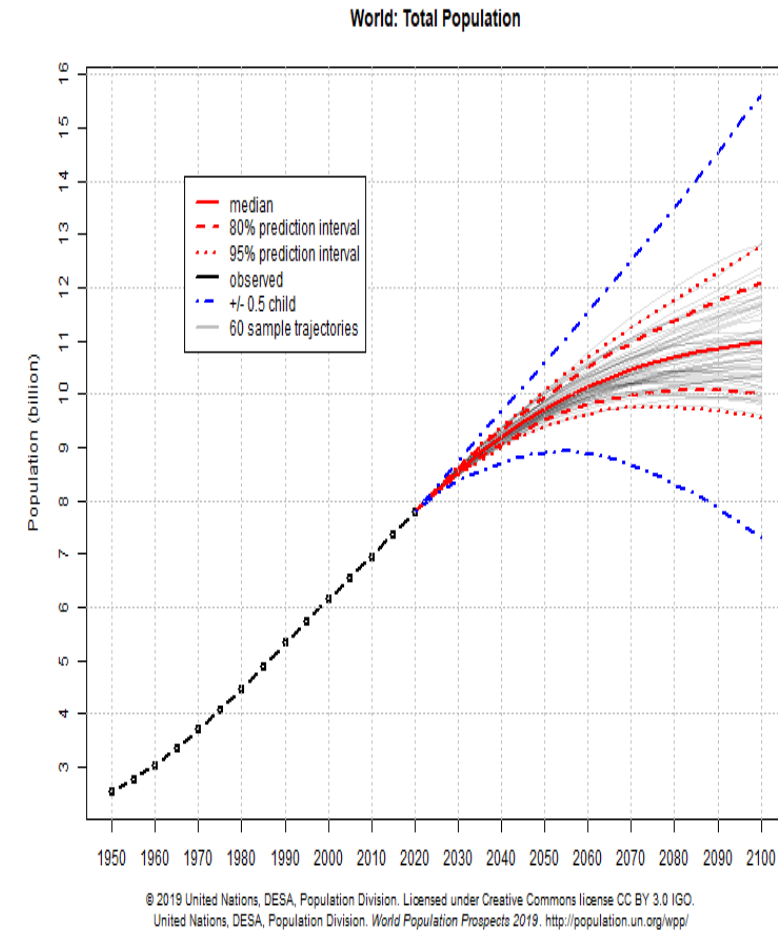


# Population pressure

- Environmental health (9) on 2nd Dec. 2021
- (cf.) Chapter 15 "Healthy Communities" of Frumkin's text 3rd ed.
- Key concepts
  - Fertility rates are falling in some regions, global population still grows, especially in poor countries
  - Global population is becoming increasingly urban
  - Population growth with affluence/technology (using resource) exerts pressures on natural resources and ecosystem integrity
  - Ecological footprint is to measure impact of population and resource use on the ecosystem
  - Carrying capacity = No. people who an ecosystem or the entire Earth can support
  - Limiting population growth and reducing per capita resource use contribute to environmental health

