

AP Environmental Science

Unit Five

I. Impacts of Population Growth

The Environment (Earth)

- Life has existed on earth for 3.8 billion years
- Earth well suited for life
 - Water covers $\frac{3}{4}$ of planet
 - Habitable temperature, moderate sunlight
 - Atmosphere provides oxygen and carbon dioxide
 - Soil provides essential minerals for plants

Human Impact on the Environment

- Humans are the most significant agent of environmental change
 - our ever expanding population is..
 - transforming natural habitats,
 - consuming increasing amounts of finite resources, like soil, water and breathable air
 - eradicating thousands of species

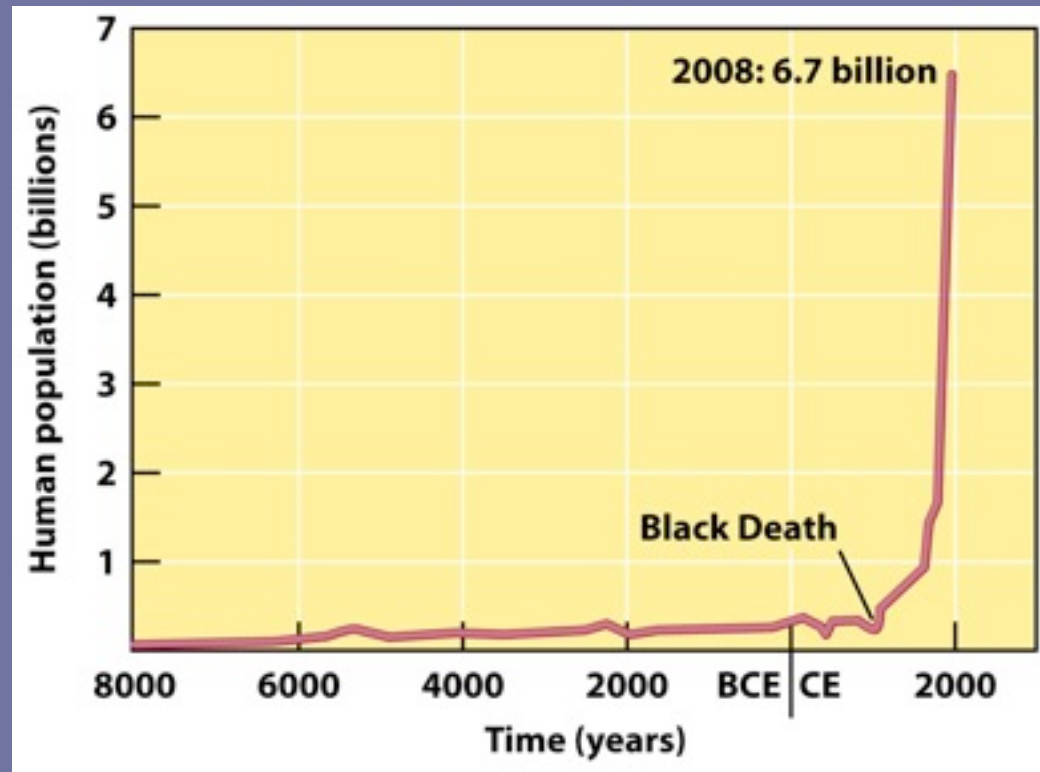
Human Impact on the Environment

- Satellite view of North America at night
 - The most important environmental problem...# of people



Human Impacts on Environment— Population

- Earth's Human Population is over 6 billion
 - Growing exponentially
- Expected to add several billion more people in 21st century
- The conditions of life worsen for many people



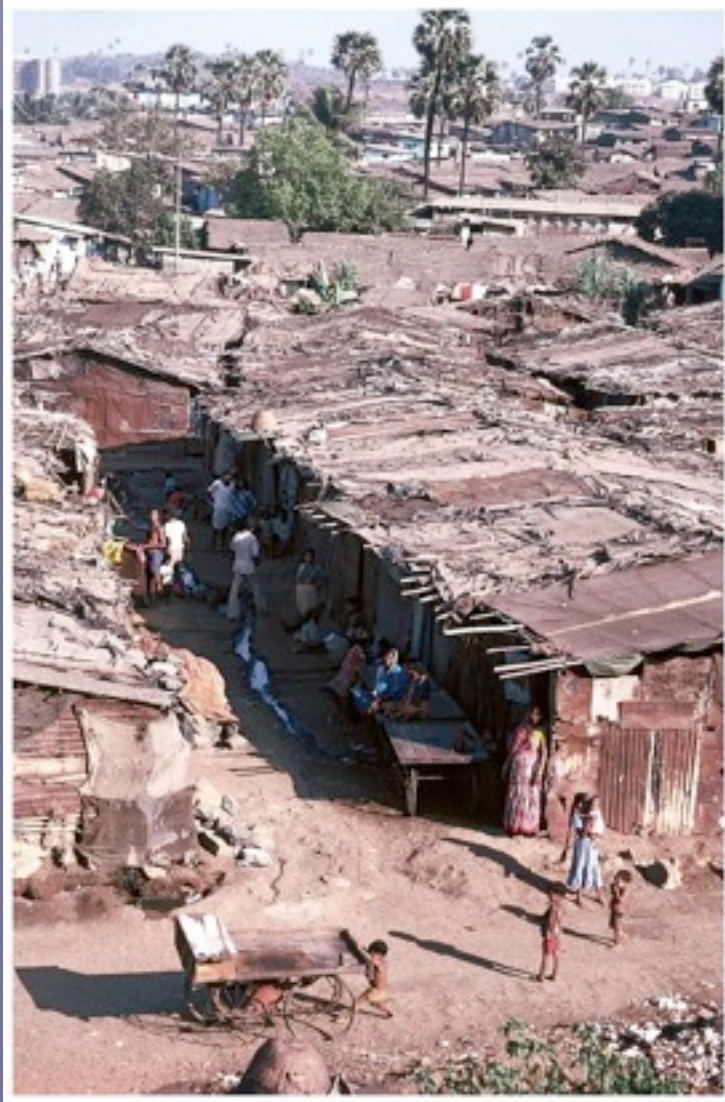
Population and Quality of Life

- Difficult to meet basic needs in developing countries
- Problems associated with overpopulation:
 - Environmental degradation
 - Hunger
 - Persistent poverty
 - Economic stagnation
 - Urban deterioration
 - Health issues



...environmental
degradation

Population



- Difficult to meet population needs without exploiting earth's resources
 - Cannot meet basic need for food, clothing, shelter, health

Types of Natural Resources

Nonrenewable Natural Resources

- **Metallic minerals (gold, tin)**
- **Nonmetallic minerals (salt, phosphates, stone)**
- **Fossil fuels (coal, oil, natural gas)**

Renewable Natural Resources

- **Direct solar energy**
- **Energy of winds, tides, flowing water**
- **Fertile soil**
- **Clean air**
- **Fresh water**
- **Biological diversity (forests, food crops, fishes)**

Overpopulation

- People overpopulation
 - Too many people in a given geographic area
 - Problem in many **developing nations**
 - Is the unifying problem in environmental issues
- Consumption overpopulation
 - Each individual in a population consumes too large a share of the resources
 - Problem in many highly **developed nations**

Consumption

- Developed Countries (20% of pop.)
 - a single child consumes more resources than 12 kids in underdeveloped nations
 - this 20% generates 75% of world's pollution and waste
 - this 20% consumes: 86% of aluminum, 76% of the timber, 68% of the energy, 61% of all meat, and 42% of the fresh water
 - (like U.S.) exploited resources to achieve its economic growth
 - now many developed nations must import resources for continued economic development

Natural Resource Consumption

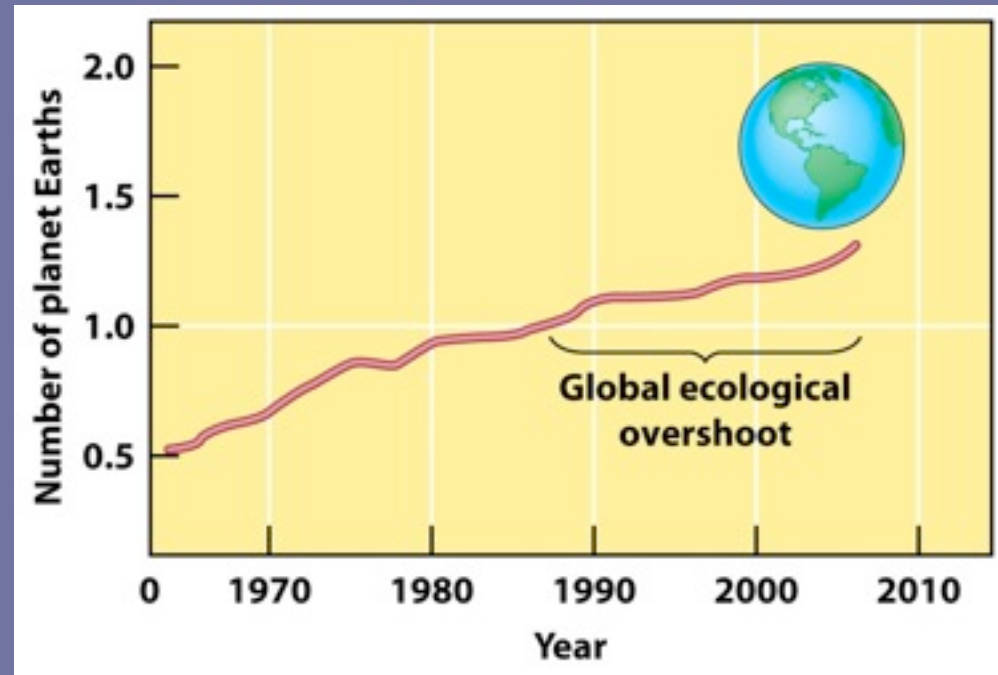
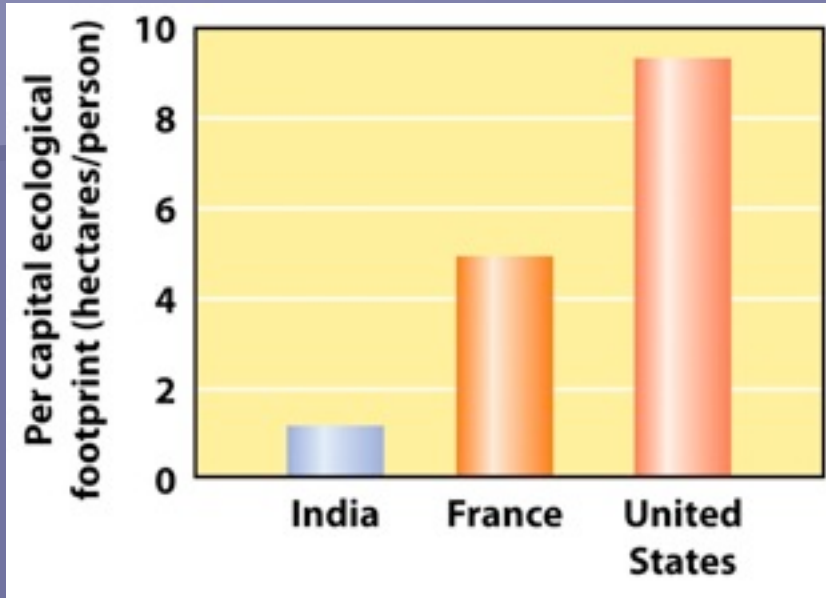
- Justification that views the value of the environment in its ability to provide individuals with economic benefits is a **utilitarian** viewpoint
- Resources can be exploited if for economic gain
- **Utilitarian Conservationists** values natural resources because of their usefulness and practicality BUT uses them sustainably and carefully

Ecological Footprint

- The average amount of land, water and ocean required to provide that person with all the resources they consume

Earth's Productive Land and Water	11.4 billion hectares
Amount Each Person is Allotted (divide Productive Land and Water by Human Population)	1.8 hectares
Current Global Ecological Footprint of each person	2.7 hectares

Ecological Footprint Comparison



IPAT Model

- Measures 3 factors that affect environmental impact (I)
- Factors are always changing thus not a great predictor of long term effects, better for current short term

Environmental
Impact

Affluence per
person

$$I = P \times A \times T$$

Number
of people

Environmental
effect of
technologies

...hunger

Population and Chronic Hunger

- Food insecurity
 - Condition in which people live with chronic hunger, malnutrition, fear of starvation
- Effects of Chronic Hunger are insidious
 - Weakened immune system, saps strength
 - Illness and disease
 - Malaria
 - Measles
 - Diarrhea
 - Acute respiratory illness
 - top 4 killers of kids



