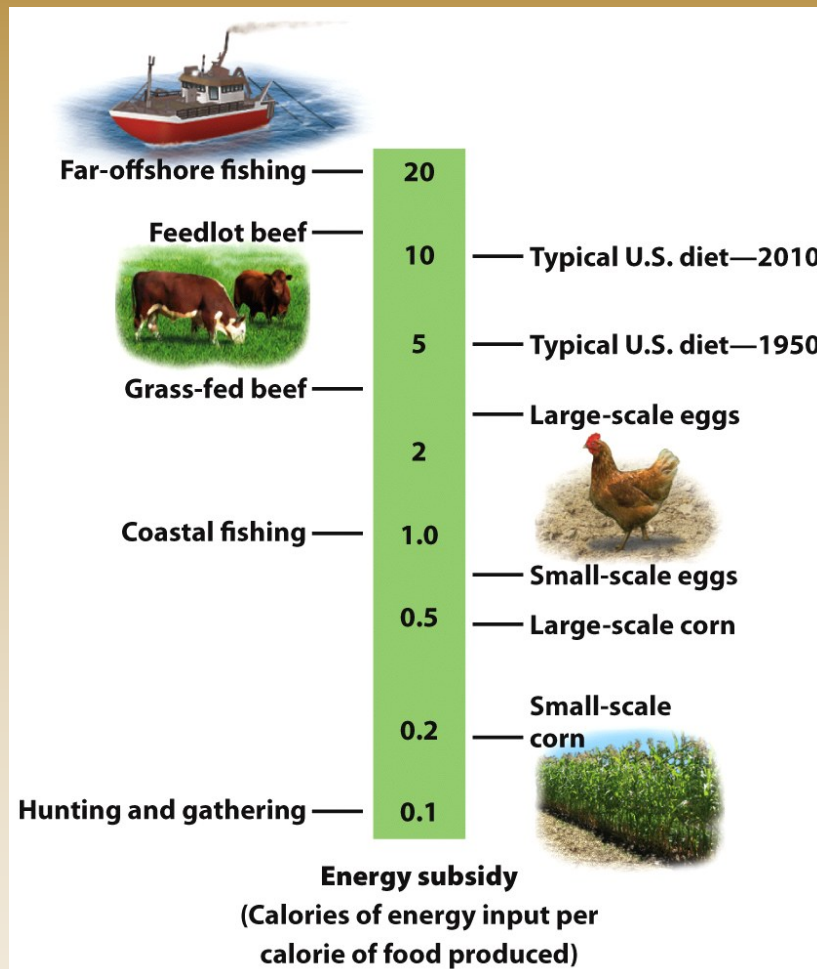


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Avg US Diet: 10 calories in for every 1 calorie you eat

...most is in the form of fossil fuels.

Mechanized Farming

- ▣ Economic advantage
 - if fuel prices are low...
 - ...if labor costs are high...
- ▣ Advantages of economies of scale.
- ▣ Grow crops like beans, wheat, corn that are more economically harvested by machine.

Irrigation



Irrigation Problems

- ❑ Waterlogging- saturated soil, impairs root growth because the roots cannot get oxygen.
- ❑ Salinization- when the small amounts of salts in irrigation water become highly concentrated on the soil surface through evaporation.
- ❑ Evaporation – loss of water
- ❑ Run-off – loss of water, soil, nutrients
- ❑ Harvest – crops represent “virtual water” export.
- ❑ Depletion – “fossil water” is depleted faster than it can recharge.

