1. Economics, Sustainability (Herman Daly, Wendell Berry)

- Announcements
  Turn in the grading criteria for your creations
  Forbes Lobby 0930-1500h Thursday

- Thank Yous
Competent before radical...
Data and science, then fingerpainting

Photos courtesy of Ben Joslin
Conservation Biology Creativity Forum

Forbes Lobby 0930-1500h Thursday 02 December 2004

Two people per hour to watch over things and help set up.

0930-1030h  a.____________  b.____________

1030-1130h  a.____________  b.____________

1130-1230h  a.____________  b.____________

1230-1345h  All students review and grade

1400-1500h  a.____________  b.____________

Move Furniture, Tables, “Table cloths”, display boards, etc.
How will you display your work?

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NAME
TITLE
GRADING CRITERIA (out of 100) and PROJECT
Economics of Conservation  Van Dyke Ch 12

1. Economics, Sustainability
   - Herman Daly
   - Wendell Berry

- Population
- Consumption
- Economies

Assumptions and Goals
- Externalities
- Genuine Progress Indicator

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**Exponential Growth**

![Exponential Growth](image)

**Logistic Growth**

![Logistic Growth](image)

**Human Population Growth**

![Human Population Growth](image)
Role of Human Population Growth...

1 million people added ~ every 5 days

Miller, 2003 Figure 1-6 Past and projected population size for developed countries, developing countries, and the world, 1950–2100. More than 95% of the addition of 3.6 billion people between 1990 and 2030 is projected to occur in developing countries. (Data from United Nations)

Role of Human Population Growth...

Demographic Transition

Miller, 2003 Figure 11-18 Generalized model of the demographic transition.
Age Structure Diagrams
- note age of reproduction
- currently 30% under 15 (=1.7 billion)

![Age Structure Diagrams](image)

**Developed Countries**
1.2 billion people (~19%)
high average per capita purchasing power
have 85% world’s wealth
use 88% natural resources
generate 75% waste and pollution

**Developing Countries**
81% of the people
have 15% world’s wealth
use 12% world’s natural resources
produce 25% waste and pollution

**I = P AT**

Environmental Impact = Population x Affluence X Technology

(impact of each unit of consumption)

(Poor parents in a developing country need to have 70-200 children to equal the impact of 2 U.S. children)
Value added
Relevant Laws

- Law of Conservation of Matter
  all atoms conserved
  there is no “away”

- First Law of Thermodynamics:
  energy neither created or destroyed, but may
  be converted from one form to another

- Second Law of Thermodynamics:
  when energy changed from one form to
  another, some of the useful energy degraded
  to low quality, dispersed, less useful energy
  (usually lost as heat; entropy)

Traditional Neoclassical Economics (Miller 2003):

Economy= system of production, distribution, and consumption
of goods and services (scarcity)

Driven by wants and needs of govt, society, individuals

Decisions about
A. what goods and services
B. how produce
C. how much
D. how distribute
  are made by individuals, governments, businesses

Use resources:
A. natural
B. human
C. financial
D. manufactured
  to make goods and services
Traditional Neoclassical Economics (Miller 2003):

Command
- government

Free Market
- markets
- competition
- information
- full cost pricing

Capitalist Market System

~ monopoly
~ global free trade
gov't subsidies/tax breaks/"insurance"
withhold information
maximize profits (pass costs to others, future)
FIGURE 2.3 Shift in Supply. If production costs fall, firms can produce the same quantity at a lower price or a larger quantity at the same price. The supply curve shifts to the right.

FIGURE 2.4 Shift in Demand. The demand for a product depends on its price but may also depend on other variables, such as income, the weather, and the prices of other goods. For most products, demand decreases when income rises. A higher income level shifts the demand curve to the right.

FIGURE 2.8 Long-Run Movements of Supply and Demand for Mineral Resources. Demand for most resources has increased dramatically over the past century, but prices have fallen or risen only slightly in real (inflation-adjusted) terms because cost reductions have shifted the supply curve to the right just as dramatically.
Traditional Neoclassical Economics (Miller 2003):

Government Intervention:

- Prevent monopolies
- Dampen boom and bust cycles
- Basic services
- Social security, welfare
- Stem fraud and other crime
- Disaster relief
- Protect common-property resources
- Manage public lands
- etc.

