

Supplementary Notes (PJ Shlachtman, Miller book)

Environmental Problems, Their Causes and Sustainability

Living Sustainably

Environment - all external conditions and factors that affect living organisms

Ecology - the study of relationships between living organisms and their environment

Environmental Science: the interdisciplinary study that examines the role of humans on earth; includes the disciplines of chemistry, economics, politics, ethics, etc.

Solar Capital - energy from the sun - provides 99% of the Earth's energy

Earth Capital - the planet's air, water, soil, wildlife, minerals, natural purification, recycling and pest control processes

Sustainability – the ability of a specified system to survive and function over a specified time

Carrying Capacity

- the maximum number of organisms a local, regional or global environment can support over a specified time period
- is dependent on the available resources and the ability of the environment to clean itself of the waste products produced
- Varies with: Location, Time, Types of technology

Growth and the Wealth Gap

Linear Growth

- a quantity increases by a constant amount per unit of time
- yields a straight line sloping upwards

Exponential Growth

- a quantity is increased by a fixed percentage of the whole in a given time as each increase is applied to the base for further growth
- Creates a J-shaped curve - e.g., the human population

Doubling Time

- the amount of time it takes to double resource use, population size, or money in a savings account that is growing exponentially
- Rule of 70: $70/\text{percentage growth rate} = \text{doubling time (in years)}$; e.g., growth rate = 3%; doubling time = $70/3\% = 23.3$ yrs
- at the current rates of exponential growth, human population will reach 8 billion by 2027 (Current global growth rate = ~1.3%)

Economic growth: an increase in (a country's, state's, world's) capacity to provide goods and services for people's final use

- **GNP – Gross National Product** = the market value in current dollars of all goods and services produced within and outside of a country by the country's businesses for final use during a year
- **GDP – Gross Domestic Product** = the market value in current dollars of all goods and services produced within a country for final use during a year
- **Per Capita GNP** = the GNP divided by the total population (used to show an individual's slice of the economic pie)

Developed / Developing Countries

- Developed countries
 - highly industrialized
 - usually have per capita GNPs
 - United States, Japan and Germany together account for over half the world's economic output
 - approximately 80% of the world's population
 - consume ~88% world's resources
 - produce 75% of waste and pollution
- Developing countries
 - low to moderate industrialization and per capita GNPs
 - most are in Africa, Asia, and Latin America (they account for 80% of the population but only have 15% of the wealth and income)

- 95% of population increase is from growth in the developing nations

What is sustainable development?

Economic Development – using economic systems to improve the quality of people’s lives and the environment

Sustainable Development – meeting present needs without preventing future generations of humans and other species from meeting their needs

Resources

Ecological resource – anything required by an organism for normal maintenance growth and reproduction (e.g., food, water, shelter, habitat)

Economic resource – anything obtained from the environment to meet human needs and wants (e.g., food, water, shelter, transportation, communication, and recreation)

Renewable (Perpetual) resources – on a human time scale these resources are essentially inexhaustible (e.g., direct solar energy, winds, tides, and flowing water)

Potentially renewable resources - resources that can be replaced rapidly through natural processes (e.g., fresh air, fresh water, fertile soil, plants and animals (biodiversity))

○ Biodiversity

- **Genetic diversity** – varies in the genetic make-up among individuals within a single species
- **Species diversity** – variety among the species or distinct types of living organisms found in different habitats of the planet
- **Ecological diversity** – variety of forests, deserts, grasslands, streams, lakes, oceans, wetlands, and other biological communities

Sustainable yield – the highest rate at which a potentially renewable resource can be used indefinitely without reducing its available supply

Environmental degradation – when the rate at which a resource is used exceeds the rate at which it can be replaced

Non-renewable Resources – resources that exist in a fixed quantity in the earth’s crust can be completely used up on the human time scale (fossil fuels, minerals)

Economically depleted resource – a resource becomes economically depleted when the cost of exploiting what is left exceeds the economic value (a resource is considered to be economically depleted when 80% has been harvested).

Reduce, Reuse, Recycle: waste less, use less, develop a substitute or do without

- **Reduce** – produce less → waste less (most energy efficient)
- **Reuse** – using a resource over and over in the same form
- **Recycling** – collecting and reprocessing resource into a new products (1^o or 2^o – least energy efficient)
- **Reserves** – known deposits from which a useable mineral can be profitably extracted at current prices

Pollution

- any addition to air, water, soil, or food that threatens the health, survival or activities of humans or other living organisms
- Enter the environment through natural (volcanic eruption) or anthropogenic activities (burning coal)

Point sources – pollutants that come from single identifiable sources (for example, smoke stack, tailpipe)

Nonpoint sources – pollutants that come from dispersed, difficult to identify, sources (runoff)