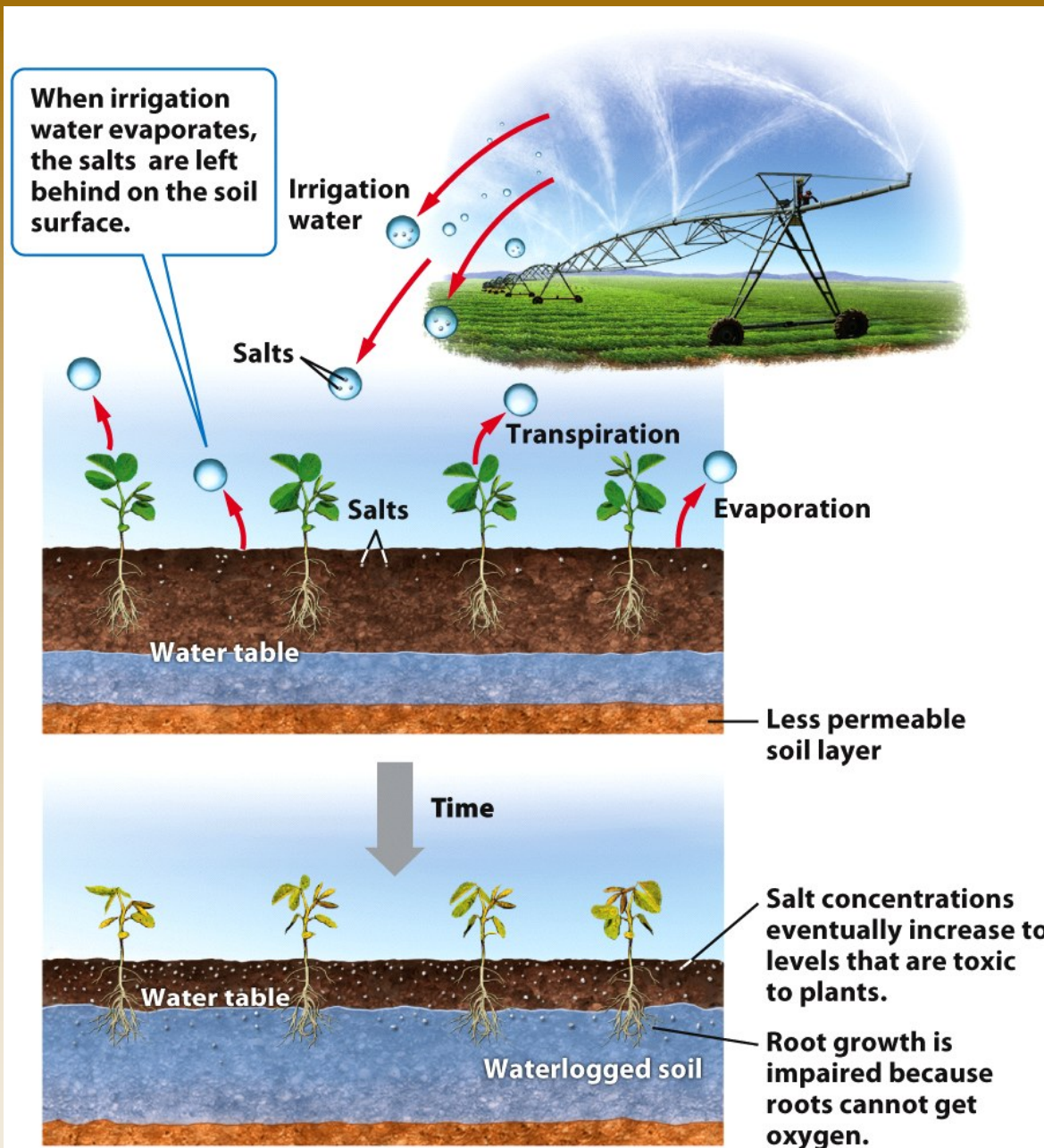


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Fertilizers

- ❑ Organic fertilizers- organic matter from plants and animals. Crop wastes and animal manure that have been allowed to decompose.
- ❑ Inorganic fertilizers (synthetic)- fertilizers that are produced commercially. This is usually done by combusting natural gas, which allows nitrogen from the atmosphere to be fixed and captured in fertilizer.



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Synthetic Fertilizers

Avantages? Disadvantages?



Synthetic Fertilizers

ADVANTAGES

- ▣ Ease of application
- ▣ Adjustable content
- ▣ Bioavailability of nutrients.
- ▣ High in N, P, K.
- ▣ Allow us to feed the world.

DISADVANTAGES

- ▣ Energy intensive production.
- ▣ Easily lost in runoff.
- ▣ Cause algae growth and eutrophication.
- ▣ Expensive and “addictive” use.

Monocropping

- ▣ Growing a large amount of a single species of plant.



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Monocropping

ADVANTAGES

- ▣ Nutrition and pesticide use is uniform.
- ▣ Large harvests or maximized yield.

DISADVANTAGES

- ▣ Exposure to erosion when planting.
- ▣ Soil loss = productivity loss.
- ▣ Pests target them.
- ▣ Loss of predator habitat.

Pesticides

- ▣ Pesticide- a substance that kills or controls organisms that people consider pests.
- ▣ Insecticide- target insects
- ▣ Herbicides- target plants

Pesticides

- ❑ Broad-spectrum pesticides- designed to kill many different types of pests.
- ❑ Selective pesticides- designed to kill a narrower range of organisms.



Pesticides

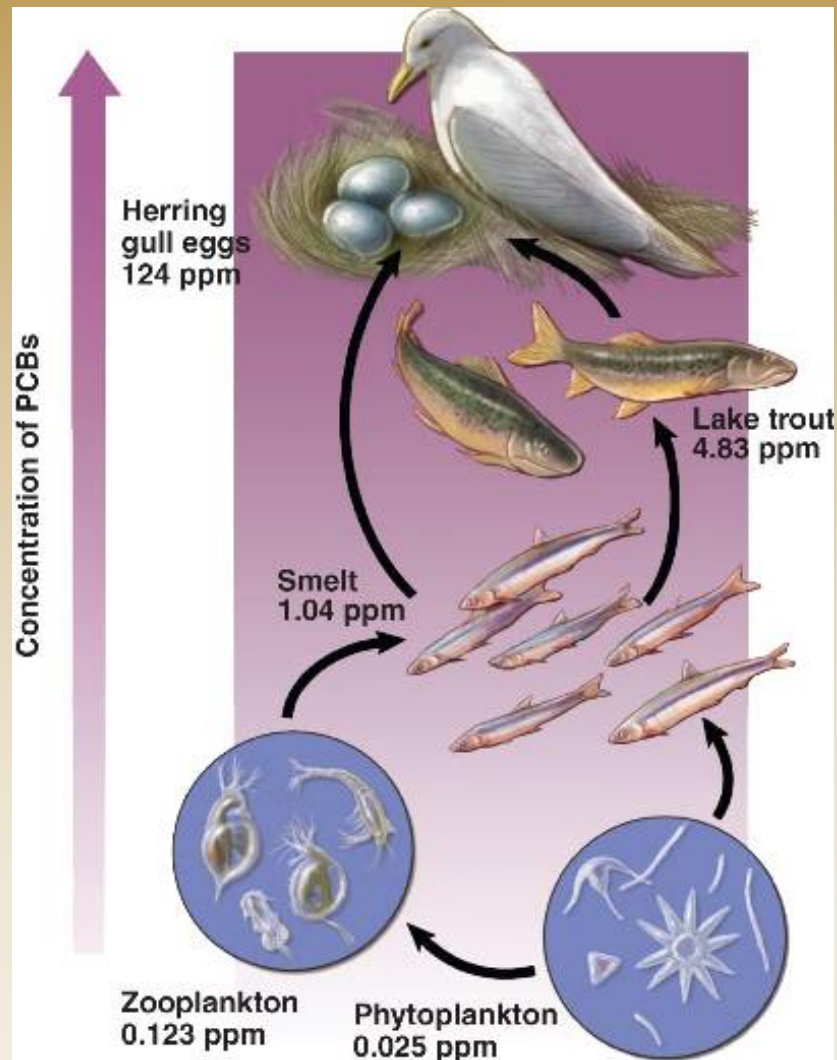
- ▣ Persistent- pesticides that remain in the environment a long time. May not degrade or biodegrade → need less; env effects
- ▣ Nonpersistent- pesticide that breaks down relatively rapidly, usually in weeks to months.

