**Env. Issues - Midterm #2 Review**

**Lecture 7: Climate Change**

***Evidence of Climate Change/Scientific Explanations***

* Since the 19th century average global temperature has increased by 0.6°C (give or take 0.2°C)
  + Warmest years since 1850
* Strong consensus that GHG increase is due to human activity
  + Deforestation, Factories, Farming

***Forecast of Impacts on Natural Systems and Human Society***

* Impacts on Cryosphere (frozen part of the earth)
  + From 1992 to 2012, most of (almost all) of the Greenland ice sheet is in the process of melting
  + Due to melting permafrost, there are a lot more landslides
  + Ice roads are unstable due to the warmth (very important for transportation)
* Impacts on Human Society
  + Hard to predict how people will behave when facing the effects of climate change in the future

***Impacts on PEI***

* Globally: sea level rise of 0.1 – 0.2 metres per century during the past 100 to 200 years
* The coast of PEI is one of Canada’s most sensitive areas to sea-level
  + This is due to the type of rock (it erodes very easily)
* Impacts on the Province:
  + Potential for ice-ride-up (ice gets pushed up onto land and can damage buildings, etc.)
  + Increased storminess/storm surges (sea rises past high tide) … this causes increased erosion
  + $200+ million causes by these factors
* Northern Quebec is actually expected to face the biggest transformation due to climate change in Canada
* Fort McMurray wildfire was the costliest disaster in Canada’s history

***The Kyoto Protocol (Terms of the Policy, Its Fate)***

* More than 160 countries represented
* ***Goal***: reduce emissions of GHGs by 2012
* 55 developed countries
* 55% of 1990 emissions
* Targets for developed nations to reduce GHG emissions by at least 5% below 1990 levels in the timespan of 2008 to 2012
* US produced 25% of GHG emissions: but only 5% of world’s population
* Canada and India had no targets (this caused criticism)
* Bush (President of US at the time) asked why is China left out?
* 18% reductions over 10 years
* GHG intensity: emissions/GDP
* Legally binding
* Emissions Credits & Trading
  + Credits can be earned by a nation based on land use or forestry initiatives that reduce measurable GHG emissions
  + Cap and Trade: If one company reduces it emissions it can sell credits to other companies that created too many emissions
* Post Kyoto: reduction in emissions by 50% by 2015

***Canada’s Record on Climate Change***

* Canada signed the Kyoto Protocol in 2002: but had no clear plan
* Called for reduction in GHG emissions from large industries
  + But car manufacturers were excluded…
* Canada ended up dropping out of the protocol to focus on the economy
* Instead of decreasing emissions, Canada increased by 20% in 2004
* In 2006: Canada was given the Fossil Award (given to a country for lack of action on climate change)
* Canada just tolerates its losses… no plans/action to change in the future

**Lecture 8: Oceans & Fisheries**

***Ocean Acidification & Impacts on Fisheries***

* As CO2 dissolves into oceans it becomes bicarbonate
* 1/3 of annual human CO2 emissions dissolve into oceans
* 50% of human emissions of CO2 since 1750 have dissolved into oceans
* Bicarbonate = HCO3
  + The more CO2 we create the more bicarbonate in oceans
  + Bicarbonate causes: lack of diversity, diminishing coral (which makes ‘slime’), hard for shellfish to grow their shells
* This may lead to a food crisis if our actions do not change

***Issues in Ocean Fishery Management***

* Continental shelves: 18% of the oceans
  + And provide for 90% of global fisheries
  + E.g. Shanghai by 2100: 75% of world’s population, 11% of land
* Fisheries provide 20% of the global protein supply
  + In Asia and Oceania, it may provide and even higher percentage
* 2.6 billion people

***Environmental Impacts of Marine Fisheries (Bycatch, Pollution, etc.)***

* More than 80% of global fisheries are either fully utilized or overexploited
* Evidence:
  + Size of predators now 20% to 50% smaller than they used to be
  + Fishers target bigger fish due to their value and release smaller fish
    - Harder to repopulate because larger fish have more success than smaller ones
* Environmental Impacts:
  + Fishing down the food chain: fish are now caught at deeper and deeper depths
    - World fish population has decreased by half
  + Bycatch: non-targeted species of marine life caught in fishing activities
    - 25% of global fisheries
* 149 aquatic dead zones in 2003… over 200 in 2006
* Impacts on Marine Ecosystems:
  + Offshore Drilling: over 60% of current oil produced
    - Deepwater Horizon explosion, 2010
    - Toxins in drill mud
* Coastal Zone Development:
  + About 5% of the world’s population lives less than 100km from ocean coasts
    - There is no legislation about coastal development in 50% of countries with coastlines
    - E.g. destruction of coastal wetlands

