Lecture # 25 – Environmental Issues in Developing and Emerging Economies

I. Environmental Priorities in Developing Countries

- Thanks to everyone for a productive discussion in class today. My notes below summarize some of the key points from the reading, but do not attempt to capture everything that was said during our discussion.
- We begin by thinking about what issues are priorities for citizens of developing and emerging economies?
    - Are there differences from the priorities of those in rich countries?
    - Can we "grown now, clean up later"?
        - Based on the logic of the environmental Kuznets curve
- What motivates changes in environmental policy?
    - Industrial nations observed a key turning point
        - Cuyahoga River fire in US
        - Mercury spill from a plastics factory in Japan killed thousands around the bay of Minamata
- Environmental problems are often, but not always, worse in low and middle-income countries
    - Deaths from air pollution increase with income (Source: Greenstone & Jack, *Journal of Economic Literature* 2015)
    - These trends still hold)
        - A 2018 World Health Organization report found that 90% of air pollution-related deaths occur in low- and middle-income countries
            - Between 2010 & 2016, air quality got worse in 70% of poor cities in south and south-east Asia
- Which issues are priorities in developing countries?
    - Local environmental problems are a priority
        - Particulate matter emissions highest in Asia and parts of Africa
        - Access to clean water is a concern
        - Indoor air pollution a problem in poor areas. Homes use wood and waste as fuel.
            - Household smoke kills 2.6m people per year
            - Urban air pollution a problem in large Indian cities
        - Poor may care less about amenity values, but care about immediate needs such as clean water and flood control
    - Role of public pressure
        - When most environmental problems are local, rather than national, in nature, it is difficult to develop a mass movement for policy.

II. Growth and the Environment

- Driving forces of environmental problems in developing countries include:
    - Population growth
        - Most are in developing countries.
    - Increasing urbanization
        - As in the developed world, developing countries are seeing a movement from rural areas to cities.
        - Most people move to cities for jobs.
    - Industrialization
        - Developed countries moved from agriculture to industry to services.
            - Industry $\Rightarrow$ more pollution
            - Services $\Rightarrow$ less pollution
    - Changing preferences (e.g. more consumption)

- These trends led to the hypothesis of the environmental Kuznets curve (EKC)
    - Posits an inverted-U shape relationship between per capita income and pollution
    - But different pollutants follow different paths, as the examples from the reading show.
            - CO_2 per capita higher in richer countries
        - Particulate levels in cities better in richer countries than poorer countries
            - Local issues that are highly visible (e.g. air pollution) are typically addressed as countries grow
            - This trend holds for other goods where demand increases as income increases, such as safe water and sanitation facilities. These are clearly normal goods.
        - Ozone shows no clear relationship

- Thus, there is no one answer to whether development helps or hurts the environment

- To assess the impact of growing income and economic development on environmental quality, we start with a theoretical framework. This comes from Greenstone and Jack (*Journal of Economic Literature* 2015), which is referenced in the reading by Jayachandran
    - Their model derives the marginal willingness to pay for environmental quality ($MWTP_E$). Key assumptions:
        - Individuals maximize utility choosing levels of consumption, improvements in environmental quality, and self-protection
        - Assume no other market failures
            - Thus, the model provides first-best outcomes
        - Factors determining $MWTP_E$:
            - Environmental quality affects utility directly (e.g. aesthetic preferences)
            - Environmental quality affects utility indirectly via health
                - Health also affects income
                - E.g. workers exposed to pollution may be less productive
            - Can mitigate health effects by spending on self-protection
                - E.g. air filters, water purifiers
            - Environmental quality affects income, which affects utility via the budget constraint
                - E.g. revenues from tourism depend on environmental quality
            - Consumption may affect environmental quality
                - Directly, by changing environmental quality
                - Indirectly, through consumption and self-protection
        - Key results
            - WTP for environmental quality is the marginal rate of substitution between income and environmental quality.
            - Decreasing marginal utility of income =>
                - low $MWTP_E$
                - spend more on self-protection as consumption goes up
                    - True even if self-protection harms environment (e.g. using more air conditioning)
            - Implications:
                - High marginal utility of consumption
                    - Money goes to consumption first
                    - Implies low environmental quality is efficient
                - As incomes increase, consumption increases, but so do expenditures to protect the environment