Pesticides

- ▣ Bioaccumulation- some pesticides are found to build up over time in the fatty tissues of predators.
 - ▣ An example was DDT.
 - ▣ Concentration in organism increases over time

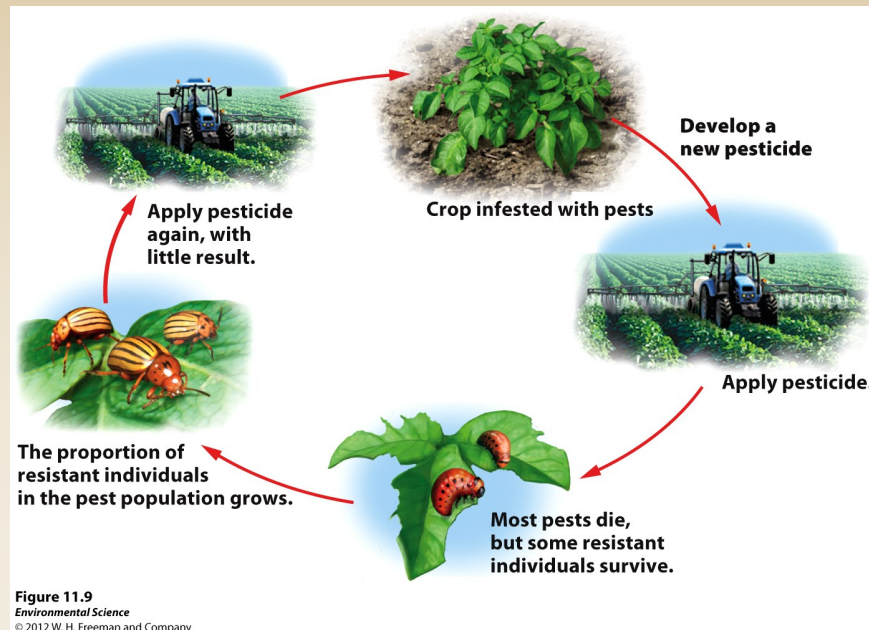
Biomagnification

concentration increases up the food chain.



Pesticides

- Resistance- pest populations may evolve resistance to a pesticide over time. Natural selection where the selective agent is the pesticide.
- Pesticide treadmill- the cycle of pesticide development followed by pest resistance, followed by development of a new pesticide.



Benefits of Genetic Engineering

- ▣ Greater yield
- ▣ Greater food quality
- ▣ Reductions in pesticide use
- ▣ Reduction of world hunger by increased food production
- ▣ Increased profits

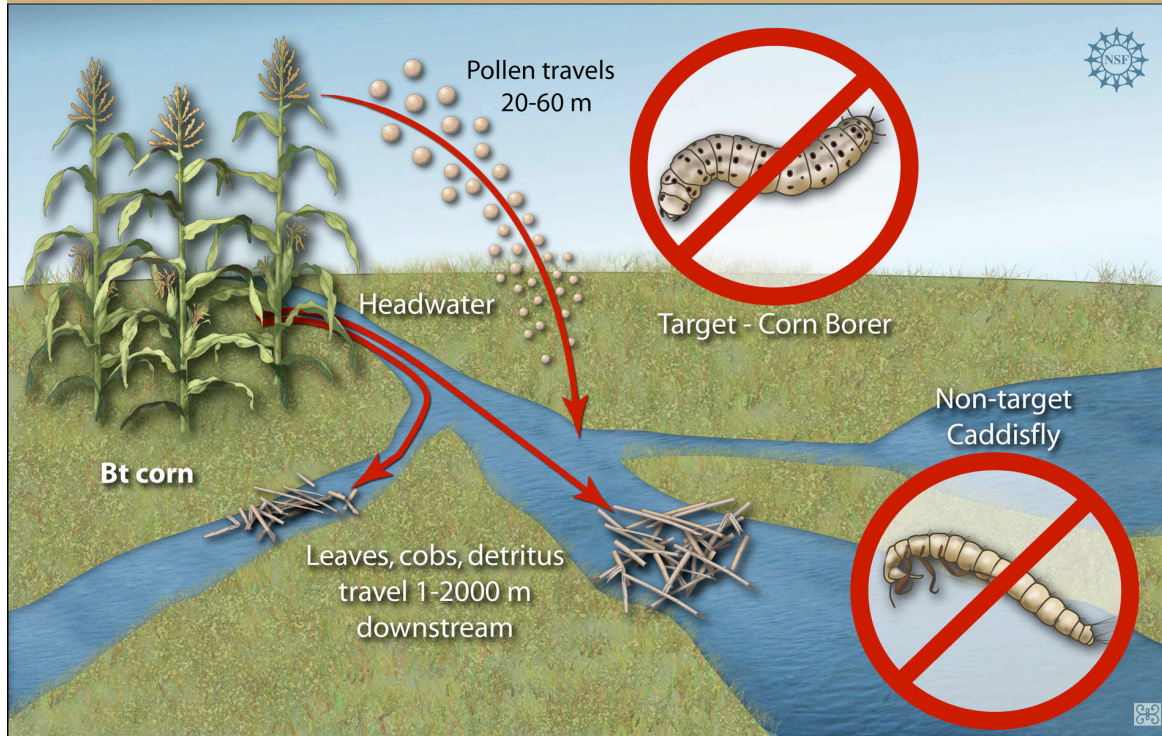
Gentically Engineered Golden Rice...figthing vitamin A deficiency