Bush Tax Cuts: Mean tax savings to top 1% over 4 years: $103,999
to bottom 20%: $45

Percent of tax benefits accruing to bottom 60%: 8.5
to top 1%: 38.9% of benefits
(Utne Reader Nov-Dec 2003)

Internal Market Costs
vs.
Externalities
- External to Market Forces
- Noise
- Pollution
- Acid rain
- Erosion
- Global Warming
- Eutrophication
- Disease
- Asthma
- Birth Defects
- Behavior and Intelligence

Figure 10.1 VanDyke, 2003
The relationship between marginal net private benefits and marginal external cost. The optimal level of economic activity occurs at point Q*. Here production is reduced from the level that maximizes profit (Q**) but reduces external costs associated with production. Areas 1 is the net benefit to society at Q*. 1 + 2 is the total profit from the economic activity, 3 is the amount of profit lost as economic activity is reduced from Q** to Q*, and 3 + 4 is the reduction in external costs associated with the same reduction in economic activity.
Pollution (marginal costs, marginal benefits)

Figure 2-6 The cost of removing each additional unit of pollution rises. Cleaning up a certain amount of pollution is affordable, but at some point the cost of pollution control is greater than the harmful costs of pollution to society.

Figure 2-7 Finding the optimum level of pollution. This graph shows the optimum level at 50%, but the actual level varies depending on the pollutant.

Education example...
A FIGURE 23–10 The benefit-cost ratio for reducing pollution. The cost of pollution control increases exponentially with the degree of control to be achieved. However, benefits to be derived from pollution control tend to level off and become negligible as pollutants are reduced to near or below threshold levels. The optimum cost-effectiveness is achieved at less than 100% control.

Wright and Nebel 2002

A FIGURE 23–11 Cost-effectiveness of pollution control over time. (a) Pollution-control strategies generally demand high initial costs. The costs then generally decline as those strategies are absorbed into the overall economy. (b) Benefits may be negligible in the short term, but they increase as environmental and human health recover from the impacts of pollution or are spared increasing degradation. (c) When the two curves are compared, we see that what may appear as cost-ineffective expenditures in the short term (5–10 years) may, in fact, be very cost effective in the long term.

Wright and Nebel 2002
Fossil Fuels
- Oil
- Natural Gas
- Coal

Arctic National Wildlife Refuge (ANWR)
- 1/5 land in wildlife refuge system
- 19% chance of finding enough oil to supply U.S. for 24 months
- Persian Gulf oil cheaper
  (more $ to defend than worth)

- Lots oil spills likely
- Pipelines vulnerable
- Fragile tundra
- Impact acreage
- Fuel efficiency better route
Fossil Fuels
- Oil
- Natural Gas
- Coal

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tr>
<td>Ample supplies (225-900 years)</td>
<td>Very high environmental impact</td>
</tr>
<tr>
<td>High net energy yield</td>
<td>Severe land disturbance, air pollution, and water pollution</td>
</tr>
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<td>Low cost (with huge subsidies)</td>
<td>High land use (including mining)</td>
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<tr>
<td>Mining and combustion technology well developed</td>
<td>Severe threat to human health</td>
</tr>
<tr>
<td>Air pollution can be reduced with improved technology (but adds to the cost)</td>
<td>Relaxes radioactive particles and mercury into air when burned</td>
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Figure 6-30 Advantages and disadvantages of using coal as an energy resource.

Figure 6-28 Advantages and disadvantages of using conventional natural gas as an energy resource.

Miller, 2003

Coal
- Ample supply
- High net energy yield
- Very high air pollution
- High CO₂ emissions
- 65,000-200,000 deaths per year in U.S.
- High land disruption from surface mining
- High land use
- Low cost (with huge subsidies)

Figure 6-35 Comparison of the risks of using nuclear power and coal-burning plants to produce electricity.

