WEEK 9: ARE CONFLICTS BETWEEN DEVELOPMENT & ENVIRONMENT INEVITABLE?
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Richard H. Bernsten
Agricultural Economics
Michigan State University

I. Basis Concerns About the Environment

A. Environmental Impacts Due to Increasing Pressure on Resources due to Industrialization + Population
   - Immediate concerns: air, water, soil, forest, ocean, reef degradation and associated species loss (Cartoon)
   - Future concerns: climate change?
   - Is it too late to save the environment? UN's Millennium Ecosystem Assessment: unpredictable changes are increasingly likely, > loss of "ecological services" to society

B. Rate of Depletion Depends On:
   - Population growth rate (mainly in LDCs) ✓ 21st century "critical bottleneck—Why?
   - Income growth rate (both in DCs & LDCs)—Why?
o Development of new technologies (R&D) that increase resource efficiency (def. greater output per unit of input)
  ✓ Energy?
  ✓ Land?
  ✓ Water?
  ✓ Materials?

o Public policies (tools) that influence private choices
  Examples?
  ✓ Subsidies (reduces investment costs)?
  ✓ Taxes/tax credits?
  ✓ Regulations?

C. All Development Transforms the Environment
Some Key Issues
  o What are the major threats to our environment?
  o Who (DCs or LDCs) is responsible for protecting our environment?
  o What can governments in DCs & LDCs do to preserve our environment?
  o What can citizens in DCs & LDCs do to preserve our environment?
  o Why have we been so slow in addressing environmental degradation
  o Other?
II. Earth Trends: Global Warming/Energy

A. Theory (What’s a theory—best guess, based on available evidence)

- Industrialization > more "greenhouse" gasses, especially CO₂ (79%) > global warming (Share, Fig. 44)

- Potential consequences (2050, or is the future here now?)
  - More extreme weather > drought, hurricanes, forest fires (Figure)
  - Melting ice cap/glacier (Alaska/Kilimanjaro) (Photos)
  - Rising sea level > threaten people (N. Orleans, Bangladesh) (Fig)
  - More acidic oceans (absorb 48% of CO₂ > CO₂ threatens marine life)
  - Warmer climates > spread of tropical diseases (malaria)
  - Mass migrations/conflicts—especially in Sub-Saharan Africa
  - Agricultural impacts: (Figure)
    Hotter climate > evaporation > droughts > lower yields

B. Evidence: Circumstantial or Beyond a Reasonable Doubt?

1. Experts Agree (facts) that:
   - CO₂ up 31% since 1750 (industrial revolution) (WRI)
   - Global temperatures are increasing (+0.7°C since 1900) (WRI)
     - 1990s = hottest decade, 5 hottest year during 1997-2003
     - 1998 = hottest year since 1861 (first records)
     - Continuing worldwide temperature increases (Figure)
   - Arctic ice 40% thinner, snow in N. hem. down 10% since 1960
   - Human activities are responsible
     - UN’s IPCC’s Report (consensus among 2,500 scientists)
       - 1995—“discernable” human influence
       - 2001—“substantial” human influence—“likely (>66%)”
       - 2007—human influence “very likely (>90%)”
     - EPA (2002)—GW is real, due to human activity
     - Evangelical leaders (2006)—global warming is a moral issue
     - British govt. report (2006)—must act immediately to avoid disaster
   - DCs are mostly responsible—the future? (WRI, WRI, P, Cartoon)
2. But Experts **Disagree** on Details Regarding Some Key Issues:
   - How much of GW (<CO\(_2\)) is due to human activity?
   - Hard to measure recent (100 yr.) temp. change
     - Large/rapid fluctuations normal
     - Historical data base is weak
   - How do the interrelated global systems work? (e.g., air, oceans, land?)
   - How will climate change rearrange global ecosystems? (e.g., vegetation, animals, diseases?)

3. Future impacts of global warming based on computer models:
   - Predictions (UN IGPC): Temp. will rise 3-10\(^\circ\) F in next 100 yrs. (2x 1995 estimate), CO\(_2\) will increase to 2x pre-industrial levels!
   - Scenarios *(Figure)*
   - Is 3-10\(^\circ\) F big deal?

4. But some **uncertainty** (scenarios based on computer models)
   - Hard to accurately predict future impacts
   - Impacts won’t be uniform (winners & losers)
     - Polar areas warmer/deserts wetter?
     - Weather more violent: more hurricanes/tornados, more erratic (El Nino)?
   - Many experts argue: since there’s a “compelling reason for legitimate concern”, we **must act now** to mitigate/adopt to potential impacts (**precautionary principle**) 
     - Many in business sector now agrees!
     - Many states, cities & towns now agree!