Concerns about Genetically Modified Organisms

- ▣ Safety for human consumption
- ▣ Effects on biodiversity
- ▣ Regulation of genetically modified organisms
- ▣ Could introduce unwanted or unexpected genes into the habitat.
- ▣ Ex: Bt corn – gene from bacterium works as a natural insecticide against larvae that eat the plant. Could it find its way into other plants?

GMO - Bt c



GMO CEREAL KILLER



Kellogg's total donation to NO on prop 37

\$790,000.00

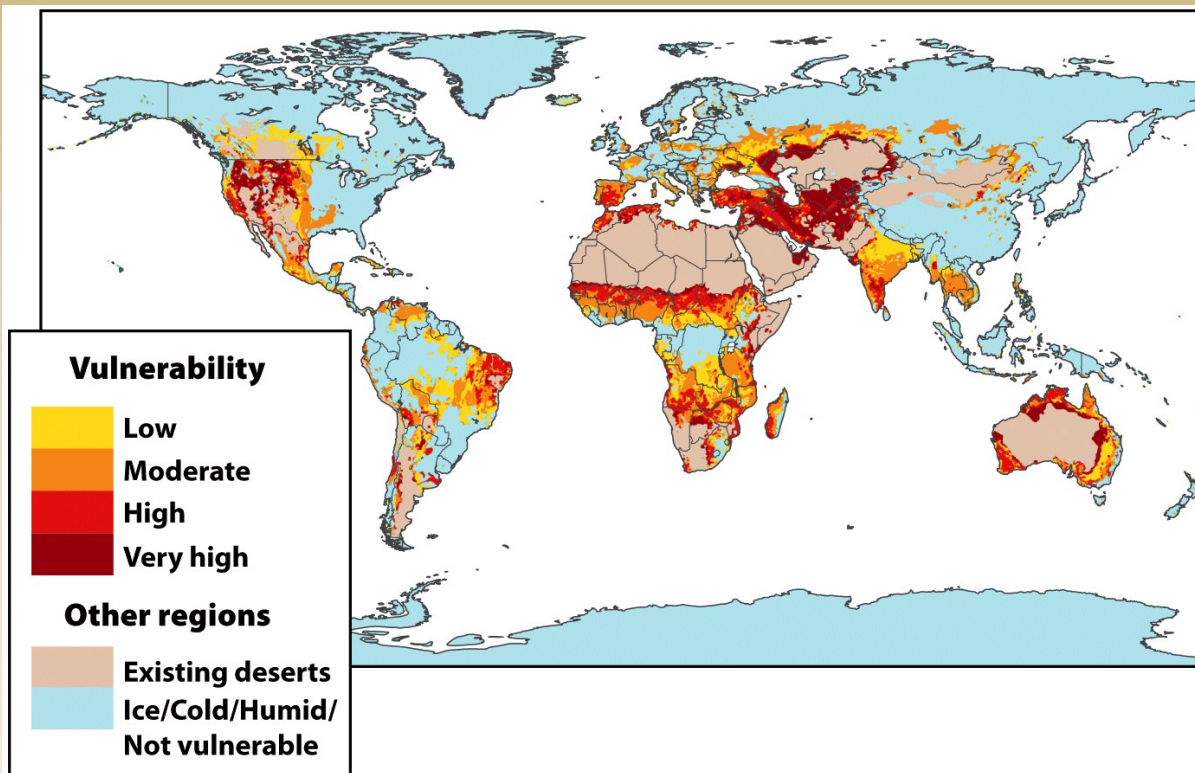
Boycott corporations that oppose GMO labeling

Farming Methods

- ▣ Conventional agriculture- industrial agriculture where labor is reduced and machinery is used.
- ▣ Traditional farming- still used in the developing world where human labor is used and not machinery.
- ▣ Shifting agriculture- used in areas with nutrient poor soils. It involves planting an area for a few years until the land is depleted of nutrients and then moving to another area and repeating the process.
- ▣ Nomadic grazing- moving herds of animals to find productive feeding grounds.

Desertification

- ▣ Desertification- When soil is degraded by agriculture to the point at which they are no longer productive.



What areas are most vulnerable?

Sustainable Agriculture

- ▣ Sustainable agriculture- producing enough food to feed the world's population without destroying the land, polluting the environment, or reducing biodiversity.
 - ▣ Intercropping- two or more crop species are planted in the same field at the same time.
 - ▣ Crop rotation- rotating crops species from season to season.
 - ▣ Agroforestry- intercropping trees with vegetables.
 - ▣ Contour plowing- plowing and harvesting parallel to the land to prevent erosion.



Intercropping

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Contour plowing

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Agroforestry

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No-till Agriculture

- ▣ No-till agriculture- helps to stop soil degradation by leaving crop residues in the fields and not tilling the land after each harvest.



