



Overview of Chapter 18

- World Food Security
- Food Production
- Challenges of Producing More Crops and Livestock
- Environmental Impacts of Agriculture
- Solutions to Agricultural Problems
- Fisheries of the World

Urban agriculture

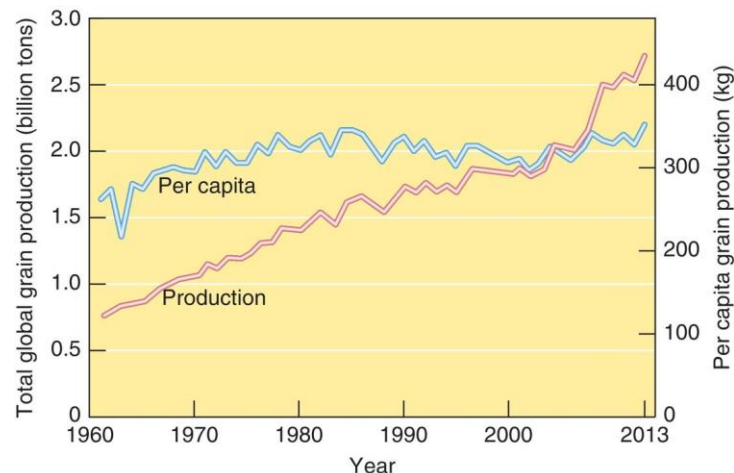
- Increases food availability for urban communities
- Does not require large swaths of land
- Rooftop gardens
 - ▣ Helps clean water, reduce flooding, runoff
 - ▣ Work experience
 - ▣ Connection to where food comes from



Nancy Gift

World Food Security

- Feeding growing population is difficult
- Annual grain production (below) has increased from 1961–2008
- Due to increase in population, amount of grain per person has not increased



FAO and other UN data

World Food Security

- Food insecurity
 - ▣ State of living in fear of going hungry
 - ▣ 49 million in U.S.
- 182 million children under age 5 underweight worldwide
 - ▣ Malnourished – not receiving specific essential nutrients
- Overeating on poor nutritional food becoming widespread problem

World Food Security

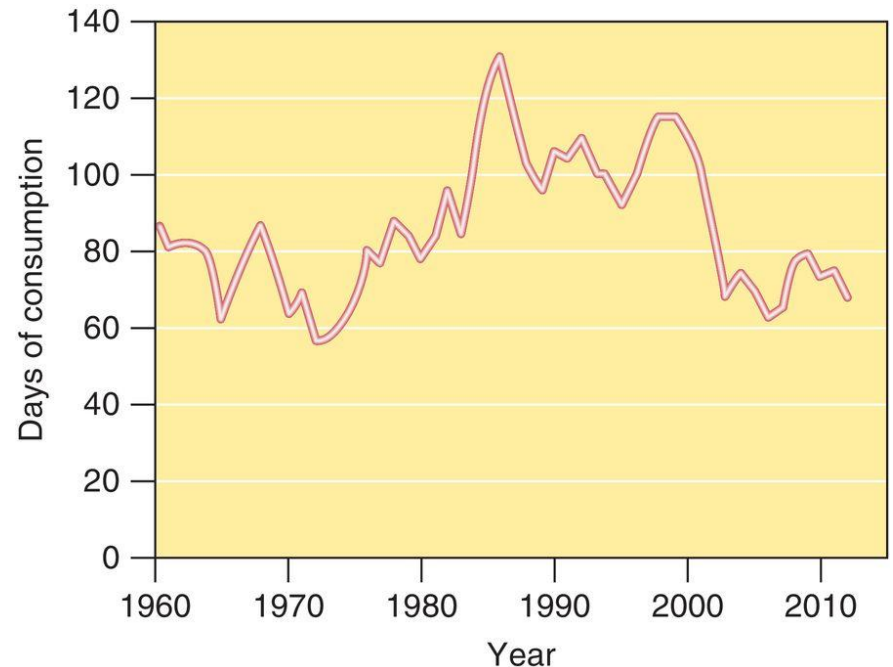
- Famine
 - ▣ Temporary, but severe shortage of food
 - ▣ Natural event such as drought, flood, accompanied by political instability
 - ▣ Developing nations of Africa, Asia and Latin America are most at risk
 - ▣ More people die from starvation than famine

World Food Security

- Maintaining Grain Stocks
 - ▣ Amounts of rice, wheat, corn and other grains remaining from previous harvest
 - ▣ Provides measure of food security
 - ▣ Decreased each year since mid 1980's
 - ▣ In 2010, UN estimated that carryover stock would last 72 days

Decline in Grain Stock

- Rising temps
- Falling water tables and droughts
- Ethanol production
- More grain is going towards feeding livestock
- Increased meat consumption in developing countries



