

CHAPTER 2

Humans and the Resources of the Earth: Sources and Sinks

THE EARTH AS SOURCES AND SINKS

- ***We draw resources from soil, water, biotic resources (forests and species diversity).***
- ***Pollution sinks are repositories of solid wastes and chemical pollutants***
- ***Each resource problem is also a social issue connected to one of the four sociocultural driving forces listed at the end of Chapter 1.***

Land and Soil

Soil is formed from minerals derived from weathered rock, decaying organic materials, and dead and decaying remains of plants.

We are completely dependent on the land for food.

- **98% of human food is produced on the land.**
- **Worldwide, food and fiber crops are cultivated on 12% of the land surface.**
- **24% is pasture used for livestock, while forests cover another 31%, most of which is used for fuel, lumber, paper and other forest products.**

Land and Soil

- ❑ Land can be degraded and eroded and become useless for human cultivation.
- ❑ Land is always eroding; the rate of natural erosion varies with local geology, climate and topography.
- ❑ A critical question concerns the rate at which soil degradation occurs relative to soil formation.
- ❑ *Agriculture is a human activity that has contributed to the accelerating erosion of topsoil and nutrients—this leads to declining crops and livestock yields.*

Soil and Food

An interesting question: if human intervention is linked to social degradation, how can increases in food production be explained?

- **Expanding cultivated areas.**
- **Increasing productivity.**
- *Increasing productivity all but destroyed traditional methods of soil preservation.*

Soil and Food

Recent estimates suggest that one third of the world's soil that ever existed is gone.

A U.N. Environmental Programme study found that soil erosion had reduced food production on 16% of the world's cropland.

This explains declining productivity—despite extensive use of fertilizers. Fertilizers are not a substitute for fertile soil.

Addressing Soil Problems

Techniques to cope with degraded soil include:

- ❑ ***Terracing***
- ❑ ***Contour plowing***
- ❑ ***Multiple cropping (planting ground cover crops between rows of other crops)***
- ❑ ***Low tillage methods (leave crop residues on the ground for soil binders and organic fertilizers)***
- ❑ ***Organic fertilizers (including human waste).***

ECONOMIC AND ECOSYSTEM SERVICES: PRICING SOIL DEGRADATION

Efforts to price soil degradation show that the costs are very high.

Direct costs replacing lost water and nutrients amount to **250 billion per year globally.**

Additional costs to health, private property, and navigation amount to **150 billion worldwide and 44 billion in the United States.**

WATER RESOURCES

Water is the lifeblood of the biosphere. Life is possible because of the solar-driven circulation of water through the hydrological cycle from the ocean to the atmosphere, from the atmosphere to the land, and back to the ocean.

Water is renewable, BUT most water circulates from the ocean to the atmosphere and back.

The recharge rate for groundwater, lakes, and rivers determines how much is available for use.

WATER RESOURCES

Human activities consume large amounts of water.

- ***Minimum requirements per day for human health = 26.5 gallons for drinking, cooking, and washing.***
- ***Agriculture accounts for about 70% of water use world-wide***
 - ***2.2 pounds of corn require 400 gallons of water.***
 - ***70-80% of water in irrigation systems is lost to evaporation or seepage.***
- ***Industry accounts for 20% of global water use.***
 - ***It takes about 400,000 liters of water to produce one car, and industrial societies produce about 50 million cars per year.***

GROWING WATER USE AND ITS PROBLEMS

To meet growing water demands, planners used dams, irrigation, and river diversion schemes.

- Problems with these techniques? Water tables are falling, lakes are shrinking, and wetlands are disappearing.**
- In coastal areas, salt water can contaminate soil when water tables shrink.**

Farmers are pumping groundwater faster than it can be recharged

GROWING WATER USE AND ITS PROBLEMS

Groundwater depletion is a problem for China as well as the U.S.

At the current rate of consumption, the Ogallala Aquifer under the Great Plains from Texas to South Dakota will be barren in several decades.

This will affect grain and beef production.

The good news is that the United States has reduced its per capita water consumption by increasing efficiency in agriculture and industries. This does not apply to household use.