# Population and resource use are uneven

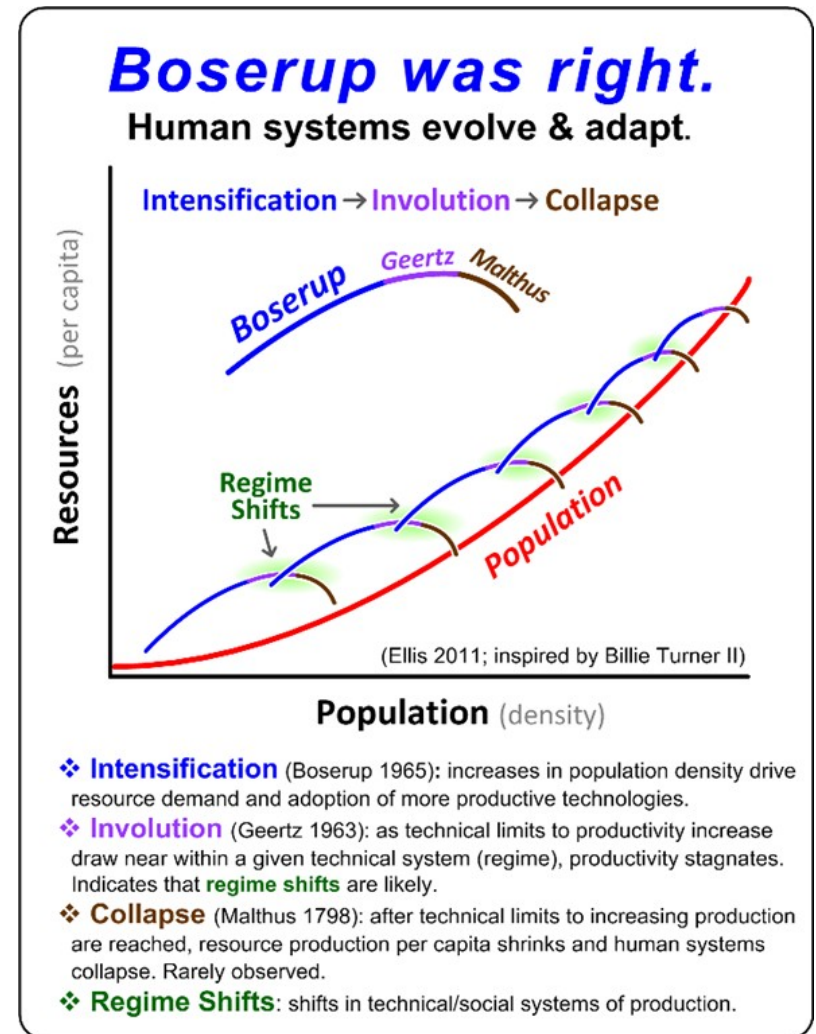
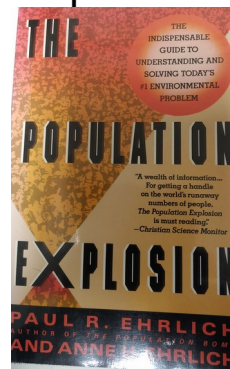
- Current world population  
7.382 billion (18 Nov 2015) → 7.468 billion (30 Nov 2016)  
→ 7.584 billion (29 Nov 2017) → 7.666 billion (26 Nov. 2018)  
→ 7.746 billion (24 Nov 2019) → 7.828 billion (25 Nov. 2020) →  
7.909 billion (27 Nov. 2021)  
<https://www.worldometers.info/world-population/>
- Fertility declines in virtually every region of the world
  - Rapid in Europe, Asia, North America "birth dearth"
  - Africa's fertility drops due to HIV/AIDS (40 million people are HIV positive, 75% of them live in sub-Saharan), but the drop is attenuated due to international programs incl. UNAIDS
- UN-DESA (United Nations Department of Economic and Social Affairs), population division's report
  - Annual population growth ~ 78 million ~ slightly more than 100 million during 2014-2017
  - Projection: 8 billion by 2025, 9.1 billion by 2050
  - 99% growth occurs in the world's poor, developing countries (sub-Saharan Africa, Middle East, South Asia).
  - 90% of 1.2 billion teenagers live in developing countries
- <https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/900>



# Measuring population impact

See, <https://ecotope.org/blog/saved-by-ester-boserup/>

- Malthus T (1803): Human populations have a tendency to increase exponentially, unless limited by starvation, disease or fertility limitation policies, but agriculture only increased its productivity in linear fashion, resulting in famines
  - Neo-malthusians: Population is a driver of negative environmental changes
  - Boserup E (1965): Population growth is the force stimulating technological change and intensification. Increases of population density resulted in land scarcity, which triggered agricultural intensification through application of improved technology (e.g. better tools, irrigation, terracing, shortening of fallows)
  - Ehrlich PR, Holdren JP (1971): Developing countries have large impact on environment due to rapid population growth, developed countries do so due to high affluence and technology level.
- \* Impact = Population x Affluence x Technology (I=PAT)  
see, Ehrlich PR, Ehrlich AH (1990) The Population Explosion, Touchstone, too.