USDA data from Earth Policy Institute

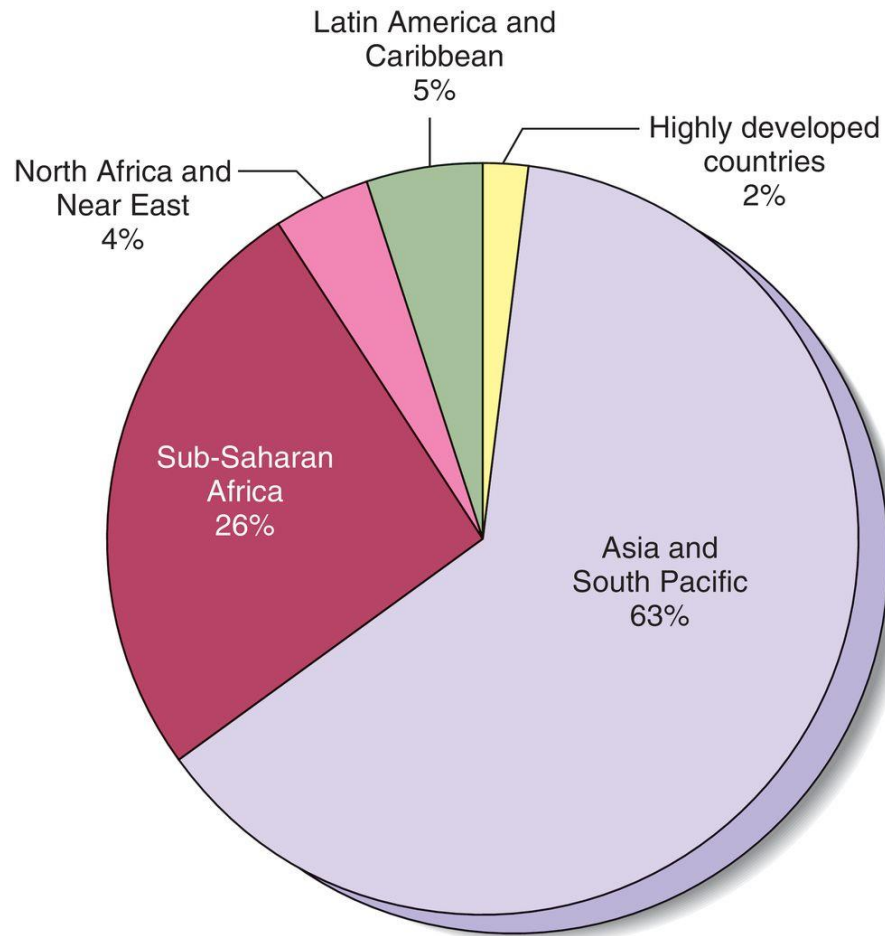
World Food Security

- Economics and Politics
 - ▣ Cost money to store, produce, transport and distribute food
 - ▣ Getting food to those who need it is political
- Globalization – process of people becoming increasingly linked through economics, communication, transportation, governance, culture

World Food Security

- Poverty and Food
 - ▣ 1.3 billion people are so poor they cannot afford proper nutrition
- Food insecurity
 - ▣ State of fear of not being able to acquire sufficient food
 - ▣ More common in
 - Rural than urban areas
 - Infants, children, and the elderly

Undernourished people



Adapted from "The Growing Problem," in the food section of Nature, Vol. 466 [July 29, 2010].

Food Production

Table 18.1 The 15 Most Important Food Crops in Terms of Production

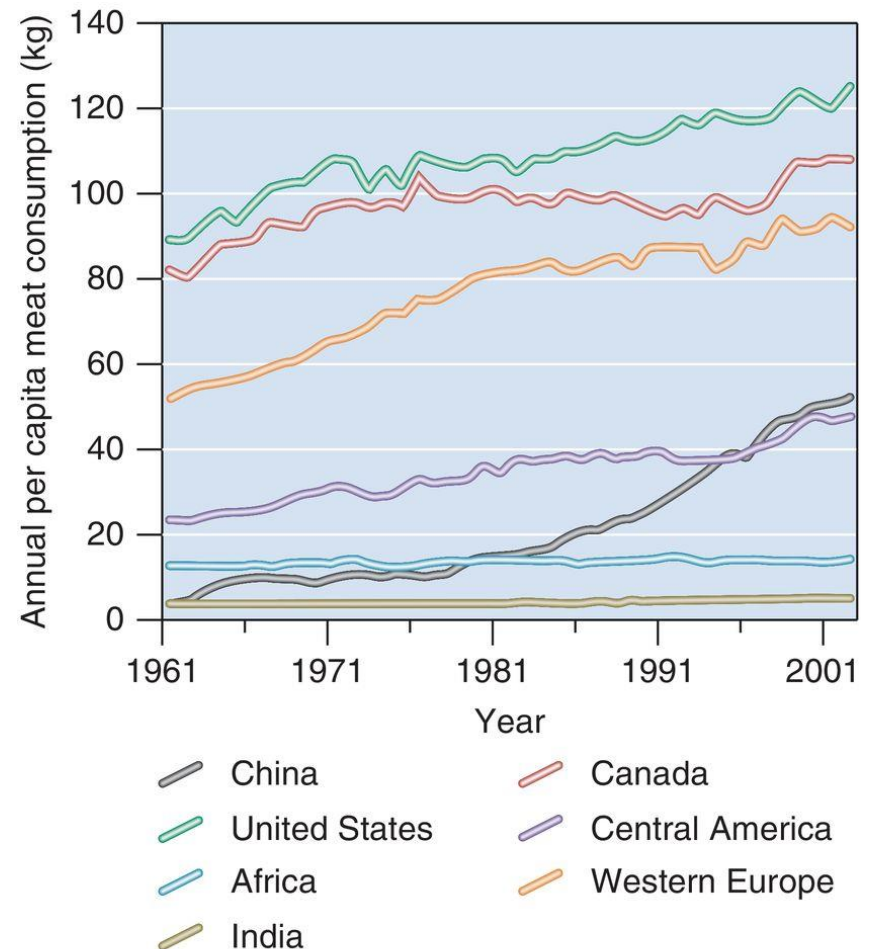
<i>Plant Crop</i>	<i>Type of Crop</i>	<i>2012 World Production*</i> (1000 tons)
Sugar cane	Sugar plant (stem)	2,020,031
Corn (maize)	Cereal grain	961,289
Rice, paddy	Cereal grain	793,376
Wheat	Cereal grain	739,513
Potatoes	Ground crop (tuber)	402,133
Sugar beet	Sugar plant (root)	297,476
Cassava	Ground crop (root)	289,451
Soybeans	Legume	266,585
Tomatoes	Fruit (annual herb)	178,347
Barley	Cereal grain	146,482
Watermelons	Fruit (vine)	116,153
Sweet potatoes	Ground crop (root)	113,698
Bananas	Fruit (tree)	112,428
Onions, dry	Ground crop (root)	91,328
Apples	Fruit (tree)	84,193

*Based on the 20 highest-producing countries for a specific agricultural commodity.

