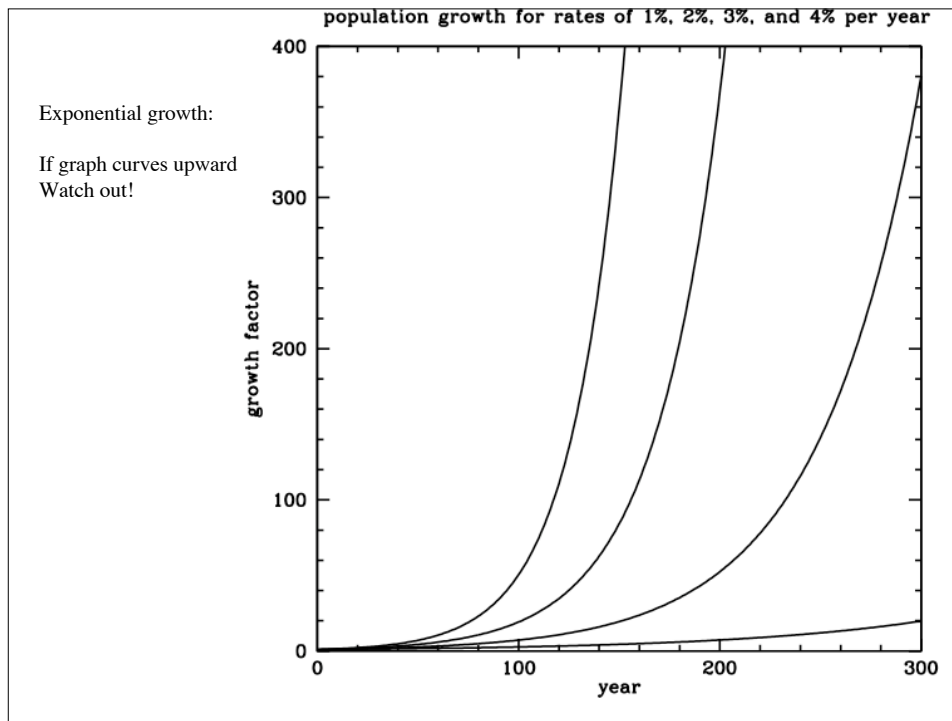


Aug 1992: GOES-7 satellite;
notice hurricane Andrew

Environmental Studies ENVR 30: Intro to Science of the Environment



Question

- ◆ If a large piece of paper could be folded in half 44 times, how thick would it be?
- A. 1/2 inches
 - B. 1/2 foot
 - C. 1/2 mile
 - D. 1/2 million miles
 -

Chapter 2

HUMAN POPULATION GROWTH

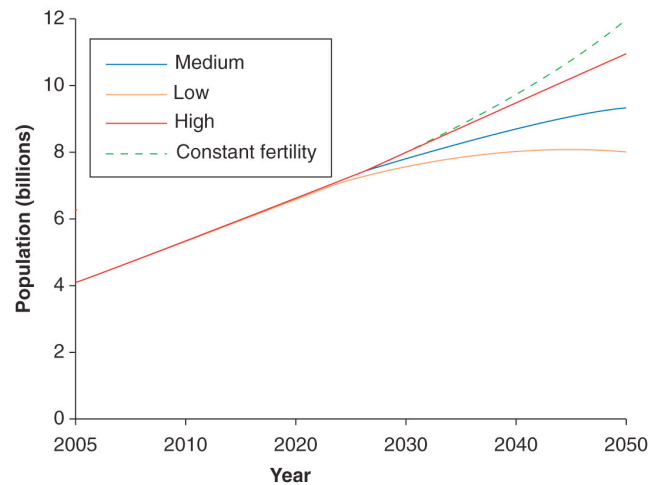
Introduction

- The current world population of more than 6.6 billion people is a cause for concern among many.



- **Although the exponential world population growth rate has declined recently, world population continues to grow rapidly.**
- **Will the world be able to feed and support the 8 to 10 billion people that will be on Earth by the middle of the twenty-first century?**
- **At what cost to the environment and standards of living?**
- **How many people can the Earth comfortably support?**

Future depends upon fertility rate, which is known somewhat, but somewhat uncertain



(b) World population projection until 2050

Figure 2-2b World population projections until 2050.

Source: United Nations Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2004 Revision, Highlights 2005.

Population History

- The total human population on the planet was small and increased slowly through most of human history. Maybe 1 million humans 125,000 years ago, growing only to 5-10 million by 10,000 years ago
- The population started to grow more rapidly due to human inventions: first agriculture, then industrial technology, and finally fertilizers and mechanized agriculture
 - 1000 BCE 50 million (0.05 billion)
 - 0 CE 0.15 billion
 - 1000 CE 0.25 billion
 - 1500 CE 0.5 billion
 - 1800 CE 1 billion
 - 1930 CE 2 billion
 - 1960 CE 3 billion
 - 1974 CE 4 billion
 - 1987 CE 5 billion
 - 1999 CE 6 billion
 - 2009 CE 6.79 billion

This is classic exponential growth: since 1800's growth rates are between 0.5% to 1.5% per year

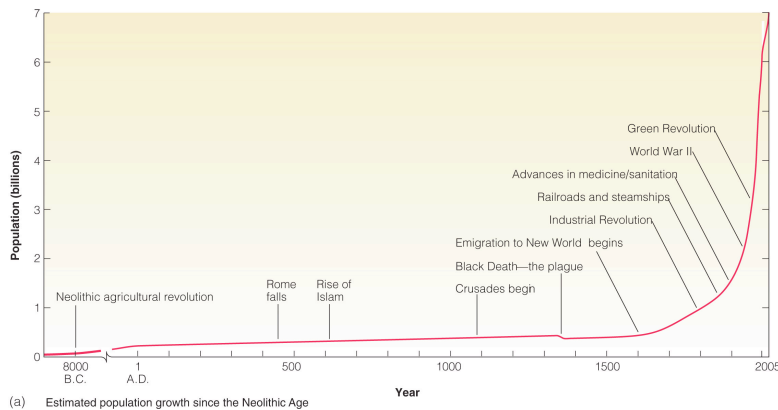


Figure 2-2a Estimated population growth in billions since the neolithic age.