Starvation and Famines

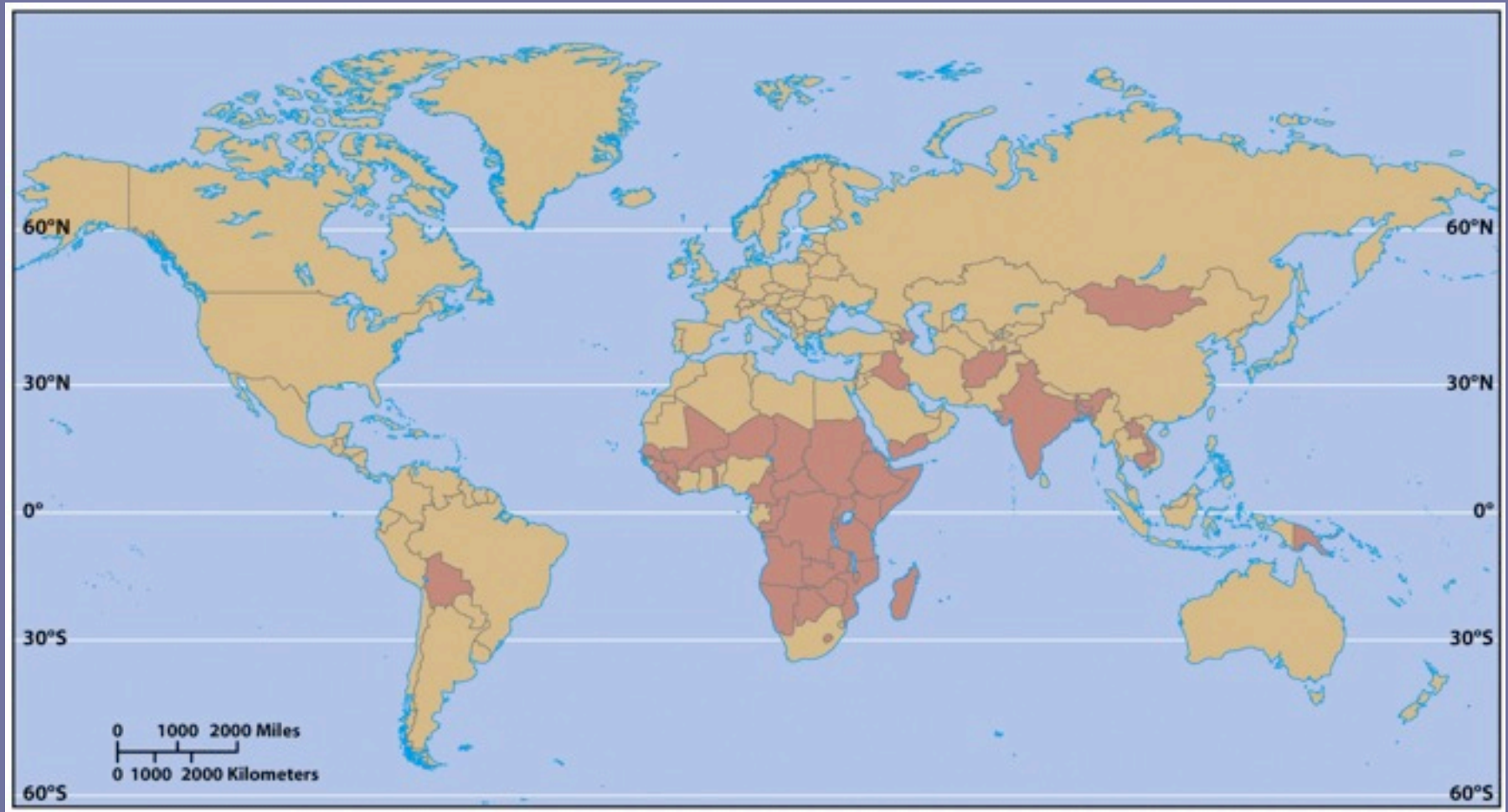
- The largest and most important cause of worldwide starvation is inadequate distribution of food resources
- Famines although widely publicized only account for 5-10% of the world's hungry people in a given year
- 850 million people have a food insecurity and nearly 2 billion experience intermittent insecurity

Population and Chronic Hunger

- Food insecurity
 - Conditions under which people live with continuous threat of starvation
- Solving the Food Problem (3 views)
 - Control population growth
 - Promote economic development of developing countries without adequate food supplies
 - Provide access to food and land resources to those who live in areas without them

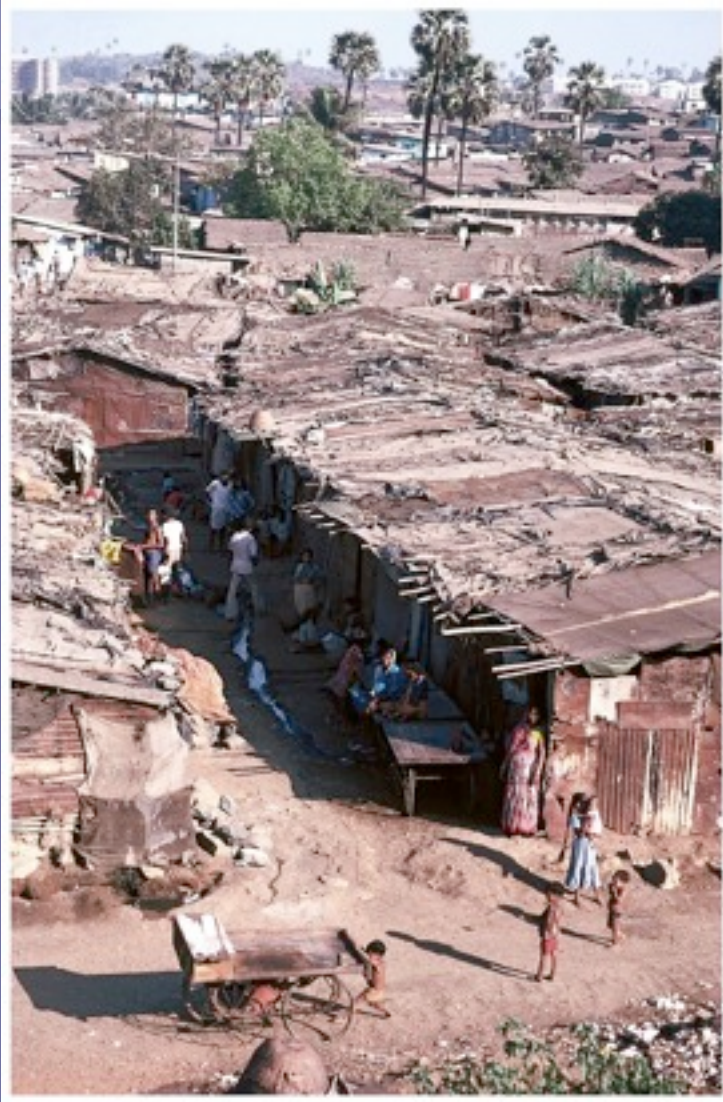
Food insecurity

- In shaded countries, more than 20% of population is undernourished



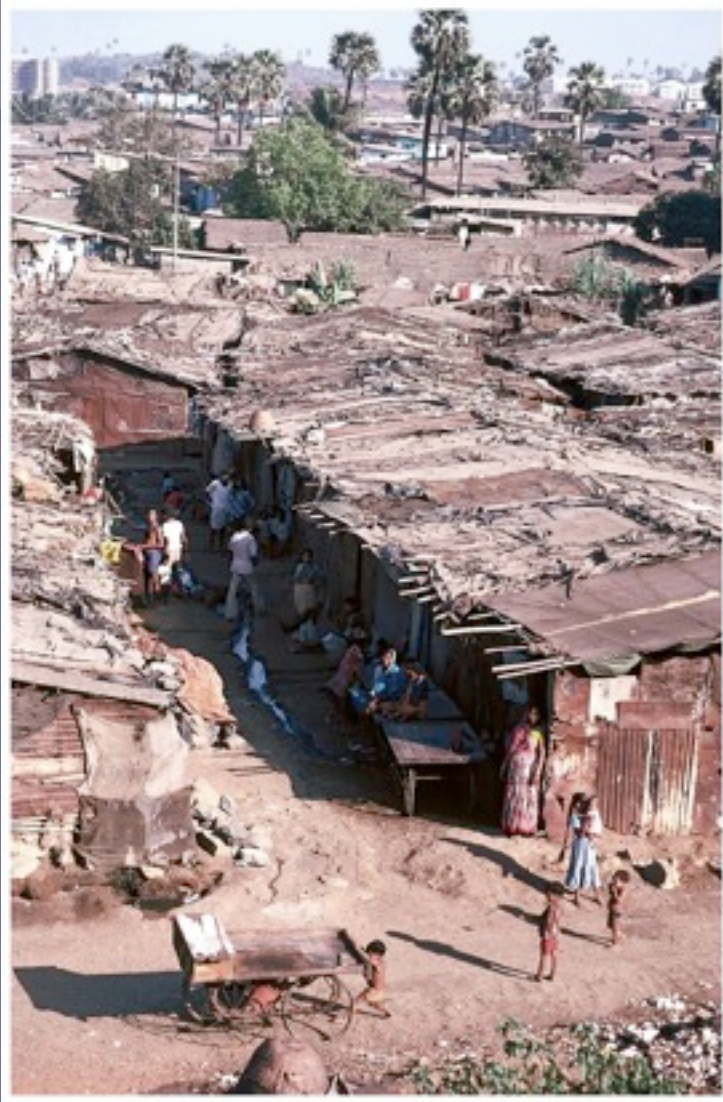
...poverty

Population



- 1 in 2 people live in extreme poverty
 - Cannot meet basic need for food, clothing, shelter, health
- 40 % of total world population lives in poverty
 - per capita income of less than 2\$ (U.S.) a day

Population



- Difficult to meet population needs without exploiting earth's resources

Gap Between Rich and Poor

- Highly Developed Countries (HDC) 19%
 - Complex industrialized bases, low population growth, high per capita incomes
 - Ex: US, Canada, Japan
- Less Developed Countries (LDC) 81%
 - Low level of industrialization, very high fertility rate, high infant mortality rate, low per capita income
 - Ex: Bangladesh, Mali, Ethiopia

...economic
stagnation

Economics & Population Growth

- Relationship between economic development and population growth is difficult to evaluate
 - Both effect each other but the extent of each on the other is unclear
 - One side argues that population growth stimulates the economy
 - The other side says population growth hampers economic development
 - most technological advances have been made in countries with low to moderate growth which would support the latter point of view

Economics & Population Growth

- The National Research Council examined this relationship and found...
 - for most of the developing world economic development would profit from slower population growth
 - population stabilization may lead to a higher standard of living if in fact it causes economic development

...disease

Disease and Populations

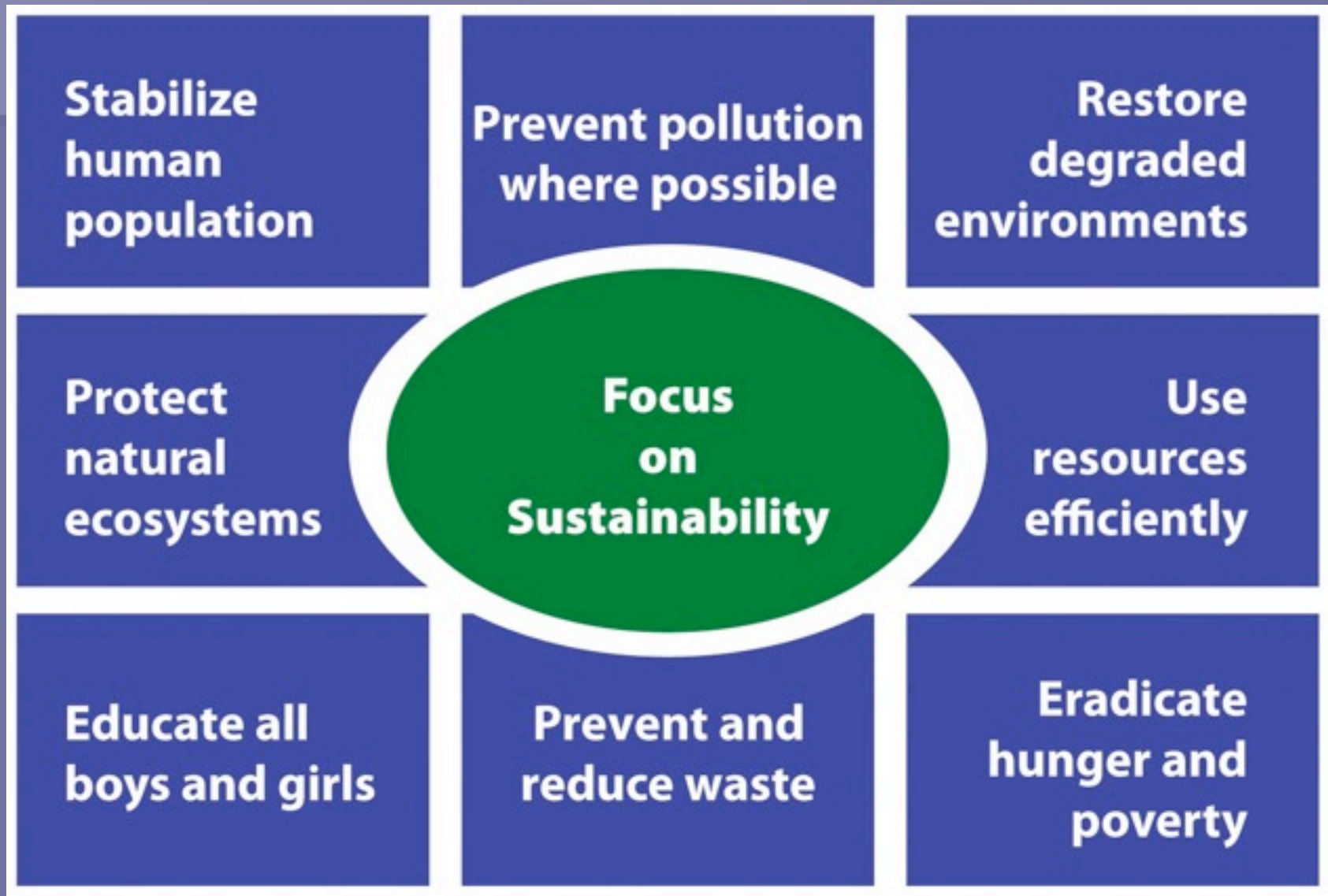
- Density Dependent Factor
 - Factor whose effect on population changes as population density changes
 - Examples: Predation, Competition and Disease
 - Epidemic Diseases include:
 - influenza, plague, cholera, measles, HIV (AIDS)
 - Developed countries suffer more from chronic disease such as diabetes and heart disease
 - Undeveloped countries suffer more from acute diseases like cholera and influenza

HIV / AIDS

- African HIV Epidemic
 - is know the leading cause of death in Africa
 - in developing countries many of which are located in Africa, almost all people infected with HIV/AIDS die
 - by 2010 18 million kids will lose at least parent to AIDS
 - more than 23 million of the world's population infected with HIV live in sub-saharan Africa

What can we do?

