



## *Environment and Natural Resources - 0722002*

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### **MEETING 3:**

## **“POPULATION AND THE ENVIRONMENT”**

*Feb. 25, 2019*



# Outline

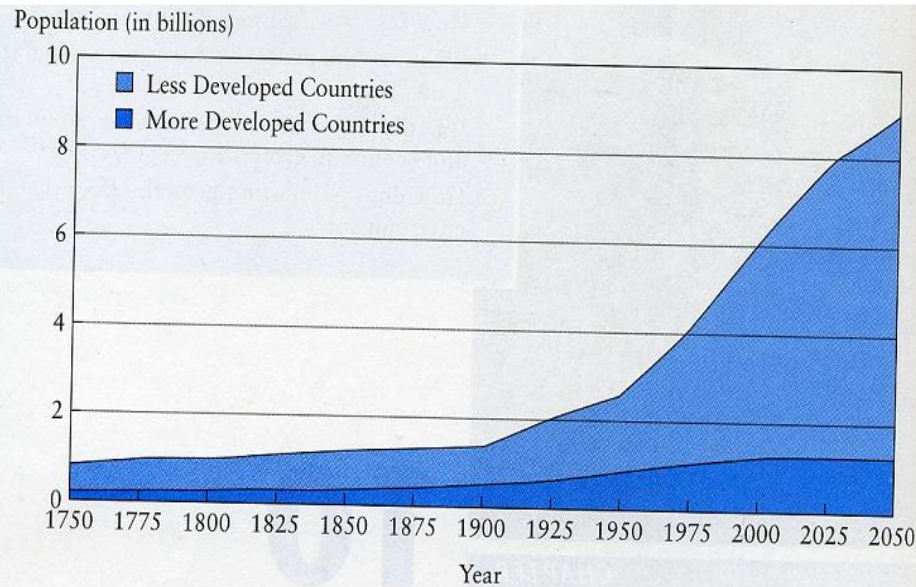
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- **The dynamics of population growth**
- **The theory of demographic transition**
- **Population growth and economic growth**
- **Ecological perspectives on population growth**
- **Population policies for the twenty-first century**
- **Conclusion**

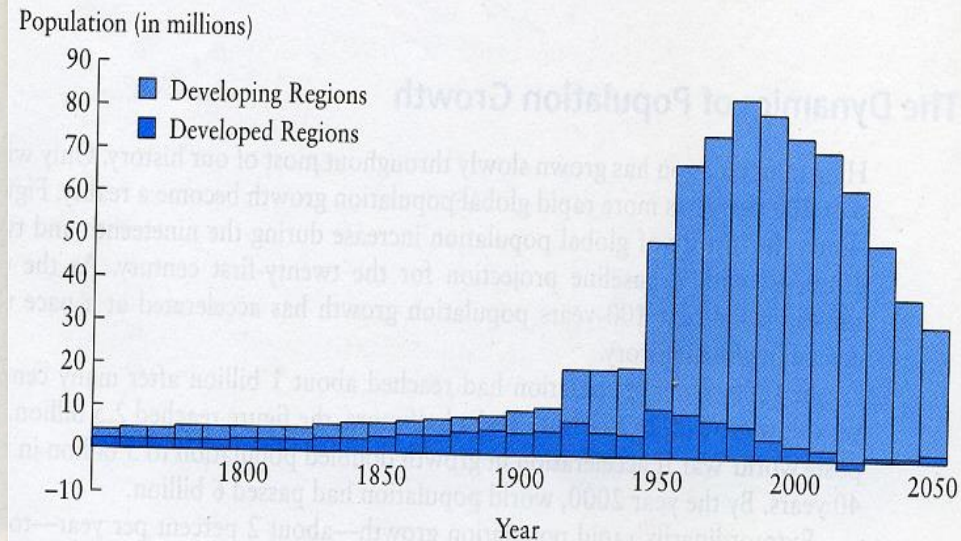


# The dynamics of population growth

- Human population has grown slowly throughout most of our history.
- Only within the past 200 years has more rapid global population growth become a reality!