Source: U.S. Census Bureau, International Programs Center, 2001.

Population increase depends upon number born - number dying.

Number born is related to TFR (total fertility rate) = average of number of children women bear: TFR=2.1 will keep population constant. TFR>2.1 => exponential increase

To place this in perspective currently

Roughly equivalent to:

360,000 people born every day	Anaheim
150,000 people die every day	Oceanside
210,000 people added to the heap every day	Irvine

AND, if population continued to double every ~40 years (1%/year growth rate) ...

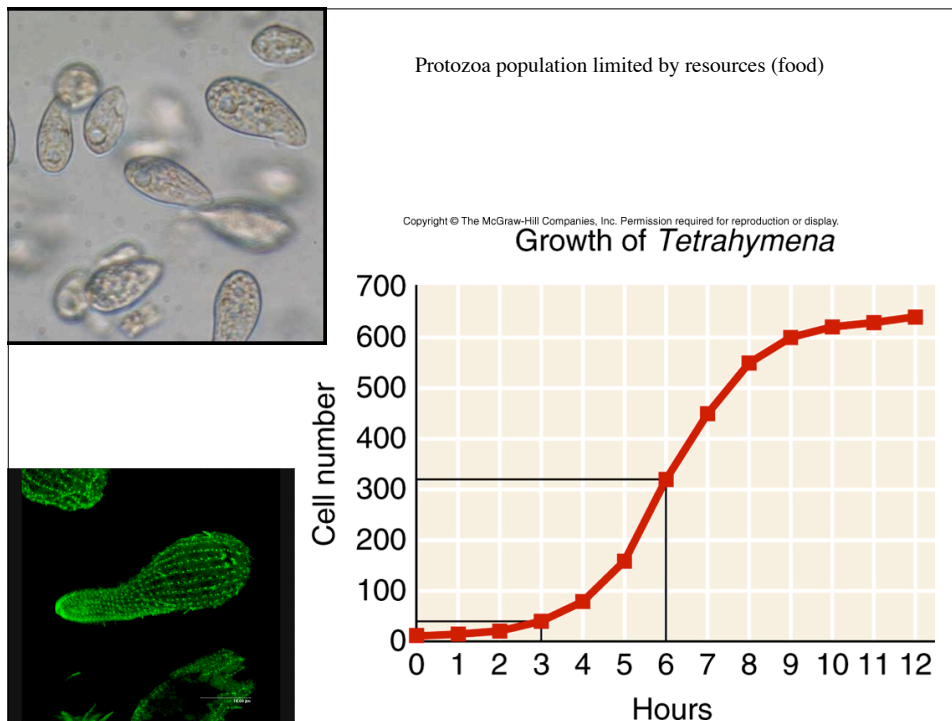
2045– 13 billion *Can human population continue to grow like this? Do we want this?*
2085– 26 billion
2125– 52 billion
2165– 104 billion

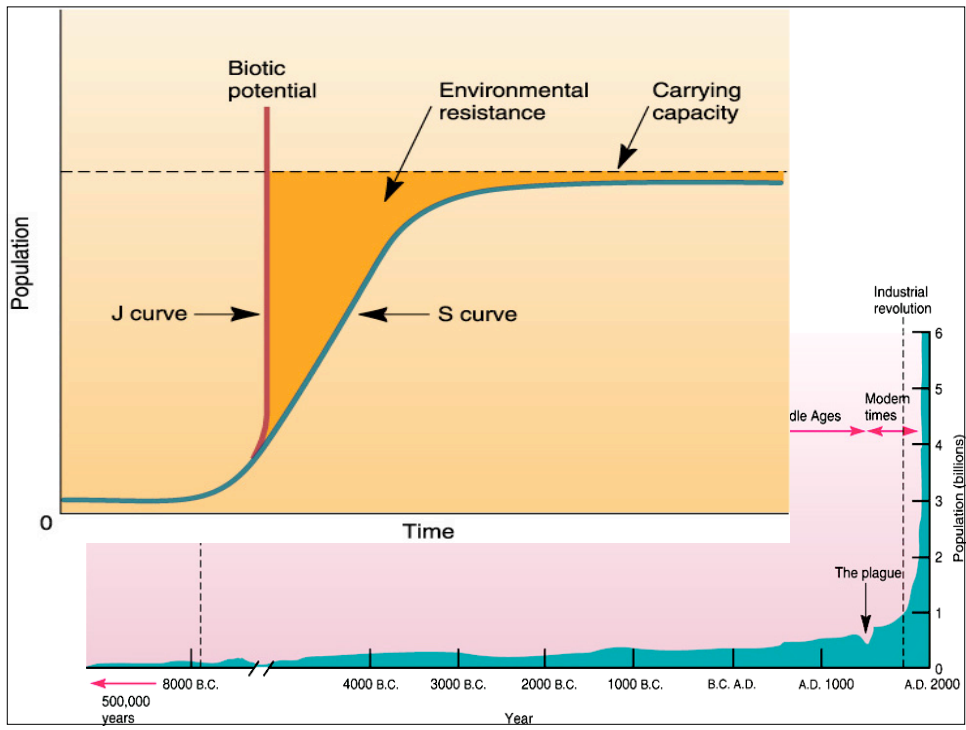
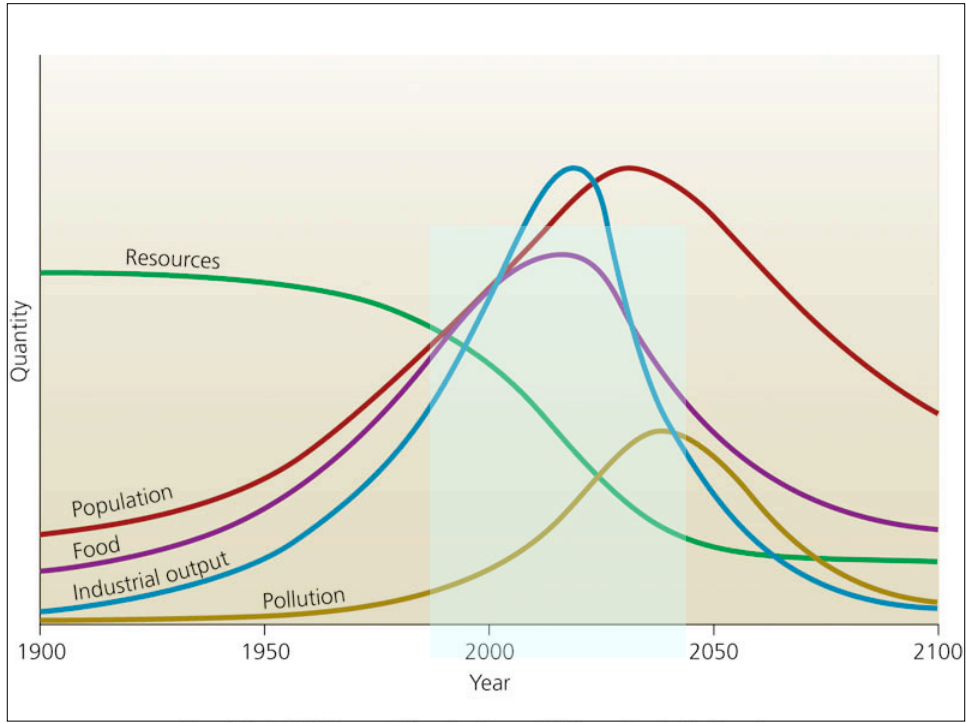
Carrying Capacity