Environmental Sustainability



Environmental Sustainability

- The ability to meet current human need for natural resources without compromising the needs of future generations
- Requires understanding:
 - The effects of our actions on the earth
 - That earth's resources are not infinite



Environmental Sustainability

- Proponents of social justice believe that environmental and social problems will decrease if resources are distributed fairly.
 - Remember most poverty in the world is not due to lack of food but simply access to food
- Various interacting ecological, societal and economic factors complicate solutions
- Furthermore are inadequate understanding of how the environment works and how we in turn effect the environment make these problems difficult to resolve

Assessing Environmental Problem

Case Study: Lake Washington

- Large, freshwater pond
- Suburban sprawl in 1940's
 - 10 new sewage treatment plants dumped effluent into lake
- Effect = excessive cyanobacteria growth that killed off fish and aquatic life



Assessing Environmental Problem

Case Study: Lake Washington

- Scientific Assessment (identify problem)
 - Aquatic wildlife assessment done in 1933 was compared to the 1950 assessment
 - Hypothesized treated sewage was introducing high nutrients causing growth of cyanobacteria
- Risk Analysis (offer solution)
 - After analyzing many choices, chose new location (freshwater) and greater treatment for sewage to decrease nutrients in effluent

Assessing Environmental Problem

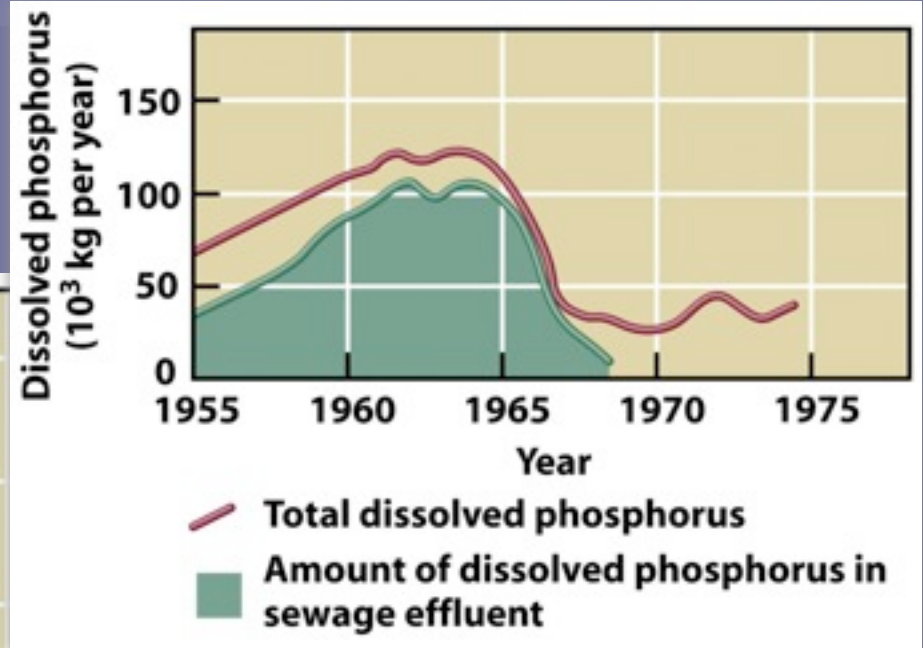
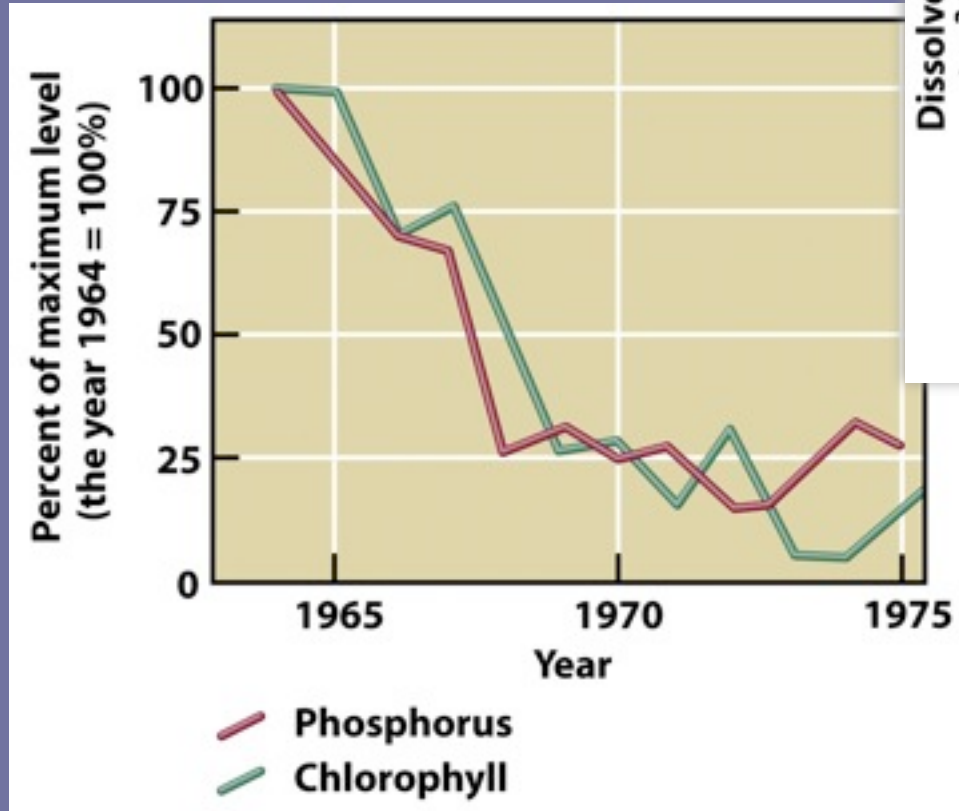
Case Study: Lake Washington

- Public Education/Involvement (explain solution)
 - Educated public on why changes were necessary
- Political Action (take action, work to solve)
 - Difficult to organize sewage disposal in so many municipalities
 - Changes were not made until 1963!
- Evaluation
 - Cyanobacteria slowly decreased until 1975 (gone)

Assessing Environmental Problem

Case Study: Lake Washington

- Results



II. Agriculture- Feeding a Growing World

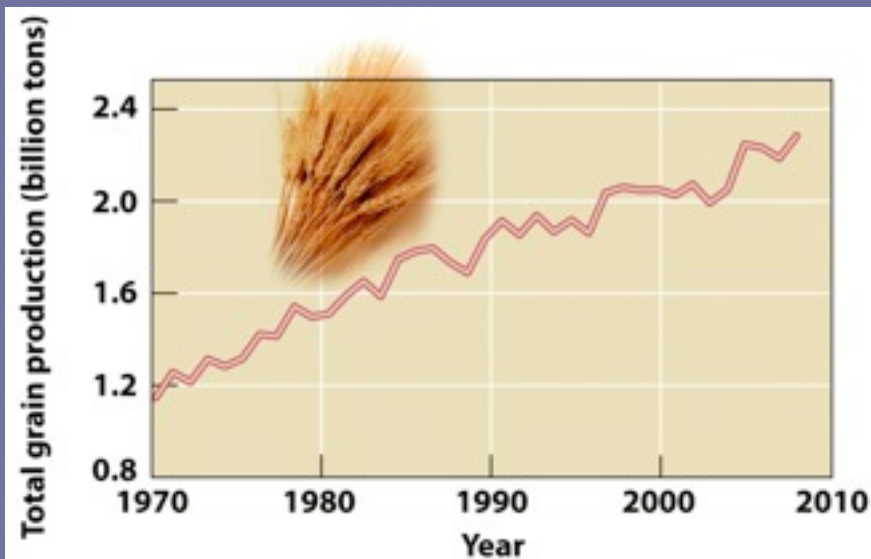
Overview

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

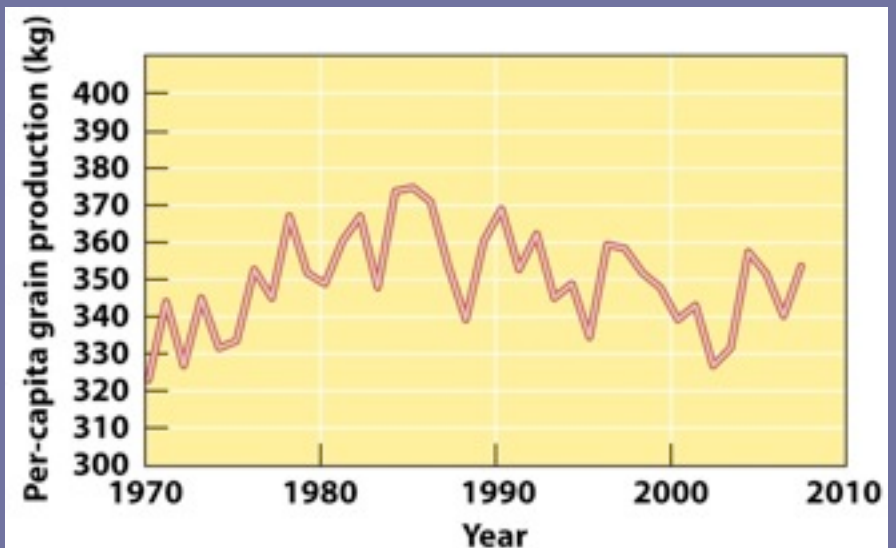
...food security

World Food Security

- Feeding growing population- most difficult
- Annual grain production (left) has increased since 1970
- Grain per person has not (right)



Total world grain production increased from about 1.1 billion tons in 1970 to 2.3 billion tons in 2007.



The amount of grain produced per person has not changed significantly in the past 40 years.

World Food Security

- Famine
 - Temporary but severe shortage of food
 - caused by drought, floods, war or some catastrophic event
 - Developing nations of Africa, Asia and Latin America are most at risk
 - More people die from undernutrition than by starvation associated with 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 1987
 - UN feels carryover stock should not fall below 70 days (in 2007 stock was 51 days)
 - optimists say a few bountiful harvests will restock our supply
 - pessimists feel that this is the beginning of food scarcity and high food prices

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



World Food Security

- Economics and Politics
 - Developed countries make enough food to feed the world
 - BUT... it costs money to store, produce, transport and distribute food
 - Sadly those who need it most are most unable to pay
 - The amount of food and its distribution is not the problem according to Nobel Prize winning economist
 - Getting food to those who need it is political

World Food Security

- Poverty is the root cause of undernutrition
 - 1.3 billion people are so poor they cannot afford proper nutrition
 - More common in
 - Rural than urban areas
 - no roads lead to lack of employment and income
 - Infants, children and the elderly
- Ultimate solution to chronic hunger is tied to stabilizing population growth in each nation at a level that its environment can support

...food production

World Food Production

- 330,000 plant species
- just over 100 of them provide humans with 90% of calories
- 3 cereal grains: corn, rice, wheat provide 50% of all calories
- relying on so few makes us vulnerable

Food Production

Table 19.1 The 15 Most Important Food Crops in Terms of Production

<i>Plant Crop</i>	<i>Type of Crop</i>	<i>2005 World Production* (1000 metric tons)</i>
Sugarcane	Sugar plant (stem)	1,168,773
Corn (maize)	Cereal grain	615,758
Rice, paddy	Cereal grain	586,743
Wheat	Cereal grain	537,978
White potato	Ground crop (tuber)	255,681
Soybean	Legume	207,834
Cassava (manioc)	Ground crop (root)	187,862
Sweet potato	Ground crop (root)	125,626
Barley	Cereal grain	113,499
Sorghum	Cereal grain	53,721
Peanuts (ground nuts)	Legume	33,395
Oats	Cereal grain	21,369
Beans, dry	Legume	15,967
Rye	Cereal grain	15,132
Peas, dry	Legume	10,639

* Based on the 20 highest-producing countries for a specific agricultural commodity.
Source: U.N. Food and Agricultural Organization.

Animals as food

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

Table 19.2 Annual Per Capita Consumption of Meat in Selected Countries

Country	Beef (kg)	Pork (kg)	Poultry (kg)	Mutton (kg)
India	1	0.4	1	1
China	4	30	6	2
Italy	26	33	19	2
United States	45	31	46	1

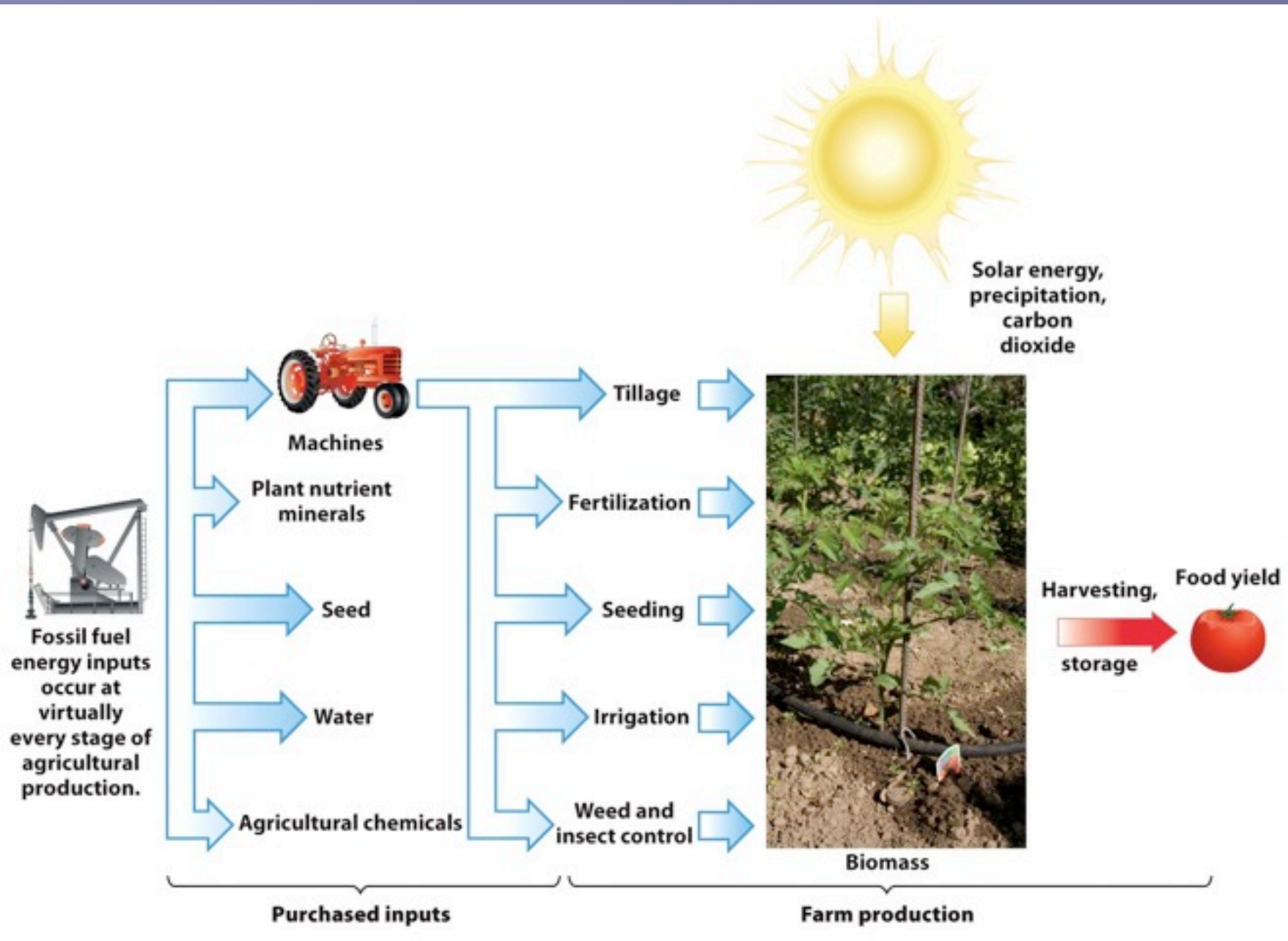
Source: Brown, L. R. Tough Choices.

