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 acetic 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:
   o How much of GW (<CO$_2$) is due to human activity?
   o Hard to measure recent (100 yr.) temp. change
     ✓ Large/rapid fluctuations normal
     ✓ Historical data base is weak
   o How do the interrelated global systems work?
     (e.g., air, oceans, land?)
   o 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):  
   o Temp. will rise 3-10$^\circ$ F in next 100 yrs. (2x 1995 estimate), CO$_2$ will increase to 2x pre-industrial levels!
   o Scenarios  
   o Is 3-10$^\circ$ F big deal?  

---

**Note**
✓ -2$^\circ$ F, Europe's small ice age (1400-1800)
✓ -9$^\circ$ F, last major ice age
✓ Sahara desert, once fertile cropland

4. But some **uncertainty** (scenarios based on computer models)
   o Hard to accurately predict future impacts
   o Impacts won’t be uniform (winners & losers)
     ✓ Polar areas warmer/deserts wetter?
     ✓ Weather more violent: more hurricanes/tornados, more erratic (El Nino)?
   o 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!
5. Should pursue a “no regrets strategy”
   (i.e., do what’s sensible, even if it doesn’t happen)

   o Governments/Private Sector Companies should:
     - Monitor climate change
     - Increase energy efficiency, US but esp. in LDCs  
       \[ \text{Note: US auto mpg declined from 26.2 (1987) to 25.1 (2004)} \]
     - Develop “Green” power—nuclear, wind, hydroelectric, 
       geothermal, solar, fuel cell, clean coal, \text{ethanol} (?)  
       \[ \text{(Fig. 41)} \]
     - Provide subsidies/tax breaks (like the oil industry gets)  \text{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
       \[ \text{Example: US companies in Brazil—$16.4 mil. to reforest 41,000} \]
       \[ \text{ha, for carbon credits} \]

   o Individuals can:
     - Invest in “Green” corps, buy “green” products  
       \[ \text{(photos)} \]
     - Modify our lifestyles, consumption habits  
       \[ \text{(Cartoon)} \]
     - Pressure our the government to take action

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

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

     \[ \text{Examples of what individuals can do?} \]

   \[ \text{▪ Pressure our the government to take action} \]
6. 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)  
  - 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”  
  - 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 dependant on foreign oil => trade deficit (e.g., 1970=30%, 2000-55%, 2010-70%) (Figure).

✓ 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 loose 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

 o Nutrient depletion—continuous cropping w/o adding nutrients.

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

 o Agrochemical contamination—overuse of chemicals.

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

 o Vegetative degradation/deforestation—agriculture, timber.

 o 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 (Box 2.2)
- 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) (Photo)
  - 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)
o Reduce the demand for fuel wood (e.g., fuel-efficient stove)

o Apply pressure on LDCs to encourage them to change policies that encourage deforestation
  ✓ Ban timber subsidies
  ✓ Control/regulate logging (Indonesia, 90% is illegal)
  ✓ Ban burning to clear land (cause of Indonesia’s fires)

o Reduce LDC’s debt burden
  ✓ Debt-for-nature swaps (NGOs are promoting swaps)
  ✓ Debt forgiveness (reduces pressure to exploit forest resources)

o Change DC consumers’ behavior
  ✓ Buy/ask firms to stock green labeled products
    ▪ Eco-bananas, shade grown coffee (preserves bird habitat)
    ▪ “Eco-friendly lumber”–Home Depot, Gibson Guitar

C. Earth Trends: Species–Plant & Animal

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

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

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

✓ Over Fishing in the Oceans  (WRI)
  • 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)  (Photo)
  • 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)  (Figure)
  • 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  (Photo)

3. Solutions?
  o 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
  o Strengthen international cooperation, treaty enforcement to reduce illegal trade (CITIES), over fishing in international waters (sea treaty)
  o Control poaching in “protected” area—strengthen, train, equip local wildlife services (Zimbabwe, Kenya, India)
  o Protect wildlife habitats—reduce deforestation, land conversion
  o Launch publicity campaign to reduce demand (Thailand)
  o 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 CO\textsubscript{2} to O\textsubscript{2}
   - 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