- Carrying capacity is the number of individuals of a certain population that can be supported in a certain area for a prolonged period of time by the resources of that area.
- When a population lives within its carrying capacity, it does not degrade the resources upon which it depends.

Carrying Capacity

- While we are degrading our resources, we are globally producing enough food to feed our current population (although 15% of it is undernourished).
- Some observers speculate that we have already overshoot our carrying capacity.
- What is carrying capacity?, i.e. how many humans on Earth is the right number? Long term, certainly not above the carrying capacity.





Question

- ◆ What do you think is the right final number for humans on Earth?
- A. About 6 billion (what we have now)
 - B. About 12 billion (double current)
 - C. Maybe about 1/2 billion so we can all have more space and resources
 - D. Can't say
 - E. Other, or no viewpoint at this time

4) Human Demography

- **Demography** - vital statistics about people, such as births and deaths
- Two demographic worlds
 - Less-developed countries represent 80% of the world population, and more than 90% of projected growth
 - Many richer countries have zero or negative growth rates

Population Growth Rates Around the World

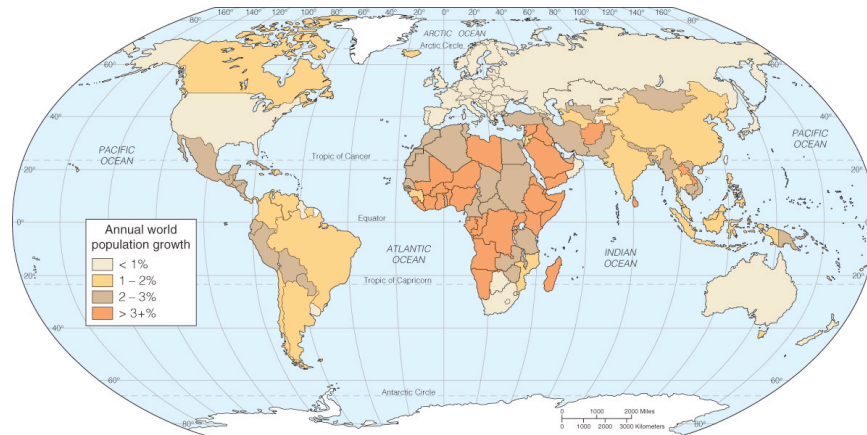


Figure 2-5 Expected annual population growth rates around the world in 2005 to 2010.

Source: United Nations Population Division, World Population Prospects: The 2004 Revision, February 2005.

Fertility and Birth Rates

- **Fecundity** - physical ability to reproduce
- **Fertility** - the actual production of offspring
- **Crude birth rate** - number of births per year per thousand people
- **Total fertility rate** - number of children born to an average woman during her reproductive life
- **Zero population growth (ZPG)** - occurs when births + immigration just equal deaths + emigration

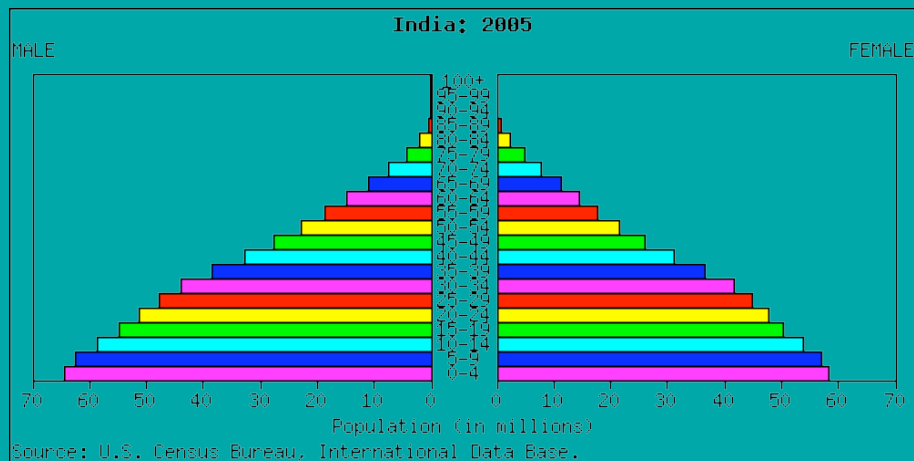
Top Ten Contributors

TABLE 2-3 Top 10 Contributors to World Population Growth, Mid 2005 (Net Annual Additions in Thousands)

