Human Population
2017

Lecture 15
Modeling
7 minute science

Questions

Debate feedback

Arctic methane emergency + discussion

Lecture on Carrying capacity and Gini
Lecture 15: Increasing carrying capacity and inequality

The Green Revolution — quadruple yields


Statue of Norman Borlaug installed at US Capitol, April 1, 2014

"Most people still fail to comprehend the magnitude and menace of the 'Population Monster'"

--Norman Borlaug, father of the “Green Revolution”
It is estimated that half of the protein within human beings is made of nitrogen that was originally fixed by this process; the remainder was produced by nitrogen fixing bacteria and archaea.

** F.H. also the “father of chemical warfare” was also responsible for the deaths of thousands from chlorine gas in WW1
Oil is not renewable

Food production, heat, transportation all depend largely on oil, a non-renewable resource. *Are we spending our savings?*
Use of non-renewable water in the US

The Ogallala aquifer is being depleted due to irrigation.

NASA ASTER image of an approx. 557 mi² area of fields (1443 km²) in Kansas which are watered from the Ogallala aquifer with center pivot irrigation systems.
How can this be economical?
Limits to food production

- Arable land -- finite, decreasing yields
- Water -- surface, aquifer, fossil water irrigation
- Fisheries -- predicted to collapse by 2050 (R. Ellis, “Empty Ocean”)
- Climate change -- high temperatures lead to crop failure. (failed pollination, insect dependence)
Timeline of Food

Events that increased carrying capacity

- Haber-Bosch
- Borlaug
- Peak Oil
- Fossil Water
What happened in Venezuela?
Mantenidos

- In poor Latin American countries, in recent history moderately well-off people had “empleadas” to wash clothes and cook. This is no longer common.

- Migrations to the US and other countries has led to an industry of family support from afar.

- People receiving money from the US have become unwilling to work for the low wages, such as of an empleada.

- Influx of dollars from abroad (remittance) is the largest single source of capital in El Salvador, Nicaragua,...

- People supported by family and called “vagos” (bums) or “mantenidos” (kept people).
Remittances

- **Remittance** is money sent from 1st world countries to developing countries by private parties. Totalled $436B in 2014.

- Remittances account for much more than the total amount of governmental aid to some poor countries.

- Main recipients are
  1. India ($70B in 2014),
  2. China ($64B),
  3. Indonesia,
  4. Mexico.

Globality

- Food flows across borders
- Energy flows across borders
- Pollution flows across borders
- Violence and disease flow across borders
- People flow across borders
Are we meta-populations?

Which graph reflects regions of the world?

No, not meta-populations

Maybe some meta-populations

Yes, meta-populations
Modeling regionality

- Is our model **global**? Or **regional**?

- Is food supply a **distribution problem**?

- What is the effect of the world not being a "mixed pot"?

  - We need a parameter for **global inequality**!

  - How does inequality affect (a) **resource availability**, (b) **affluence**, (c) **technology**, (d) **conservation**... anything else?

  - How do each of those variables affect death rate, birth rate, etc.

- Feedback: what **causes** inequality?
Gini coefficient

- Measure of inequality in a dataset.
- Invented to describe income inequality.
- Area over Lorenz curve and under the diagonal.
- $0 \leq G \leq 1$
- $G=0$ represents perfect equality
- $G=1$ represents a perfect inequality.

$$G = 1 - 2 \int_0^1 L(X) \, dX$$
Trend towards increased Gini

http://acivilamericandebate.com/2014/06/14/picking-piketty-apart-part-i-his-contribution
Lorenze curve for world income, by whole countries

World Bank data, $PPP 2012

Countries: Gini=.48 (N=131)
Gini-quality