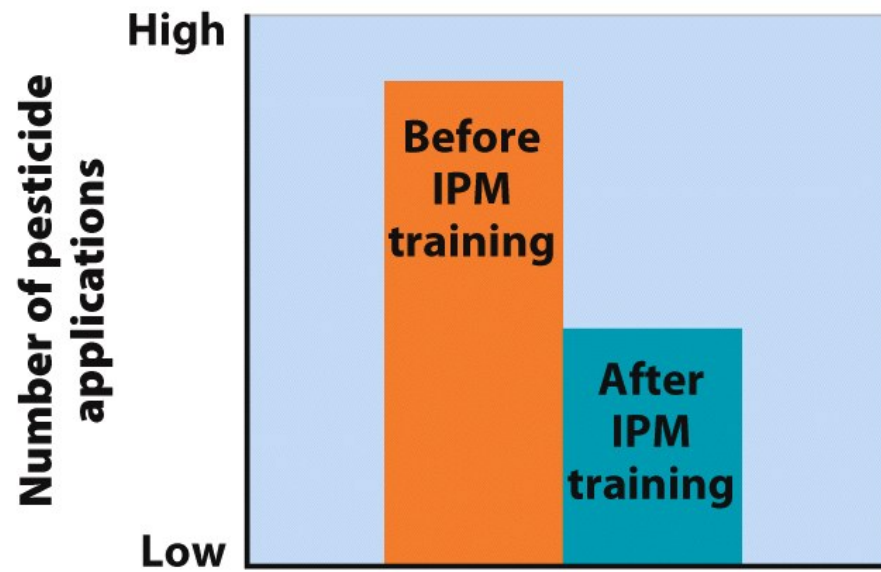
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Integrated Pest Management

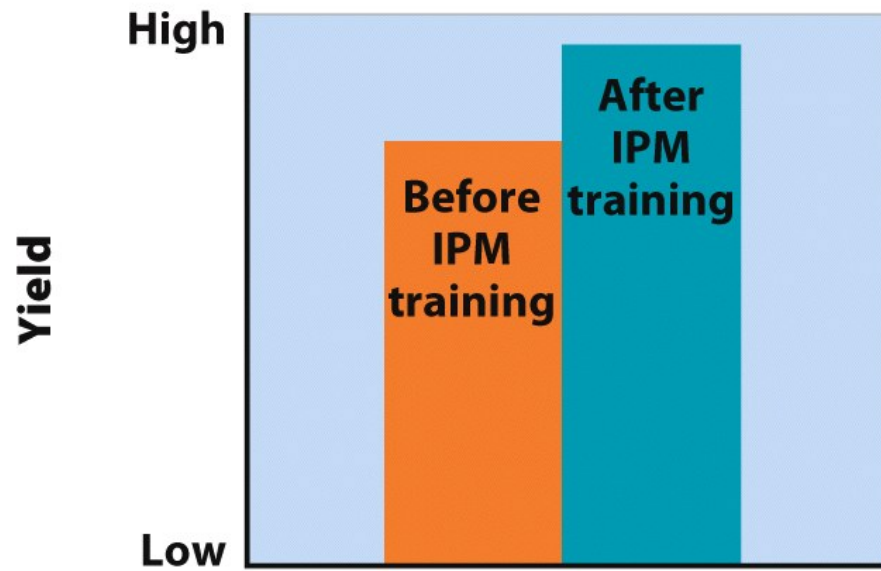
- ▣ Integrated pest management- using a variety of techniques designed to minimize pesticide inputs.
 - ▣ Crop rotation
 - ▣ Intercropping
 - ▣ Planting pest resistant crop varieties
 - ▣ Creating habitats for predators
 - ▣ Limited use of pesticides

Integrated Pest Mgmt.





(a) Pesticide use



(b) Harvest

Organic Agriculture

- ▣ Organic agriculture- production of crops without the use of synthetic pesticides or fertilizers.



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High-Density Animal Farming

- ▣ CAFOs (concentrated animal feeding operations)- large structures where animals are being raised in high density numbers.



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CAFOs

Pros	Env impact
Economical	Lots of waste
Less land	Run-off of nutrients
	Run-off of sediments
	Antibiotic resistant microorganisms (E. coli)

Free-range

Pros	Env impact
Less spread of disease	More land needed
Less supplemental feeding	Overgrazing leads to poor soils
Less fossil fuel use	Still some run-off
Natural decomposition of manure	

Free-range livestock



More land, but land that can't be used for agriculture...

Harvesting of Fish and Shellfish

- ❑ Fishery- a commercially harvestable population of fish within a particular ecological region.
- ❑ Fishery collapse- the decline of a fish population by 90% or more.
- ❑ Bycatch- unintentional catch of non-target species.