***Collapse of Cod Fisheries (What Happened?)***

* Large boats from all over the world came to the Grand Banks in Newfoundland to fish cod outside on the limits
  + Then the traditional Canadian fishermen boats fished this area in the summer
* Catch in the late 1950s: about 150,000 tonnes
* Catch in 1974: about 35,000 tonnes
* The rate fish were caught was beyond the rate they could reproduce
* So Canada closed off its territorial waters from foreign fishers
  + But local fishers still only caught smaller fish
* DFO (Department of Fisheries and Oceans) said there were still a lot of fish
* Population of cod crashed in 1986… closed off all commercial fishing of cod
* Now cod is an endangered species
  + Probably will never fully recover

***Aquaculture & Related Issues***

* Fastest production of food sector in the world
* About 50% of global fisheries
* British Columbia: 4th largest producer of farmed salmon
* Problems:
  + Escaped fish… can become invasive species
  + Parasites… because of high density of fish, disease travels fast/easily and can infect the wild population
  + Fish waste… some fish farms create as much waste as a small city (causes water quality problems)
  + Energetics… 3 to 4kg of marine fish produce only 1kg of salmon
  + Economy… controlled by 5 multinational corporations that don’t really care about locals and can just leave and relocate their operations if problems begin… locals are stuck with the mess
  + Astaxanthin & Canthaxanthin… farmed salmon have 11 times more toxins as wild salmon
  + Closed systems are more expensive but more sustainable… there is no incentive to use a closed system because of lack of regulations

***Pollution and its Impacts on the Marine Food Chain***

* Mains source of marine toxicants in Canada:
  + Airborne pollutants
  + Agricultural runoff
  + Sewage
  + Waste and refineries
* Bioaccumulation and Biomagnification:
  + Top producers tend to collect toxins from their prey and carry the highest load of contaminants
* PBDEs: Polybrominated Diphenyl Ethers
  + Used as a flame retardant
  + Causes many health effects

***What to do?***

* Less than 1% of oceans are protected
* Less than 10% of Canada’s coastlines protected
* In 1998: Canada passed the Oceans Act
  + Little resources to legislate
  + Poll: people believe 20 to 23% percent of shores are protected… in reality 0.66%
* Small scale fishing is almost as effective + way less damaging compared to large scale
* Large scale fishing must be subsidized and creates much more GHG

**Lecture 9:**

***How is Water used in Canada? (Compared to Other Countries)***

* Canada’s Water:
  + Canada has 20% of the world’s fresh water reserve
  + Canada only has 0.5% of the world’s population
  + Water contributes $23 billion to Canada’s economy
* Most Important Natural Resource:
  + 55% of people think that water is Canada’s most important resource
  + 61% of people have no idea how much each household pays for water
  + 30% of household water use is from flushing toilets

***Issues with Point Source Pollution & Emerging Contaminants***

* Water Quality:
  + 2006: Environment Canada in Southern Canada water quality study from 379 stations showed:
    - Good/Excellent Quality: 48%
    - Fair: 30%
    - Marginal/Poor: 22%
* 22% of Canadians without secondary treatment of water
  + In 1999 this number was 78%
* Point Source Pollution: (e.g. from factories or sewage plants directly into water)
  + Has inadequate monitoring
* 1998: 3.5 million people in large municipalities were not connected to sewer systems
* 57% of small cities have no waste water treatment
  + 1987 to 2012: need $5.4 billion each year to upgrade these systems
* 90% of industrial release from Alberta and Ontario
* Wastewater filtration cannot get rid of pharmaceutical drugs from waste water

***Access to Safe and Sufficient Water (Issues)***

* 2/5 of the world doesn’t have access to sanitation
  + Just over 1 billion people
* 2/3 of the world’s population gets less than 50L/person/day of water
* Canada = about 300L/person/day (4% of world’s population gets this much)
* 3L/person/day is absolute minimum

***Access to Water for First Nations***

* Kashechewan, October 2005:
  + Health Canada discovers high levels of E. coli in treatment system
    - This caused “impetigo” … a disease that causes scars on skin
* In 2004, 460,000 people living in 600 reserves across Canada
* 75% of reserves have a significant risk to the quality/safety of water
* Neskantaga: since 1995 (20 years) have had a boil water advisory

***Exposure to Floods & Reduction of Damage***

* People live near water for
  + Potable water (Drinking water)
  + Waste disposal
  + Transportation
  + Energy
* Problem is rivers fluctuate in flow
* Reducing Flood Damage:
  + Structural Approaches:
    - I.e. concrete banks
    - Behavior of systems is modified
    - May give a false sense of security
    - Most are built for “50 year floods” but if a “100 year flood” occurs it is not going to stop the water
  + Non-Structural Approaches:
    - I.e. zoning restrictions, land use
    - Modifying behavior of people
* Floods are somewhat predicable… you know it is going to happen sometime, just not the specific date
  + Actions can be taken to prevent SOME of the damage