- But other factors besides income matter. Jayachandran's paper extends this work, looking at multiple possible links between economic growth and environmental quality. How do these affect environmental quality as income increases?
    - Factors likely to increase environmental quality as income increases
        - Stronger property rights increase long-term investment in land
            - The expected return to investing in one's land is higher if the risk of land expropriation is lower
            - Formally owning property allows one to use it as collateral, which helps lower the cost of borrowing.
            - If the property can be sold to someone who can use it more productively, investments that might not be profitable for the current owner become attractive
            - Someone who expects to use their land for a sustained period will pursue sustainable agricultural practices. A forest owner with a short time horizon might cut down trees and sell them, or a farmer might over-farm their land. With more secure property rights, this deforestation and over-farming might be avoided
            - Most, but not all, of the studies cited in this section find that improved property rights reduced tree loss
        - Regulatory capacity
            - Resources matter
                - Access to satellite imagery improved Brazil's enforcement of illegal deforestation (Assuncao et al (2020)
                - Increased inspections at Indian industrial plants reduced pollution (Duffo et al. 2015)
            - Corruption reduces effectiveness of policies
                - Third-party auditors often used for enforcement
            - The *Economist* article "When the smoke clears" gives examples of the importance of regulatory capacity for cap-and-trade
                - Successful cap-and-trade requires:
                    - Reliable data
                    - More bureaucratic capacity
        - Population growth
            - Birth rates typically fall as incomes rise

- Factors likely to decrease environmental quality as income increases
    - Consumption increases as households have more income. But what they consume also changes
        - Examples in Jayachandran include Randomized Control Trials where treated families are given extra income.
        - Energy
            - Richer households more likely to use electricity
                - What does this displace?
            - Richer households more likely to drive cars
        - Diet
            - Meat and dairy consumption increases

- Uncertain impacts on environmental quality
    - Access to capital
        - Whether access to capital is good or bad for the environment depends on whether the credit-constrained option is better or worse for the environment
        - Empirical evidence is mixed
            - Results where access to capital hurts the environment
                - Assuncao et al. (2020) used a DiD design to study a tightening of access to credit in rural Brazil
                    - The policy change reduced deforestation, as access to credit helped landowners pursue cattle ranching
                - Wilebore et al. (2019) found that access to capital had a similar negative effect on forest protection in Sierra Leone
                    - Cash transfers helped households purchase agricultural inputs, labor, and tools to clear land

- Results where access to capital helps the environment
    - Lopez-Feldman and Chavez (2017) showed that remittances sent from international migrants to families in Mexico caused family members to shift away from environmentally-intensive activities
    - Andersen (2016) and Andersen (2017) found that increases in access to credit among manufacturing firms had positive environmental effect
        - Allows firms to purchase more pollution abatement equipment
    - Several studies show access to credit increased use of energy efficient cookstoves in Africa
    - In a payments for ecosystems program to that gave payments conditional on tree survival on their land, more cotton farmers in Zambia participated if upfront costs (e.g. purchase of seedlings) were subsidized (Oliva et al. 2020)
- Natural resources can be a source of emergency cash
    - E,g, cutting down forests when money is tight
    - Ferraro and Simorangkir (2020) found cash transfers to poor households in rural Indonesia reduced forest cover loss by 30%
        - This benefit occurred in years with low rainfall, so that agricultural output was low
    - Jayachandrian (2013)
        - Households forgo two types of income when they stop deforesting.
            - 1) The clear less land for growing crops and so have a lower flow of income from agriculture.
            - 2) They no longer earn lump-sum income from selling timber.
        - Payment levels that are high enough to offset lost agricultural income and typical revenue from timber may not be adequate when a household has an emergency need for cash.