Source: World production data from FAO.

Animals as food

- Constitute 40% of the calories consumed in developed countries
- Only comprise 5% of calories consumed in developing countries

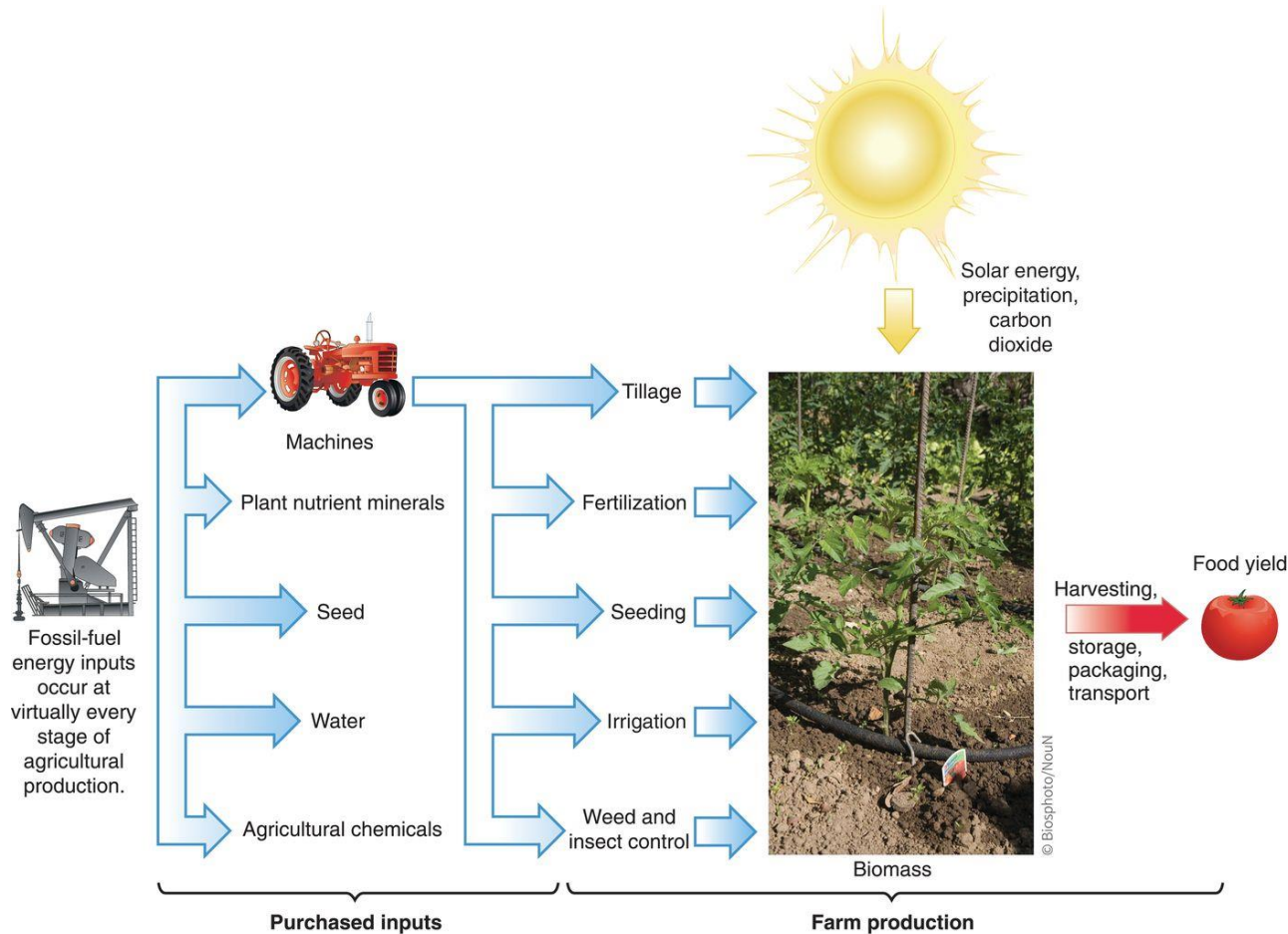


FAO, World Resources Institute

Principle Types of Agriculture

- Industrialized agriculture
 - ▣ Modern agriculture methods that require large capital input, and less land and labor
 - ▣ High input agriculture
- Subsistence Agriculture
 - ▣ Traditional agricultural methods, which are dependent on labor and large amounts of land
 - ▣ Shifting cultivation, Slash and burn agriculture, Nomadic herding, Intercropping

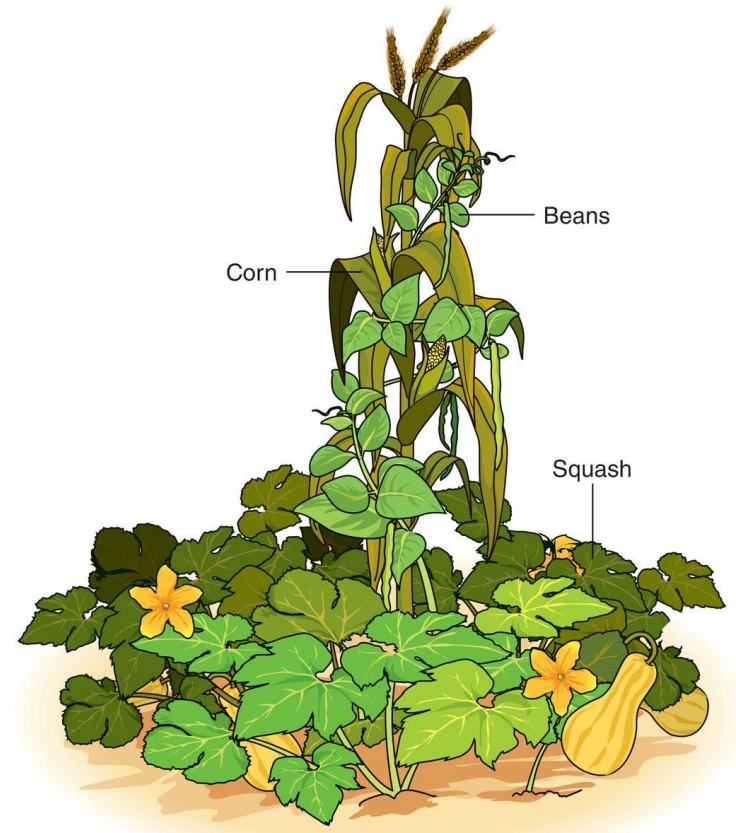
Energy Inputs in Industrialized Agriculture



