

Environmental Problems, Their Causes, and Sustainability

Ashok Choudhary
Ranchi University

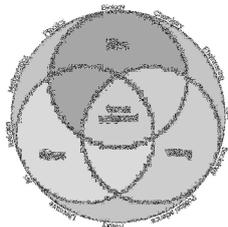
Introduction

Humans have always inhabited both the natural world and the social world.

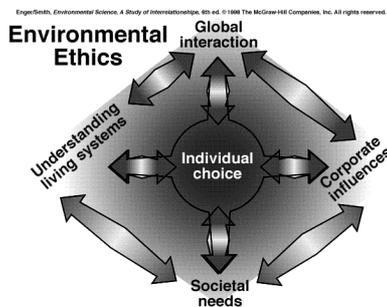
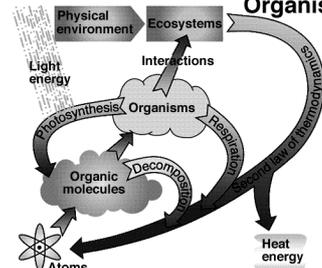
- *Environment*: everything that affects an individual or community
- *Ecology*: biological science that studies the relationship between living organism and their environment
- *Environmentalism*: a social movement dedicated to protect earth's life support systems

- *Environmental Science*: Systematic study of our environment, and our proper place in it.

- Interdisciplinary
- Integrative
 - Natural Sciences
 - Social Sciences
 - Humanities
- Mission Oriented



Interactions – Environment and Organisms



What keeps us alive? Natural Capital

- Resources
- Solar Energy
 - Water
 - Air
 - Soil
 - Minerals

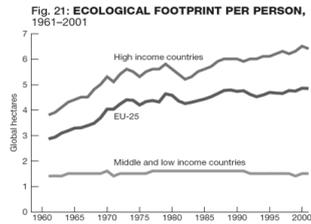
- Services:
- Climate Control, Nutrient Recycling, Pollution Control, Population Control, Water Treatment, Pest & Disease Control



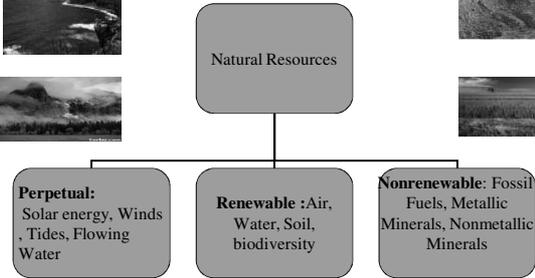
Ecological Footprint



Is a measure of how much of the earth's natural capital and biological income each of us uses.



What is a Resource?



Major Environmental Problem

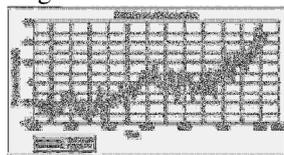
Biodiversity Depletion *habitat destruction *habitat degradation *extinction	Air Pollution *global climate change *stratospheric ozone depletion *urban air pollution *acid deposition *outdoor pollutants *indoor pollutants *noise
Food Supply Problems *overgrazing *farmland loss and degradation *wetlands loss and degradation *over fishing *coastal pollution *Soil erosion *Soil salinization *Soil waterlogging *Water shortages *Groundwater depletion *Loss of biodiversity *Desertification	Water Pollution *sediment *nutrient overload *toxic chemicals *infectious agents *oxygen depletion *pesticides *oil spills
Waste Production *solid waste *hazardous waste	

Causes of Environmental Problems

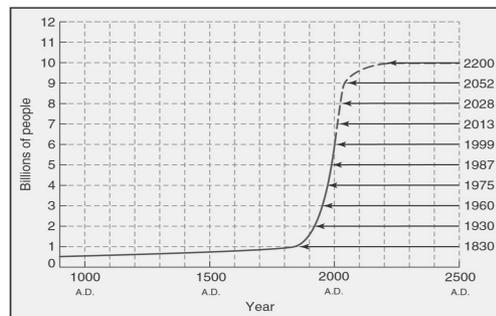
- rapid population growth
- rapid and wasteful use of resources
- simplification and degradation of the earth's life-support systems
- poverty causes people to use potentially renewable resources unsustainable for short-term survival
- economic and political systems fail to encourage "earth friendly" 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