No.	Country and 2001 Population	Net Addition	Percentage	Cumulative Percentage
1.	India, 1.008 billion	15,929	20.7	20.7
2.	China, 1.275 billion	9,246	12.0	32.7
3.	Pakistan, 141 million	3,818	5.0	37.7
4.	Nigeria, 113 million	3,172	4.1	41.8
5.	Bangladesh, 137 million	3,023	4.0	45.8
6.	Indonesia, 212 million	2,679	3.4	49.2
7.	United States of America, 283 million	2,567	3.3	52.5
8.	Brazil, 170 million	2,136	2.8	55.3
9.	Democratic Republic of the Congo, 50 million	1,852	2.4	57.7
10.	Ethiopia, 62 million	1,611	2.1	59.8
	Subtotal	46,033	59.8	59.8
	World total	76,857	100	100

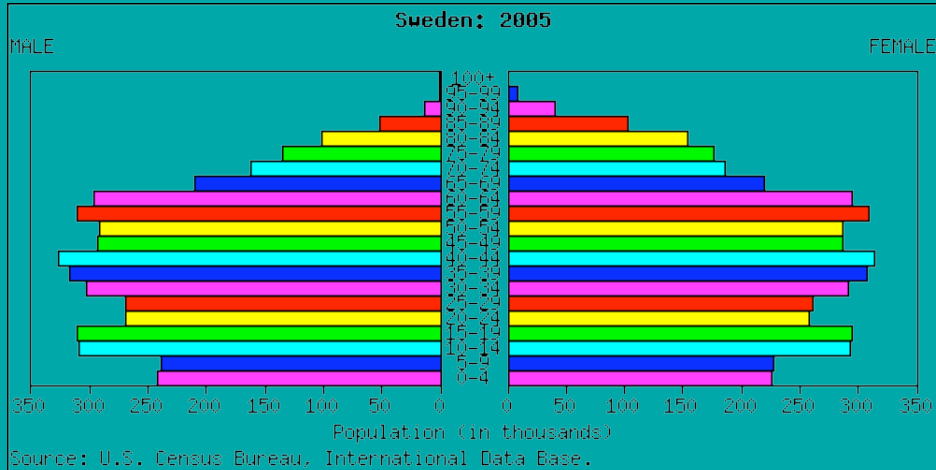
Source: United Nations Population Division. *World Population Prospects: The 2004 Revision, February 2005.*

India Demographics



Population momentum

Sweden Demographics



Consequences of Overpopulation

- Overpopulation is putting an increasing burden on the Earth's natural resources and environment.
- Resources which take millennia (soils) to hundreds of millions of years (ores, fossil fuels) to accumulate are being consumed and dispersed on time-scales of centuries (fuels, ores) to decades (water, soils, species).

Consequences of Overpopulation

- Persons in rich, industrialized nations create a much bigger per capita impact on the environment than persons in poor, non-industrialized countries.
- The U.S. has less than 5% of the world's population but consumes about 25% of the world's natural resources and produces about 25% of the world's pollution.
- Even if U.S./European populations do not grow, impact can grow if consume more

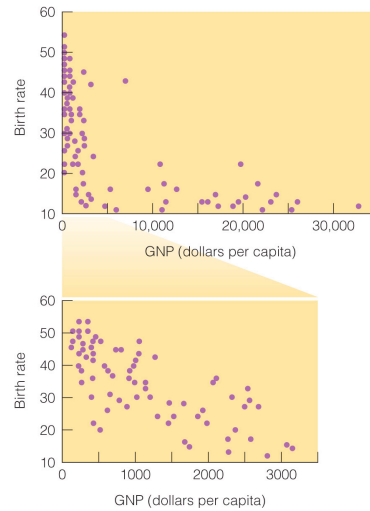
Social Effects of Overpopulation

- Rapid population growth and overpopulation lead to increased urbanization, increased unemployment, and spreading poverty as well as putting the earth under increasing strain.
- Projections indicate that 60% of the world's population will live in urban areas by 2025.
- Increasing population pressures lead to political instability and political and civil rights abuses.

Why lower pop growth in rich countries? Demographic Transition?

- The theory of demographic transition implies that as a nation undergoes technological and economic development, its population growth rate (birth rate) will decrease.

Figure 2-9 Increasing GNP per capita correlates with decreased birth rates.



Source: Pulliam, H. R. and N. M. Haddad, "Human Population Growth and the Carrying Capacity Concept." Bulletin of the Ecological Society of America, September 1994:141-157.

Question

- ◆ Is Demographic transition theory a manipulative scientific theory or a correlational scientific theory?
 - A. Manipulative
 - B. Correlational
 - C. Not actually scientific since it can't be disproved
 - D. Can't say from information given
 - E. Other, or no viewpoint at this time

Problems with the Demographic Transition Model

- Most developed nations achieved development by degrading their environments and exploiting resources from other parts of the world.
- The Earth does not have sufficient resources to permit the developing nations to reach the developed nations' level of affluence.

Reducing Population

- There does not appear to be a necessary causal relationship between development, industrialization, and fertility rates.
- Partial or stalled development leaves countries with populations growing faster than the nation's resources can support.
- Evidence suggests that fertility rate declines are caused primarily by rising levels of education, nutrition, and infant survivorship.

Factors that Reduce Fertility Rates

- Education, especially for young girls and women
- Family Planning availability and affordability
- Employment opportunities, economic security
- Access to the “means of production” (e.g. land, financial capital)
- Health and nutrition, better pre- and post-natal care and reduced infant mortality
- Urbanization, modernization
- Improved “status” of women in society, changes in societal definitions of what a “successful” woman is.

Education of Women

- Perhaps best ways to decrease the growth rate of a particular population is to increase the average educational and societal status of women.
- Improved education results in better healthcare and nutrition, effective contraceptive use, and increased status and prestige.



© REUTERS/Amir Masoudi/Anadolu

Figure 2-13b: Women attending class in Afghanistan.