***Water Ethics and Canada’s Role***

* Water Ethics:
  + Water resources may become as strategic as oil resources during current century
  + Water as a human right and human need
  + Help ecosystems
  + Monitor and change water efficiency
* Belief that Canada’s sovereignty over its waters would be challenged
* Canada wants to have ownership over its fresh water
  + 2002: opposed
  + 2006: opposed
  + 2010: opposed
* Canada has no role in making water a human right
* Canada wants to have ownership over its water so other nations cannot just take it

**Lecture 10: Agricultural Issues**

***Geographical Distribution of the Major Types of Food Production***

***Traditional Vs. Industrial Agriculture***

* Traditional Agriculture:
  + Extensive amount of land required
  + Little labour and capital needed
  + No energy demand (less/no large machine)
* Industrial Agriculture:
  + Moderate amount of land needed
  + Little labour
  + Substantial investment of capital = Extensive fossil fuel use
  + 8% of population in developed nations
  + 60% of individuals in developing countries

***Trends in Agriculture (Past 50 Years)***

* Increased use of land, pesticides and fertilizers
* Increase in nitrogen, water and phosphorus
* Crop and pasture land increase
* Increase in genetically modified crops (GMOs)

***The Green Revolution (And Impacts)***

* Production of more food by increasing the number of arable hectares and increasing yields
  + Increase yields by increasing intensity and frequency of cropping
* Quinoa has not seen it yield increase from the green revolution
  + It used to be cheap for locals… now that global demand has increased so much the price has also been driven up
* Pesticide use has increased more than fertilizer and fossil fuels over the last 40 years
* What is the Cost of the Green Revolution?
  + 4-fold increase in fossil fuel use
  + 10-fold increase in fertilizer use
  + 2.5-fold increase in irrigated area
  + 30-fold increase in pesticide use

***Trends in Food Availability, Energy Consumption, and The Human Diet***

* Under nutrition: cannot buy/grow enough food to make their basic energy/calorie needs
* If all food in the world was spread fairly we would be able to feed the entire world population
  + But countries with higher income are consuming more
* Cattle need the most grain out of pigs, chickens and fish (catfish, carp)
  + They need 7kg of grain per kg of their weight
  + Is this a good use of grains?
* Is It a problem?
  + To supply a meatless diet population growth requires doubling of the 1990 grain production
  + Global population expected to be 8 billion by 2025

**Lecture 11: Agriculture**

***Worldwide Trends in Food Production***

* Between 1700 and 1950: cropland increased from 250 million to 1.2 billion hectares
* Well suited land is becoming limited
  + And small opportunity for expansion because cities are growing more and more
* Intensification of production: a key strategy for most parts of the world
  + 1967: 648 Mha
  + 2002: 671 Mha
    - Not a lot of growth in area, but production has increased
* Production of cereals do not match worldwide demands
  + 2011: 2.3 billion tonnes created
  + lowest stocks of grain in 30 years caused by this
* 48% of human’s diet from grains

***Impacts of Global Warming***

* Over 30 years yields are likely to decline by 10% for every 1°C increase in temperature
* Rice: no fertility at all at 40°C
* 40% reduction in yields
* Deforestation to make room for sugar cane

***Consequences of Alternative Fuel Sources***

* Oil is used for 95% of transportation
* 30% of corn used to make biofuel: this only reduced reliance on oil for transportation by 3%

***Problems Associated with the Green Revolution***

* Global production of wheat and rice =
  + Selective breeding
  + Intensive irrigation
  + Fertilizer use
* 1st Revolution: Developed countries
* 2nd Revolution: New strains and farming practices in developing countries
  + NERICA (“new rice for Africa”) rice
  + This rice produced 50% more yield
* Depletion of Nutrients:
  + Use of fertilizer has reached its limits
  + More fertilizers do NOT equal more yields… in the future it will decrease yields
* Irrigation:
  + 70% of freshwater is used for irrigation
  + up to 90% in developing countries
  + Can be up to 5000L/day/person
  + 1000L for 1 tonne of grain
  + Mostly used in dry areas: in Canada 75% in Prairies

***Rise in the use of GMOs***

* Miracle seeds = New strains
  + Increased yields and tolerance to environmental changes
* Use of GMOs is because conventional techniques will not significantly increase yields in the future
* Some countries choose to label GMO foods
  + Canada does NOT require GMOs to be labeled