The Global Environmental Picture

- Rapid human population growth and increasing consumption per person
- Decline of ecosystems
- Global atmospheric changes
- Loss of biodiversity



Rapid Human Population Growth



Environmental Impact (I)

Depends on three factors (Paul Ehrlich)

- The number of people (population size, **P**)
- The average number of units of resource each person uses (per capita consumption or affluence, **A**)
- 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**)
- $P \times A \times T = I$ (environmental impact)

Indicators of Decline of Vital Ecosystems

Human Population > 6 Billion.

- Food shortages and famines exist in many densely populated areas
- Water Quantity and Quality Issues
- Agricultural soils degraded
- Oceans over fished
- Fossil Fuel Burning
 - Air and Water Pollution
- * Landscape Destruction
 - Loss of Biodiversity

Growth and the Wealth Gap

Linear Growth

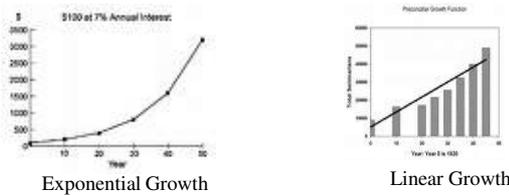
- a quantity increases by a constant amount per unit of time
- yields a straight line sloping upwards

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

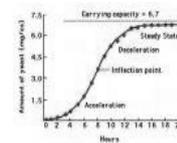
Doubling Time

- 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/percentage growth rate = 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%)



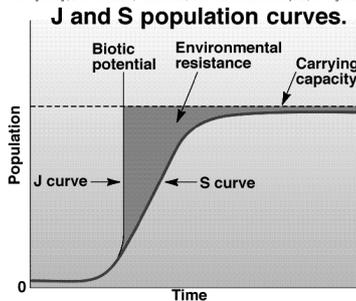
Exponential Growth

Linear Growth



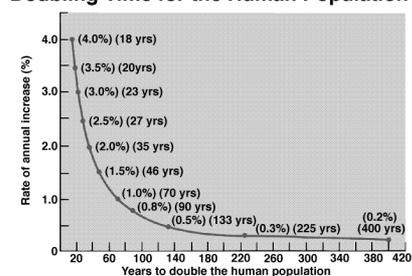
S Curve Population Growth

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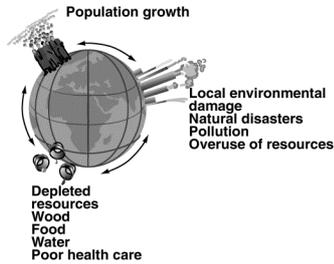
Population Growth: How fast is the human population growing?

Doubling Time for the Human Population



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Human Population Growth



Economic Growth & Economic Development

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

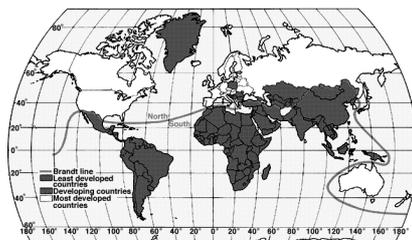
- **Developed countries**
 - highly industrialized
 - usually have per capita GNPs
 - United States, Japan and Germany together account for over half the world's economic output
 - approximately 80% of the world's population
 - consume ~88% world's resources
 - produce 75% of waste and pollution
- **Developing 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

NORTH / SOUTH DIVISIONS

- Poor countries tend to be located in Southern Hemisphere.
- World Bank estimates more than 1.3 billion people (1/5 world population) live in acute poverty of < \$1 (U.S.) per day.
 - 70% women and children
 - Self-Sustaining
 - Daily survival necessitates over-harvesting resources thus degrading chances of long-term sustainability.