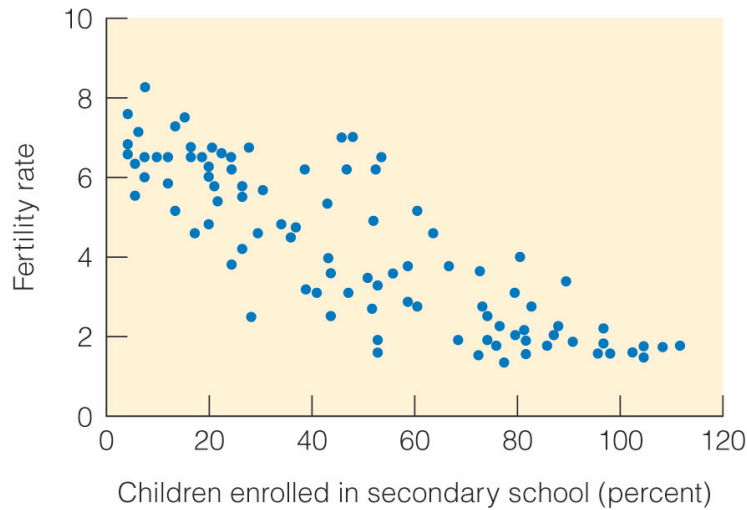
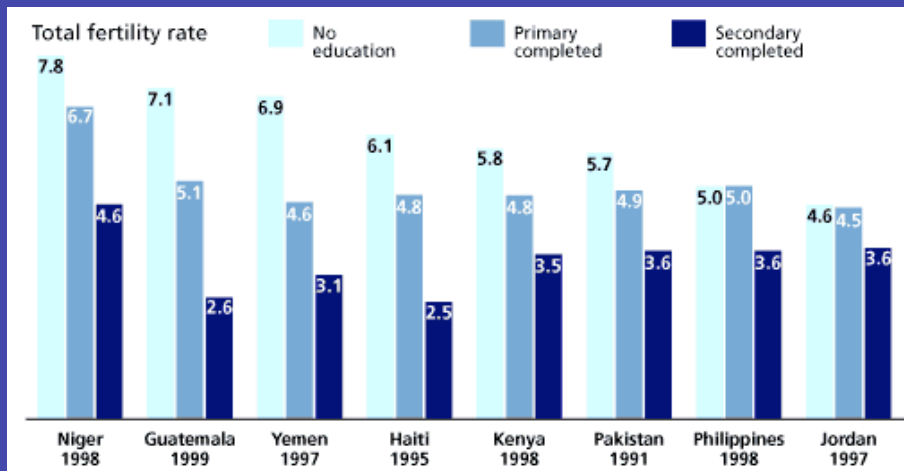


Figure 2.13a: Increased average education levels correlate with decreased fertility rates.

Source: Pulliam, H. R. and N. M. Haddad, "Human Population Growth and the Carrying Capacity Concept." Bulletin of the Ecological Society of America, September 1994:141-157.

Kerala, 1957; tfr 40% below rest of india; 100% literacy; poor even for india

Fertility and Education

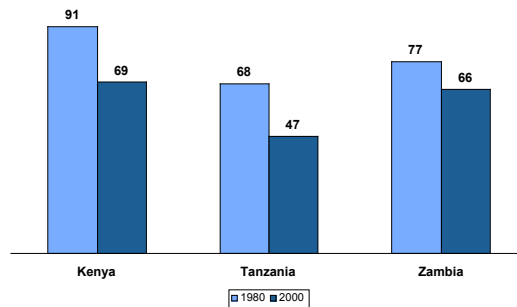


Declining Primary School Enrollment

Declining Primary School Enrollment, Africa

Net Enrollment Ratio

Primary-school-age children enrolled as a percentage of primary-school-age children



Source: World Bank, *World Development Indicators 2003*.

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Why?
What will this mean?

Family Planning

- Family planning includes the distribution of contraceptives, the availability of safe, legal abortions, and promoting reproductive rights of women.
- These practices are often in conflict with traditional religious and cultural values.

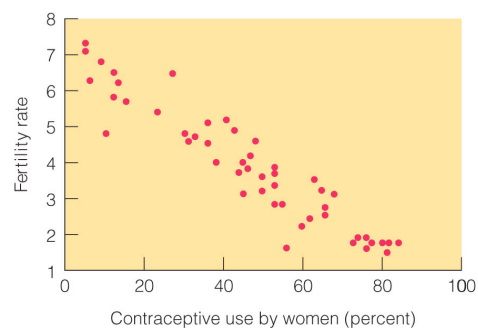


Figure 2-10a Contraceptive use by women strongly correlates with decreased fertility rates.

Source: Pulliam, H. R. and N. M. Haddad, "Human Population Growth and the Carrying Capacity Concept." *Bulletin of the Ecological Society of America*, September 1994:141-157.

Family Planning Availability is Not Enough

A study done in the 1990s compared fertility rates in a number of African and Caribbean countries with similar access to contraceptives (Handwerker, W.P., 1991, Women's power and fertility transition: the cases of Africa and the West Indies. Population and Environment 13(1):55-78).

Caribbean

- Dominican Republic TFR = 2.8
- Jamaica TFR = 2.5
- Trinidad and Tobago = 1.7

Africa

- Benin TFR = 6.1
- Chad TFR = 6.7
- Mali TFR = 7.0

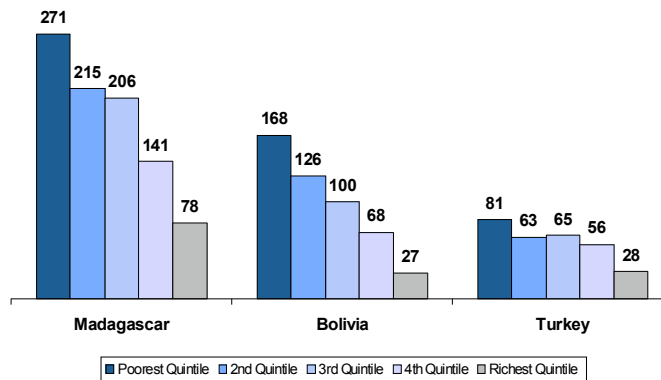
Economic Incentives and Government Regulation of Childbearing

- Some governments have used economic incentives and disincentives to promote population control.
- Another approach is increasing accessibility to modern birth control methods and family planning information without mandating the number of children a family may have.
- Strict government policies have been mandated at times; for example, in 1979 China implemented a one child per couple policy.