**Note**
- -2\(^\circ\) F, Europe's small ice age (1400-1800)
- -9\(^\circ\) F, last major ice age
- Sahara desert, once fertile cropland
5. Should pursue a "no regrets strategy"  
(i.e., do what's sensible, even if it doesn't happen)

- Governments/Private Sector Companies should:
  - Monitor climate change
  - Increase energy efficiency, US but esp. in LDCs  
  - Develop "Green" power—nuclear, wind, hydroelectric, geothermal, solar, fuel cell, clean coal, ethanol (?)  
    (Fig. 41)
  - Provide subsidies/tax breaks (like the oil industry gets)  
    Why?
  - Research new CO₂ disposal options  
    (e.g., carbon sequestration/carbon sinks)
  - Develop new markets for trading carbon to create value for preserving the environment
    Example: US companies in Brazil—$16.4 mil. to reforest 41,000 ha, for carbon credits

- Price energy at “real cost” to achieve greater efficiency  
  (Cartoon)
  Note:
  - Real gas prices (constant $) have fallen until recently  
    (e.g., 1950=$2.00  1970=$1.80  1983=$3.00  2000=$1.50)
  - Europeans & LDCs tax gas more than US  
    (Figure)  Why?
  - US subsidizes oil companies: tax breaks, production subsidies, not charged for environmental/health costs (externalities)
  - Cheap gas decreases R&D for alternative fuels, urban sprawl

- Develop capacity to adapt to anticipated consequences:
  - Build sea walls to protect coasts (Holland, New Orleans?)
  - Develop drought-tolerant crops/new farm practices (drip irrigation)

- Individuals can:
  - Invest in "Green" corps, buy "green" products  
    (photos)
  - Modify our lifestyles, consumption habits  
    (Cartoon)
  - Examples of what individuals can do?
  - Pressure our the government to take action
LDCs (Myth: LDCs aren’t doing anything!)

- Thailand—charges a 1% tax on electricity use, fuel imports => uses $ to fund projects to reduce demand/alternative energy
- Indonesia—tolls, rush hour (3 people/car in city), converting cars to use natural gas
- Kenya—developing geothermal (Philippines = 22% of energy)
- China—investing heavily to increase efficiency/reduce pollution

Global Cooperation Required to Reduce Global Warming

- Post Rio Conference (1992) Agreements
  - LDCs promised to avoid LDCs’ mistakes, but not required to reduce emissions
  - DCs
    - Pledged to reduce energy use (-5% 1990 levels by 2012)
    - Promised to provide LDCs AID to address environmental problems, but didn’t deliver!

- Kyoto Conference (1997) Agreements
  - Agreed: growing consensus that GW is “real” & need “binding” limits
  - Disagreement: should same rules apply to South?

New Global Warming Treaty Signed in 2004

- Ratified by 157 countries (including EU, Japan, Russia) (Map)
- Needed approval by DC who produced 55% of 1990 emissions (Note: US produced >30% of global emission)

- Key provisions
  - DCs must reduce 1990 emissions by 5% by 2012
  - LDCs don’t have to reduce emissions
  - Cash penalties levied, if quotas not achieved
  - Countries will receive credits for carbon sinks (forests)

- New Goal for Post-2012 (all G-8 members except the US)
  - Consensus to reduce emissions 50% below 1990 levels (by 2050) to hold temperature change to 3.6° F

- But Bush/US didn’t sign Kyoto—GW is only a “theory” (Cartoon)
  - Only supports voluntary limits, fears hurting economy
  - US should meet its energy needs by increasing supplies
Concerns/Criticisms of US’s Supply Focused Strategy

- US is increasingly dependent on foreign oil => trade deficit (e.g., 1970=30%, 2000-55%, 2010-70%?)

- Foreign oil sources are politically unstable, vulnerable to terrorism (e.g., Nigeria, Sudan, Venezuela, ME) (Figure)
  Note: RMI-increased efficiency could eliminate imports by 2040

- Focus on increasing supply has potential environmental impacts (e.g., Arctic Nat. Wildlife Refuge, Gulf coast)

- US will lose market share of “energy efficient” technology market

- Oil prices will continue to increase—output peaked in 2005, demand is rising more rapidly than expected, esp. in India/China

LDC’s Perspective on GW

- DCs (1/5 of the world’s population) account for 7 times (per capita) more greenhouse gases than LDCs

- So DCs must bear 1st responsibility for reducing GW

III. Impact of Development on Land, Habitat & Species

Problem: land degradation => habitat & species losses, plus loss of land to agriculture => increasing rural poverty, migration to the cities.

