

Reading material for Second year economics students

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Chapter Seven

International Environmental Issues and Economics of Climate Change

Outline

- The following topics will be covered in our discussions in this chapter.
 - Causes of Environmental Problems
 - Global Warming (GW) and Climate Change
 - Impacts,
 - Climate Change (CC) and Costs
 - Abatement and collective action
 - Overall Recommendation for GW/CC Abatement
 - Strategies for Action: Responding to Environmental Problems (experiences)
 - Payment for Ecosystem Services (PES)

Introduction

- Many important environmental problems concern public goods or external effects affects not only a given area but also all nation states.
- These international and global environmental problems are the subject of this chapter.
- Important examples include;
 - global warming,
 - ozone-layer depletion,
 - acid rain, biodiversity loss, and
 - the control of infectious diseases

7.1 International Environmental Externalities

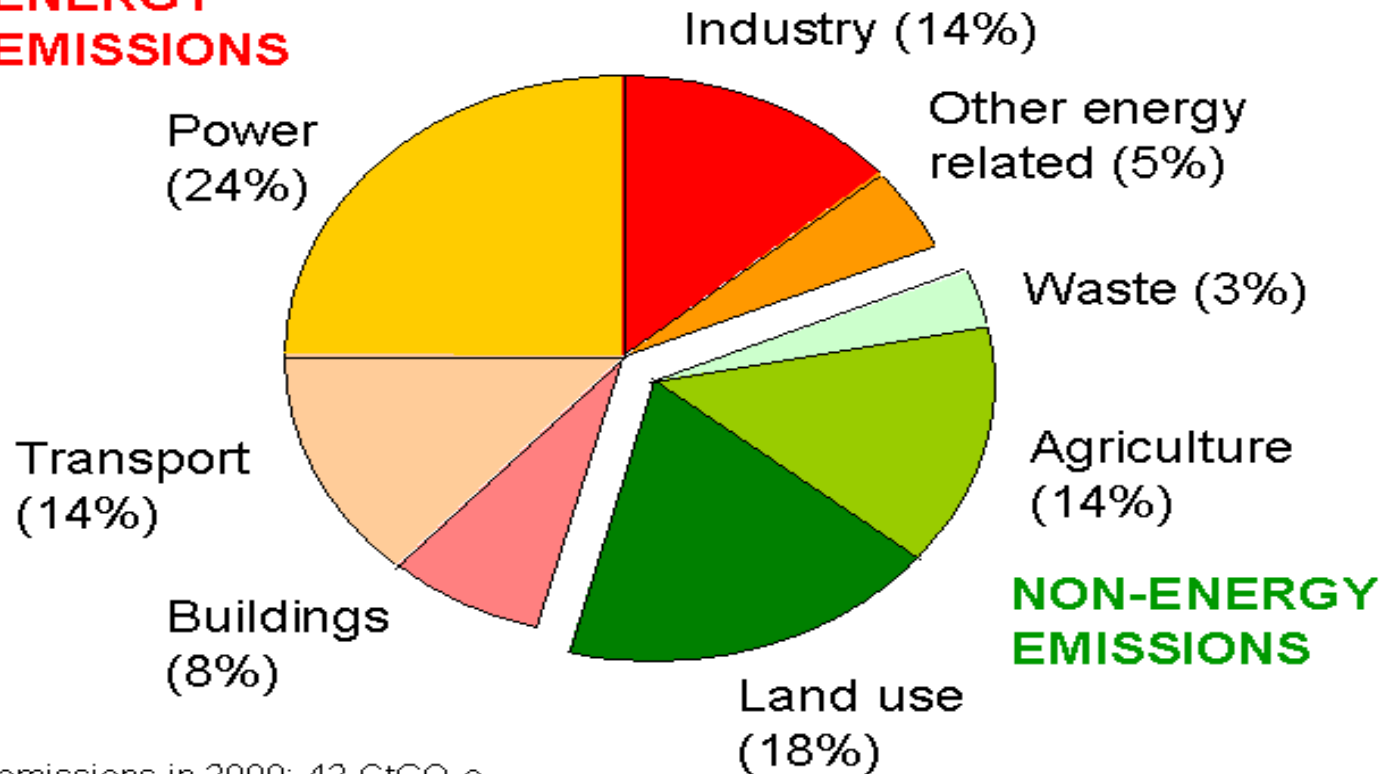
Causes of Environmental Problems

- Environmental externalities are those external effects that asserted to the environment either in the consumption or production process of economic activities.
- The cause of these problems include;
 - **Social Causes (Population Growth)**
 - The world's population is growing
 - Increased demands on natural resources-increased waste/ emission