Adapted from G.H. Heichel, "Agricultural Production and Energy Resources." *American Scientist*, Vol. 64 [January/February 1976]; photo from Biosphoto/NouN/Peter Arnold/Photolibrary.

Principle Types of Agriculture

- Renewing interest in subsistence or growing a lot of your own food
- Polyculture
 - ▣ Type of intercropping that grows plants together each maturing at different times



Three sisters

Challenges of Producing More Crops

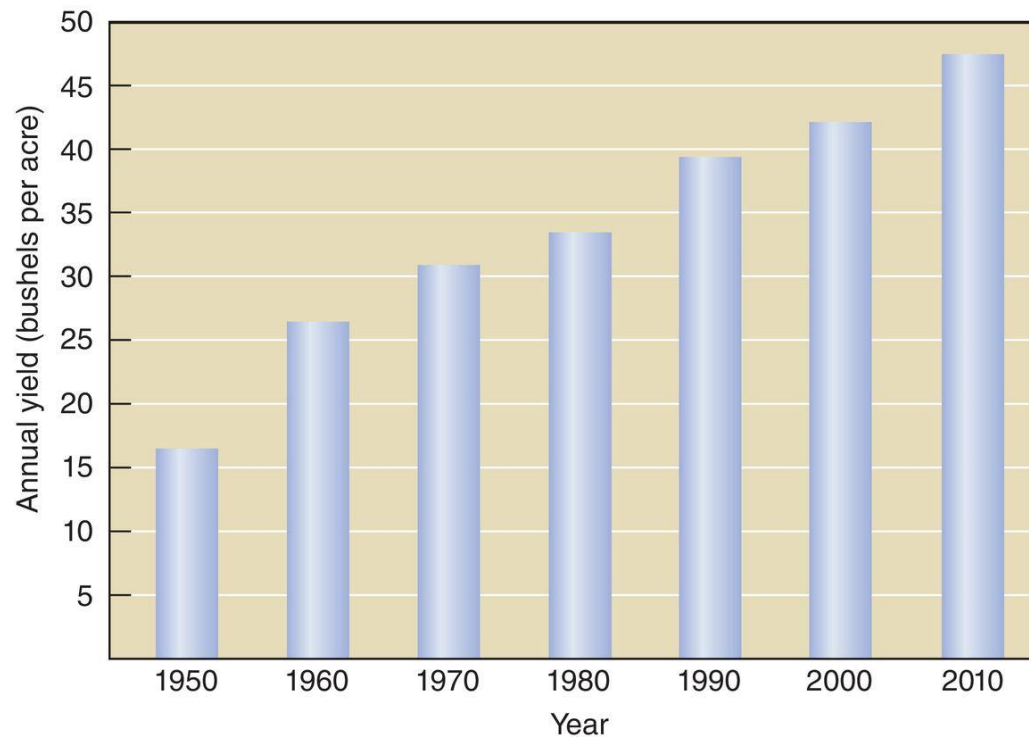
- Domestication and Genetic Diversity
 - ▣ Domestication of crops and livestock causes a loss of genetic diversity
 - ▣ Farmer selects and propagates animals with desirable agricultural characteristics



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Challenges of Producing More Crops

- Increasing Crop Yield
- Food production increased in developed countries
- Pesticides
- Selective breeding
- Green Revolution



USDA

Grow Appalachia

- Mountains primarily forested
- Coal main economy
- Big gap between wealthy and poor
- Project in 2009 to address food insecurity