Principle Types of Agriculture

- Industrialized agriculture
 - Modern agriculture methods that require
 - large capital and energy (fossil fuels) input,
 - and less land and labor
 - high yields
- Industrialized Agriculture
 - has drawbacks: soil degradation and pesticide resistance,

Principle Types of Agriculture

- Subsistence Agriculture
 - farmers grow enough to feed their family and sell what is left over
 - Traditional agricultural methods, which are dependent on
 - high energy input from labor not fossil fuels
 - and large amounts of land (see below)
 - Shifting cultivation,
 - Slash and burn agriculture,
 - Nomadic herding,
 - Intercropping
 - growing many varieties at one time...advantages?



...challenge to
produce more

Challenges of Producing More

- General Trend is moving toward greater uniformity in the food we eat.
- Remember:
 - Wild plants/animals have high genetic diversity
 - Diversity contributes to their long term survival
 - Domestication is eliminating diversity



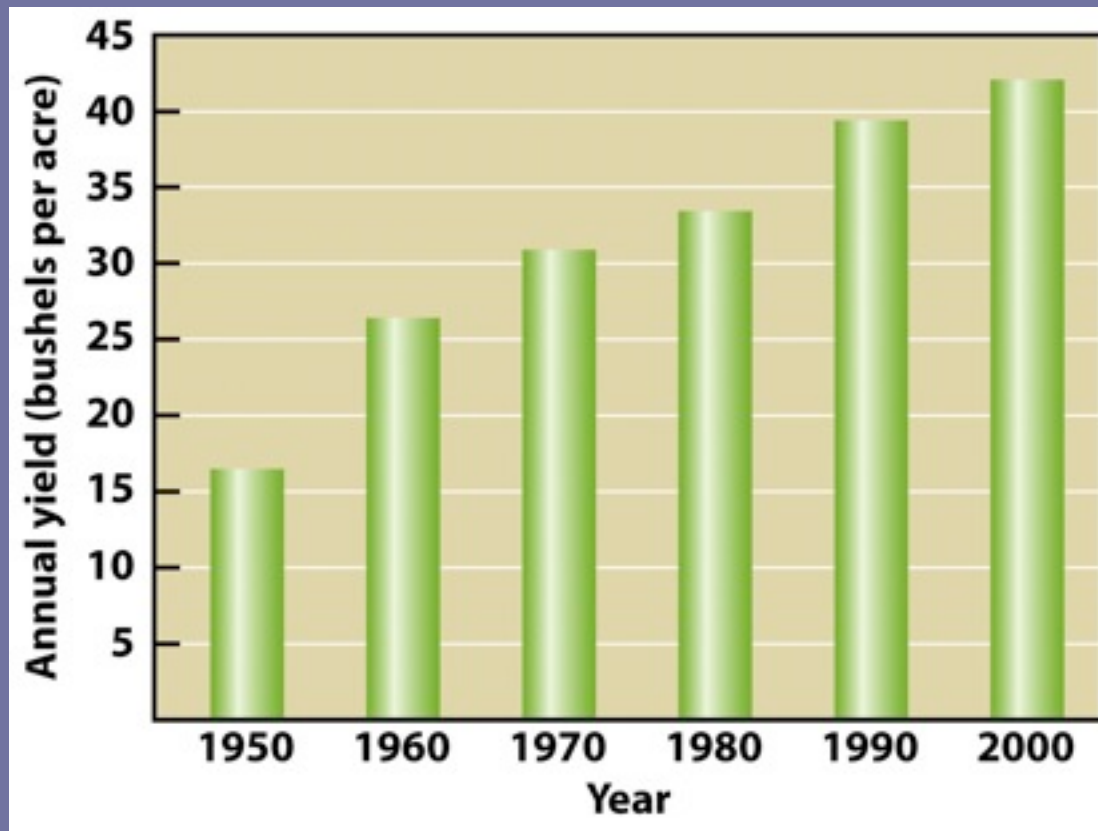
Challenges of Producing More

- Domestication and Genetic Diversity
 - Farmer selects and propagates animals with desirable agricultural characteristics and often times eliminate traits whose value is not obvious



Challenges of Producing More Crop and Livestock

- Increasing Crop Yield



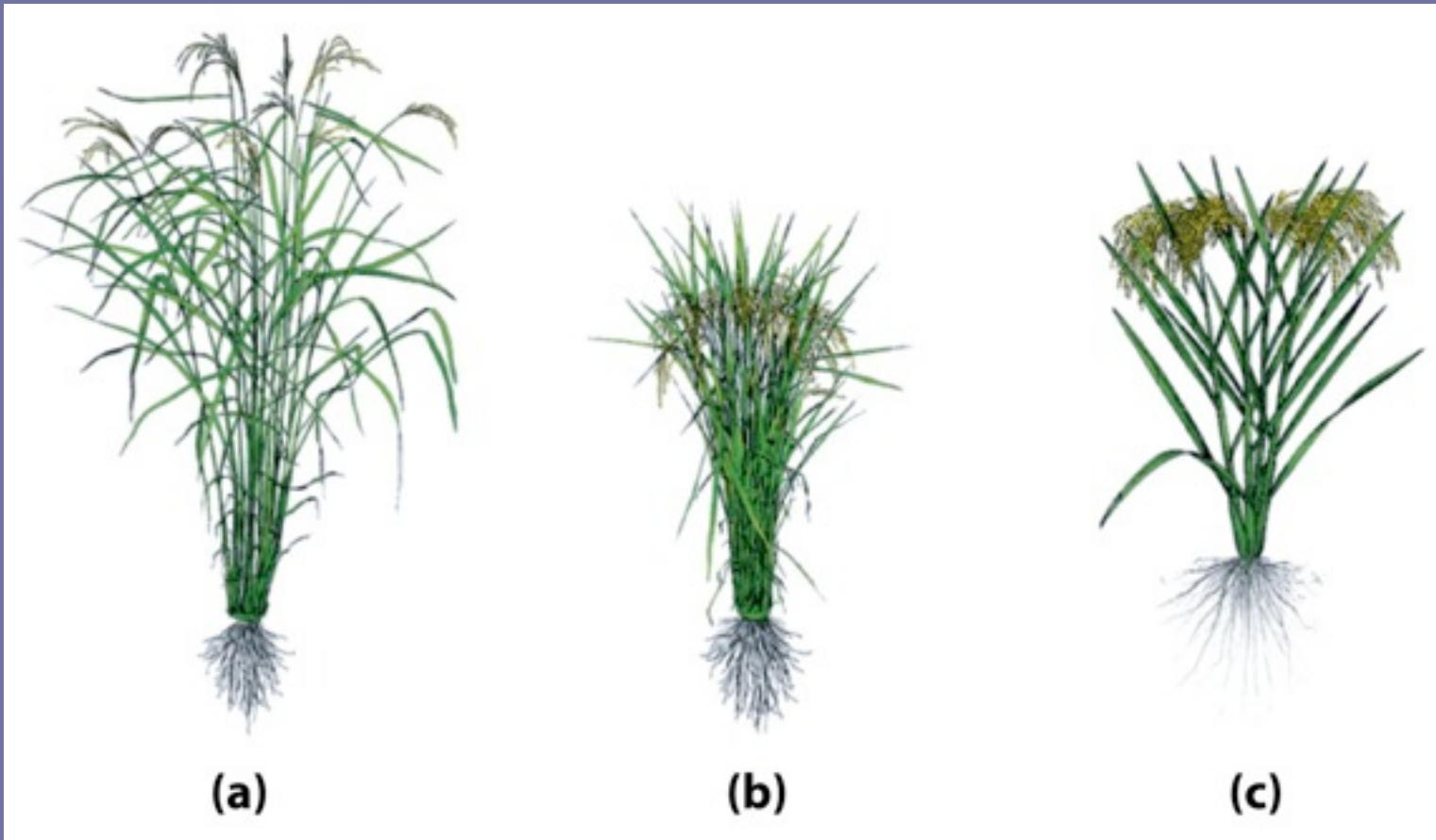
- Food production increased in developed countries (wheat (left))
- Pesticides
- Selective breeding

Green Revolution

- Modern Cultivation and High Yielding crop varieties to produce more food per acre.
- Norman Borlaug a US scientist won a Nobel Prize in 1970 for his work with high yield wheat and the subsequent green revolution
- Some success stories are remarkable
 - Not only did some countries feed themselves but they improved their economic development as well

Case-In-Point Green Revolution

- High Yielding Rice Varieties



Green Revolution

- Critics point out:
 - that developing countries have become even more dependent on developed countries technologies
 - and higher crop production has high energy costs and significant environmental issues
- Overall the green revolution has benefited the large land owners not the subsistence farmers

Green Revolution in the future?

- World demand for rice, wheat and corn will surely increase
- The challenge can not met by increasing the amount of land cultivation
- and coaxing more more grain (green revolution) out the crops is now seeing diminishing returns
- Many Believe the future lies in the following:
 - genetically modifying organisms
 - more modern agriculture methods
 - water efficient irrigation

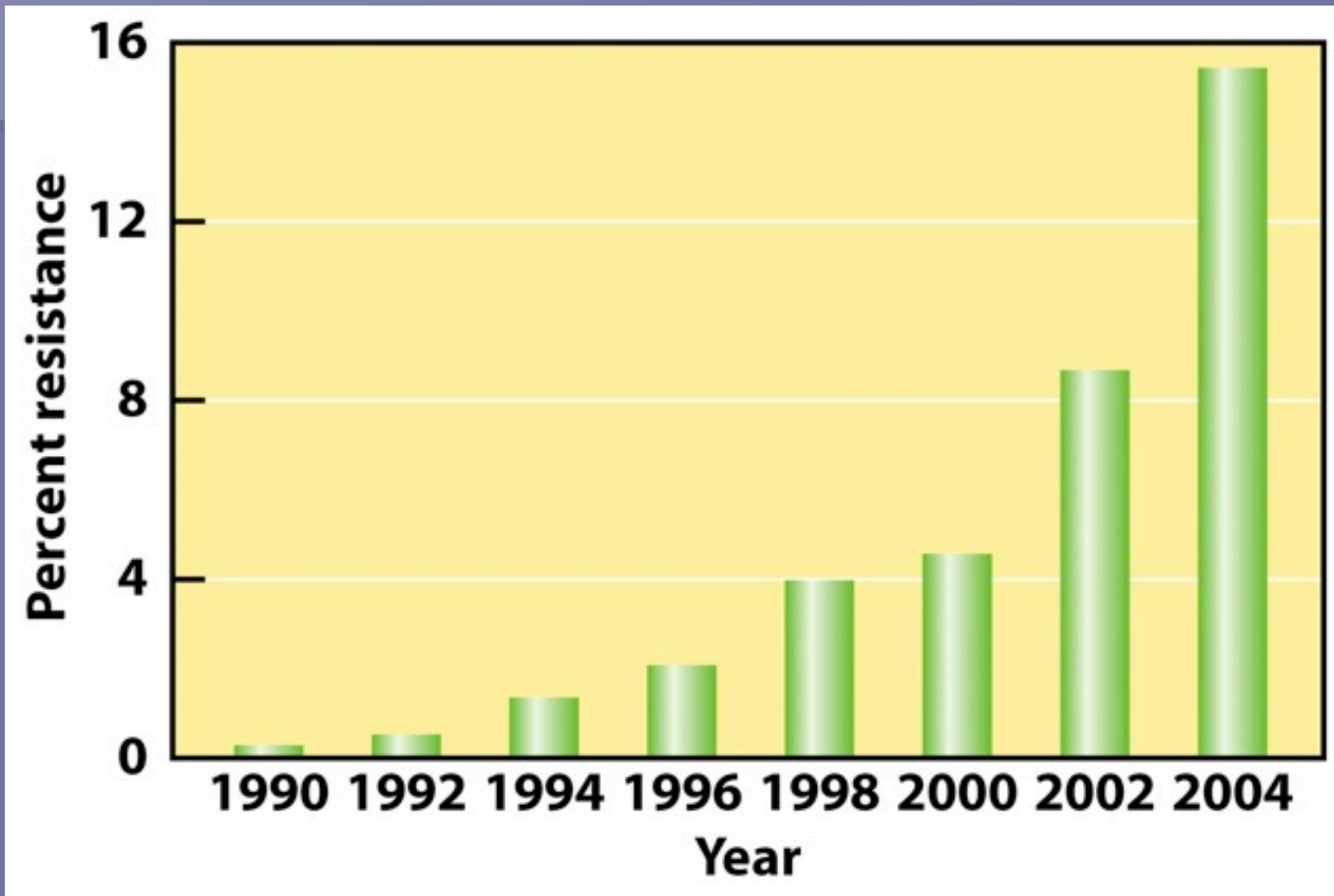
Challenges of Producing More Crop and Livestock

- Increasing Livestock Yields
 - (Controversial) Hormone supplements
 - promote faster growth
 - US and Canada
 - Not used in Europe they are banned
 - potential carcinogen and/or effects normal child growth
 - In 1999 WHO concluded levels of hormones are safe
 - Critics say EU ban is a move to reduce competition and protect their beef industry
 - they continue to point out that some other common foods have more hormones than the beef