Nuclear Energy

Accidents catastrophic? sabotage?

Chernobyl, Three-Mile Island

What to do with
Radioactive Waste?
- 10k-240k years
- bury it (ground)
- bury it (ice)
- bury it (ocean)
- shoot into space
- descending subduction zones

Yucca Mountain, NV
- leaks, faults, volcanoes
- 6 shipments/day for 30 years

Nuclear Weapons

Advantages
- Ample supplies (125 years)
- High net energy yield
- Low cost (with huge subsidies)
- Less air pollution than other fossil fuels
- Lower CO₂ emissions than other fossil fuels
- Easy transport by pipeline
- Good fuel for fuel cells and gas turbines

Disadvantages
- Nonrenewable resource
- Releases CO₂ when burned
- Difficult to transport among countries
- Methane (a greenhouse gas) can leak from pipelines
- Sometimes burned off and wasted at wells because of low price
- Requires pipeline distribution system

Nuclear
- Ample supply of uranium
- Low net energy yield
- Low air pollution (mostly from fuel reprocessing)
- Low CO₂ emissions (mostly from fuel reprocessing)
- About 6,000 deaths per year in U.S.
- Much lower land disruption from surface mining
- Moderate land use
- High cost (with huge subsidies)
-Tragedy of the Commons
e.g., grazing, fishing
-Market Failure

Figure 2.5
A classic example of Commons’ “tragedy of the commons” (1968), in which a commons is a resource to which is mindlessly overgrafted by the normal decison behavior of each individual. In the same way, in the future, a large amount of oil will be freely used as long as there is no economic incentive. If we continue to plant and harvest according to this principle of maximizing personal benefits and minimizing personal costs, the oil population will be depleted.

Natural Capital and Natural Resources:
- everything flowing in natural economy and human economy
Conventional Neoclassical Economics

- Private Property
- Economic Growth always good
- Allocate based on price
- More always better for an individual (utility curves)

Figure 2-2: Conventional view of economic activity. In a market economic system, economic goods and money flow between households and businesses in a closed loop. In many economics textbooks, both market economic systems are shown as here, as if they were self-contained and thus independent of the natural resources that support all economies and all life. This model reinforces the idea that unlimited economic growth of any kind is sustainable.

Pindyck and Rubinfeld 1992
FIGURE 3.11 Maximizing Consumer Satisfaction. When the budget line and the indifference map are combined, consumers maximize their satisfaction by choosing A. At this point the budget line and indifference curve $U_4$ are tangent, and no higher level of satisfaction can be attained. At A, the point of maximization, the marginal rate of substitution between the two goods equals the price ratio. At B, however, the marginal rate of substitution (1) is greater than the price ratio (1/2), and maximization does not occur. Pindyck and Rubinfeld 1992

FIGURE 23-2 Classical view of economic activity. Land (natural resources), labor, and capital are the three elements constituting the "factors of production." Economic activity involves the circular flow of money and products.

Wright and Nebel 2002
Scavengers are key; we can't really throw things away.
Figure 12.10
An alternative view of the relationship between the economy and the environment as understood within the framework of environmental economics. The physical environment provides raw materials and energy, stock (nonrenewable) resources, and services, all of which are used by human economic systems. In the past, the human economy was small relative to the biosphere, and sources of raw materials and sinks for wastes were relatively large. As the human economy has grown, the capacity and limits of the biosphere have diminished because of use and degradation, and so have their capacities to provide resources and services. This has led to an increasing reliance on environmental constraints and an explicit consideration in producing goods and services and disposing of the waste that such production creates. 

VanDyke, 2003

Adapted from Goodland, Daly, and JU Sant’Anna (1992) and Costanza et al. (1997)

MSY

Wright and Nebel 2002

**Figure 12.6** Maximum sustainable yield. The maximum sustainable yield occurs when the population is at the optimal level, i.e., the rate of increase in population is at a maximum. (a) The logistic curve of population size in relation to carrying capacity. (b) Recruitment plotted against population size, showing the effects of competition and decreased population levels.