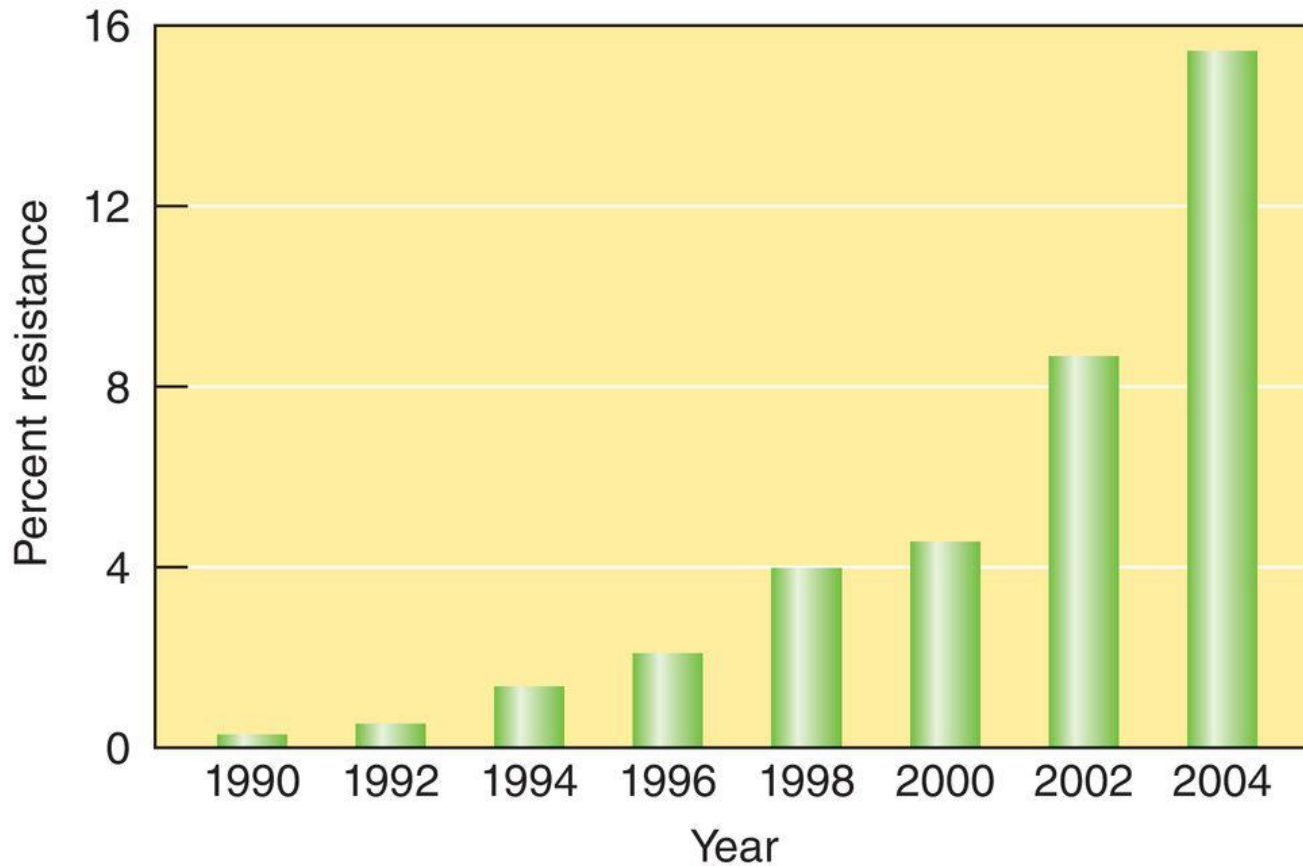


Courtesy Grow Appalachia

Challenges of Producing More Livestock

- Increasing Livestock Yields
 - ▣ Hormone supplements
 - US and Canada, not used in Europe
 - ▣ Antibiotics
 - 40% of antibiotics produced in US are used in livestock operations
 - Problems with increased bacteria resistance- some bacteria are resistant to every antibiotic known