Ester Boserup  
1910-1999  
Danish Economist

# Long term history of world population growth

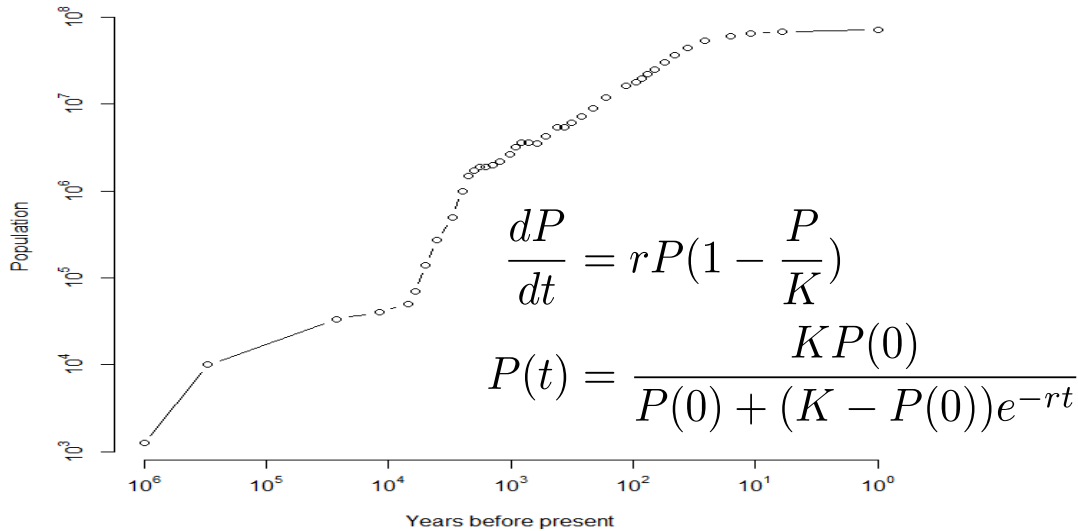
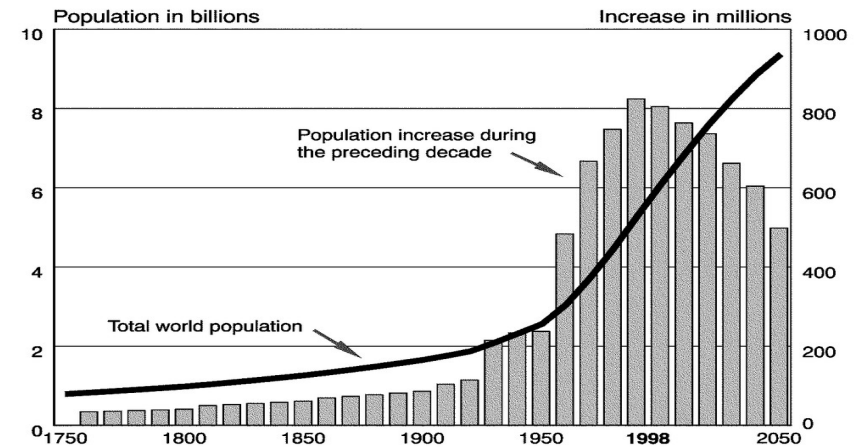