Employment Opportunities and Economic Security

Adolescent Fertility Rate

Births per 1,000 Women Ages 15-19



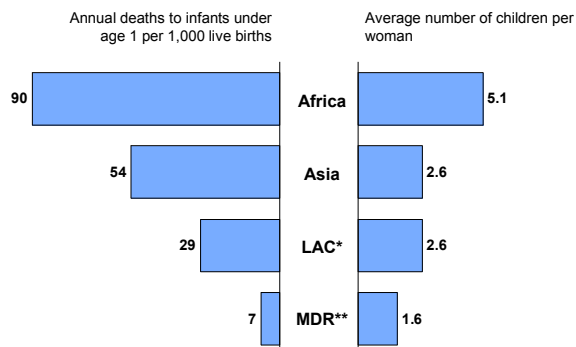
Source: D.R. Gwatkin, S. Rutstein, K. Johnson, E.A. Suliman, and A. Wagstaff, *Initial Country-Level Information about Socioeconomic Differences in Health, Nutrition, and Population, Volumes I and II* (Washington, DC: The World Bank, November 2003).

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Health Care and Reduced Infant Mortality

Infant Mortality and Childbearing, by Region

Infant Mortality Rate and Total Fertility Rate



* LAC=Latin America and the Caribbean; ** MDR=More Developed Regions.
Source: Population Reference Bureau, 2004 World Population Data Sheet.

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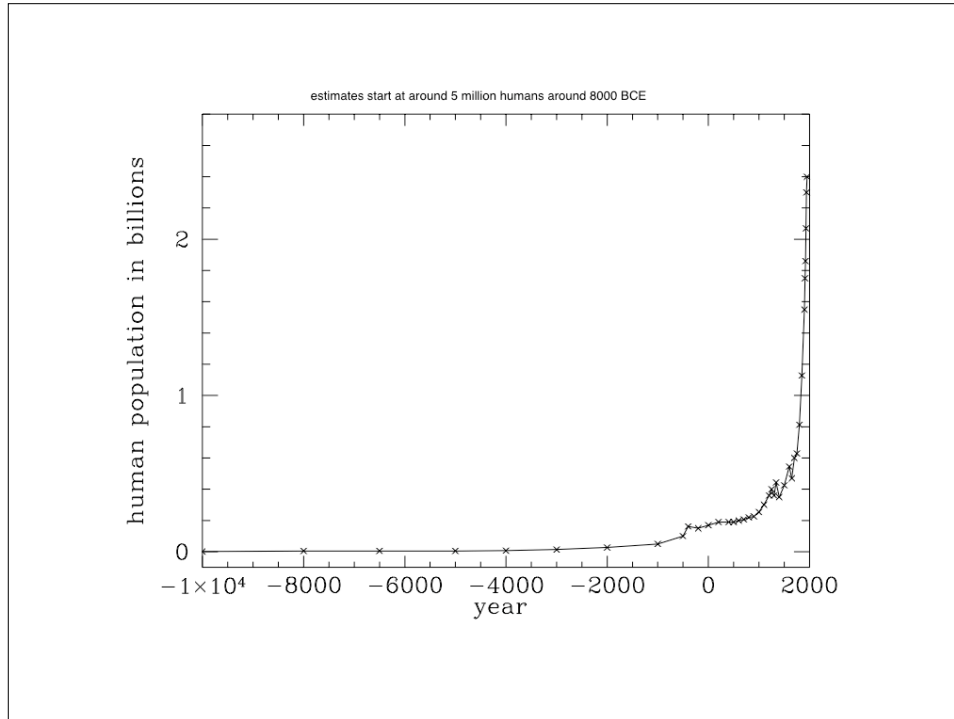
Population Counter

<http://www.ibiblio.org/lunarbin/worldpop>

Question

What do you think will ultimately limit human population?

- A. Disaster, starvation, disease, or war
- B. Education, family planning, public policies, etc
- C. Common sense among the population
- D. Technology will mean that the population can continue to grow
- E. Other, or no viewpoint at this time

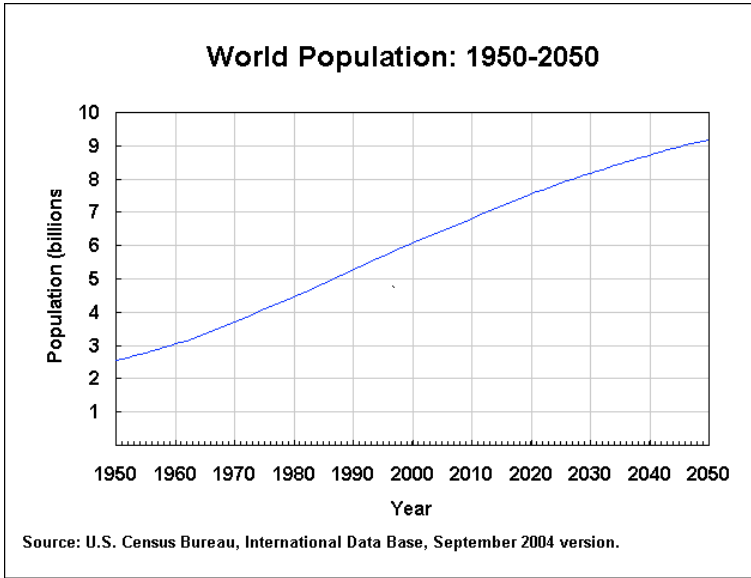


Population Changes Over Time

- World population reached:
 - 1 billion in ~1800
 - 2 billion in 1930 (130 years later)
 - 3 billion in 1960 (30 years later)
 - 4 billion in 1974 (14 years later)
 - 5 billion in 1987 (13 years later)
 - 6 billion in 1999 (12 years later)
- World population may reach:
 - 7 billion in 2013 (14 years later)
 - 8 billion in 2027 (14 years later)
 - 9 billion in 2045 (18 years later)