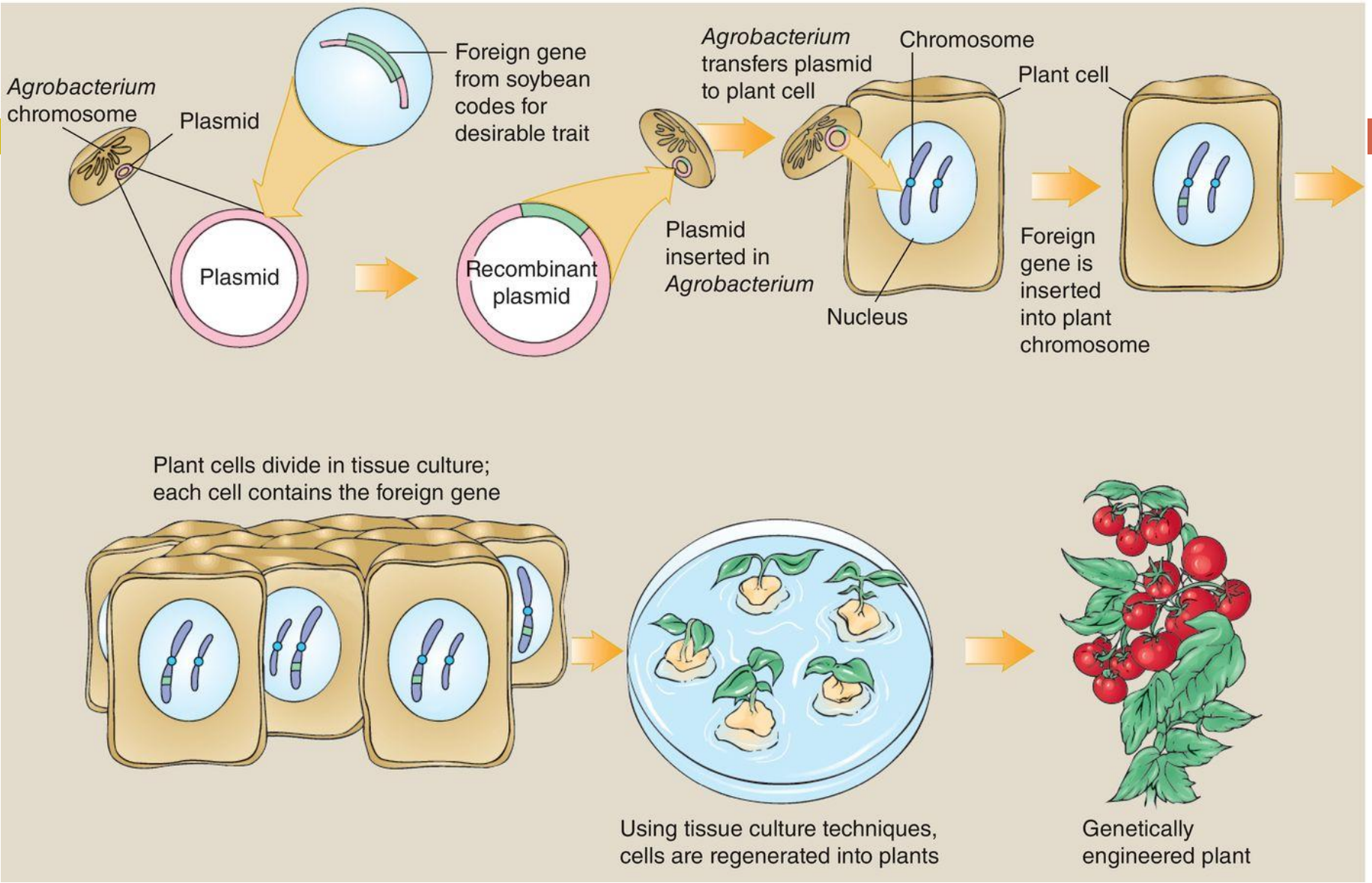
Antibiotic Use and Resistance



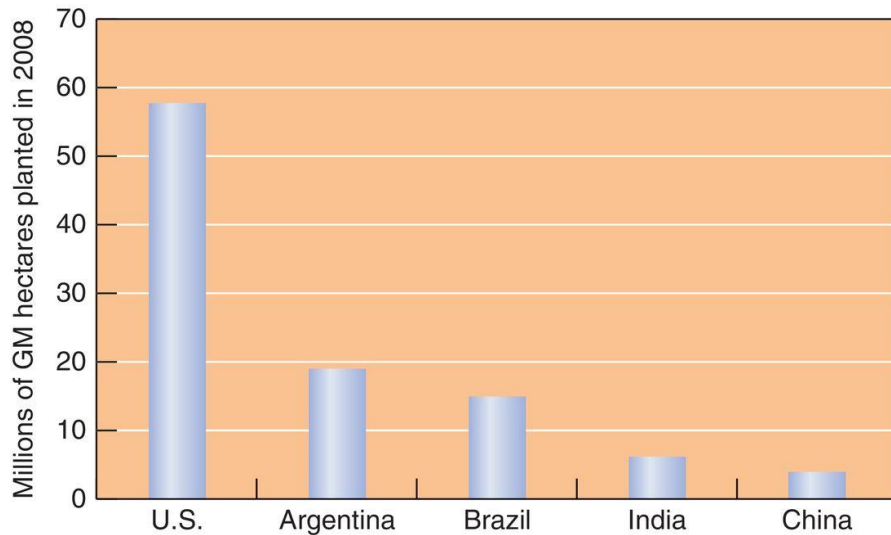
Data from D. Livermore, Health Protection Agency's Resistance Monitoring and Reference Laboratory, United Kingdom.

Genetic Engineering

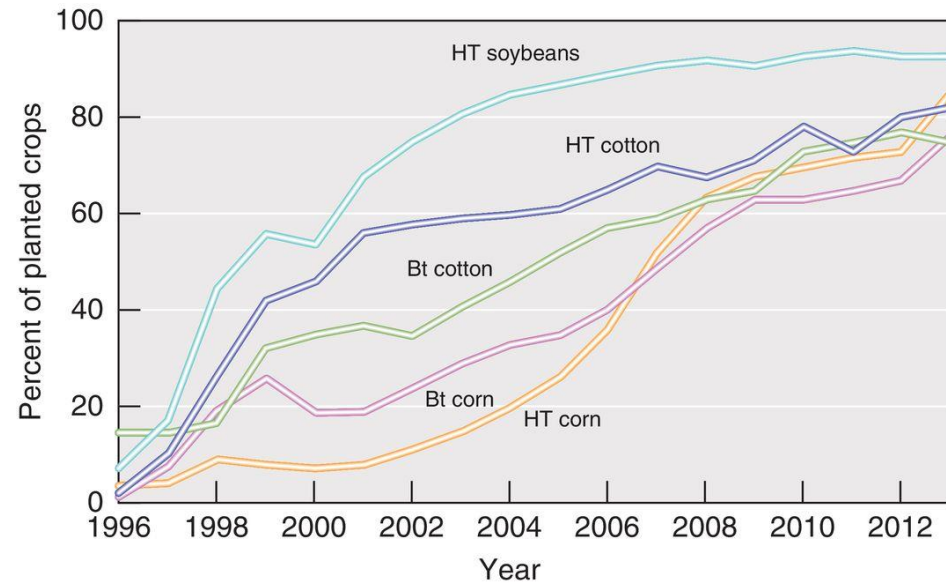
- Manipulation of genes by taking specific gene from a cell of one species and placing it into the cell of an unrelated species
- Used to produce Genetically Modified (GM) food
 - ▣ Ex: golden rice - rich in beta carotene (prevent Vitamin A deficiency in developing countries)
 - ▣ Plants that are tolerant to insect pests, heat, cold, drought, or acidic soils
 - ▣ More productive farm animals



GM foods in the U.S.



Data from WorldWatch Vital Signs 2010.



USDA, Economic Research Service

Safety of GM Foods

- Determined to be safe for human consumption
- Concerns about GMO seed or pollen spreading in wild
 - ▣ Currently does not appear to be an issue
 - ▣ Long term unknown
- European Union has approved on one GM crop (2014)
- GMOs are not currently labeled
 - ▣ FDA finds it would be counterproductive and expensive to label
 - ▣ Health risks uncertain (food allergies?)