Figure. World population growth (Deevey's steps), based on Cohen 1998 data

Figure 1.  
World Population Still Far From Stabilizing

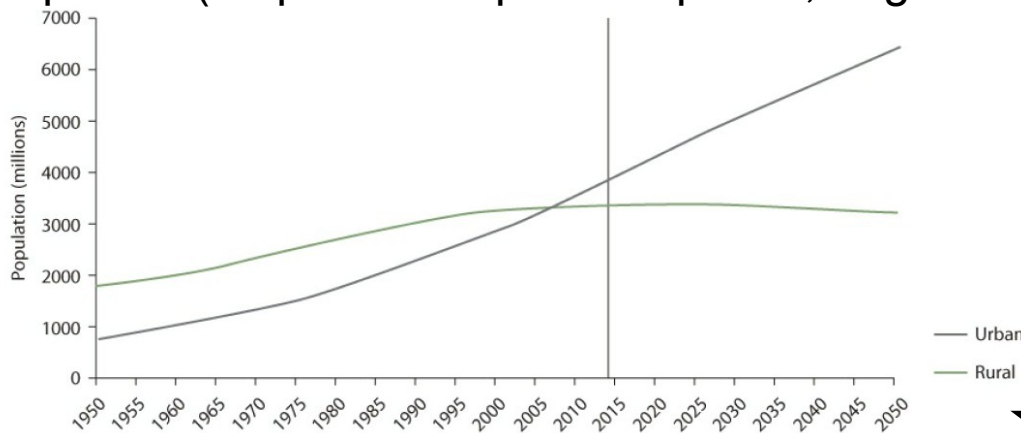


Source: United Nations (1995:97) and U.S. Bureau of the Census, International Data Base.

- Deevey (1960) <https://www.jstor.org/stable/10.2307/24940623>
  - Log-log graph shows a sequence of multistep logarithmic growth
  - "Three population surges" correspond to cultural revolution (use of stone tools), agricultural revolution (farming with sedentary life), scientific-industrial revolution (use of fossil fuels and machinery)
- Annual increase rate since 1750 (bars in the Figure 1 top right)
  - Before 1750, less than 0.5%
  - 1750-1930, 0.5-1%
  - After 1950, higher than 1.6%, mostly in developing countries

# Population and urbanization

- World is in the middle of urban revolution
- Global population live in urban area
  - More than 50% (2008) → 60% by 2030
  - UN-DESA: 3.3 billion (2007) → 6.4 billion (2050)
- Big cities in Africa are growing at 4% per year. It will be double within 20 years
- Infrastructure of most cities in developing countries cannot keep pace with such rapid/continuous urban growth
- Urban growth ← fleeing collapsing rural economies, lack of rural infrastructure/services, landlessness, lack of rural employment opportunities (push factors)
- On the other hand, urban sprawl also occur in some places (emphasis on private spaces, large footprint).



**Figure 15.1** World Population: Urban and Rural, 1950–2050

Source: United Nations, 2014, p. 7.



**Figure 15.4** Schematic Comparison of Street Networks and Land Use in a Traditional Neighborhood and in an Area of Sprawl

Source: Courtesy of Thomas E. Low, DPZ, Charlotte, North Carolina.

The traditional town and city design in the upper panel features a gridlike arrangement of streets, high **connectivity**, placement of different land uses near each other, and high **density**. In the *loop and lollipop* arrangement of streets shown in the lower panel, different parcels of land are developed independently and not linked to each other, resulting in low connectivity, low-density land use, and separation of different land uses.

(Source: Frumkin's text 3rd Ed.)

# Population and environment

[https://assets.wwf.org.uk/downloads/city\\_footprint2.pdf](https://assets.wwf.org.uk/downloads/city_footprint2.pdf)

- Ecological Footprint
  - (Wackernagel and Rees, 1997) A measure of how much area of **biologically productive land and water** an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates using prevailing technology and resource management practices.
  - Usually measured in global hectares. Because trade is global, an individual or country's footprint includes land or sea from all over the world.
- Carrying Capacity
  - The number of people the Earth (or specified region) can support. Estimates depend on what's included and how it's measured
  - vegetarian diet with 2500 kcal/day → 40 billion, meat diets → 10 billion, if developing population live at the standard of developed, 2 billion