© Greg Baker/AP Photos

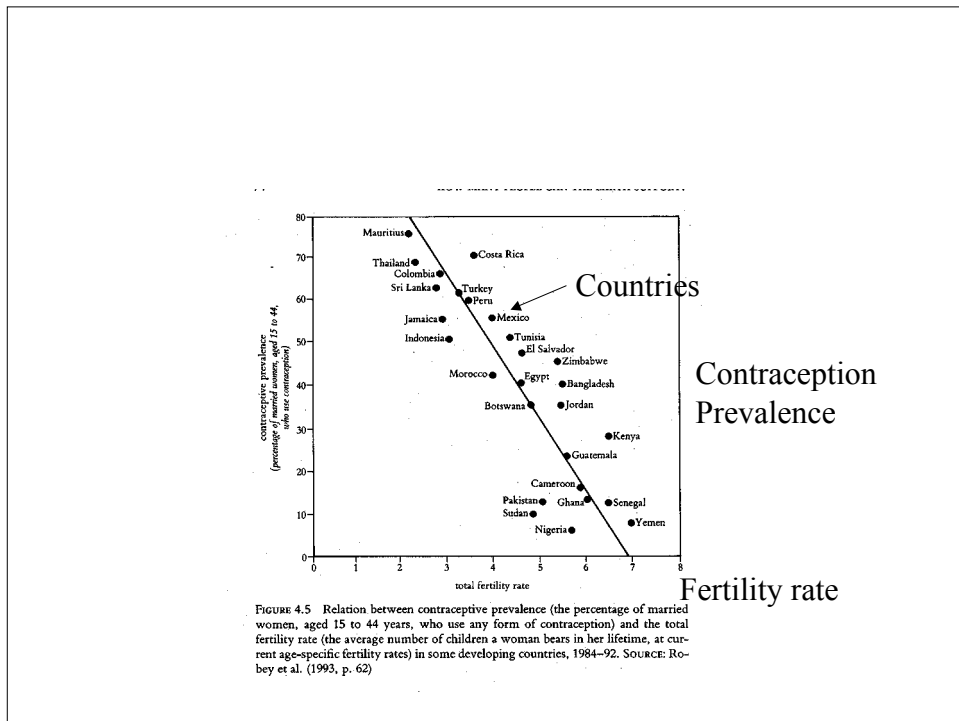
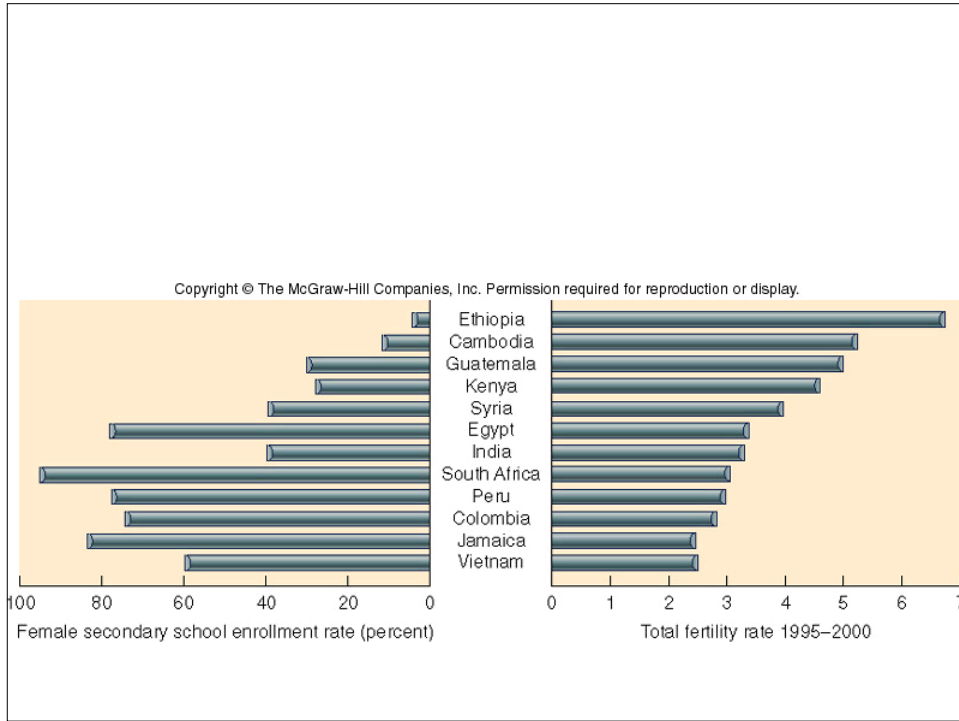


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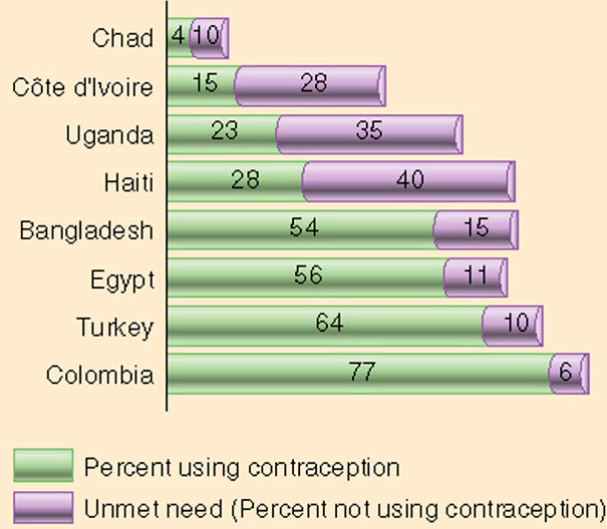
TABLE 4.1 World Population Growth and Doubling Times

Date	Population	Doubling Time
5000 B.C.	50 million	?
800 B.C.	100 million	4,200 years
200 B.C.	200 million	600 years
A.D. 1200	400 million	1,400 years
A.D. 1700	800 million	500 years
A.D. 1900	1,600 million	200 years
A.D. 1965	3,200 million	65 years
A.D. 2000	6,100 million	51 years
A.D. 2050 (estimate)	8,920 million	215 years

Source: United Nations Population Division.