        - Technology and infrastructure
            - New technology allows producing goods at lower costs
                - Expanded prosecution can hurt environment
                - Might also reduce use of natural resources, which helps environment
            - Effect on agriculture and land use
                - Borlaug hypothesis: higher yields reduce pressure to clear land
                - Jevons paradox: Increased productivity lowers costs, shifting the suppl curve out. Farmers demand more land
                - Empirical evidence is mixed
            - Effect on transportation
                - Building roads increases pollution and deforestation
                - Public transport reduces pollution
                    - Although not noted in the article, this seems to suggest different effects at different levels of development – e.g. which comes first?

- Can we "grown now, clean up later"? Should environmental protection be more of a priority in developing countries?
    - Key criticisms of EKC
        - Need to distinguish between environmental impacts that affect welfare through income and consumption versus those affecting welfare through amenity value
            - Poor may place less weight on amenity value
            - But care about access to clean drinking water, solid waste management, flood control, etc.
        - Poor may care about environment but not have the voice to make concerns heard
            - Are policies implemented in developing countries more representative of the elite?
        - Influence of environment is often indirect, so that people may not link environmental problems to health consequences
            - Information is a barrier
        - Not all measures of environmental quality improve with income
            - Local issues that are highly visible (e.g. air pollution) are typically addressed as countries grow
            - Global public goods with long term consequences are more difficult to address.

        - Show a correlation, but not the mechanism for change
            - Authors of original study (Grossman and Krueger 1991) emphasize that there is nothing inevitable about their relationship
            - Key contribution was to show that growth need not lead to a dirtier environment.
                - But whether growth can lead to a cleaner environment is more controversial
    - Delay can be costly
        - It may be more economical to reduce or prevent pollution at an early stage than clean up afterwards
        - Important if infrastructure investment locks-in polluting technologies
            - Relevant in developing countries, where infrastructure may not yet be in place
                - May be easier to never build a coal-fired power plant than to replace an existing one
                - E.g.: denser cities have lower CO_2 emissions from transportation.
                    - Influencing the shape and density of cities now important if want more energy efficient cities in the future.
        - Cost of needed technologies won't fall unless there is sufficient demand to deploy them to scale
            - The argument is that new technologies will only be developed with sufficient demand for them.
            - Early action justified by the technological change induced.
    - Some damage is irreversible
        - Lost biodiversity is an example

III. Infrastructure

- Availability of infrastructure is also important. We use electricity as an example.

- Consider, for example, why charcoal is often used as cooking fuel.
  - Charcoal is cheap, particularly if wood is gathered for free.
  - But using charcoal teads to deforestation and indoor air pollution.

- Electricity in Africa
  - Electricity consumption much lower in Africa
    - Average consumption per person per year:
      - sub-Saharan Africa (excluding S. Africa): 185 kwH/year
      - Europe: 6,500 kWh/year
      - United States: 12,700 kWh/year
  - Without electricity, people spend more money to get lower quality energy
    - May pay up to $10 per kWh for fuels such as kerosene or batteries for cooking and lighting
    - Often use charcoal or biomass for cooking
    - When electricity connections are available, they are often lower quality.
    - Thus, alternatives to electricity are often dirtier
  - Even diesel generators have higher costs
    - Cost more than electricity from the grid
    - Generate lots of pollution
  - Expansion of both generating capacity and transmission lines are needed
    - June 2022 IEA report: To provide universal access to electricity by 2030, Africa would need to double its total generation capacity
      - Renewables could provide 80%, but not all

- What are the challenges to continued expansion of the electric grid?
  - Low demand is a challenge
    - Low income families cannot afford electricity connections (and perhaps not the appliances to use them)
    - What could be done?
      - Improving reliability to increase willingness to pay
        - This requires better transmission infrastructure
      - Aid to low income families
      - Better regulatory processes
        - Consider the example where a utility in Uganda received a 20% return on investment