Environmental Impacts of Agriculture



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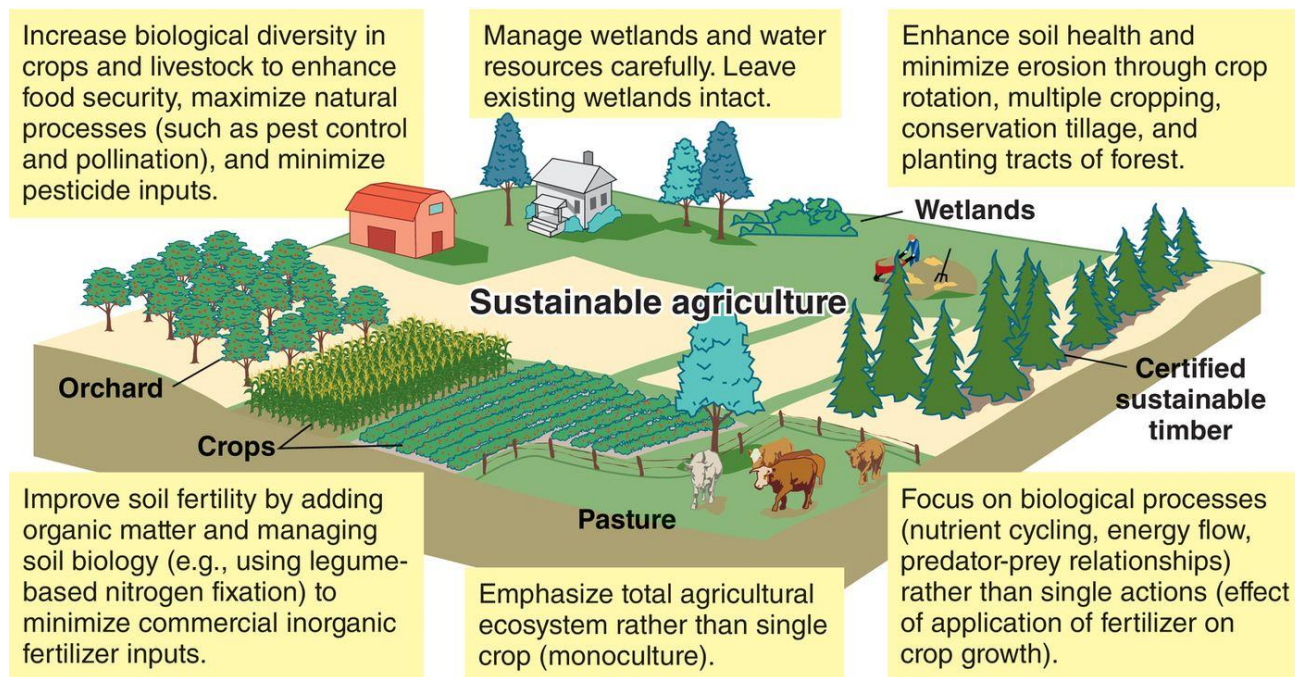


naturemania / Shutterstock

Water issues	Air pollution	Land degradation	Loss of biological diversity
<ul style="list-style-type: none"> • Groundwater depletion from irrigation • Pollution from fertilizer and pesticide runoff • Sediment pollution from eroding soil particles • Pollution from animal wastes (livestock factories) • Enrichment of surface water from fertilizer runoff and livestock wastes 	<ul style="list-style-type: none"> • Pesticide sprays • Soil particles from wind erosion • Odors from livestock factories • Greenhouse gases from combustion of fossil fuels • Other air pollutants from combustion of fossil fuels 	<ul style="list-style-type: none"> • Soil erosion • Loss of soil fertility • Soil salinization • Soil pollution (pesticide residues) • Waterlogged soil from improper irrigation 	<ul style="list-style-type: none"> • Habitat fragmentation (clearing land and draining wetlands) • Monocultures (lack of diversity in croplands) • Stressors from air and water pollution • Stressors from pesticides • Replacement of many traditional crop and livestock varieties with just a few

Solutions to Agricultural Problems- Sustainable Agriculture

- Agricultural methods that maintain soil productivity and a healthy ecological balance while having minimal long-term impacts

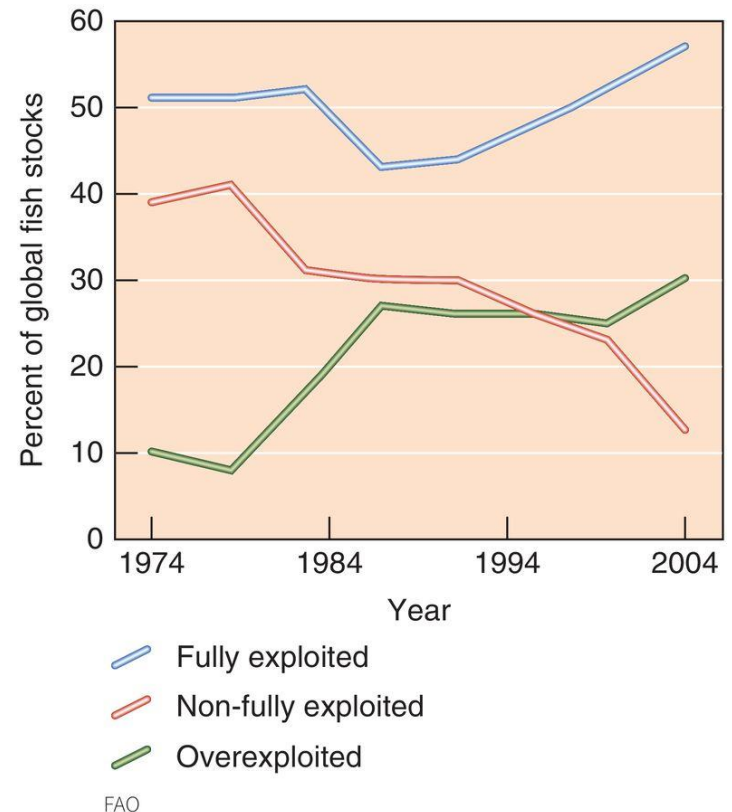


Sustainable Agriculture

- Examples:
 - ▣ Natural Predator-prey relationships instead of pesticides
 - ▣ Crop selection
 - ▣ Crop rotation and conservation tillage
 - ▣ Supplying nitrogen with legumes
 - ▣ Organic agriculture
- Integrated Pest Management (IPM)
 - ▣ Limited use of pesticides with sustainable agriculture practices