Challenges of Producing More Crop and Livestock

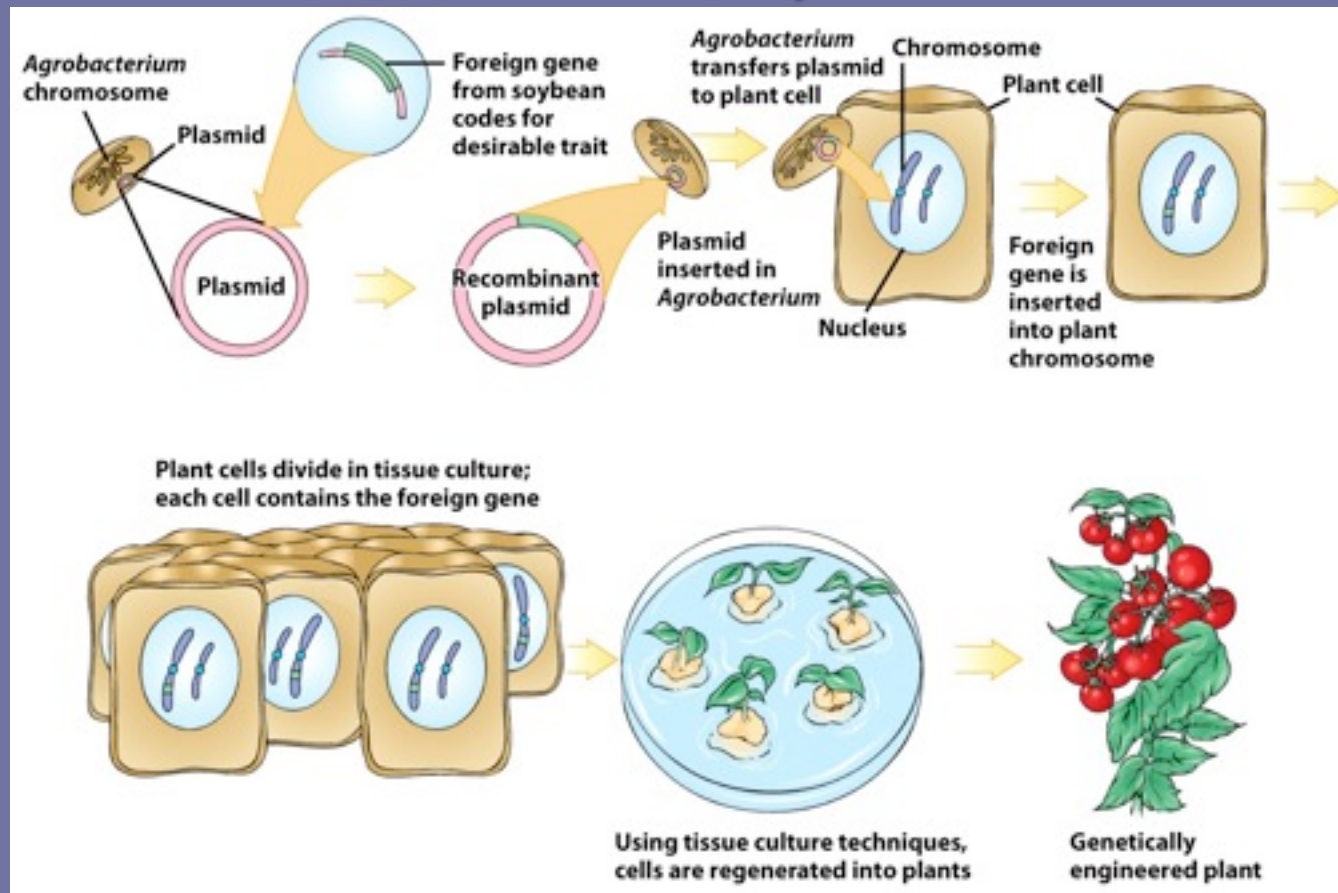
- Antibiotics
 - modern agriculture routinely administers antibiotics to live stock to increase weight
 - 40% of antibiotics produced in US are used in livestock operations
 - Studies link with increased bacteria resistance
 - In 2003 WHO recommended that routine antibiotic use be eliminated
 - antibiotic resistant forms of dangerous bacteria (over 20 kinds including TB)
 - some are resistant to every known antibiotic

Antibiotic Use and Resistance



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



Genetically Modified Organisms

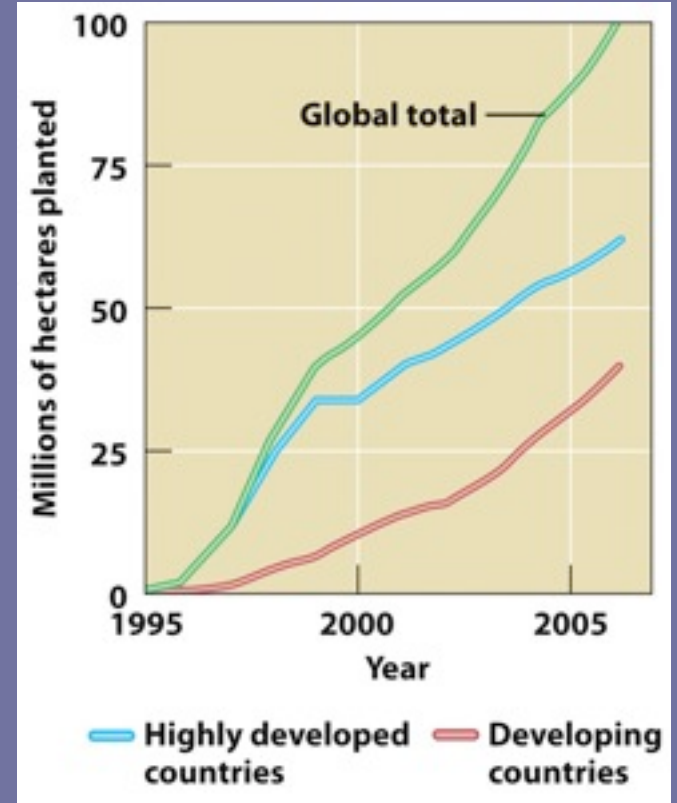
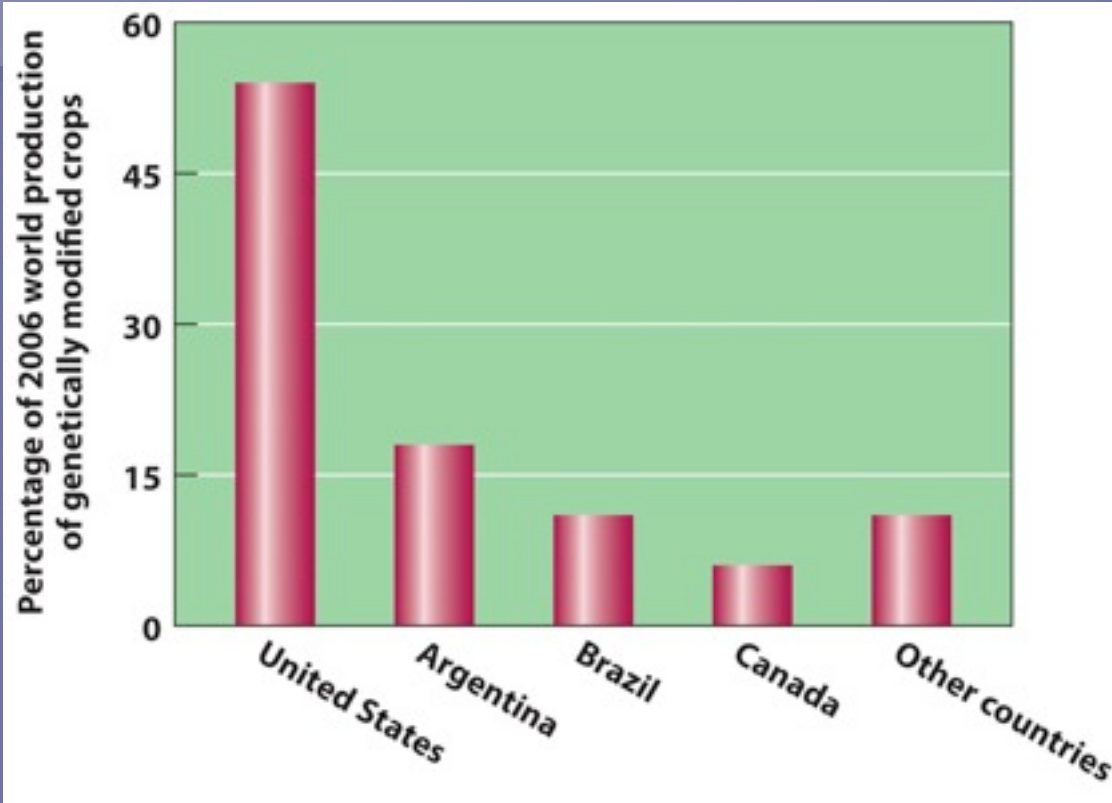
- Add beneficial characteristics to crops
 - Additional nutrition
 - Resistance to pests
 - Drought resistances (below)
 - Herbicides



(a) Unmodified corn acted as a control. Note the poor yield.

(b) GM corn withstood drought better than the control corn.

Genetically Modified Organisms



Safety in Genetic Engineering

- Determined to be safe for human consumption
- Concerns about GMO seed or pollen spreading in wild
- Backlash against GMOs
- GMOs are not currently labeled
 - FDA finds it would be counterproductive and expensive to label

...environmental
impacts of
agriculture

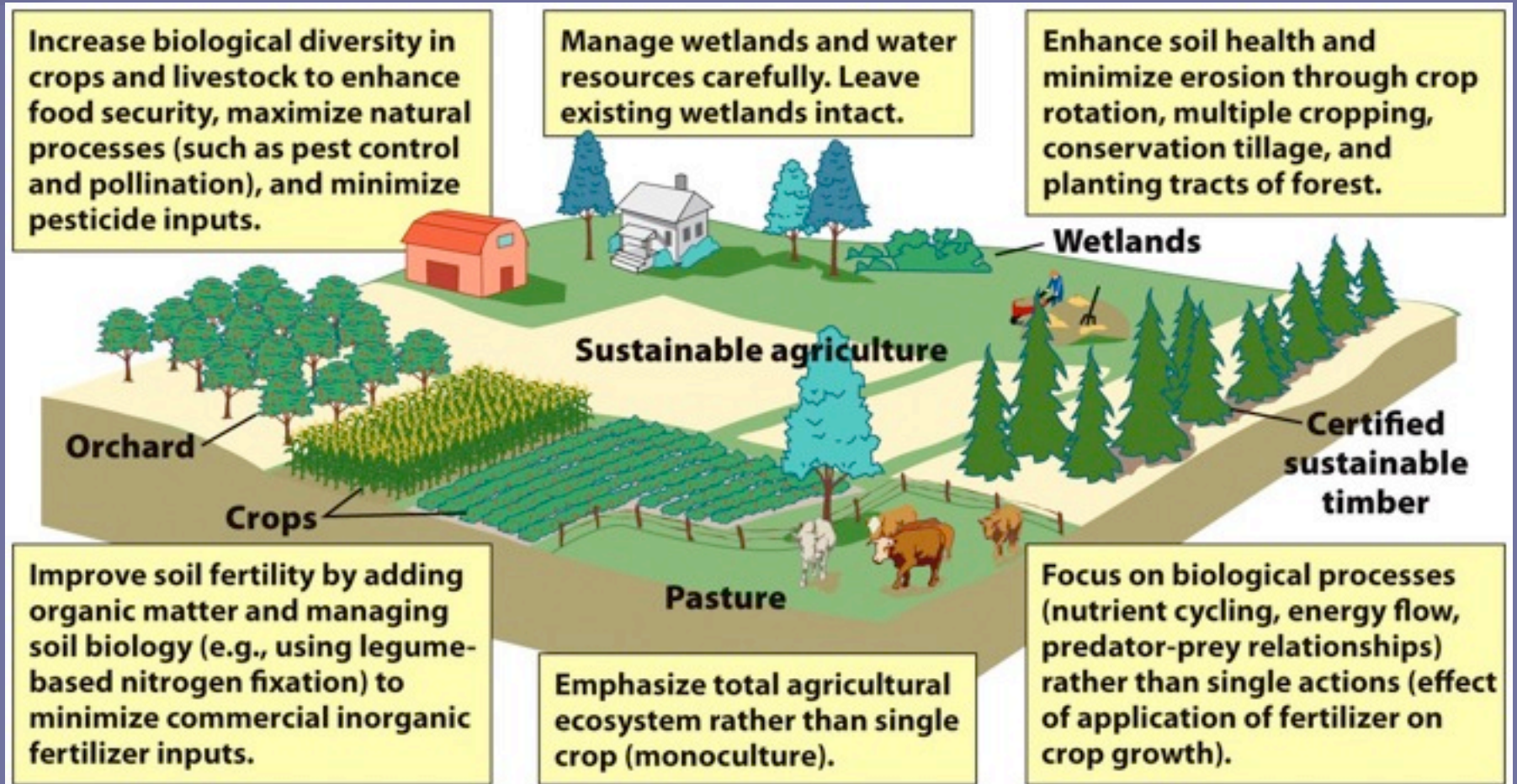
Environmental Impacts of



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

Solutions to Agricultural



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

III. Economics,
Ethics &
Legislation In a
Growing
Population

Overview

- Brief US Environmental History
- US Environmental Legislation
- Economics and the Environment
- Environmental Ethics, Values and Worldviews

...U.S. History and legislation

Environmental History of the US

- 17th and 18th Centuries-
Frontier Attitude
 - Natural Resources (land, timber soil, water) seemed inexhaustible
 - Widespread Environmental Destruction
 - from 1860 to 1900 loggers deforested an area as large as Europe



Establishment of Jamestown, VA

Dominated by Frontier Attitude

1600

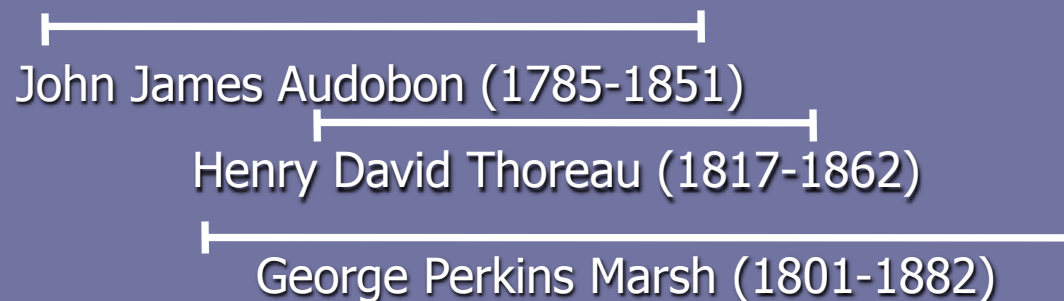
1700

1800

1900

Environmental History of the US

- 19th century - US Naturalists voiced concerns about natural resources
 - John James Audobon - painted nature, which increased interest in environment
 - Henry David Thoreau - naturalist author on simplifying life
 - George Marsh - wrote Man and Nature



