Population

Malthus

• Published essay in 1798 – Malthusian Growth Model
  – Population increase exponentially
  – Ability to produce food increased arithmetically
  – Population would outgrow ability of land to produce food – population limited by food sources

Malthus

• Believed that war, famine, disease would control population
• Had short time scale in prediction
• Prior to the industrial and agricultural revolution.
Density

- Could the earth become too populated?
- More population = more living space = less land to grow crops
- More population =? More harm to the environment

Population density, 2008, per km²

<table>
<thead>
<tr>
<th>Country</th>
<th>Density (per km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>18,513/mi²</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>2,497/mi²</td>
</tr>
<tr>
<td>U.K.</td>
<td>690/mi²</td>
</tr>
<tr>
<td>U.S. (#179)</td>
<td>63/mi²</td>
</tr>
</tbody>
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Standard of living

- Varies among societies
- Factors related to quality of life
  - Economic well-being
  - Health
  - Ability to change one’s society status
- Affect of standard of living on environment
  - Mining of resources
  - Comfort
Environmental impact of food production

- Majority of population still live off land
  - 63% of Chinese and 72% of Indians live in rural areas
- Grow food: convert natural ecosystems to agricultural ecosystems
  - Can lead to problems
    - Desertification, soil erosion, loss of habitat, species die-off

Human energy pyramid

- Tropic levels – feeding positions in a food chain

- People in less-developed worlds eat at a lower tropic level
- Converting plants into more nutritionally valuable protein is expensive
Impact

- Less-developed countries: less animal protein, undernourished
- Developed countries: abundant animal protein, “over nutrition”?
  - Ecological impact
    - 1 person eating at carnivore level ~ 10x person eating at a herbivore level
    - Larger impact on world’s resources

Food producers and hunger

- Countries that produce more food than population needs – net food exporters
  - U.S., Canada, Australia
- Countries that do produce enough food, but no surplus
  - India, China
- Countries that do not produce enough food – net food importers
  - Eastern European countries, Japan, sub-Saharan Africa

Hunger

- Countries cannot produce enough food to feed population AND cannot obtain food through purchase
- Needed to produce food: arable land, labor, machines
  - Other issues: poor management, war, corruption
Factors of future carrying capacity

- Limit of food
  - ~ 1 billion people lack adequate food
- Energy – dependent on fossil fuel to raise food, modify the environment
  - Increase in fuel prices affect food production
- Waste disposal – product of human activity
- Interaction and survival of other organisms

Ultimate carrying capacity

- Humans have limiting factors
  - Food, clean water, environmental considerations
- Population projections
  - ~ 6.6 billion now
  - With current doubling time (1.2): 12 billion by 2060
  - If growth rate is slowing: ~9 billion by 2050

Population pyramid