- **Industrialization and Economic Development**
 - Environmental problems are associated with industrialization and economic development
 - Industrialization – natural resources, energy, chemicals - pollution
 - Industrialized countries consume more energy and contribute more pollution to the environment than poor countries
 - Economic development – rising per capita demand and emissions
- **Cultural Values and Attitudes**
 - Selfishness/Individualism
 - Consumerism
 - Militarism

Sources of emissions

ENERGY EMISSIONS



Total emissions in 2000: 42 GtCO₂e.

Everything (all emission types) are related to human activity

- Wider environmental problems threatening the ecosystem
- Greater demand for environmental policy (EP)
 - EP is about what government does and does not do to address environmental problems
- Environmental politics - clash of values & interests that occur in the course of formulating and implementing policy
 - Among developed countries
 - Between developed and developing (emerging) countries
- This suggest something must be done about international environmental politics and policy

Global Warming and Climate Change: Impacts, Costs and Abatement

- Major Global (international) Environmental Problems include:
 - Global warming: increase in the world's average temperature (**Greenhouse Effect causes Climate Change**)
 - Climate change: change in the average temperature
- These happened due to high emission of pollutants and causes:
 - Ozone layer depletion
 - Acid rain
 - Biodiversity loss
 - Infectious disease

Global Warming (GW)

- Greenhouse Gases: atmospheric gases that contribute to global warming by trapping heat in the earth's atmosphere.

Solar radiation

- Some is reflected by the earth and the atmosphere
- Some is absorbed by the earth, warming it

Infrared radiation

- Some passes through the atmosphere
- Some is absorbed and re-emitted in all directions by greenhouse gas molecules

Causes of Global Warming

GHG: due to natural and human economic activities

Gases	Source
carbon dioxide (CO ₂)	fossil-fuel burning, de-forestation
methane (CH ₄)	agriculture activity, decomposition and disposal of waste
nitrous oxide (N ₂ O)	emitted during agricultural and industrial activities, and during combustion of solid waste and fossil fuels
hydro fluorocarbons (HFCs)	industrial activities
Per-fluorocarbons (PFCs)	industrial activities
sulphur hexafluoride (SF ₆)	industrial activities

- Major source of global warming is carbon emissions
- Direct relationship between per capita income and carbon emissions
 - U.S. emits five times the world average per person carbon emissions
- As populations increase, carbon emissions will increase (production, industrialization, energy consumption, waste, deforestation....)
- As the large populations in Asia (India & China) continue to develop economically, carbon emissions will continue to increase

Impacts of Global Warming

Physical impact

- Shrinking glaciers & melting permafrost
- Later freezing and earlier break up of river and lake ice
- Sea level rise
- Higher incidence of floods and droughts in some regions

Biological impact

- Longer growing seasons
- Pole ward and altitude shifts of plants and animal ranges
- Decline of some plant and animal population (15 -37% of living species toward extinction)
- Early tree flowering and birds eggs laying,
- Emergence of insects
- Damage to the overall natural system
 - Many of these impacts are irreversible

Impact on human system

Systems at risk include:

- Water resources
- Dams, irrigation, energy
- Agriculture and forestry
- Coastal zones and marine systems
- Human health and risk of disease

Climate Change

- Climate Change: change in the weather patterns when that change lasts for an extended period of time
- Climate change:
 - increases in average global temperature (global warming);
 - changes in cloud cover and precipitation (rainfall);
 - melting of ice caps and glaciers and reduced snow cover; and
 - increases in ocean temperatures and ocean acidity
 - Also decrease world's temperature (too cold weather)

- Climate Change is a unique externality”
 - The emission of greenhouse gasses imposes costs on others that are not borne by the emitter
 - The costs will be felt over a long time period and over the entire world
 - But, the exact nature of costs is shaped by policies, market mechanisms, & other events
 - Those most affected—future generations— cannot speak up today for their interests

Costs

- A loss of 5% average per capita GDP ‘now and forever’
- Costs are not evenly distributed
 - Developing nations will pay higher price
 - Sub-Sahara Africa (high non-market costs)
 - India & Southeast Asia (9-13% loss in GDP)
- Cost on developed nations will vary depending upon geography
 - US (1 - 1.2% loss in GDP)

What kinds of costs?