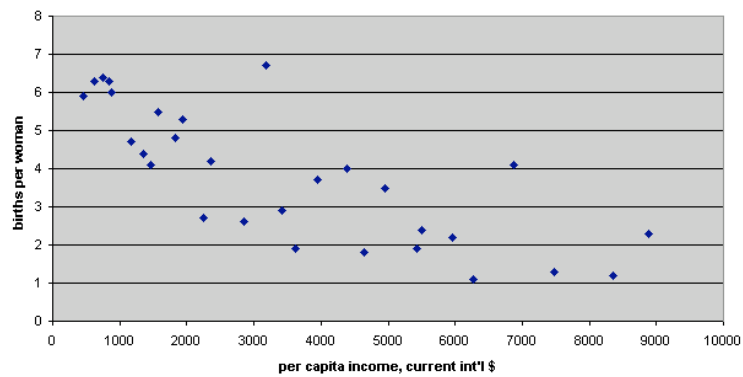
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Statistical Interlude: correlation \neq causation

Decreasing poverty works

Fertility and per capita income, selected developing countries

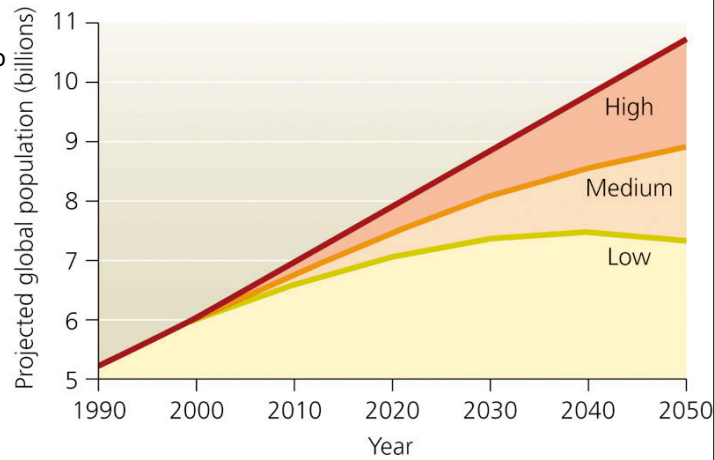


The UN program to reduce population growth.

1998 UN Population Projections:

The UN, through the late 90's kept reducing the time to population stabilization, and the level of that predicted population. What factors drove these reduced predictions?

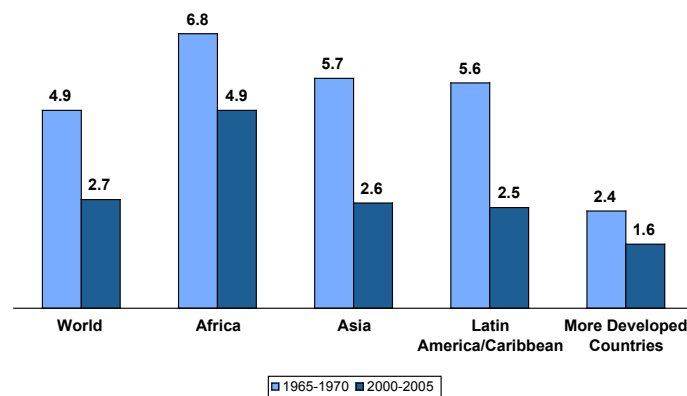
1. Higher mortality
2. Lower fertility



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Trends in Childbearing, by Region

Average number of children per woman

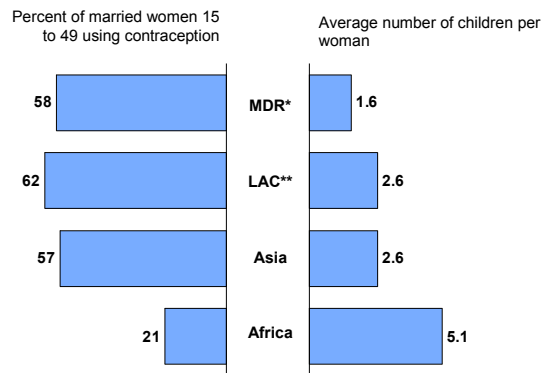


Source: United Nations, *World Population Prospects: The 2002 Revision* (medium scenario), 2003.

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Contraceptive Use and Childbearing

Contraceptive Prevalence and Total Fertility Rate



* MDR=More Developed Regions; ** LAC=Latin America and the Caribbean.
Source: Population Reference Bureau, 2004 World Population Data Sheet.

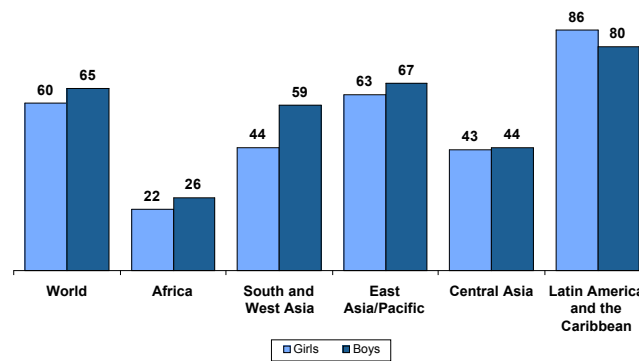
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Secondary Enrollment Boys v. Girls

Secondary School Enrollment, by Region

Ratio of Enrollees to Enrollment-Eligible Population, 1999-2000

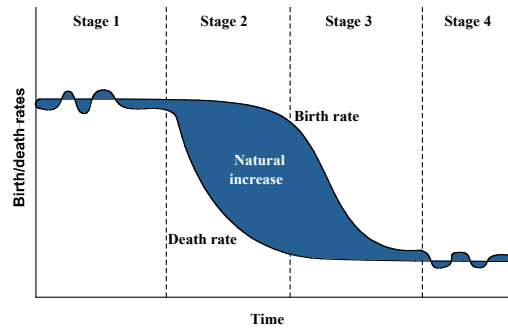
Percent



Source: UNESCO Institute of Statistics, The 2002 Education for All Global Monitoring Report.

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The Classic Stages of Demographic Transition



Note: Natural increase is produced from the excess of births over deaths.



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