Harmful Impacts of Pollutants

Three factors determine how severe the harmful effects of pollution are:

1. **Chemical nature** – how active and harmful it is to living organisms
2. **Concentration** – the amount per unit of volume
3. **Persistence (degradability)** – how long it stays in the air, water, soil or body

Pollution Solutions

Two basic approaches to dealing with pollution:

1. Prevention (input)
2. Clean up (output)

Three major problems with Clean-Up:

1. Temporary
2. Usually transfers a pollutant another location

3. Too costly
4. Currently 99% of government spending goes to clean-up and only 1% to prevention

Environmental And Resource Problems: Causes and Concentrations

Causes of Environmental Problems:

- rapid population growth
- rapid and wasteful use of resources
- simplification and degradation of the earth's life-support systems
- poverty causes people to use potentially renewable resources unsustainable for short-term survival
- economic and political systems fail to encourage "earth friendly" forms of development
- economic and political systems fail to have market prices of goods reflect overall environmental costs
- our urge to dominate nature and manage it for our own use before knowing about how nature works

Environmental Impact (I) (depends on three factors)- Paul Ehrlich

1. The number of people (population size, **P**)
2. The average number of units of resource each person uses (per capita consumption or affluence, **A**)
3. The amount of environmental degradation and pollution produced for each unit of resource used (destructiveness of the technologies used to provide and consume resources, **T**)

$$P \times A \times T = I \text{ (environmental impact)}$$

Cultural Changes and Sustainability

What major Human Cultural Changes have taken place?

- Age of our solar system - 4.6 billion years
- Humans have been on Earth for 60,000 years

The Evolution of People:

Hunter's and gatherers – until about 12,000 years ago we moved as needed to find food for survival

- survived through expert knowledge of their natural surroundings
- had only three energy sources:
 1. the sun
 2. fire
 3. their own muscle power
- advanced hunter-gatherers had a greater impact on their environment than the earlier hunter-gatherers who were much more Earth friendly
- attempted to live sustainably through low resource use per person and working with nature in small groups

The Agricultural Revolution

- began 10,000 to 12,000 years ago
- involved a gradual transition from nomadic hunting lifestyle to a lifestyle based on a centered community where people domesticated wild animals and plants
 - initially involved subsistence farming (growing only enough to feed your individual family)
 - impact on the environment included:
 - use of domesticated animals to have increased energy
 - more reliable food source led to increase in birth rates
 - large areas were cleared and irrigation systems were built
 - People began accumulating material goods
 - Farmers could grow more than just enough for their families
 - Urbanization became practical and prevalent
 - The survival of plants and animals once vital to humanity became less important
 - human population began working to tame and manage nature rather than working with nature to survive

The Industrial Revolution

- began 275 years ago (~1870s in the US)
- production, commerce, trade, and distribution of goods expanded rapidly

- shifted dependence from renewable resources to non-renewable resources
- new machines were then created and large-scale production became prevalent
- more food and supplies became available so the population began to grow rapidly

Information Revolution – current cultural shift

- new technologies are enabling people to deal with more information more rapidly
- the impact of this on the environment is not yet clear
- positively: we are finding out new information on how to respond to environmental problems more effectively
- negatively: there is so much information that we are being faced with that the small useful amount may be overlooked

Is our present course sustainable?

Two opposing views:

1. The world is not overpopulated. People are the most valuable resource. Technological advances will allow us to clean up pollution, find substitutes for resources and continue to expand the Earth's ability to support more humans as it has done in the past.
2. Environmentalists feel we are depleting and degrading Earth's natural capital at an accelerating rate, faster rates and over larger areas than ever before in the history of our existence, and we are causing Earth great harm that is not fixable on a human time scale.

Environmental Worldviews and Sustainability

Environmental worldviews – how people think the world works, what they think their role in the world should be, and what they see as right and wrong environmental behavior

The basic **planetary management beliefs** of the world:

1. We are Earth's most important species, and we are in charge of the rest of nature
2. There is always more
3. All economic growth is good, more economic growth is better, and the potential for economic growth is essentially limitless.
4. Our success depends on how well we can understand, control, and manage the earth's life-support systems for our benefit

The basic **earth-wisdom worldview** beliefs of the world:

1. Nature exists for all of Earth's species, not just for people
2. There is not always more
3. Some forms of economic growth are environmentally beneficial and should be encouraged, but some are environmentally harmful and should be discouraged
4. Our success depends on learning to cooperate with one another and with the rest of nature to learn how to work with the earth

The key to creating a sustainable society:

Earth Wisdom – Learning as much as we can about how Earth sustains itself and adapts to ever-changing environmental conditions and integrating such lessons from nature into the ways we think and act