**FIGURE 10-1** Global Population Growth and Projections, 1750–2050  
Source: United Nations Department of Economic and Social Affairs, Population Division, 2001.



**FIGURE 10-2** Net Annual Increase in Population Per Decade, 1750–2050  
Source: United Nations Department of Economic and Social Affairs, Population Division, 2001; Repetto, 1991.



# The dynamics of population growth

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- During this extremely rapid growth, various authors sounded the alarm regarding the dangers of exponential growth (a population of 5 billion that continued to grow at 2 percent per year, for example, would reach 20 billion in 70 years).
- Authors such as Paul and Anne Ehrlich warned in *The Population Bomb* (1968) that runaway population growth could overcome all the benefits of modern science and economic growth, leaving a devastated and miserable planet.



# The dynamics of population growth

- Another group of authors believe that Ehrlich's perspective is too negative because they declare that **population growth rate** have been declining since the 1970s.
- ...does this mean that population size will soon stabilize??

## **NOT REALLY! :**

- First, the declining growth rate is occurring at a time when total population is much higher than ever,
- Second, continuing population growth will be most rapid in the poorest and most hard-pressed nations.



# The dynamics of population growth

**TABLE 10-2** 2050 Population Projections Under Three Fertility Scenarios

Region	2000 population (millions)	2050 population projections (millions)		
		Low Fertility	Medium Fertility	High Fertility
Africa	794	1,694	2,000	2,320
Asia	3,672	4,527	5,428	6,430
Latin America and Caribbean	519	657	806	975
Europe	727	556	603	654
Northern America	314	389	438	502
Oceania	31	42	47	53
More-developed regions	1,191	1,075	1,181	1,309
Less-developed regions	4,865	6,791	8,141	9,625
World total	6,057	7,866	9,322	10,934

Source: United Nations Department of Economic and Social Affairs, Population Division, 2001

**... developed nations currently create the greatest environmental impact through their high per capita demand on resources, as well as pollution generation!**



# The dynamics of population growth

## Predicting Future Population Growth...

- Assumptions about **changes in fertility rates** influence projections:

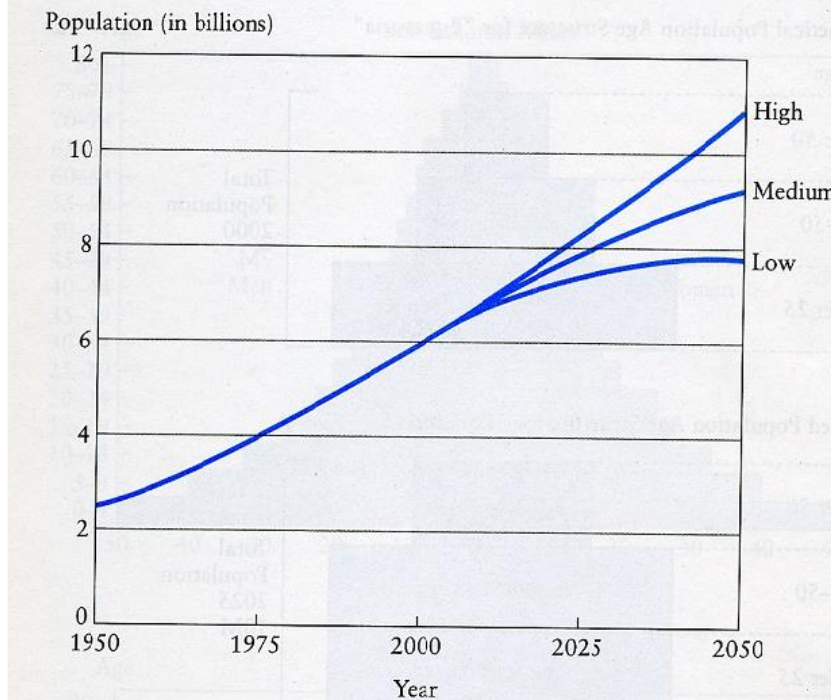
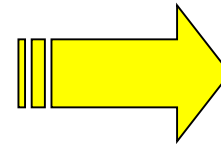


FIGURE 10-3 Population Projections Under Three Fertility Scenarios

Source: Adapted from United Nations Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2000 Revision*. United Nations, 2001. The United Nations is the author of the original material.