- **Reduction in agriculture production; due to**
 - Rainfall, drought, change in season, yield...
- **Shortage of water and change in temperature**
 - Increased flooding/droughts
 - Extreme weather events
- **Rise in Mortality**
 - Heat, Malnutrition, Disease
- **Damage to infrastructure**
 - Fast wear/tear
 - Storm damage
- **High cost for coastal protection**
- **Species Loss**

Abatement Opportunities to Global Warming/Climate Change

Abatement Opportunities I

- Reduce non-fossil fuel emissions
 - Emission control systems from burning non-fossil fuels
- Healthy Land Use
 - Minimize deforestation (especially in tropics)
 - Plant new forests
 - Install enforcement & regulatory instruments
 - Require aid from developed world
- Agriculture
 - Change tilling practices
 - Produce bio-energy crops

Abatement Opportunities II

- Reduce demand for emission-intensive goods:
 - Energy use in heating, transport, & electricity
 - Introduce price signals via taxes
 - Change preferences via information

Abatement Opportunities III

- Improve energy efficiency
 - During power generation
 - During energy use
 - Efficient appliances, vehicles, industries
 - Greatest abatement potential may lie here

Abatement Opportunities IV

- Switch to lower carbon emitting energy production
 - Wind
 - Solar
 - Hydrogen
 - Nuclear
 - Hydroelectric
 - Bio-energy

Actions on Climate change

(i) Policies

- Carbon Pricing
 - The cost of carbon emissions must be included in the pricing of carbon emitting goods
 - Types of pricing
 - Taxes – serves as source of revenue for investment to mitigate climate change
 - Carbon trading (cap & trade) - controls amount of emissions and encourages investment in climate change mitigation actions

Technology Policy

- Investment in Research and Development (R&D)
- R&D subsidies to encourage private firms to invest in clean technology

Standards and Awareness

- **Standards**
 - Where carbon pricing proves ineffective, regulatory standards may be useful
- **Education**
 - Enhancing understanding of causes of climate change and its consequences can shape human activities and future policy

(ii) Adaptation Strategies

- Disseminate High-quality climate information
 - On critical Rainfall & Storm patterns
- Introduce Land-use standards
 - Agricultural practice and infrastructure development should account for climate change
- Invest in Climate sensitive public goods
 - Natural resource & coastal protection
 - Emergency readiness
- Encourage Social safety nets
 - Insure/protect those vulnerable and cannot afford

(iii) Collective Action

- Climate change is a global problem which will require:
 - Shared understanding of long-term impacts
 - Designing instruments for collective action
 - Building effective institutions
 - Lasting Goals, Strong Leadership and Trust among Parties

- Meetings of the UNFCCC Parties (Conference of the Parties)
 - assess progress in dealing with climate change
 - negotiate the Kyoto Protocol
 - establish legally binding obligations for developed countries to reduce their greenhouse gas emissions
 - Discuss on support and cooperation to developing countries

Attempts to control global warming? Few insights

- Carbon dioxide targets
- GHG control (quantitative incentives)
- Commitments to industrialized nations on targets
- Supports/commitments to developing countries
 - Reducing emission from deforestation and forest degradation
 - Deep cuts in global emissions (Kyoto protocol)
 - Develop adaptation strategies and response measures
 - Design national action and international cooperation for reducing vulnerability and building resilience
 - Use markets to enhance cost-effectiveness and promote mitigation actions

Overall Recommendation for Global Warming Abatement

- Decrease the rate of emissions of GHG (reducing GHG inflows)
- Increase the capacity of ‘pools’ that absorb carbon dioxide and other GHG from the atmosphere
- Stop using burning fuels and promote changes in fuel mix (from fossil to renewable energy)
- Use new technologies
- Stabilizing population growth worldwide
- Ban discharging warm cooling waters into rivers/oceans by power stations

- Financial and technological transfers from developed to developing nations
- Supporting low-income nations develop/grow clean
- Learn and use good ideas and solutions from other countries that help eliminate global warming
 - For example,
 - Brazil:
 - producing less polluting fuels (bio-fuels)
 - use alcohol instead of gasoline which is made from sugar cane and cassava
 - The exhaust fumes from this alcohol fuel are almost clean enough to breathe