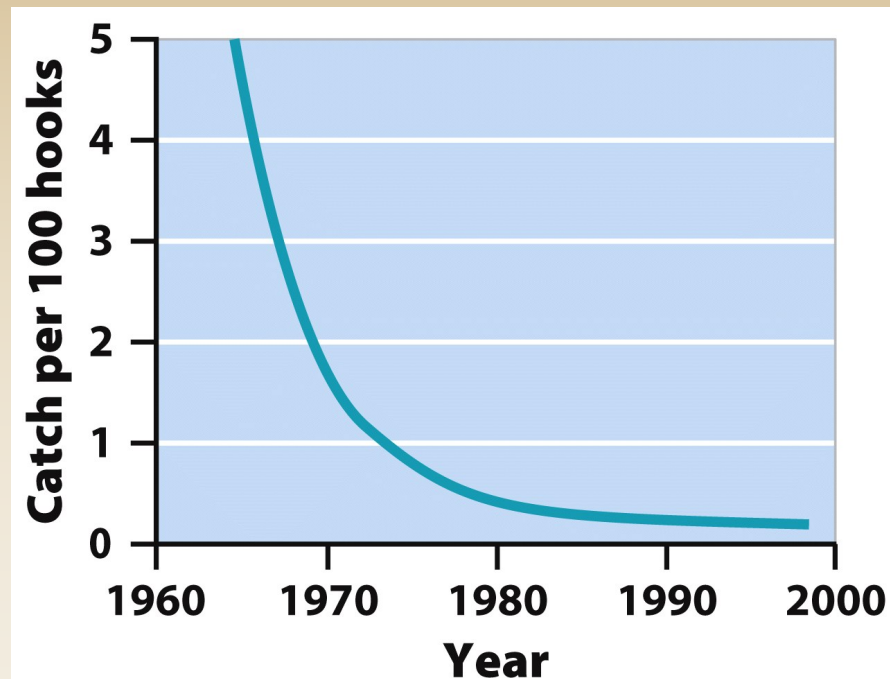


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Fishing and Fisheries

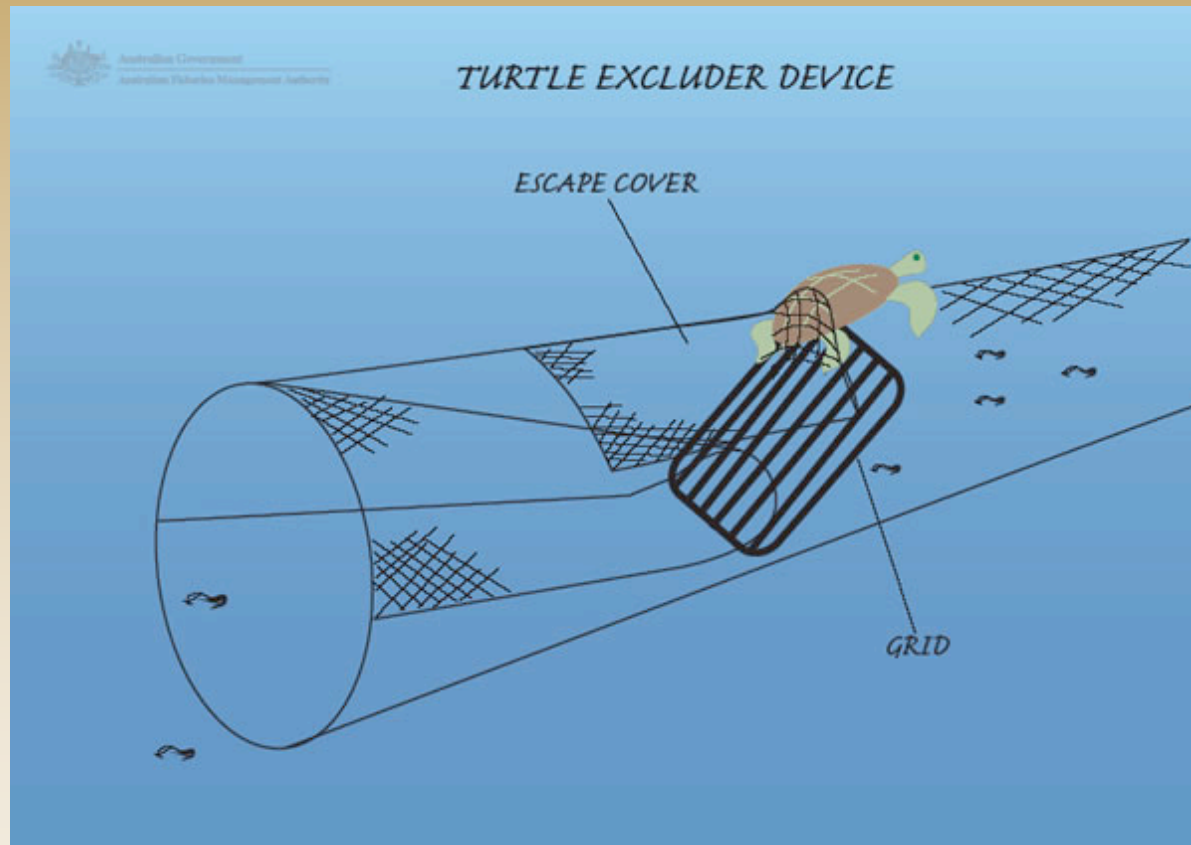
FACTORY FISHING

BYCATCH



Solving problem of Bycatch

- ▣ TED = Turtle Exclusion Device



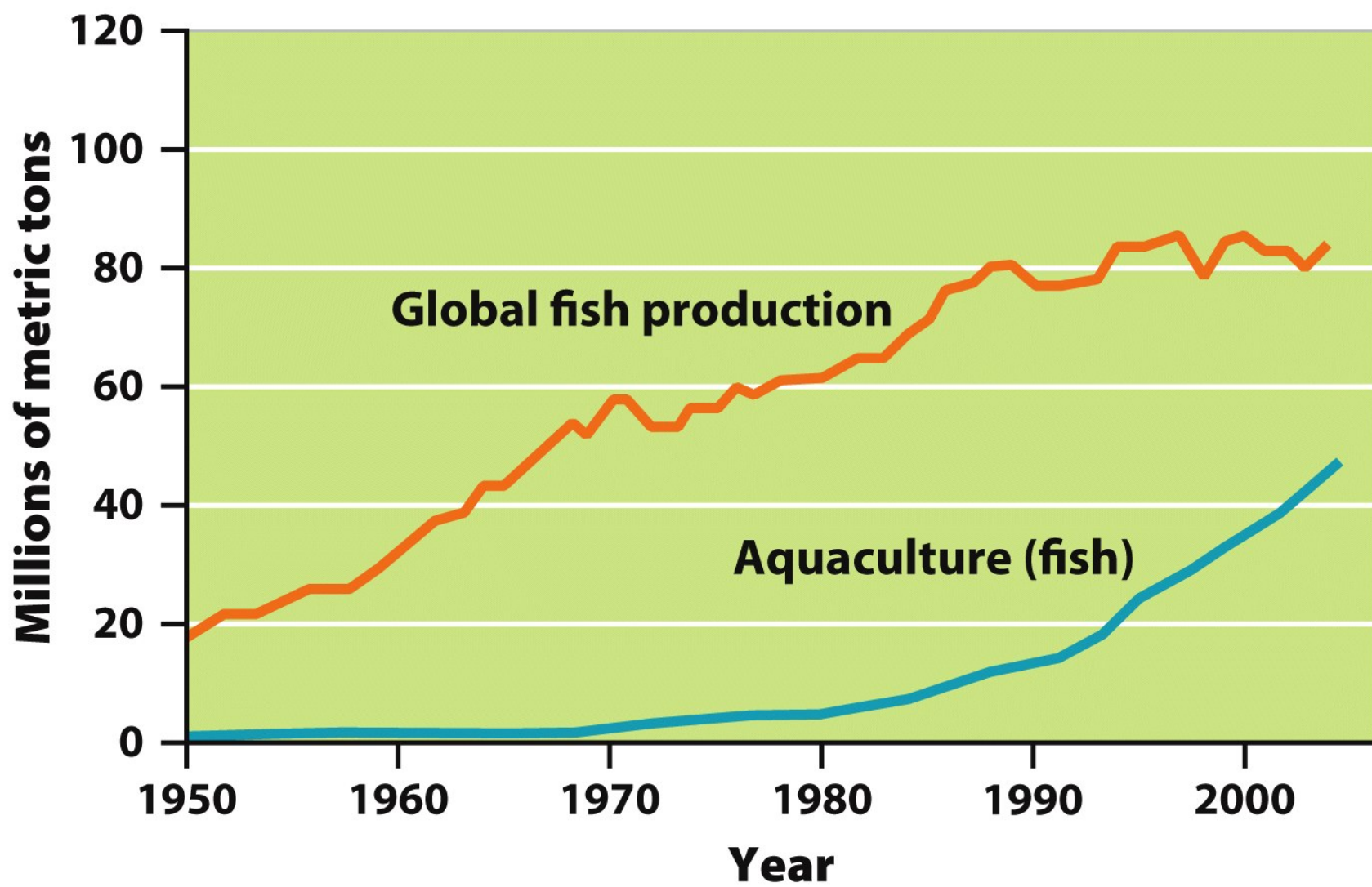


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Sustainable Fishing