A. Types of land degradation & causes

- Nutrient depletion—continuous cropping w/o adding nutrients

- Salinization—arid/semi arid areas, poor irrigation drainage (Photo)

- Agrochemical contamination—overuse of chemicals

- Soil erosion—wind, rain, cropping sloping land (Photo)

- Vegetative degradation/deforestation—agriculture, timber

- Desertification: def. loss of fertility due to excessive cultivation, over grazing, firewood cutting (38,000 sq miles/year lost annually) (Photo)
B. Earth Trends: Habitat Loss Consequences ==> Biodiversity Loss
(Habitat loss def. conversion to a less diverse uses)  (Fig. 21)

1. Forests (tropical) losses due to deforestation
   o Extent of loss since prehistory (5 billion ha)
     ✓ Decreased by 1/5
     ✓ Extreme cases: Sahara, Australia
   o Estimates of annual decline (uncertain)
     ✓ Worldwide: 14-20 m. ha/yr (230-270 miles²)
     ✓ Rate >1%/year in several countries (1980-95)  (Fig. 29)
       (e.g., Mexico, Indonesia, Pakistan, Nepal, Burma, several
        African countries)
     ✓ Brazil—has lost 16% of original cover, 2% loss in 2003 (size of
        N. Hampshire), 2nd highest since 1988  (Photo)
     ✓ Data (1980-95) show > forests in DCs, < in LDCs  (Box 2.18)

1. Causes of deforestation
   Direct causes include:
   o Logging for timber
   o Land converted to agricultural uses/plantations, settlement
     (In Brazil, agriculture is cause of 90% of deforestation)  (Photo)
   o Cutting for household fuel (2/3 of all wood cut)  (Photo, Fig. 2.21)
   o Forest fires, El Nino (1998, Brazil, Indonesia)  (Photo, Figure)
     (Indonesia—biggest fires: 2 billion tons of CO₂, impacted health)
   o Drilling for oil (Ecuador, roads opens up remote areas)  Impact?

Indirect causes include:
   o Government policies--tax breaks, concessions, credit/subsidies to
     loggers, poor enforcement of land clearing/burning laws
   o Poverty--the poor need land, illegal loggers need income
   o Foreign demand for hardwood, furniture, beef, plantation crops
     (Cartoon)
   o Debt crisis & national poverty—LDCs need foreign exchange
     (Need to export oil, plantation crops, timber to pay debt)
3. Deforestation impacts are significant

Global Impacts
- Burning contributes 15-30% of CO₂ emissions, CO₂ released from carbon sinks
- Changes rainfall patterns
- Habitat loss => species loss--butterflies, birds, mammals, plants (50% all species live in tropical forests)

Local Impacts
- Changes local climate (Nanking)
- Reduces future logging income
- Reduces land use potential (Brazil: cattle/agriculture => erosion)
- Reduces $ to local people--rubber tappers, fruit/nut gatherers, firewood, wild game
- Floods downstream--deforestation in Nepal => flood in Bangladesh

4. Actions DCs & LDCs need to take to reduce deforestation

- Support targeted projects--meet the economic needs of the local people
  - "Tibet compact"--NGO provides seedlings, clinics, credit, roads, schools
  - Mexico--butterfly tourism (ecotourism)
  - Ecuador—NGO sets up coop to market traditional handicrafts
  - Ethiopia—jobs for wood gatherers

- Support environmental activism--groups/NGOs in LDCs that are working to reduce deforestation
  - Kenya "Green Belt Movement", planted 30 million trees in 18 African countries
    Note: Wangari Mathai received the Nobel Peace Prize, represents a broadening vision of what’s needed for peace!

- Pass new laws that promote reforestation/reduce deforestation
  - Tax credits for creating reserves/private tree plantations (Brazil)
  - New laws to limit logging (Peru)
  - Environmental friendly "oil pipelines" (Brazil)
C. Earth Trends: Species—Plant & Animal

1. Estimated loss is extensive (Fig. 6.1)
   Worldwide (5-30 million species exist)
   - Losses to year 2000—decreased by 15-30%
   - Losses in Amazon—12% birds, 15% plants
   - Current loss rate—1,000 times natural rate, 50% loss by 2100
   - Rainforest critical, most biodiverse & highly threatened (Fig. 33)
   - Next 100 years most critical! Why?