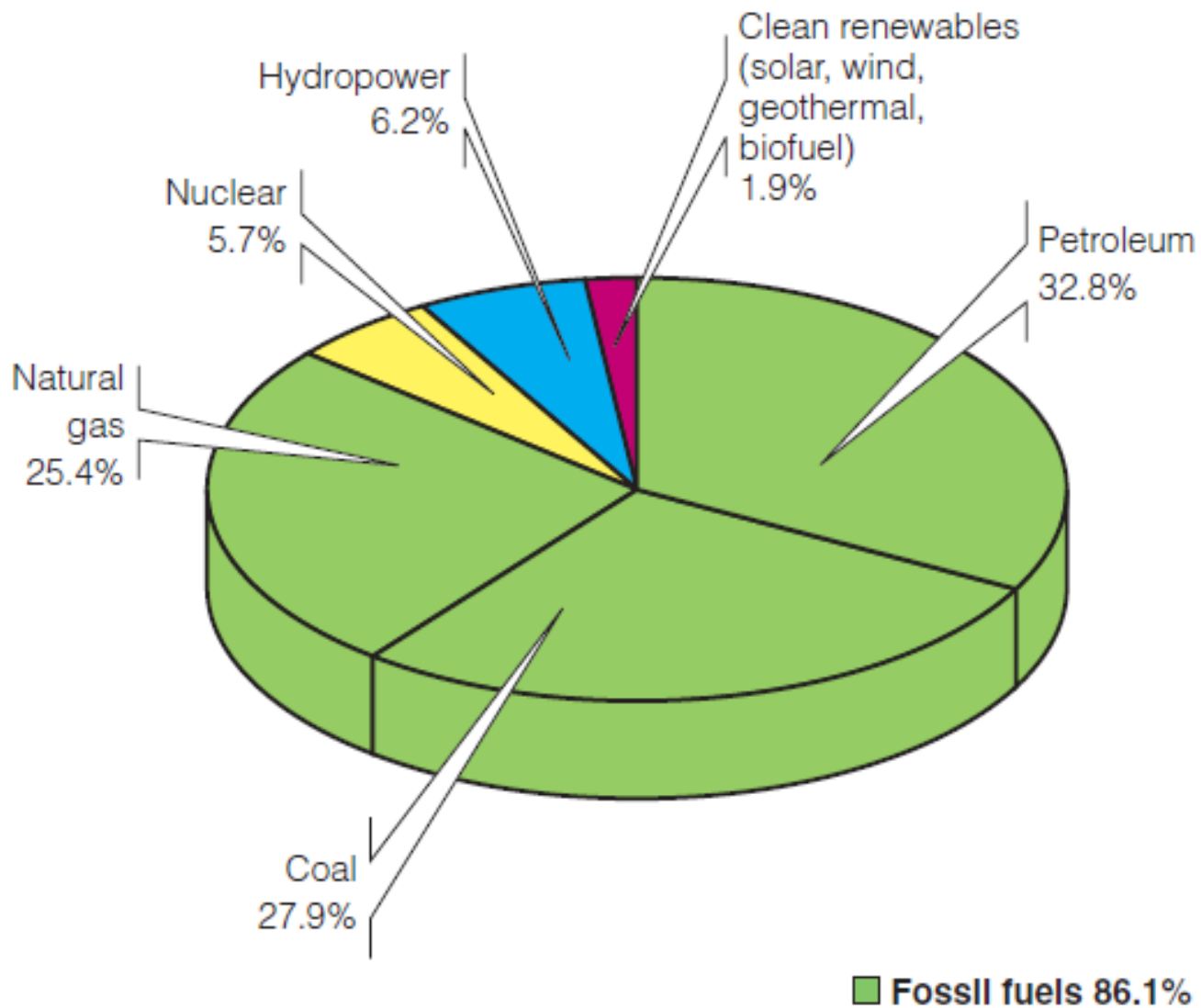
Other Environmental Problems

(a) Change in ecosystem

- Ecosystems are the complex and dynamic relationships between forms of life and the environments they inhabit
- Over the past 50 years, humans have altered ecosystems more rapidly and extensively than in any other comparable period of time in history
 - Air pollution
 - Soil erosion/degradation
 - Deforestation
 - Water pollution

(b) Aggravated Energy Use Worldwide

- Most of the world's energy comes from fossil fuels, which include petroleum (or oil), coal, and natural gas
 - *Important pollutant*
- The next source of energy is hydroelectric power (6.2%), which involves generating electricity from moving water
 - Clean and renewable, but affects natural habitats
- The world energy production by 2007 is illustrated in the next graph by sources based on energy information administration, 2010