1750

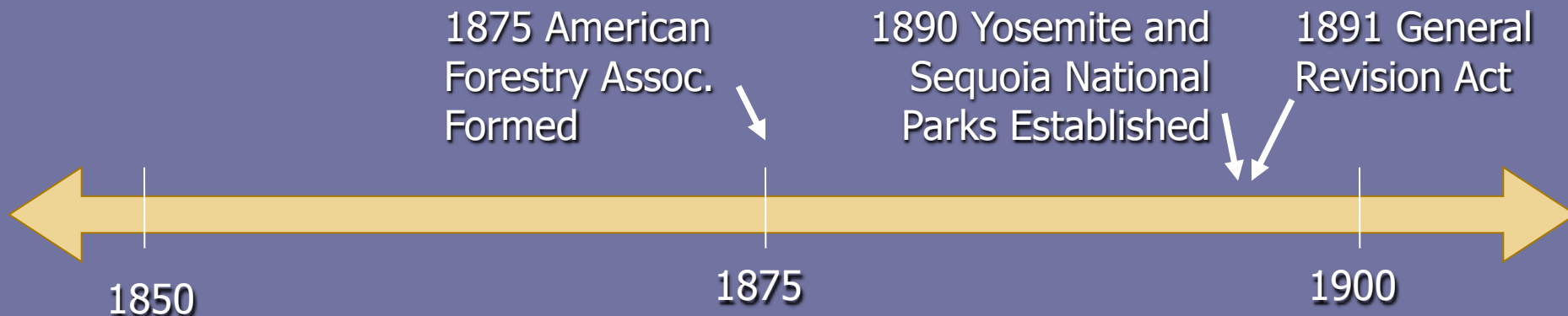
1800

1850

1900

Environmental History of US

- General Revision Act
 - Gave President authority to establish forest reserves
 - Presidents Harrison, Cleveland, Roosevelt
 - Put 17.4 million hectares into reserve
 - President Roosevelt
 - Reserved additional 6.5 million hectares before signing bill preventing further forest reservation, 21 new national forests



Environmental History of US

- Utilitarian Conservationist

- Value natural resources for their usefulness
- Roosevelt

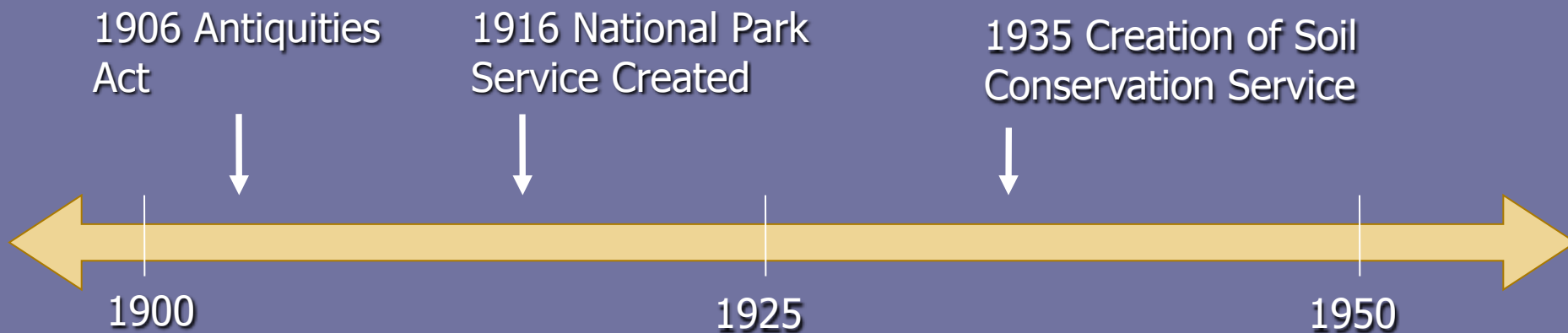


- Biocentric Preservationist

- Protect nature because all life deserves respect
- John Muir (founded Sierra Club)
 - Fought for National Parks
 - today: 58 National Parks & 73 National Monuments

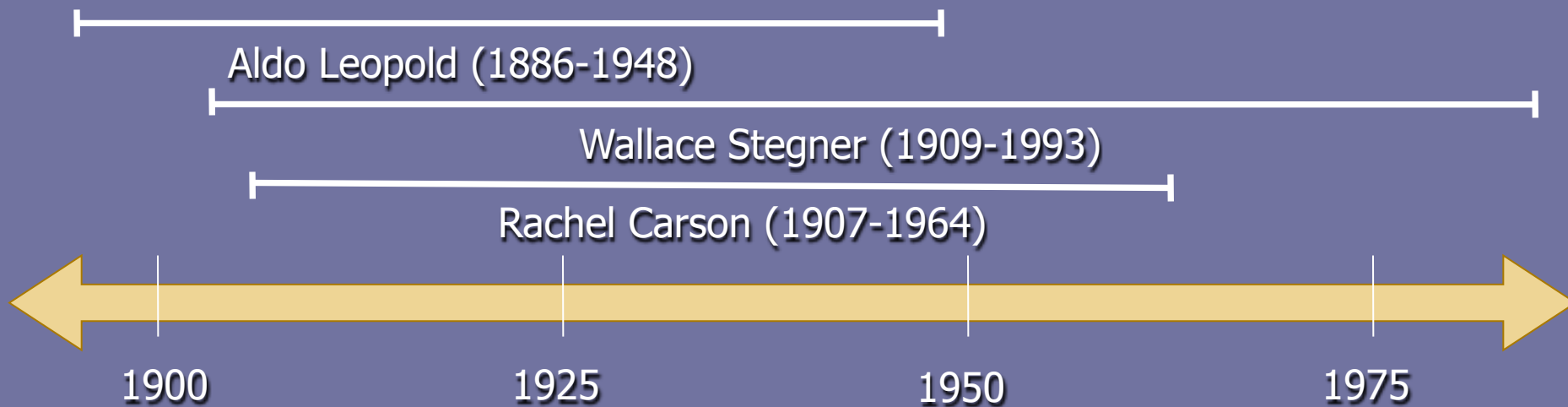
Environmental History of US

- Antiquities Act
 - Allows president to set aside sites of scientific or historical importance (monuments)
- American Dust Bowl (1930s droughts)
 - Basis for Soil Conservation Service
 - Created by Franklin Roosevelt



Environmental History of US

- 20th Century Naturalists
 - Leopold - Author (A Sand Country Almanac)
 - Stegner - Author (Wilderness Essay)
 - Carson - Author (Silent Spring)
 - Heightened awareness of DDT and pesticides

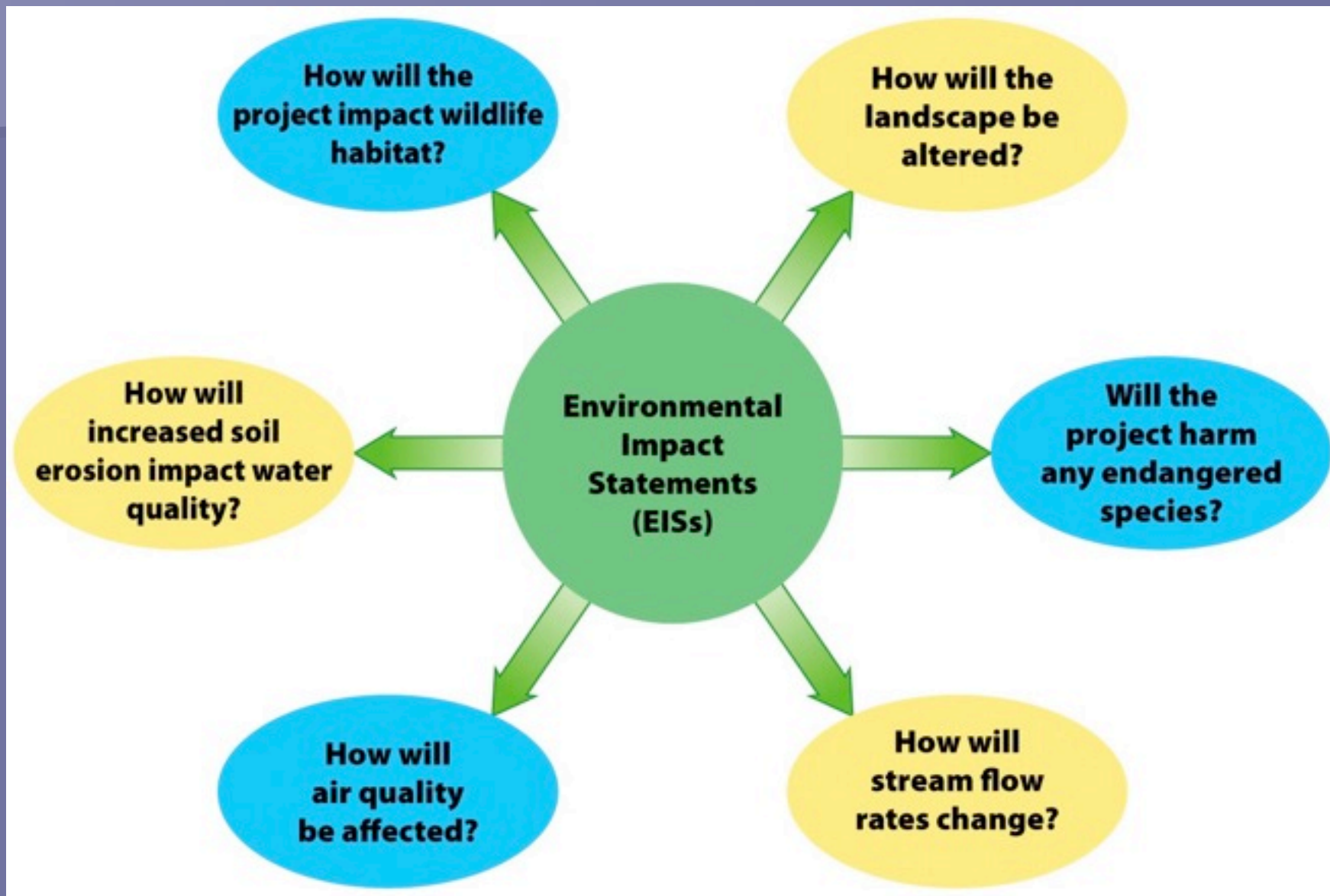


1970s	1980s	1990s	2000s
<ul style="list-style-type: none"> • 1970 Millions in United States gather for first Earth Day. • 1972 Scientists report most acid rain in Sweden originates in other countries. • 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora protects endangered species. • 1973 Arab countries in OPEC announce oil embargo against United States. • 1974 Chlorofluorocarbons are first hypothesized to cause ozone thinning. • 1976 Dioxin (poisonous chemical) released in industrial accident at pesticide plant in Italy. • 1979 Worst nuclear accident in U.S. history occurs at Three Mile Island nuclear power plant in Pennsylvania. 	<ul style="list-style-type: none"> • 1982 Convention on the Law of the Sea developed to protect ocean's resources. • 1984 World's worst industrial accident at pesticide plant in India kills and injures thousands. • 1985 Scientists discover and measure size of ozone hole over Antarctica. • 1986 World's worst nuclear accident occurs at nuclear power plant in Chernobyl, Soviet Union. • 1986 International Whaling Commission announces moratorium on commercial whaling. • 1987 Montreal Protocol requires countries to phase out ozone-depleting chemicals. • 1989 Exxon Valdez oil tanker creates largest oil spill in U.S. history. 	<ul style="list-style-type: none"> • 1990 First Intergovernmental Panel on Climate Change (IPCC) Assessment warns of possible global warming. • 1991 World's worst oil spill occurs in Kuwait during war with Iraq. • 1992 U.N. conference on Environment and Development (Earth Summit) held in Brazil. • 1994 International Conference on Population and Development held in Egypt. • 1995 Second IPCC Assessment warns of human influence on global warming. • 1997 Forest fires destroy more tropical forests than ever recorded before; Indonesia is particularly hard hit. • 1999 Human population reaches 6 billion. 	<ul style="list-style-type: none"> • 2000 Treaty on Persistent Organic Pollutants requires countries to phase out certain highly toxic chemicals. • 2001 Third IPCC Assessment cites strong evidence humans are responsible for most of observed global warming in past 50 years. • 2001 President Bush decides the United States will not ratify the Kyoto Protocol, which mandates reductions in CO₂ emissions to combat global warming. • 2002 Oil spill off Spain's coast raises awareness of ocean's vulnerability. • 2004 Record heat waves in Europe highlight threat of climate change. • 2006 Clinton climate initiative established; signatories include California governor Arnold Schwarzenegger and Britain's prime minister Tony Blair, but not the U.S. government. • 2007 Fourth IPCC Assessment concludes that it is "very likely" that global warming has been caused by human activity. • 2008 U.S. Supreme Court decides that EPA must regulate CO₂.