2. Causes of extinctions—vary by ecosystem & region (Fig. 34)
   - Exotic species introduction—39% (Michigan problem?)
   - Habitat destruction—36% (logging, agriculture, cities, pollution)
   - Hunting—23% (e.g., US, passenger pigeon) (Photo)

   ✔ Nile perch in Lake Victoria (E. Africa, Africa’s largest lake)
     - Cause—British introduced Nile perch in 1950s (Photo)
     - Impact—was 98% cichlids, now 80% perch, 1% cichlids
       (200 of 500 species have disappeared) (Fig.)
**Water Hyacinth in Lake Victoria**
- Cause—plant introduction/escape (bioinvasion)
- Impact—oxygen depletion, decline in fish catch

**Over Fishing in the Oceans**
- Causes—growing demand, subsidies, new trawler technology, pollution, poor enforcement, DCs want access to LDC’s fisheries
- Impact—70% of world stocks are extinct or threatened

**Endangered Species (e.g., tigers, elephants, rhino, birds)**
- Causes—habitat loss, poaching => demand for exotic species for pets, medicine, poachers need $, poor law enforcement (CITES)
- Impacts—many species approaching extinction

**Ocean Reefs (51% at risk)**
- Causes—pollution (dead zones), coastal development, destructive fishing methods (trawlers)
- Impacts—reef loss => fish habitat loss => declining populations

**Wetland species**
- Causes—critical water/energy scarcity => dams for water, electricity (Examples: Botswana/Namibia—Okavanga River; China—Three Gorges dam)
- Impacts—habitat loss => species loss & people displaced

3. **Solutions?**
   - Involve local people to protect the habitat, so they benefit:
     ✓ Ecotourism—generates income for the local people
     ✓ Permit controlled hunting (rhino, elephants) to create an incentive for conservation
     ✓ Cambodia—established local conservation teams/rangers
   - Strengthen international cooperation, treaty enforcement to reduce illegal trade (CITIES), over fishing in international waters (sea treaty)
   - Control poaching in "protected" area—strengthen, train, equip local wildlife services (Zimbabwe, Kenya, India)
   - Protect wildlife habitats—reduce deforestation, land conversion
   - Launch publicity campaign to reduce demand (Thailand)
   - Breed/reintroduce threatened species (rhino, condor, wolves)
D. Why maintain biodiversity—what will we lose?

Note: 2/3 of world’s biodiversity in 17 priority/poor countries (Fig. 31)

1. Serves world society ($33 billion of services generated/year)
   - Cleans air—forests recycle CO₂ to O₂
   - Stabilizes weather (forests)

2. Generates economic value
   - Holds solutions to future problems
     - New crop genes (wild species)
     - New drugs (malaria, heart disease)
   - Income sources to people, nation
     - Timber, gathering, food/game
     - Wildlife tourism (Photo)

3. Provides aesthetic value

4. Risk—losses => unknown consequences on ecology/life chain
   - Yellowstone—cascade effect: wolves, elk, willow, beaver, ponds, birds

IV. Third World Often Critical of Western-Led Environmental Movements

1. Do what you “say”, not what you “did” to develop
   - US destroyed species/habitats: buffalo, carrier pigeon, prairies

2. DC’s cause most environment degradation
   - US uses 15 time more energy per capita than Brazil
   - DCs use 85% of world’s energy

3. DCs want changes, but want LDCs to bear the costs
   - Loss of money from timber, beef sales, ivory sales

4. Many of DC’s policies self-serving, undermine development efforts
   - Trade—tariffs, quotas (sugar) limit LDC’s access to DC’s markets

5. Environmentalists are more concerned about animals than people
V. **Key Lessons**

1. Environmental degradation will negatively impact development & the quality of life in both LDCs and DCs.

2. Must involve local people in developing solutions to environmental problems.

3. Environmentalists/informed citizens can make a difference in changing governmental policies.

4. DC’s governmental policies & the behavior/choices of consumer in DCs have a major impact on the environment in LDC.

5. DCs must share the costs to insure sustainable development by helping LDCs to address threats to the environment.

6. Global cooperation is needed to succeed—environmental challenges have no borders.
Contribution of greenhouse gases to global warming, 1980-1990

Agricultural activities are responsible for large-scale emissions of greenhouse gases. Tropical land use (mainly deforestation) contributes some 25 percent of carbon dioxide. Fertilizer use is one of the main humanmade sources of nitrous oxides.