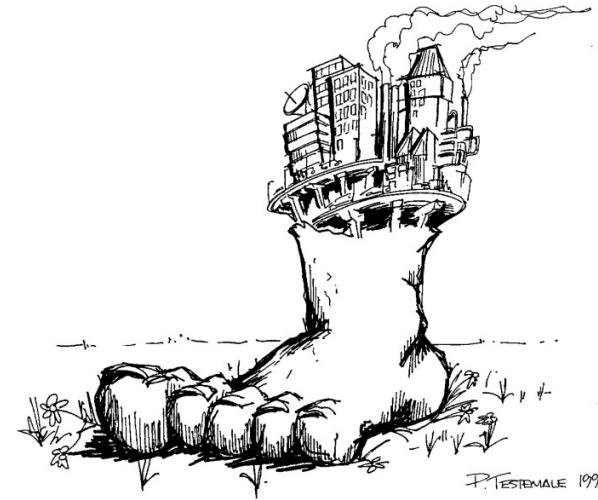
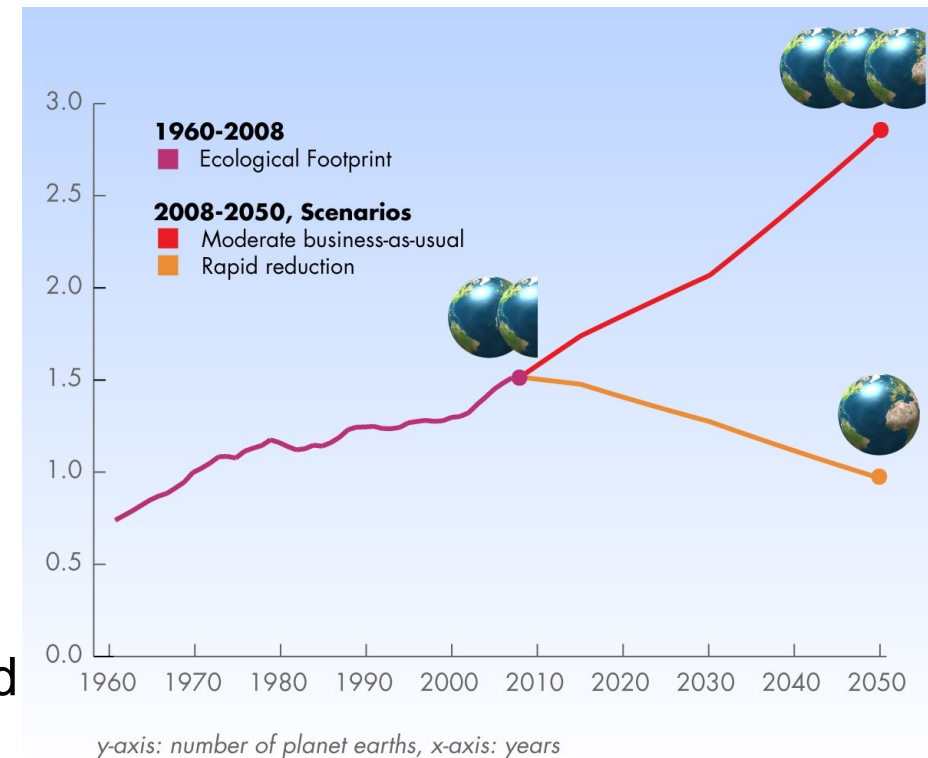


Fig. 1. The ecological footprint. The ecological footprints of individual regions are much larger than the areas they physically occupy. Since industrial economies draw on resources from all over the world, we say that they are in effect appropriating carrying capacity from elsewhere, including the global commons (Phil Testemale).



Population → Land Use (← Urbanization, Policy)  
→ Biodiversity, CO<sub>2</sub> emission

- Weber H, Sciubba JD (2019) The Effect of Population Growth on the Environment: Evidence from European Regions. *European Journal of Population*, 35(2): 379-402.  
<https://dx.doi.org/10.1007%2Fs10680-018-9486-0>
- de Leon Barido DP, Marshall JD (2014) Relationship between urbanization and CO<sub>2</sub> emissions depends on income level and policy. *Environmental Science & Technology*, 48: 3632-3639.  
<https://doi.org/10.1021/es405117n>
- Foley JA et al. (2005) Global consequences of land use. *Science*, 309: 570-574.  
<https://doi.org/10.1126/science.1111772>