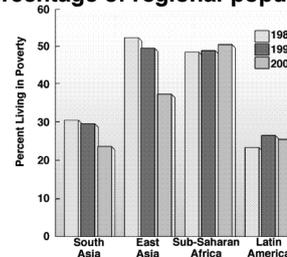
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The world of underdevelopment.



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People living in poverty as a percentage of regional population.

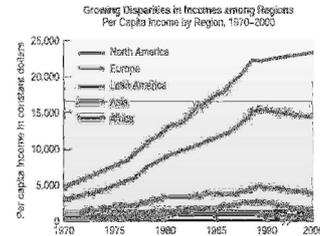


What is sustainable development?

- **Economic Development** – using economic systems to improve the quality of people’s lives and the environment
- **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)
- **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).
- **Sustainable Development** – meeting present needs without preventing future generations of humans and other species from meeting their needs

Division of Resources

Affluent lifestyles of richer countries consume inordinate share of natural resources and produces high proportion of pollutants.



Where do pollutants come from, and what are their harmful effect?

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:

- Prevention (input)
- Clean up (output)

Three major problems with Clean-Up:

- Temporary
- Usually transfers a pollutant another location
- Too costly
- Currently 99% of government spending goes to clean-up and only 1% to prevention

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** (12,000 years ago)
- **The Agricultural Revolution** (10,000 to 12,000 years ago)
- **The Industrial Revolution** (275 years ago 1870s in the US)
- **Information Revolution** (current cultural shift)



Sustainable Development

“Meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

- Benefits must be available to all humans, not just sub-set of privileged group.

Is our present course sustainable?

Two opposing views:

- 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.
- 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

The basic planetary management beliefs of the world:

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



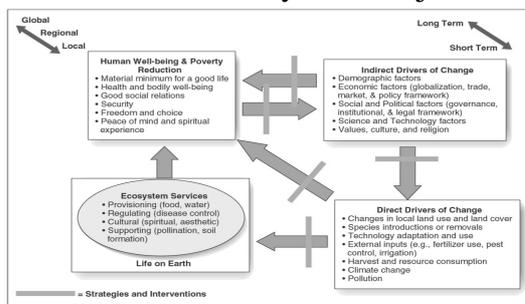
The basic earth-wisdom worldview beliefs of the world:

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

Global Efforts

- Montreal Protocol - 1987
- Kyoto Protocol – 1997 (166 nations)
- Millennium Ecosystem Assessment, 2001 (MEA)
- Pilot Analysis of Global Ecosystem (PAGE)

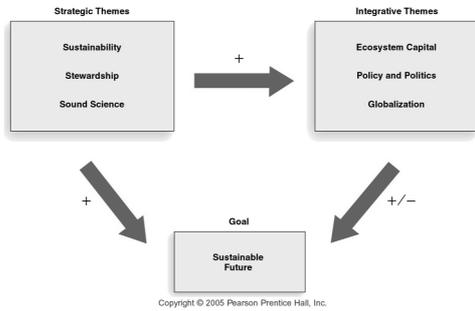
Conceptual Framework for Millennium Ecosystem Project



Three Strategic Themes

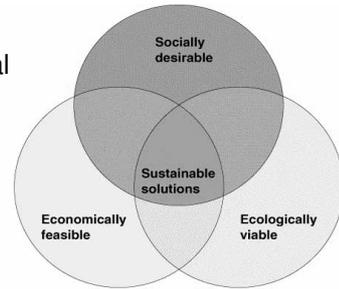
- Sustainability: interactions with the natural world that we should be working toward
- Stewardship: the ethical and moral framework of our actions
- Sound science: the basis for our understanding of how the world works

Unifying Themes



Four Dimensions to Sustainable Solutions

- Environmental
- Social
- Economic
- Political



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