WATER AND POLITICAL CONFLICT

The potential for conflict for water is great. However, this varies by the wealth of the country.



Addressing Water Problems

Irrigation

- Wasteful irrigation can be replaced with drip irrigation.

Bottled Water

- Affluent people drink bottled water for “safety” and taste.
- This is very costly, and produces a stream of plastic that is often not recycled.

Higher Prices

- Government policies could discourage excessive water usage.

Biodiversity and Forests

We often fail to appreciate the diversity of plant and animal life. *Forest resources are being rapidly depleted.*

Boreal

- Circle northern latitudes.
- Largest of remaining forests.
- Rapidly being destroyed by commercial logging

Temperate

- In the U.S. and Europe.
- Now stable in area, but tend to be regrown secondary forests.
- More fragmented and less diverse.

Tropical

- Brazil, Indonesia, Zaire, and Peru contain more than half the world's tropical forests.
- Rapidly being destroyed by commercial logging, farmers, and ranchers.

Tropical Deforestation

Temperate forest history not likely to be repeated in tropical forests because of climate, soil and ecosystem types.

- ❖ **Tropical forests are richer in biodiversity**
- ❖ **Faster growing**
- ❖ **More vulnerable**
- ❖ **Depend on nutrient recycling within the forest**
- ❖ **At their present rate of destruction, they are nonrenewable resources.**
- ❖ **Between 2020 and 2090 expected to be gone.**

FOREST ECONOMIC AND ECOSYSTEM SERVICES

Human and ecosystem services provided by forests:

- ❖ **Stabilizing landscapes.**
- ❖ **Protecting soils from erosion.**
- ❖ **Helps them retain moisture.**
- ❖ **Buffers against pests.**
- ❖ **Regulate waterflow and moderate floods.**
- ❖ **Keep rivers and seacoasts free from silt.**
- ❖ **Modulate climate at local and regional levels.**
- ❖ **Shape sunlight reflectivity.**
- ❖ **Help contain global warming.**

HUMAN CAUSES OF DECLINING BIODIVERSITY

❑ **HIPPCO acronym stands for:**

- ❑ **Habitat destruction.**

- ❑ **Invasive species.**

- ❑ **Pollution.**

- ❑ **Population (human)**

- ❑ **Climate change**

- ❑ **Overharvesting**

CONCERN FOR BIODIVERSITY: WHO CARES ABOUT WILD CREATURES?

Biodiversity is important for at least three reasons.

- **First:**

Tropical forests provide essential oils, gums, latexes, resins, tannins, steroids, acids, waxes, phenols, alcohols, rattans, bamboo, flavorings, sweeteners, spices, pesticides, and dyes.

More than half of all modern medicines are derived from or modeled on natural compounds from natural species.

Value of pharmaceuticals estimated at more than 30 billion per year.

CONCERN FOR BIODIVERSITY: WHO CARES ABOUT WILD CREATURES?

Biodiversity is important for at least three reasons.

- **First continued:**

Pharmaceutical companies are prospecting for useful products.

Two famous cases: Taxol and Rosy Periwinkle.

Amphibians are good sources of medicine and pharmaceuticals.

Wild species of foods can help with world food problems.

Pollinators provide services that exceed 30 billion per year in the U.S.

CONCERN FOR BIODIVERSITY: WHO CARES ABOUT WILD CREATURES?

Biodiversity is important for at least three reasons:
Second:

Ecosystem services include roles in niches played by a diversity of species in maintaining food chains, energy and matter cycles, and population balances.

CONCERN FOR BIODIVERSITY: WHO CARES ABOUT WILD CREATURES?

Biodiversity is important for at least three reasons.

Third:

Preserving diversity is important for esthetic and spiritual reasons.

Biodiversity is one of the world's most valued and irreplaceable resources.

Every living thing contains from 1 to 10 billion bits of information in genetic code, brought into existence over millions of years.

Species diversity is a source of beauty and mystery to many people.

Addressing Deforestation and Declining Biodiversity

Specific initiatives to preserve forests and biodiversity.