(c) Depletion of Natural Resources

- Freshwater resources are being consumed by agriculture, industry, and for domestic use
 - More than 1 billion people lack access to clean water
- The demand for new land, fuel, and raw materials resulted in deforestation, the conversion of forest land to non-forest land
- Desertification is the degradation of semi-arid land, which results in the expansion of desert land that is unusable for agriculture

(d) Air Pollution

- Growing levels of air pollutants, (carbon monoxide, sulfur dioxide, nitrogen dioxide, mercury, dioxins, and lead) from:
 - Transportation vehicles (fuel consumption),
 - Industrial processes (burning coal and processing minerals from mining), and
 - Solid waste disposal (households and firms)
- Air pollution, which is linked to heart disease, lung cancer, bronchitis, asthma.... kills about 3 million people a year

(e) Indoor air pollution

- Exposure to indoor smoke increases risk of pneumonia, chronic respiratory disease, asthma, cataracts, TB, and lung cancer, - up to 1.6 million deaths a year (WHO, 2010)
- Exposure is high among women and children, who spend the most time near the domestic hearth or stove
- It is a serious problem in developing countries
- As this woman cooks food for her family, she is exposed to harmful air contaminants from the fumes

(f) Destruction of the Ozone Layer

- The ozone layer of the earth's atmosphere protects life on earth from the sun's harmful ultraviolet rays
- Yet, ozone layer has been weakened by the use of certain chemicals: chlorofluorocarbons (CFCs), used in refrigerators, air conditioners, spray cans, and other applications
- Depletion of ozone layer allows hazardous levels of ultraviolet rays to reach the earth's surface and is linked to a variety of problems

(g) Acid Rain

- Some air pollutants, such as sulfur dioxide and nitrogen oxide, mix with precipitation to form acid rain
- Polluted rain, snow, and fog contaminate crops, forests, lakes, and rivers
 - Species and human beings are affected by acid rain

(h) Land Pollution

- About 30% of the world's surface is land, which provides soil to grow the food we eat
- Humans are polluting the land with nuclear waste, solid waste, and pesticides
- In 2011, 1,287 hazardous waste sites (also called Superfund sites) were on the Priority List of the world for action

(i) Solid Waste

- Households across the world generate 2 – 5 kg of garbage on average every day
- More is produced from mining, agriculture, industries...
- Demolition and construction wastes; junked autos; or obsolete equipment wastes
 - Less than half of this waste is recycled or composted - Just over half of this waste is dumped in landfills
 - E-waste: discarded electrical appliances and electronic equipment has become serious concern for the world
 - Plastic waste (bags, bottles, cans....) has been headache to deal with for many countries (Kenya, Uganda...)

(j) Water Pollution

- Water is being polluted by harmful substances: pesticides, vehicle exhaust, acid rain, oil spills, sewage, industrial, military, and agricultural waste
- Water pollution affects the health and survival of fish and other marine life
- Countries - issuing warning against the consumption of certain fish caught in local waters because of contamination with pollutants such as mercury and dioxin waste
 - Gulf of Mexico.....known as ‘dead zones’ due to pollution runoff from agricultural uses of fertilizer—have oxygen levels so low they cannot support life

(k) Chemicals, Carcinogens, and Health Problems

- About 3 million tons of toxic chemicals are released into the environment each year
- Chemicals - enter our bodies via the food and water we consume, air we breathe, and substances with which we come in contact
- 240 chemical substances that are ‘known to be human carcinogens’ meaning that they are linked to cancer are identified by the WHO

- Multiple chemical sensitivity (MCS), or environmental illness is;
 - a condition whereby individuals experience adverse reactions when exposed to chemicals (vehicle exhaust, fresh paint, housecleaning products, perfume and other fragrances, synthetic building materials, and numerous other petrochemical-based products)
- Many personal care products contain chemicals with known or suspected adverse health effects

(L) Threats to Biodiversity

- There are an estimated 8.7 million species of life on earth
- This enormous diversity of life, known as biodiversity,
 - provides food, medicines, fibers, and fuel;
 - purifies air and freshens water;
 - pollinates crops and vegetation; and
 - makes soils fertile
- The biodiversity is threaten by unwise human interventions (air, water, and soil pollution; climate change, global warming....)
 - Nearly 1 million are in extinction – affect future human activity and survival

