Module 3: Environmental Crisis

I=PAT

- A simple mathematical formula to capture human impact on the environment:
  - I: Impact (on the environment)
  - P: Population
  - Affluence of said population
  - Level of Technology
- Idea formulated by Barry Commoner, Paul Ehrlich, and John Holdren in 1970, during a debate about the origins of the environment issues raised at the time
- Heavily criticized at the time and now, but generally seen as useful way to capture essence of problem
  - overly simplistic, over exaggerated
- I is expressed in aha, P is expressed in human number, A is expressed in gha per capita, and T is a unites efficiency factor
- I=PAT can be used to measure impact of a small region, a country, or the entire world.
- The "I" (impact)
  - The I in the formula is often referred to as the ecological footprint
    - More technically, this footprint can be expressed in global hectares (gha), which is a measure of the quantity of Earth's productive surface which is needed to regenerate the resources used, per capita
  - Can measure for one person
- The P (population)
  - Population, according to I=PAT, is a factor in overall environmental impact.
    - Logical , more population means more impact!
  - Since industrialization, world population has been growing exponentially
  - This has prompted some, like Thomas Malthus (1766-1834), to fear an eventual population catastrophe, unless checked by savage wars or widespread famine
    - Turns out population growth is not necessarily exponential
    - Demographic transition: relationship between birth rates and death rates and their affect on total population
      - Japan already declining
      - India & China booming => most pop in east asia
      - Africa up and coming
  - Currently, the UN projects that world population should stabilize around 11.2 billon before 2100
    - Could start declining after that
    - These are only projections. Hard to know for sure
  - Is this a problem?
    - According to I=PAT, it certainly is…
    - But are there subtleties not captured by this equation?
      - India big population but low ecological foot print
  - More on the "ecological footprint" (gha)
    - Gha= global hectares
    - Different countries consume different quantities of gha
    - Humanity's overshot day August 2
- The "A" (Affluent)
  - The A in I=PAT stand for Affluence
  - Definition
    - A plentiful supply of material goods; wealth
    - A great quantity; an abundance
    - Large supply of material wealth => more stuff you own
  - In this case, A represents the average consumption of each person in the P studied
  - Because calculating this is quite difficult, we often resort to GDP/capita, as a proxy of affluence
    - GDP: Gross domestic population => everything a country produces

    - It is reasonable to claim that, all other things being equal, a rise in GDP/capita (A) provokes a rise in environmental impact (I)
  - What types of things make up Affluence?
    - Ownership and use of cars/motorcycle
    - Size, quality, luxury of household
    - Overall consumption of energy
    - Quality and variety of food
    - Consumption (clothing, electronics, etc)
  - One key example, the construction of a car
    - 2.3 million litres of water (for tires and car parts) => to make plastic and rubber
    - 310 kg of lead pollution for construction of the car battery
    - 990 kg of polluted discharge for copper contained in car
    - 2.5kg of Co2 per litre of fuel consumed
      - Perhaps 10 tons in lifetime of regular car
      - Plastic, rubber, runoffs, waste
- T "Technology"
  - The T in I=PAT stand for Technology
  - The idea is that generally, and all other things being equal, greater technology leads to greater environmental impact
    - Often tailored to type of impact measures:
      - For example, in terms of CO2 emissions, T would be identified as emissions per units of consumption
    - But wait isn't it possible that improved technology can mean improved efficiency
      - Yes but
        - 1. That is generally not the case, in overall trends
        - 2. In this case we would simply reduce the value of T
    - Ex: Fishing
      - Better technology leads to decreased fish populations
      - Green fish eating habits usually mean eating less fish and avoiding certain species altogether => T is no help!
    - River damming
- So to recap, I=PAT means that the human impact on the environment is the product (multiplication) of population, affluence and level of technology.
- Since the beginning of industrialization (circa 1750):
  - Population has grown exponentially
  - Affluence (GDP/capita) has grown exponentially
  - Technology has progressed exponentially
    - Moore's Law ever 18months the power of processors is multiplied by 2
- So what does this mean for I (Impact)?
  - The environmental imply of humans (or at least potential impact on the planet has EXPLODED)
  - When somebody says something like, "But humans have always exploited the environment, what's so different about today?", the answer is: "Everything".
  - Comparing the situation in 2018 to the situation in any previous era in human history makes no sense at all.
    - P x GDP/capita X Technology
    - 7.6 billion X 10 500$ X current technology = around 1.6 aha (Earths needed for human needs)
- READING
  - Naomi Klein "Beyond Extractivism"
    - Economic needs are odds against nature
    - Climate needs contraction of human use of resources
    - Extractivism => using nature as a means to an end
    - Nature is here for humans
    - Extractivism: Philosophy that describes human's relationship with nature => one sided (humans take, nature gives)