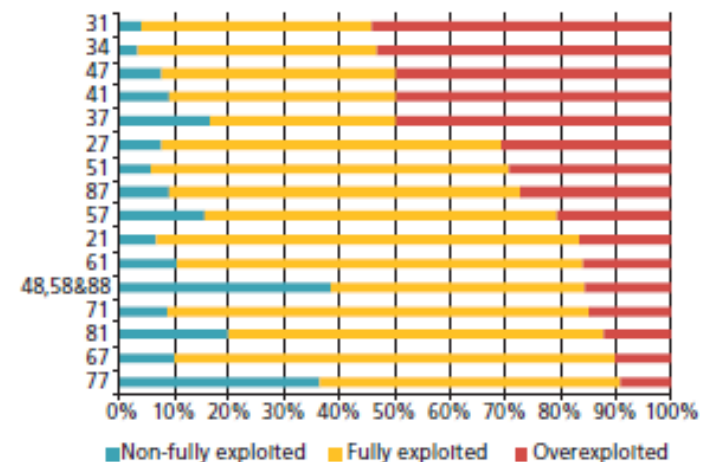
# Population-Environment Scoreboard

- "Earth Summit" (at Rio de Janeiro, 1992) : set specific goals
  - \* Rio+5 (UN General Assembly, 1997): little progress or worsened
  - \* Rio+20 (UN Conference on Sustainable Development, 2012)
- Poverty had increased, partly due to population growth
- Situation of environments
  - Arable Land: Degraded, Small scale farmers cannot produce enough food to feed their families
  - Freshwater: Growing populations place pressure on freshwater supplies. In 1995, 2.3 billion lived in water stressed areas. Lack of clean water: 1 billion in 1990, 1.2 billion in 2007. Chronic water shortages will be the most limiting factor on future economic development. World Resource Institute prospects 3.5 billion people live under water-shortage stress by 2025.
  - Oceans: Coastal wetland have deteriorated. 40% of coral reefs were lost. FAO (2009, 2011) reported 3/4 of world major commercial fish stocks are fully/over-exploited or depleted. 2 billion people depends on seafood for protein  
<https://www.fao.org/3/i2389e/i2389e.pdf>
  - Forests: Deforestation increased (Brazilian amazon, rate was 70% increased in 1992-2002). 37 million ha forest was lost in 2000-2005.
  - Biodiversity: Losing species at 100-1000 times faster than natural loss. During 1990s, 27,000/yr animal/plant species extinct. IUCN Red list: 41415 species. Species diversity is essential for human health as the source of medicine and food.
  - Climate Change: Population growth → energy use → CO2 → global warming and climate change. Though COP3 FCCC Kyoto Protocol → COP21 Paris Agreement, still ongoing

FIGURE A1  
FAO marine major fishing areas for statistical purposes



FIGURE A12  
Percentages of fish stocks in different status by major fishing areas in 2009





# Poverty and population

- Rapid, unsustainable population growth = a principal contributor to poverty
- 1/4 ~ 1/5 of Earth's people live in extreme poverty (**absolute poverty**: spend less than US\$1/day in 1985, \$1.25/day in 2008, \$1.90/day in 2015)  
(cf.) **Relative poverty** (the poorest segment ~ 1/5 or 2/5 ~ of the population, sometimes **less than half of the median income**) should also be paid attention.  
<https://openknowledge.worldbank.org/bitstream/handle/10986/11985/9780821376133.pdf>
- Lower fertility and slower population growth have not brought an improved living standard for the average person. In 1980, about 2.5 billion people lived in less than \$2 per day.
- Extreme poverty decreased during recent decades (from 1.9 billion in 1981 to 1.8 billion in 1990, 1.4 billion in 2005) partly due to MDG1

# Environmental Distress Syndrome

- Population pressure and excessive resource use threatens the health of the environment
- Deteriorating environmental conditions and concomitant threats to human health
- Five symptoms
  - Reemerging/Emerging infectious diseases
  - Loss of biodiversity
  - Growing dominance of generalist species
  - Declines of pollinators are intrinsic to the propagation of flowering plants.
  - Proliferation of harmful algal blooms along the world's coastlines → outbreaks?