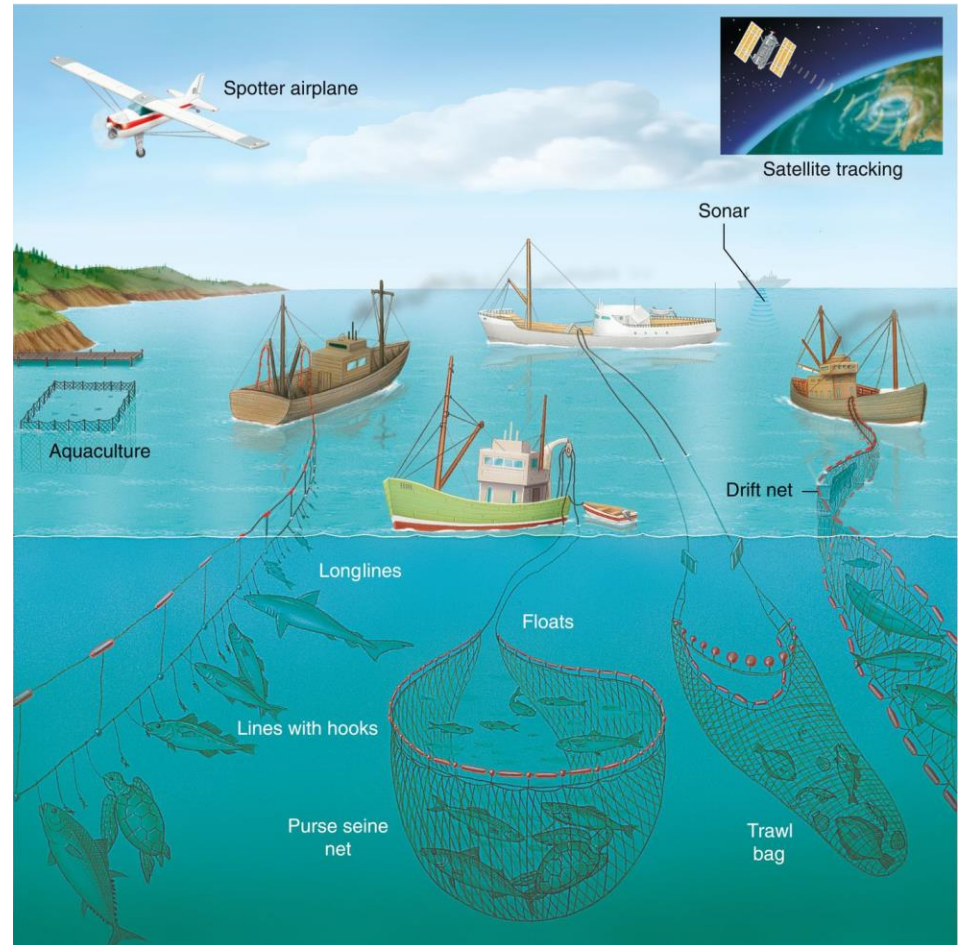
Fisheries of the World - Problems

- No nation lays claim to open ocean
 - ▣ Resource susceptible to overuse and degradation
- Overharvesting
 - ▣ Many species are at point of severe depletion
 - ▣ Declines of 90% of large predatory fish
 - ▣ ~30% of world's fish stock are overexploited



Fisheries of the World - Problems

- Overharvesting (continued)
 - ▣ Sophisticated fishing equipment
 - ▣ Bycatch killed off
 - ▣ Magnuson Fisheries Conservation Act

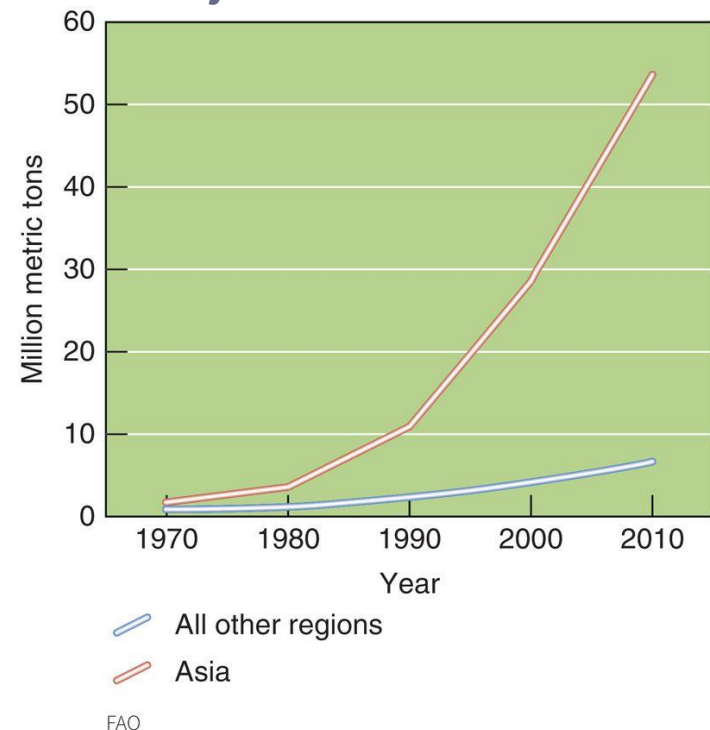


Fisheries of the World - Problems

- Ocean Pollution - dumping ground
 - ▣ Oil
 - ▣ Heavy metals
 - ▣ Deliberate litter dumping
 - ▣ Storm water runoff from cities and agricultural areas
- Aquaculture
 - ▣ Growing of aquatic organisms for human consumption
 - ▣ Great potential to supply food, huge industry

Fisheries of the World - Problems

- Aquaculture (continued)
 - ▣ Locations of fisheries may hurt natural habitats
 - ▣ Produce waste that pollutes adjacent water
 - ▣ Fish grown on antibiotics may escape and interbreed with wild populations
- Mariculture – cultivation of marine organisms



Fisheries of the World - Problems



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