US Environmental Legislation

- The 60's sees growing public distrust
 - towards gov. and industry and their public interest
- Up to 1970 most environmentalists were heard through societies like Sierra Club
- Environmental Protection Agency, Est. 1970
- National Environmental Policy Act (NEPA)
 - Cornerstone of Environmental Law
 - Requires Environmental Impact Statements (EIS) for any proposed federal action
 - Ex: highway or dam construction
 - Revolutionized environmental protection in US

Environmental Impact Statement



US Environmental Legislation

- Numerous laws passed since 1970
- They address:
 - Clean water
 - Clean air
 - Energy conservation
 - Hazardous waste
 - Pesticides
 - Federal regulation of pollution

Table 2.1 Some Important Federal Environmental Legislation

General

Freedom of Information Act of 1966
National Environmental Policy Act of 1969
National Environmental Education Act of 1990

Conservation of Energy

Energy Policy and Conservation Act of 1975
Northwest Power Act of 1980
National Appliance Energy Conservation Act of 1987
Energy Policy Act of 1992

Conservation of Wildlife

Fish and Wildlife Act of 1956
Anadromous Fish Conservation Act of 1965
Fur Seal Act of 1966
National Wildlife Refuge System Act of 1966
Species Conservation Act of 1966
Marine Mammal Protection Act of 1972
Marine Protection, Research, and Sanctuaries Act of 1972
Endangered Species Act of 1973
Federal Noxious Weed Act of 1974
Magnuson Fishery Conservation and Management Act of 1976
Whale Conservation and Protection Study Act of 1976
Fish and Wildlife Improvement Act of 1978
Fish and Wildlife Conservation Act of 1980
Fur Seal Act Amendments of 1983
Wild Bird Conservation Act of 1992
National Invasive Species Act of 1996

Table 2.1 Some Important Federal Environmental Legislation

Conservation of Land

General Revision Act of 1891

Taylor Grazing Act of 1934

Soil Conservation Act of 1935

Multiple Use Sustained Yield Act of 1960 (re: national forests)

Wilderness Act of 1964

Land and Water Conservation Fund Act of 1965

Wild and Scenic Rivers Act of 1968

National Trails System Act of 1968

Coastal Zone Management Act of 1972

National Reserves Management Act of 1974

Forest and Rangeland Renewable Resources Act of 1974

Federal Land Policy and Management Act of 1976

National Forest Management Act of 1976

Soil and Water Resources Conservation Act of 1977

Surface Mining Control and Reclamation Act of 1977

Public Rangelands Improvement Act of 1978

Antarctic Conservation Act of 1978

Endangered American Wilderness Act of 1978

Alaska National Interest Lands Act of 1980

Coastal Barrier Resources Act of 1982

Emergency Wetlands Resources Act of 1986

North American Wetlands Conservation Act of 1989

California Desert Protection Act of 1994

Farm Security and Rural Investment Act of 2002 (the latest version of the "farm bill," which has been amended and renamed every 5 years or so since the 1930s)

Table 2.1 Some Important Federal Environmental Legislation

Air Quality and Noise Control

Noise Control Act of 1965

Clean Air Act of 1970

Quiet Communities Act of 1978

Asbestos Hazard and Emergency Response Act of 1986

Clean Air Act Amendments of 1990

Water Quality and Management

Refuse Act of 1899

Water Resources Research Act of 1964

Water Resources Planning Act of 1965

Clean Water Act of 1972

Ocean Dumping Act of 1972

Safe Drinking Water Act of 1974

National Ocean Pollution Planning Act of 1978

Water Resources Development Act of 1986

Great Lakes Toxic Substance Control Agreement of 1986

Water Quality Act of 1987 (amendment of Clean Water Act)

Ocean Dumping Ban Act of 1988

Oceans Act of 2000

Table 2.1 Some Important Federal Environmental Legislation

Control of Pesticides

Food, Drug, and Cosmetics Act of 1938

Federal Insecticide, Fungicide, and Rodenticide Act of 1947

Food Quality Protection Act of 1996

Management of Solid and Hazardous Wastes

Solid Waste Disposal Act of 1965

Resource Recovery Act of 1970

Hazardous Materials Transportation Act of 1975

Toxic Substances Control Act of 1976

Resource Conservation and Recovery Act of 1976

Low-Level Radioactive Policy Act of 1980

Comprehensive Environmental Response, Compensation, and Liability ("Superfund") Act of 1980

Nuclear Waste Policy Act of 1982

Hazardous and Solid Waste Amendments of 1984

Superfund Amendments and Reauthorization Act of 1986

Medical Waste Tracking Act of 1988

Marine Plastic Pollution Control Act of 1987

Oil Pollution Act of 1990

Pollution Prevention Act of 1990

State or Regional Solid Waste Plans (RCRA Subtitle D) of 1991

Effects of Environmental Legislation (-)

- Not all Env. Laws work as intended
 - Clean Air Act of 1977 requires expensive scrubbers on smoke stacks
 - Loop hole allows for tall stacks, which increase dramatically over the years
 - Since then acid rain has continued to be produced in the northeast US
 - Clean Air Act of 1990 went a long way to close this loop hole



❑ Oliver Houck of Tulane Law School states that Environmental Laws have a compliance rate of roughly 50%

Effects of Environmental Legislation (+)

- Since 1970
 - Six air pollutants have dropped by 25%
- Since 1990
 - wet sulfate levels decreased 20–35%
- As of 2007
 - 90% of US had healthy drinking water (up from 75% in 1993)
- As of 2006
 - 45% of municipal waste is burned as waste-to-energy or recovered for recycling
- As of 2007
 - Human exposure to hazardous waste



...environmental economics

Sustainable Development

- Economic development that meets the needs of the present generation without compromising future generations



Sustainable Development

- More Specifically: Improve living conditions without overusing natural resources and generating excessive pollution



Millennium Summit

- In 2000, 189 countries meet and set Lofty Millennium Development Goals
 - 1. Eradicate extreme hunger and poverty
 - 2. Achieve universal primary education
 - 3. Promote gender equality/empower women
 - 4. Reduce child child Mortality
 - 5. Improve maternal health
 - 6. Fight HIV/AIDS, malaria and other diseases
 - 7. Ensure environmental sustainability
 - 8. Develop global partnership for economic development

Millennium Summit

- Despite lofty Goals limited progress has been made
- Many governments have shifted their attention to other challenges
- Most significant changes / progress have occurred at local and national levels

Precepts to study Economics

- 1. Economics is utilitarian
 - Goods and services have value that can be converted to currency
 - dollar values based on what someone is willing to pay for them
- 2. Rational Actor Model
 - Assumes all individuals spend limited resources (money and time) to maximize individual goods and services (utilities)
- 3. Ideal economy
 - Resources are allocated efficiently
 - Efficiency is an economic term describing multiple individuals getting the greatest amount of goods/services

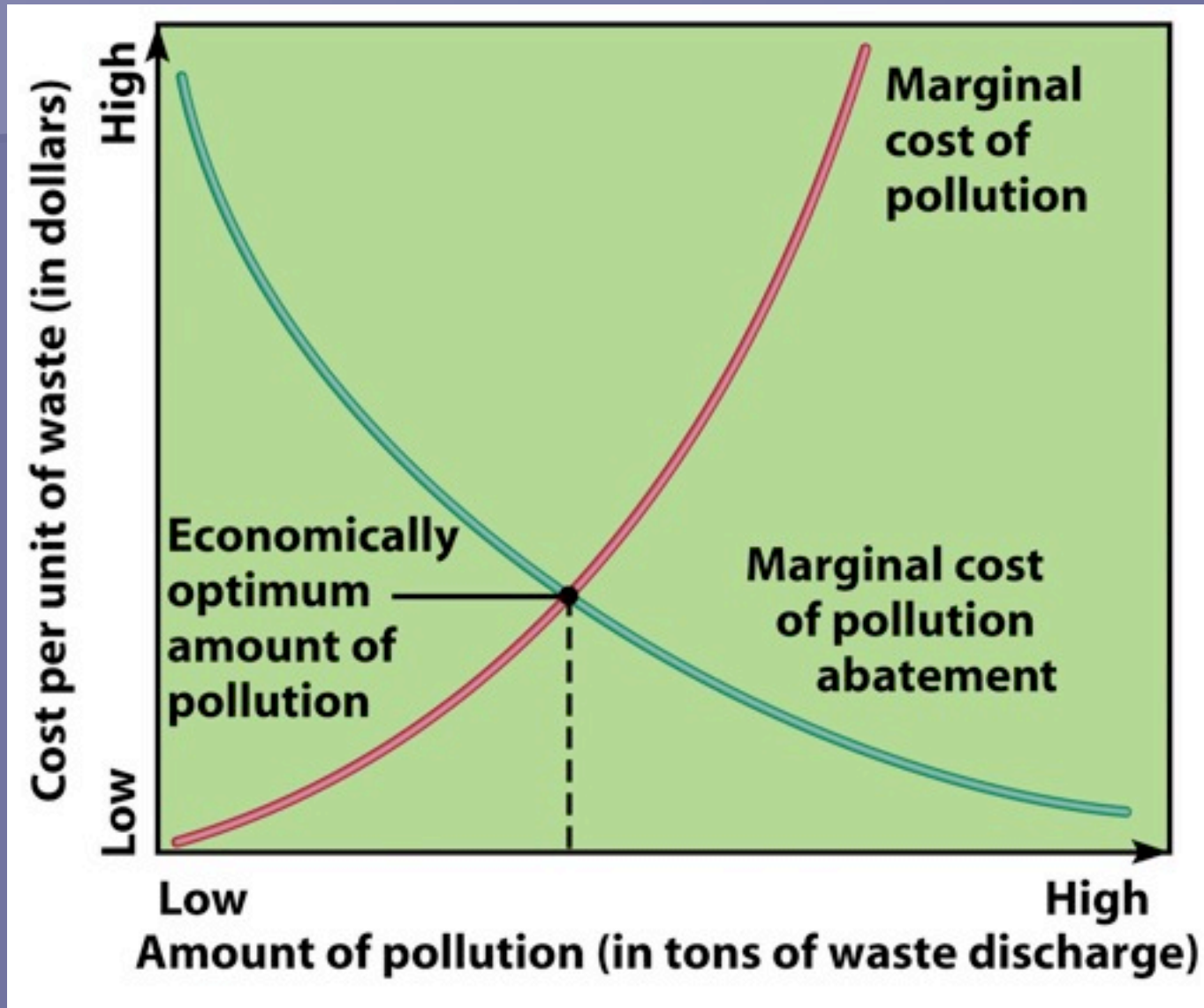
Externalities

- To Economists, environmental problems arise when market failures occur in one of several ways, principal to these is externalities and inefficiencies.
- Externalities occur when a producer of goods or services does not pay full cost of production.
 - ex. blacksmith and drip/dry laundry
 - Solution is to clearly define rights of ownership
 - Does blacksmith have the right to release soot?
Regardless of your answer the efficient solution is one where it the least money for everyone
 - Unfortunately most environmental externalities are not clearly defined...auto exhaust for instance

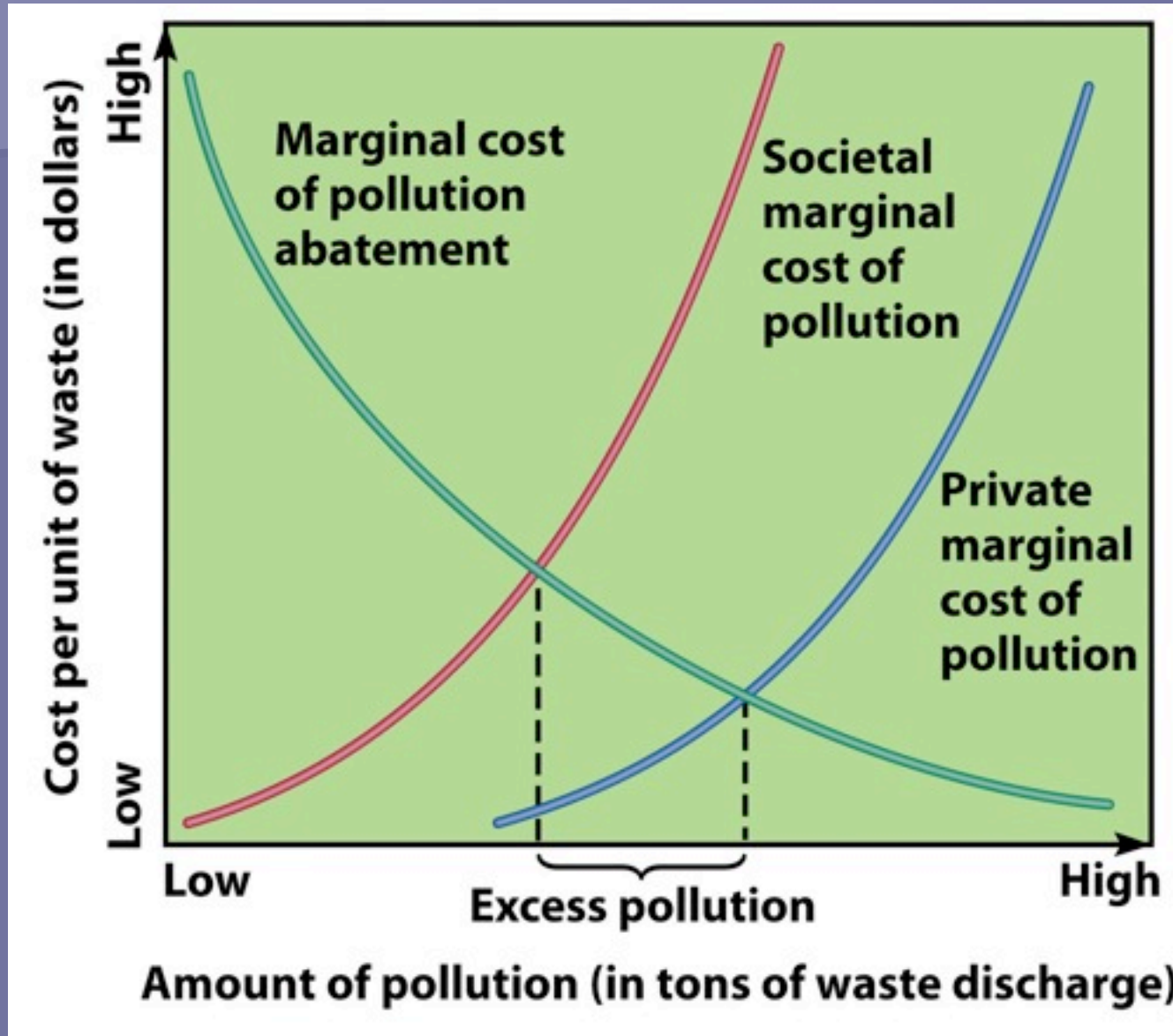
Optimum Amount of Pollution

- Economic solutions for multiple polluters
- Optimum Amount of Pollution
 - Cost to society of having less pollution is offset by benefits to society of activity creating pollution
- Must identify
 - Marginal Cost of Pollution - Cost of small additional amount of pollution
 - Marginal Cost of Abatement - Cost of reducing small amount of pollution