        - It's its own economic economic system
    - Magical thinking: everything will somehow end up ok
        - Optimistic scenario related to technology
        - Is nature a "complex machine" that can be fully understood (…)
- Malthusian Theory of Population
    - Population will outgrow resources
    - Suggestion: Late marriages => will have less kids
- Population & Sustainability
    - Suggestion
        - Help women who want to have kids, have kids
        - Educate women
        - Contraception
- Population Myth by George Monbiot
    - Consumption bigger impact than population
    - Population growth not always correlated with environmental impact
    - Way to shift blame onto the poor
    - Change to I=CAT c for consumer not p for population
- **<u>Impact on the environment</u>**
    - Climate Change and Global Warming
        - Very efficiently portrayed in An Inconvenient Truth
            - An Inconvenient Sequel (2017)
        - There is **NO** scientific debate about whether or not the world's climate is getting warmer. This is a matter of **scientific certainty**
            - There is some measure of scientific debate around whether or not global warming is caused by human activity, but far less than conservative media asserts
            - The Intergovernmental Panel on Climate Change (IPCC), an international scientific organization overseen by the UN, claimed in its 2013 " Fifth Assessment Report", that it is extremely likely that human influence has been the dominant cause of the observed warming since the mid 20th century
        - By the end of the 21st century, the **average surface temperature** of the Earth is predicted to increase somewhere between 2 to 5 degrees Celsius
            - Temp mostly change in places where there are huge land masses
                - Worse on land than over sea
            - Can translate to 8 degrees in the North Pole
            - Worse in polar regions than in equatorial regions
        - Long list of potential impacts, many of which unknown
            - Rise in sea levels
                - Glaciers melting
                - Warm water is less dense => water expands slightly
            - Expansion of deserts
            - Melting of glaciers and permafrost
                - Houses have no foundation so they get destroyed
                - Because methane gets released from the permafrost that encourages global warming which then heats more permafrost
            - More frequent extreme whether events (hurricanes, extreme heat waves, tornados, droughts, floods, heavy snowfall, ocean acidification, ecosystem disruptions, etc.)
                - More people living in these danger zones
            - Large scale population movements, refugee crises,etc.
        - Global warming has a strong force of **inertia**
    - Air and water pollution
        - Air pollution: the release of harmful substances in the atmosphere in the form of particulate and biological molecules
            - Greenhouse gases are not the only harmful gases released in our atmosphere!

- According to a 2014 World Health Organization report, an estimated 7 million worldwide died from air pollution
  - CO2: about 405 parts per million, about 280 in preindustrial era
  - Sulfur oxides (SOx): main contributor to acid rains
  - Nitrogen oxides (NOx): poisonous smog in major cities
    - Breaks biological compounds => takes away the smell of nature
  - Carbon monoxide (CO): mostly produced by car
    - Poisonous gas
  - Volatile organic compounds (VOCs): methane or similar organic compounds, these are powerful greenhouse gases, and also carcinogens, linked to leukaemia
  - Particulates: small solid particles
  - Toxic metals
- Water pollution: the release of harmful substances in hydrological systems (lakes, rives, underground aquifers, groundwater, oceans, swamps, etc)
  - Major sources include **organic compounds:**
    - Fecal matter released by towns and cities
    - Phosphates from detergents and other household chemicals
    - Insecticides and herbicides from agriculture
    - Hydrocarbons (fuel runoff, gasoline, diesel, lubricants, etc)
    - VOCs from industrial solvents and chemicals
    - Drug pollutants (pharmaceuticals, hormones, etc)
  - And **inorganic compounds**
    - Acidity (industrial waste, often from power plants)
    - Ammonia (mostly from food processing plants)
    - Chemical waste from industrial production
    - Heavy metals (mostly from vehicle and electronic waste)
- Ecosystem disruption and loss of biodiversity
  - Humans have been interfering with the ecosystems in various ways since the dawn of civilization
    - Vast acceleration with the “Columbian Exchange”
    - With modern modes of transportation, considerable problems due to introduction of “invasive species”
  - The world is currently experiencing an impressive loss of biodiversity, in both flora and fauna
    - First were big mammals
    - Are we in the midst of a 6th mass extinction event?
- Deforestation and destruction of old growth forest
  - About 1/3 of the world’s land area is covered with forest
    - About 75 000km^2 lost to deforestation **every year**
      - Roughly **150 times** the island of Montreal
  - This is mainly due to the growth of agriculture land, as a response to growth in population (I=**P**AT)
    - Slash and burn agriculture in many parts of the world
      - Slash and burn => forest fire gives productive land in the absence of industrial fertilizer
        - burn down forest to have productive land
    - More people => need more land and more food
  - Also due to logging activities, due to increased consumption of wood and paper products (I=P**A**T)
    - Much of this logging activity happens illegally
  - A lot of deforestation is unintentional
    - Forest fires => Wildfires and overgrazing
      - Old forests have less intense forest fires since the trees are diverse and different heights
      - Monoculture forest => oxygen between similar trees causes fires
    - Forests hit by diseases
      - Pine beetles
    - Forests planted by humans not a complex as old forests
  - Destruction of old growth forests

    - When ancient forests are destroyed, their ancient and complex ecosystems are often destroyed for good
    - Clear-cutting leads to regrowth are far simpler forests, with dominant species of trees, far more susceptible to forest fires and spread of tree disease
        - This is even more the case when forests are replanted
    - Major problem in British Columbia, Canada
        - This begs a question that is dear to environmental ethics: do ecosystems deserve dignity, the right to existence?
        - Otherwise, do forests deserve to exist solely for the services they provide to humans?
- Soil Erosion
    - Over time, deforested and farmed land decreases in quality
        - Soil Erosion is a natural process on all land, due to rainfall, ice and snow meld and wind
        - However, deforestation, and especially intensive agriculture, accelerate this process of immensely
- Animal cruelty
    - Vegan diet most environmentally friendly
- Degradation of landscapes
- Ocean acidification and coral bleaching
- Depletion of ozone layer
- Natural resource depletion
- Acid rain
- GMOs spreading to natural ecosystems
- Light and Noise pollution
- Overflow of landfills