Evidence of:
- Warmer winters
- Hotter/dryer summers
- Melting permafrost
- Warmer rivers
- Melting glaciers
- Changing whale migration patterns
- Coastline thawing
- Spruce beetle infestation

Some effects of global warming on agriculture:
- Loss of biodiversity in fragile environments/tropical forests
- Increased frequency of weather extremes (storms/floods/droughts)
- Loss of fertile coastal lands caused by rising sea levels
- Longer growing seasons in cool areas
- More unpredictable farming conditions in tropical areas
- Increase in incidence of pests and vector-borne diseases
- Dramatic changes in distribution and quantities of fish and sea foods

Long-term fluctuations in weather patterns could have extreme impacts on agricultural production, slashing crop yields and forcing farmers to adopt new agricultural practices in response to altered conditions.
Note: Recent data: approaching 450 ppm (2007)
1990: DCs produced 7 times as much GHGs/capita as LDCs
China!!

Figure 10. World Marketed Energy Use by Fuel Type, 1970-2025

Quadrillion Btu

Global Warming
A Weapon of mass destruction?

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Global Warming

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Gasoline and Grade Oil Prices in the U.S. 1819-2006 (in constant 2006 dollars)

Gasoline & Diesel Prices (US Sper gallon), Selected countries, 1997

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By 2010, OPEC will control 78% of proven reserves.
Since the 19th century, the forests of the northern temperate zones have suffered the most severe losses as a result of human activity. In recent years, they have begun to recover. Meanwhile, new areas have been lost at a faster rate than ever before in human history, and the remaining forest areas in many countries are threatened by deforestation.

Many of the world’s forests grow in areas that are only partially forested. These lands are valuable for many of the goods associated with forests, especially wood products, species habitat, and soil protection. But these areas are also particularly vulnerable to destruction, as they are either more accessible and less likely to be legally protected than forest areas with higher tree cover.

Since 1990, the extent of forests has decreased by 16%. The United Nations Food and Agriculture Organization estimates that 20% of the world’s forests are in areas that are unlikely to be protected, and another 20% are in countries that lack the resources to protect them. The remaining 60% are in areas that have already experienced significant deforestation.

The Changing Extent of Forests

Box 1.16

Change in Forest Area, 1980-95 (%)

Source: Nations et al. (1997) and FAO (2000). Map is based on Defresne et al. (2001). Figure is based on FAO (2003).
Wheatfields are the most important source of material energy. Wood-sourced fuels, including forest and charcoal, account for approximately half the total energy used in developing countries (FAO 1991). Burns in several developing countries such as Kenya, Uganda, and Rwanda, and in southern Asia are a major fuel source. As water supply and sanitation improvements increase, less wood is needed for preparation of food and water. However, the demand for wood is expected to remain high, and the use of wood for energy will likely continue. Although woodfuel production was assumed to be a major source of deforestation, recent studies show that up to 20% of all woodfuel is collected from harvested trees and vegetation on farmlands (FAO 1991).
CO₂ released by fires (1997-98) was equivalent to 14-40% of global CO₂ emissions from fossil fuel burned (Nature, 11/7/03)
Carbon sinks

Carbon stored in terrestrial ecosystems plays a large role in the global carbon cycle. To map the distribution of terrestrial carbon storage, PACE researches combined satellite maps of Earth's vegetation with estimates of how much carbon various types of vegetation and soil store. As the maps show, the highest quantities of stored terrestrial carbon are located in the tropics and in the boreal regions. In the tropics, a larger portion of the carbon is found in the vegetation, while in boreal regions, especially peatlands, most carbon is stored in the soils. Bosnian peatlands are especially important carbon storage areas. Unforested lands generally store less carbon than forested ecosystems.
Known Causes of Animal Extinctions Since 1600

Species introductions 39%
Hunting 23%
Other 2%
Habitat destruction 38%

Trading Biodiversity for Export Earnings
Percentage Contribution to Lake Victoria Fish Catch (Kenya Only), 1968–1988


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“tickle the ivories”
### Corn Ethanol vs. Sugarcane Ethanol

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<th></th>
<th>Corn Ethanol</th>
<th>Sugarcane Ethanol</th>
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<tr>
<td>Energy balance:</td>
<td>1.3</td>
<td>8</td>
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<td>(fossil-fuel used)</td>
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<tr>
<td>GHG emissions:</td>
<td>16 lbs/gal</td>
<td>9 lbs/gal</td>
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<td>(gasoline=22lb/gal)</td>
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<td>Production cost:</td>
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![Temperature Increases 2001-2005](image)