Strategies for Action: Responding to Environmental Problems

(i) Environmental Activism

- More than 10s of thousands with millions of members (national and international) environmental organizations undertake environmental movement
 - Exert pressure on government and private industry to initiate or intensify actions related to environmental protection

(ii) Religious Environmentalism

- From a religious perspective, environmental degradation can be viewed as sacrilegious, sinful, and an offense against God

(iii) Radical Environmentalism

- Is a grassroots movement of individuals and groups that employ unconventional and often illegal means of protecting wildlife or the environment
- Radical environmentalists believe in deep ecology
 - humans have no right to dominate the earth and its living inhabitants and maintaining the earth's natural systems should take precedence over human needs, that nature has a value independent of human existence,

(iv) Eco-terrorism

- Any crime intended to protect wildlife or the environment that is violent, puts life at risk, or results in damages of \$...(Denson 2000)
- Some argue that environmental terrorists plunder the earth

(v) Environmental Education

- One goal of environmental organizations and activists is to educate the public about environmental issues and the seriousness of environmental problems
- Being informed about environmental issues is important because people who have higher levels of environmental knowledge tend to engage in higher levels of pro-environment behavior

(vi) Promoting Green energy (clean energy)

- Green energy: - renewable and nonpolluting—can help alleviate environmental problems associated with fossil fuels
- Solar power (sun light and photovoltaic cells), wind power (wind and turbines), bio-fuel (agricultural crops to ethanol and biodiesel)

(vii) Green Building:

- Energy efficient buildings

(Viii) Energy efficient cars

- Small, fuel-efficient car

7.2 International Agreements

- United Nations Climate Change Conferences: yearly conferences held by the United Nations Framework Convention on Climate Change (UNFCCC)
 - Berlin in 1995;
 - Kyoto in 1997;
 - Kenya in 2006;
 - South Africa in 2011;
 - Poland in 2018
 - Toronto in 1988;
 - The Hague in 2000;
 - Copenhagen in 2009;
 - Paris in 2015;

- For Example: Paris Agreement (2015)
- Brought all countries on board for ambitious efforts to combat climate change and adapt to its effects (clear and measureable commitments and actions...)
 - undertake rapid reductions of greenhouse gas emissions thereafter in accordance with best available science
 - achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century
 - on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty, enhance support to assist developing countries to do so

7.3 Payment for Ecosystem Services (PES)

- Ecosystem Services: include water, soil, and biodiversity conservation; carbon sequestration, flood control, eco-tourism.....activities
- Products can be forest and pasture products, fuel wood, food, medicine, etc from the conservation activities
- Payment can include cash payments as well as other types of benefits such as land tenure, social services, technical assistance to improve livelihoods....of those involved in ecosystem service
- PES = benefit (cash or other) provided to purchase one or more ecosystem services or products

- PES also known as payments for environmental services (benefits)
 - are incentives offered to farmers or landowners in exchange for managing their land or other natural resources to provide some sort of ecological service
- Grants, donations (development projects) to support conservation, climate adaptation, poverty alleviation...
- Investment by the private sector for specific ecosystem services (carbon credits, water, biodiversity....)
- Local tax revenues and legal rights directed to communities that conserve watersheds and other critical ecosystems needed by a broad range of citizens

- Product buying linked to conservation and/or fair trade (goods and services purchased by companies and consumers often using a certification mechanism)
- Carbon trading – money payments for trees/forest for carbon sequestration
 - Could be international carbon markets – REDD and REDD+ through Voluntary Carbon Standard
- People be compensated for conserving unique biodiversity - Climate, Community and Biodiversity (CCB); in few developing countries (Philippines....)

- Energy products and changes in agriculture practices – Clean Development Mechanism (CDM) and Gold Standard in energy use (non-fossil) and Climate Smart Agriculture
- Water – watershed management groups get compensated for protecting the watershed that provides water for lowland communities
- Forest Products (timber and non-timber forest products) – about sustainable enterprises that protect losses and participate in reforestation - grant and bank credits certification programs

Discussion Questions

1. Explain the importance of international agreements on mitigating GHG emission in controlling global warming and climate change.
2. Refer to the Kyoto protocol and Paris agreements on the environmental issues; and forward your own opinion on the effectiveness and effects of those agreements.
3. Does PES meets the environmental protection goals?
4. What suggestions do you forward on the sustainable environmental protection and sustainable development?