1. **Promoting sustainable use: use by local and indigenous peoples can generate more value than logging.**
2. **Debt for nature swaps: participating nations can act as custodians for protected forest reserves in return for debt relief or foreign aid.**
3. **Preserving nature in place: set up wilderness reserves.**

Addressing Deforestation and Declining Biodiversity

Specific initiatives to preserve forests and biodiversity, continued.

4. **Gene banks and conservatories:** place plants and animals in specialized institutions such as zoos, gene banks, etc.
5. **Bioprospecting:** Companies like Merck are trying to locate tropical organisms as sources of pharmaceuticals.
6. **International treaties.** For example, 1973's Convention on International Trade in Endangered Species of Wild Fauna and Flora provides a legal tool for controlling trade in threatened plants and animals.

WASTES AND POLLUTION

HUMAN ECONOMIES GENERATE ENORMOUS AMOUNTS OF WASTE.

EPA estimates of solid waste sources:

75% produced by mining, oil and gas production.

13% by agriculture.

9.5% by industry.

1.5% by municipal garbage.

1% by sewage sludge.

WASTES AND POLLUTION

HUMAN ECONOMIES GENERATE ENORMOUS AMOUNTS OF WASTE.

Electronic, or e-waste (discarded TVs, cellphones, computers, etc.) is the fastest growing solid waste problem in the United States and the world.

- ***They are a source of toxic waste such as polyvinyl chloride, lead, and mercury.***
- ***In the U.S., only 2% of e-waste is currently recycled.***

Chemical Pollution from Agriculture

Agriculture is a source of pollution and toxic substances.

***Modern pesticides increase crop production, but at a cost.
Today's pesticides are 10 times as toxic as their
predecessors .***

***DDT has been banned, but organophosphates are more
toxic—although not as long-lived.***

***WHO estimates that 25 million LDC agricultural workers are
poisoned each year; at least 20,000 die.***

***Pesticides have limited effectiveness—insects develop
tolerance, and predators that eat insects are harmed.***

Addressing Solid Waste Problems

Strategies for dealing with solid waste:

Incineration

- Reduces volume of waste, but produces ash with high levels of chemicals. Does not discourage production of wastes and transfers many of them from one sink to another.

Recycling

- Best known solution. Switzerland and Japan recycle about half their solid waste. The U.S. recycles about 30%. Profitability often determines what is recycled.

Reuse

- Extends resource supplies and reduces energy use and pollution more than incineration or recycling. Beverage bottles are a good example. Germany reuses 95% of its bottles. In the U.S., this is done on a limited basis.

Addressing Solid Waste Problems

Dematerialization of production and consumption

The solid waste stream could be reduced by introducing efficiencies in extraction, production, or consumption.

For consumers, this means manufacturing more durable, long-lasting goods, rather than disposable ones. Reusing things and reducing packaging.

This means significant adjustments to the throwaway economic model.

Municipal Pollution

Municipal pollution includes water and air pollutants.

In LDCs, human sewage is typically not treated and is contaminated with microorganisms that cause dysentery, typhoid and cholera.

LDCs frequently lack access to clean water, so people are exposed to food and soil that causes disease.

The poor in MDCs are often exposed to pollution hazards.

Disadvantaged populations everywhere have lower life expectancies.

Pollution Trends

Some problems:

WHO estimates that 1.4 billion people in LDCs do not have access to clean water.

Consequently, about 93,000 people die prematurely from infectious diseases.

In the U.S., nitrogen dioxide levels have not dropped since 1980.

Urban smog and air pollution are problems for many countries.

Conclusion: The Resources of the Earth

A summary of the earth's vital signs:

Pollution is a problem for both MDCs and LDCs, although some progress has been made.

Wild biological resources are threatened worldwide, and are underappreciated for their usefulness to humans.

Severe water problems loom because of increased demand and uneven water supplies.

Land and food security problems suggest an upper limit to previously successful techniques.

Conclusion: The Resources of the Earth

The human “footprint” on nature is very large—very little untouched nature is left anywhere in the world.

Humans appropriate 25% of the photosynthetic product of the earth as a whole and 40% of the of the photosynthetic product on land.

The Netherlands Fallacy refers to countries like the Netherlands and England that appear to be environmentally protective and frugal, but in fact, import so many goods that their environmental impact spreads far beyond their borders.