1973 Individual Transferable Quotas

- ▣ Favor those with long history in fishery
- ▣ Secure rights to catch quotas
- ▣ Can sell your quota rights to others at market prices if you choose.

- ▣ With less competition, no need to have bigger boats and more hours

Sustainable Fishing

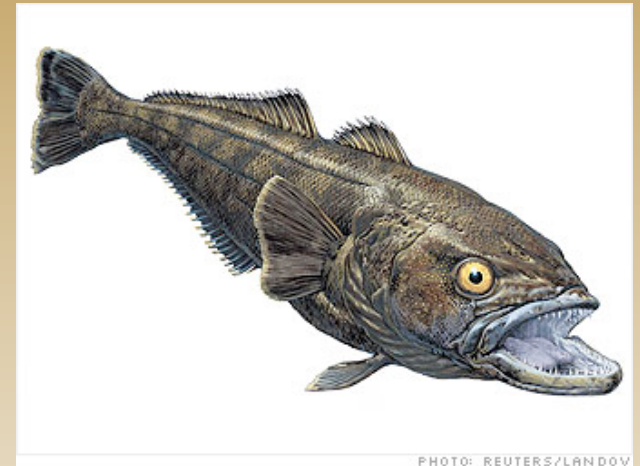
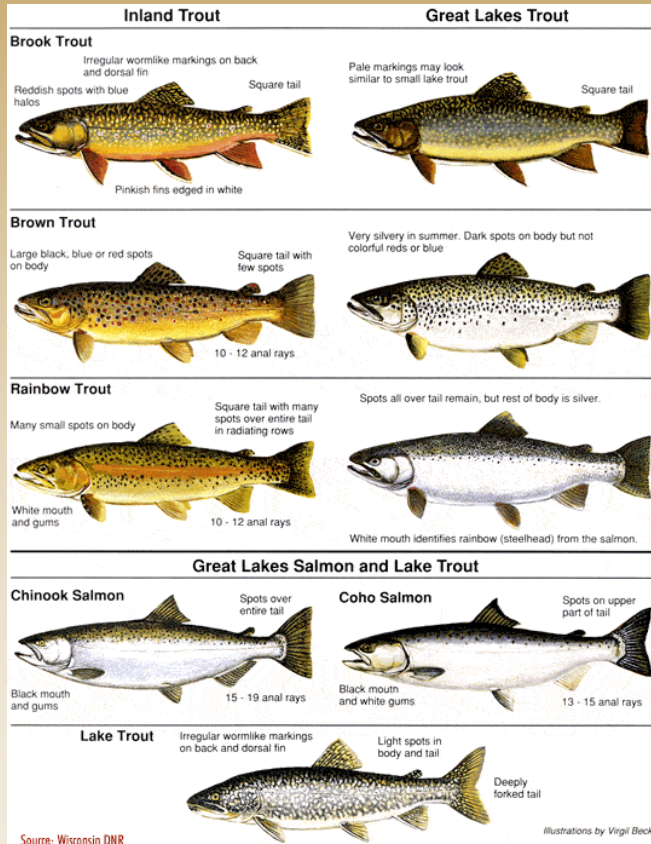
1996 Sustainable fisheries Act