***Agriculture as an Ecological Process (Use of Biocides)***

* Subsistence farming: production of food is intended to satisfy the needs of only the farm household
  + This is less energy intensive
  + Per unit of food produced: 10 times less energy needed
* Rise of Chemicals
  + Fertilizers and biocides are important inputs to modern farming systems
  + Canada: 54kg/hectare
  + US: 103kg/hectare
  + China: 301kg/hectare

***Meat Consumption and the Livestock Revolution***

* Trends in Meat Consumption:
  + Developed countries consume: 85kg/person/year
  + Developing countries consume: 32kg/person/year
* We are eating food at the highest level of the food chain
  + This causes loss of energy due to how much animals eat
  + Not an effective transfer of energy
* Livestock Revolution:
  + Shift from family farms to factory farms/feedlots
  + Canada Produces
    - 43% of worlds beef
    - 50% of worlds poultry
* 2005: These operation contributed to 66% of N20 (Nitrogen/Nitrous Oxide) emissions
* Many concerns about having so many animals concentrated in small areas
  + Ontario/Quebec: 10,000 animals per farm

**Lecture 12: Forestry**

***Who Manages Canada’s Forests***

* 119 million hectares available/used for timber production
  + Provinces: 77%
  + Federal & Territories: 16%
  + Private Landowners: 7%

***Rates of Forest Conversions***

* Culmination Age: when trees are first getting big enough to be harvested, but noy fully matured
  + Culmination age = 60 to 120 years’ old
* Waiting until ecological maturity (old-growth stage) is less profitable than just waiting until culmination age… because you have to wait longer to cut the tree down

***Harvesting Systems, Impacts, Trends***

* Clear Cutting
  + All trees (no matter what size, age, etc.) are cut at once
  + Most nutrient loss from this method
  + Size of cuts vary: from 15 to 250 hectares
  + 90% of harvesting is from this method
* Seed Tree Cutting
  + Remove most trees in an area, but leave some to produce seed for regeneration
* Shelter-wood Cutting
  + Leave some large trees to shelter young trees
  + Used to protect and shelter regeneration
* Selective Cutting
  + Cut down selected trees so forest growth is not disrupted
* Clear cutting is the cheapest method of harvesting
* To make it slightly more sustainable you can only cut segments of a forest and leave “wildlife corridors” for animals to live
* There is a decrease in “stand diversity” (idk what it means, just diversity in general I guess) when you cut large areas down
* Reforestation:
  + Until 1985: considered unnecessary
  + Now: still mismatch between three removed and reforestation
    - Less REforestation then Deforestation
    - A lot due to economic downturn/crash of housing market
  + 2009: over 450,000 hectares planted
  + 2009: about 19 million hectares destroyed

***Trends in use of Biocides***

* Reduces competition for seedlings
* Protects seedlings from insect damage
* Spruce Budworm (very damaging to coniferous [spruces and true firs] trees)
  + Used a biocide to control them that caused Reye’s Syndrome (swelling in liver and brain)
* Now Bt (Bacillus Thuringiensis) is used

***Forest Fires and Impacts of the Mountain Pine Beetle***

* Suppression in fire-dominated systems has resulted in uncharacteristic ecological changes
* A lot of fires from ground fuel
  + B.C. fires in 2003
* 1990s: 3.2 million hectares from forest fires destroyed
* 2001 to 2006: 2 million hectares
* 2009: 0.8 million hectares
* 2010: 3 million hectares
* Mountain Pine Beetle:
  + Lay larvae in trees
    - Causes fungal infections in trees
  + Estimated $30 billion lost in forest products from this beetle
  + 270 metric tonnes of carbon released as a result
  + by 2013: over 80% of mature pine trees were consumed by the beetle

***Forests and Species at Risk***

* Of species considered at risk in Canada 65% are forest-related
* 85% of species in some forests are insects
* Over 1000 species of invertebrates in a single stand (a place i.e. forest I think?)
* The Spotted Owl:
  + Most endangered species in Canada
    - 2003: 25 breeding pairs left
    - 2007: 11 pairs
    - 2011: 6 pairs
  + Logging makes it very hard for the species to survive
  + Their natural habitat is a “multi-layered canopy” forests (old-growth forests with many levels/ages of trees and vegetation)
  + Bushy-tailed woodrat is the owls main prey
  + We should close areas were these owls remain from logging
  + We have started to kill “barred owls” to “make room” for more spotted owls

***Climate Change and the Role of Forests***

* Some years’ forests create more GHGs than they remove
  + Largely due to insects
* 1990: 29 million tonnes released (GHGs) from forestry operations
* 2009: 18 million tonnes released
  + The number has gone down slightly due to more ecologically friendly practices in the forestry industry