Economic Optimum Amount of Pollution



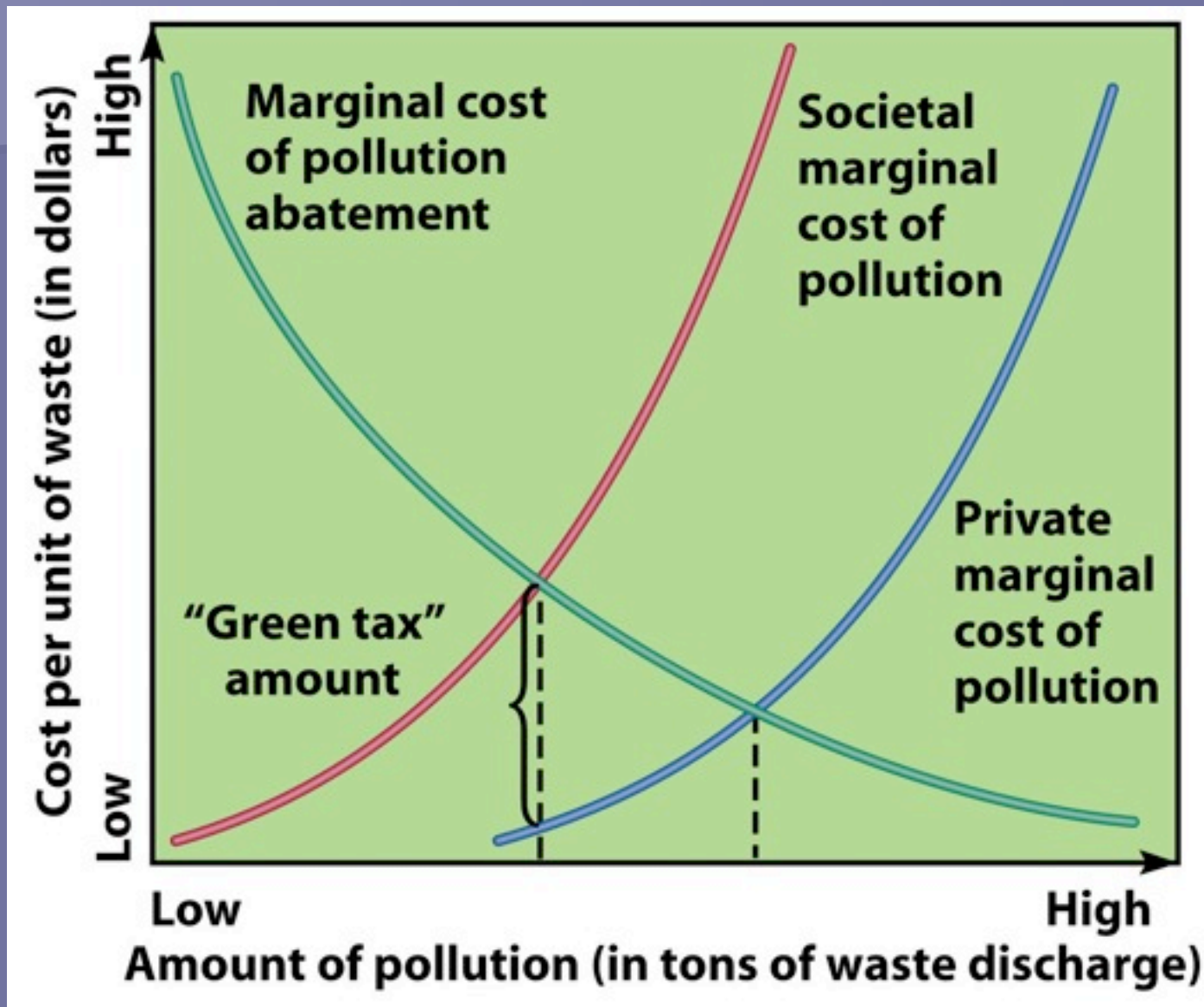
Private vs Social Cost of Pollution



Strategies for Pollution Control

- Command and Control Solutions (most economists do not prefer)
 - Government agency requires limitations to emissions or pollutants
 - Discourages development of low-cost alternatives
- Environmental Taxes/Tradable Permits (more economists prefer over the above)
 - If taxes are set at correct level private marginal cost of pollution = social cost of pollution

Effect of Tax on Optimum Pollution



Critiques of Environmental Economics

- Difficult to assess true costs of environmental pollution and abatement
 - Impacts of pollution on people and nature is uncertain
 - Ecosystem services have no known value
- Utilitarian economics may not be appropriate
 - Dynamic changes and time are not considered



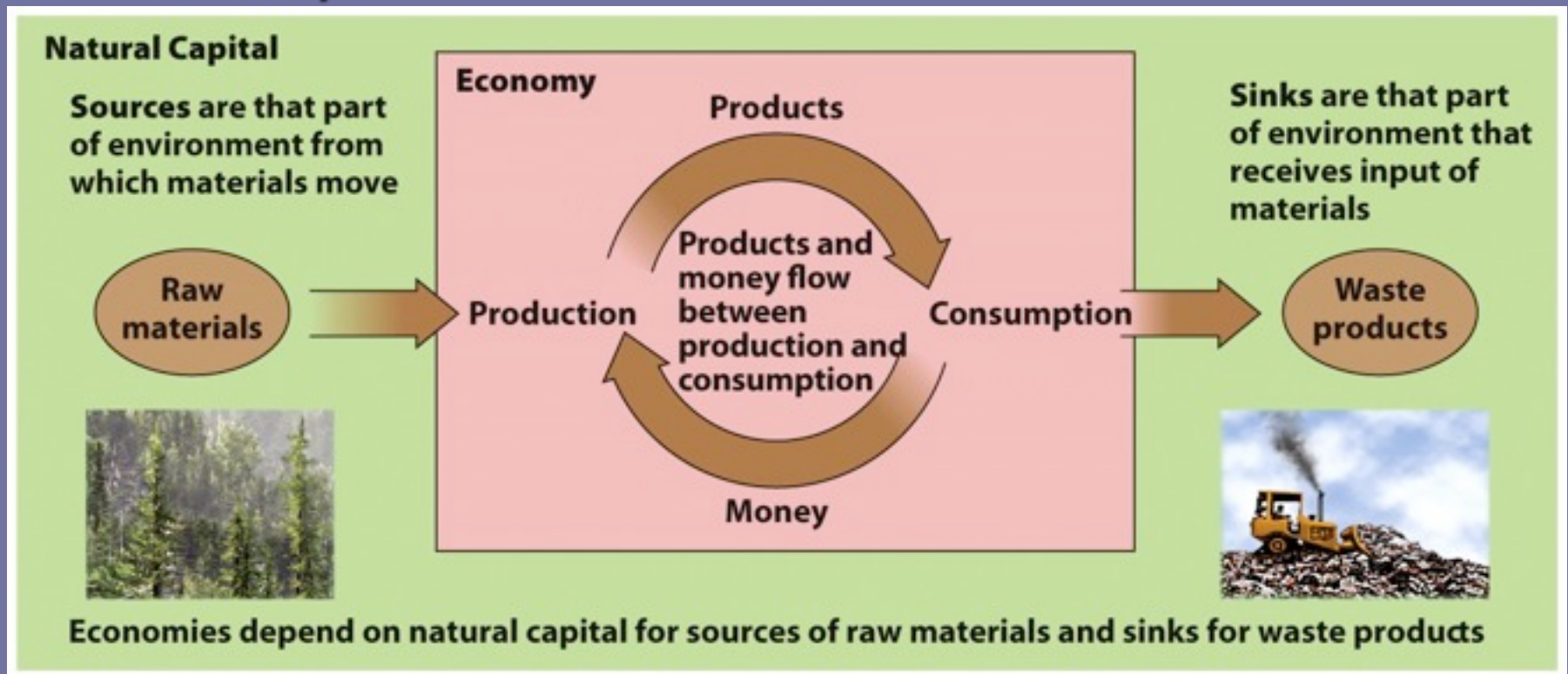
Critiques of Environmental Economics

- Utilitarian economics may not be appropriate
 - Dynamic changes and time are not considered
 - Does not account for equity, society wins but certain individuals lose
 - Economics chooses efficiency as its guide, if it is inefficient to save a species then we should not
 - This idea clashes with religious/personal beliefs



Economics and the Environment

- Economics - study of how people use limited resources to satisfy unlimited wants
 - Analytical tools include models

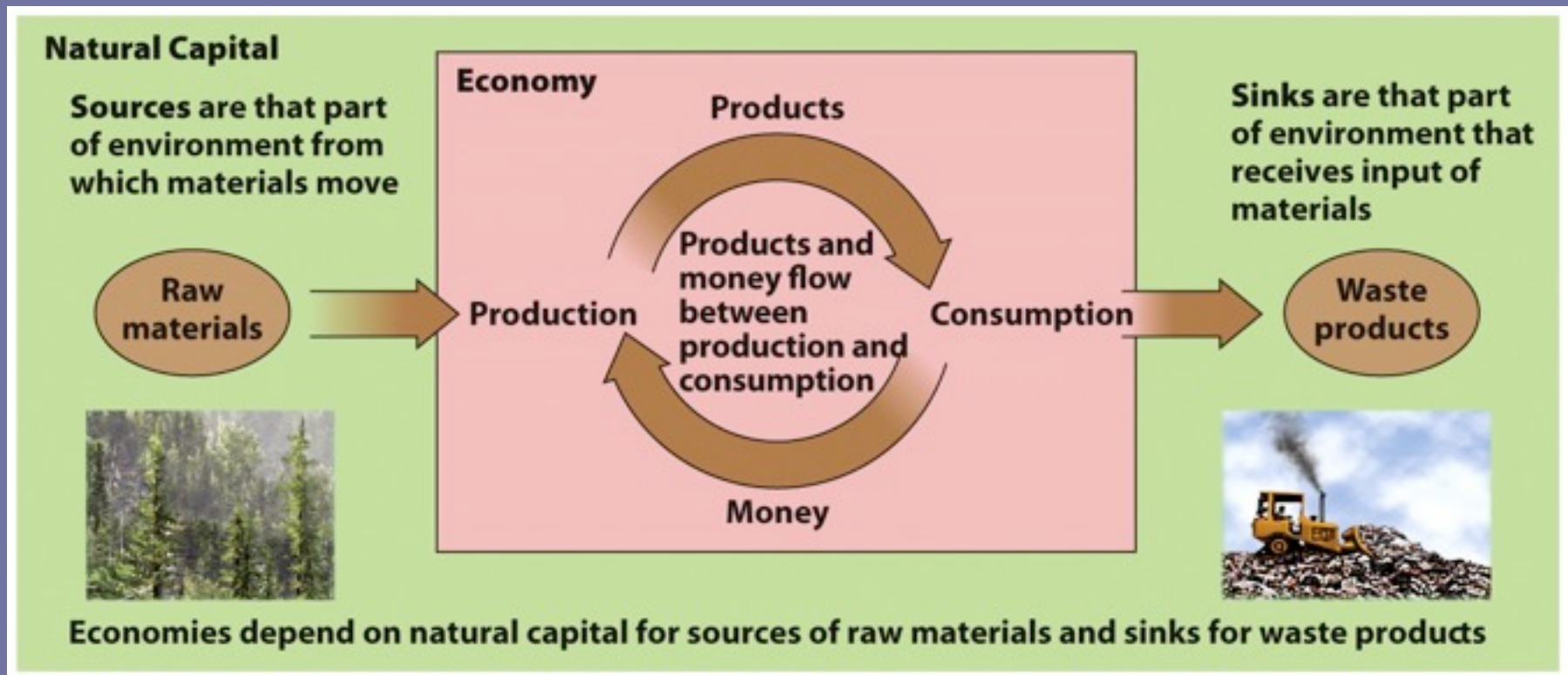


National Income Accounts

- Estimates of National Economic Performance and used in Politics
 - Gross Domestic Product (GDP)
 - Net Domestic Product (NDP)
- Many policies are developed from this accounts
- Environment may be overexploited to yield a higher GDP in developing countries
 - Ideally economic costs of env. degradation would be subtracted from GDP and any env. improvements would be added

Economics and the Environment

- Much of economic well being flows from natural, rather than human made assets and we should thus include their use and misuse into our National Income Accounts



National Income Accounts

- Environment may be overexploited to yield a higher GDP in developing countries
 - EPI (Environmental Performance Index)
 - Assesses a country's commitment to environmental and resource management

Table 2.2 Environmental Performance Index Scores and Rankings for Select Countries.

<i>Country</i>	<i>2008 EPI score</i>	<i>2006 EPI Ranking*</i>	<i>2008 EPI Ranking**</i>
New Zealand	88.9	1	7
Sweden	93.1	2	3
Finland	91.4	3	4
United Kingdom	86.3	5	14
Canada	86.6	8	12
Japan	84.5	14	21
Costa Rica	90.5	15	5
Australia	79.8	20	46
United States	81.0	28	39
Mexico	79.8	66	47
China	65.1	94	105
India	60.3	118	120
Mali	44.3	130	145
Mauritania	44.2	131	146
Chad	45.9	132	143
Niger	39.1	133	149

Canada ranks highest among North American countries. The lowest-ranked countries are in sub-Saharan Africa.

*Out of 133 countries

**Out of 149 countries

Source: www.yale.edu/epi

...environmental
ethics, values &
world views

Environmental Justice

- The right of every citizen regardless of age, race and gender, social class or other factor, to adequate protection from environmental hazards
- Generally, members of low income and minority communities:
 - Face more environmental threats and have fewer environmental amenities
 - Have less voice in planning
 - less access to health care, fresh foods and education

Environmental Justice

- Few studies have been done that examine how env. pollutants interact with socioeconomic factors to cause health issues
 - those that have been done fail to **conclusively** link the two
 - although anecdotal evidence abounds
 - residents in SF Bay-view Hunters point (a heavily polluted area) had 4x the hospitalizations for chronic illnesses
- Environmental Justice
 - that it is a fundamental human right and
 - a moral imperative to prevent them today so that pollution does not disproportionality affect any segment of society

Environmental Justice

- Challenge of environmental justice
 - To find equitable solutions that respect all groups of people
- Local issue
- National issue
 - 1994 Clinton signed an executive order to address his issue
 - NRC/New Orleans in 1997
- International issue
 - developed nations send waste to under developed nations
 - Basel Convention - no hazardous waste transport
 - climate change greatest social injustice of all time?

Environmental Ethics

- Field of ethics that considers the moral basis of environmental responsibility
- Western Worldview
 - Human superiority and dominance over nature
- Deep Ecology Worldview
 - All species have an equal worth to humans
- Most people's ethics fall somewhere in between

Tragedy of the Commons



- Garrett Hardin (1915-2003)
- Solving Environmental Problems is result of struggle between:
 - Short term welfare
 - Long term environmental stability and societal welfare
- Common pool resources
- Garrett used Common Pastureland in medieval Europe to illustrate the struggle