- ▣ Shift focus from economic sustainability to species conservation sustainability.
- ▣ Protect critical marine habitat for target and non-target species.
- ▣ “No-fishing” periods to allow fish pops to recover.

Env. Defense Fund's Choices

BEST CHOICE – SALMON & FARM TROUT

WORST CHOICE – CHILEAN SEA BASS & SHARK



Aquaculture

- ▣ Aquaculture- the farming of aquatic organisms such as fish, shellfish, and seaweeds.

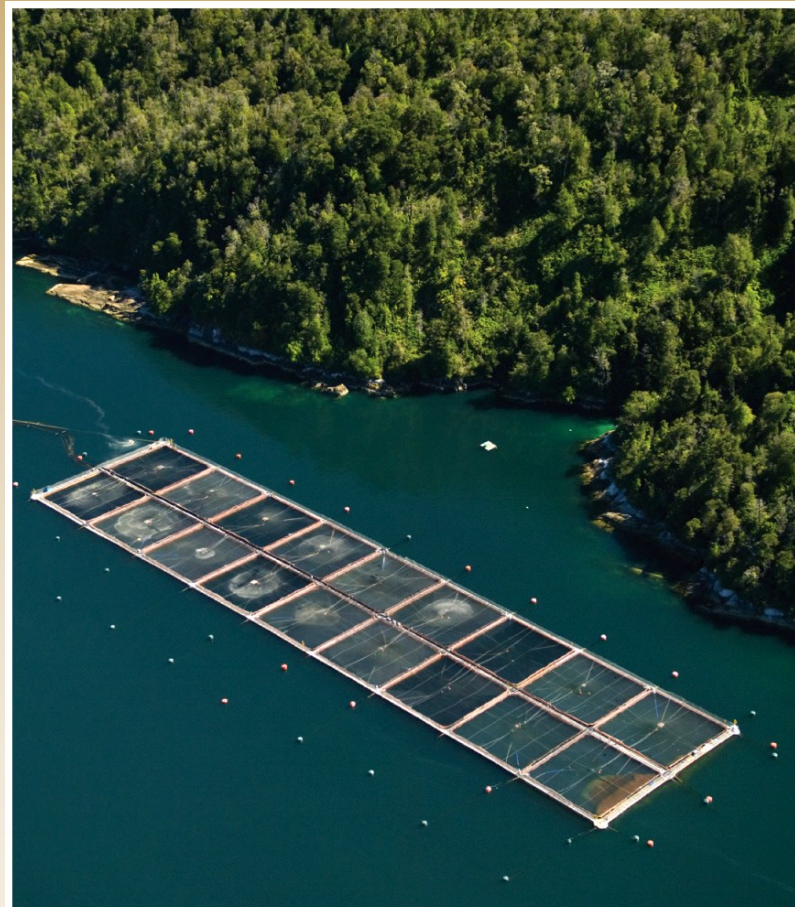


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Aquaculture

PROS

- ▣ Reduce pressure on overexploited fisheries.
- ▣ Protein for 1 billion people.
- ▣ Boost economies of developing nations.

CONS

- ▣ Pollution due to concentrated wastes.
- ▣ Disease due to concentrated pathogens and parasites.
- ▣ Escape of domestic species...may hybridize with native species.

Perennials vs. Annuals

- ▣ Developing food crops from perennials, so they don't need to be planted every year.
- ▣ Selective breeding programs
- ▣ Ex: Wheatgrass...looking to produce larger and more numerous seeds...hardier plants...deeper roots...etc.



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Organic Foods Defined

CRITERIA	ORGANIC
Prohibition of toxic pesticides	✓
No GMOs	✓
No antibiotics	✓
No growth hormones	✓
Animal welfare requirements	✓
Lower levels of env. Pollution	✓
Audit trail from farm to table	✓
Maintenance or enhancement of water quality	✓
Healthy use and proper care of water, water resources and all life therein	✓
Low Density (<10kg/m ³ in saltwater)	✓
Legal restrictions on allowable materials	✓
Encourage use of local resources/services	✓

Does Natural mean Organic?

natural \neq organic

Everyday on-farm dairy practices



"NATURAL DAIRY"

CERTIFIED ORGANIC

Toxic synthetic pesticides, herbicides, fungicides or fertilizers?

ALLOWED

NEVER

Animals confined with no outdoor access?

ALLOWED

NEVER

Animal feed may be grown with sewage sludge and genetically modified organisms (GMOs), containing rendered animal by products?

ALLOWED

NEVER

Antibiotics used to compensate for an unhealthy diet and stress?

ALLOWED

NEVER

Animals injected with growth and breeding hormones?

ALLOWED

NEVER

Ever-increasing amounts of soil damaging synthetic nitrogen fertilizer and pesticides used to make food grow?

ALLOWED

NEVER