- Another roadblock is getting customers to pay their bills
  - Electricity is easier to steal
    - People often have illegal hookups
    - Harder to cut off people who don't pay
      - Compare to cell phone, were service turned off if don't pay
    - Example from the *Economist*: Ghana amnesty program led to 120,000 illegal hookups being removed. The Electric Company had no record of most of these people.
  - Customers are reluctant to pay because service is unreliable
  - Households can bypass the grid, such as by using solar
    - Pay for this through loans, repay with mobile money
    - But if customers use solar instead of connecting to the grid, that leaves a smaller customer base to cover fixed costs.
  - But, industry needs a reliable, large scale power supply.
    - Thus, lack of infrastructure hinders economic development.
    - Many now rely on generators
- Regulators keep prices low
  - Prices are often less than costs
  - Subsidies are politically difficult to remove
  - in other cases, regulatory capture can lead to high return on utility investment, such as in the Uganda from "Purchasing power"
- Many utilities are state-owned and poorly managed
  - Poor record keeping (e.g. the example of illegal hookups above)
  - Poor maintenance records
- Raising capital difficult
  - Capital costs up to 7 times higher in Africa than in US and Europe
  - Investors prefer short-term projects
    - 70% of loans are for less than five years
  - Renewable projects particularly sensitive to costs of capital, since nearly all costs are up-front costs
  - Rich country donors reluctant to fund fossil fuel projects
    - Fossil fuel projects relatively cheap to build
    - Gas power can replace renewables when supply of renewables low
- Coordination among governments needed
  - Grid infrastructure is fragmented
  - Better connections would allow better management of intermittent renewables

- Are “microgrids” a solution?
  - Smaller grids and solar technologies may help households.
  - Advantages:
    - Decentralized, so doesn’t require additional grid infrastructure
    - Costs are falling
    - Because the grid is unreliable, many firms rely on diesel generators as backups. Displacing these generators has positive environmental effects.
  - Challenges
    - Many utilities bundle generation, transmission, and distribution.
    - But since prices are set artificially low by governments, these utilities struggle to recover costs.
    - Removing customers from the grid could make this worse.
    - Expanding grid connections makes adding more renewables easier. Microgrids discourage expansion.
- Another challenge is integrating renewables into the electric grid
  - Donors prefer renewables, so as to not lock in countries to new fossil fuel plants
    - But renewables are expensive and intermittent
      - Need good baseload power to develop industry
    - Possible baseload sources:
      - geothermal
      - hydro
  - Note that if all new electricity in Africa came from natural gas, global emissions would increase by1%
  - Without donor financing, most fossil fuel projects financed through the private sector
    - Higher prices have made developing projects easier
      - E.g. Europe now wants African natural gas
    - Also turn to China for loans

IV. International Aid

- International aid and climate change
    - The *Economist* article “Development v climate” suggest a conflict between aid for poverty reduction and aid for climate change. What are the potential tradeoffs?
        - Aid budgets are limited. More money spent on climate projects leaves less money available elsewhere.
            - In 2021, less than ¼ of grants and loans went to low-income countries. Was about 1/3 10 years earlier.
        - Aid for poverty reduction primarily targets low-income countries. Aid for climate mitigation primarily targets middle-income countries.
            - These countries pollute more and use more energy
        - Aid money goes further in middle income countries
            - More likely to attract follow-on private investment
        - Low-income countries are the most vulnerable to climate change. But aid for adaptation doesn’t reduce emissions.
    - Note potential tension between addressing climate change versus local air pollution
        - Investing to reduce emissions or build sea walls protects future generations, but takes money from the current generation
    - Climate adaptation vs climate mitigation
        - Adaptation investments have large net benefits, but those benefits are avoided damages
            - It is cheaper to avoid damages than to repair damage after a storm, for example.
            - But private sector investors do not earn revenues from avoiding damages.
            - Compare to investing new technology (e.g. installing new renewable energy), where the investor earns money by selling energy produced.
    - How does this relate to the arguments on “loss and damage” compensation? Is such funding appropriate? If so, how would you implement a “loss and damage” fund?
    -