Three scenarios shown cover a range of possibilities for global population in 2050, ranging from 7.8 to 10.9 billion people.

Within this range, the major factor lending credibility to projections of continued population growth is the phenomenon of **population momentum**.



# The dynamics of population growth

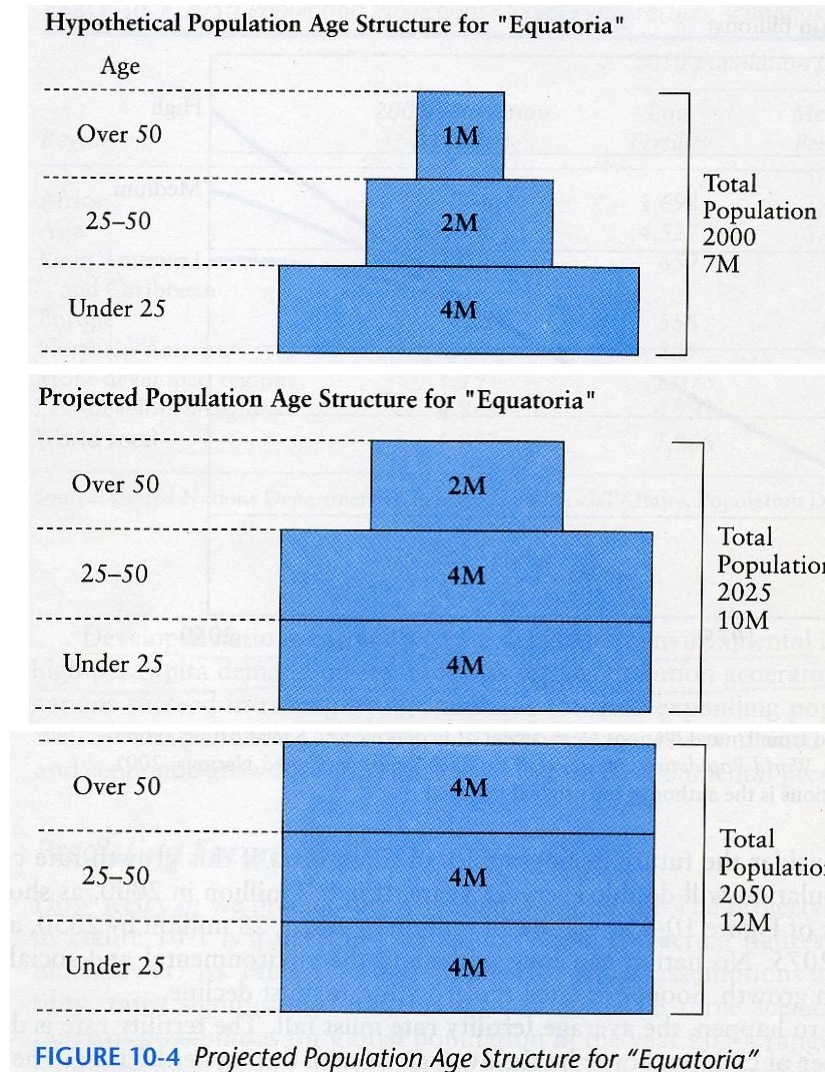
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- ...consider a hypothetical country, EQUATORIA 😊
  - experiencing rapid population growth for several generations.
  - divide the population of Equatoria into three age categories: under 25, 25 – 50, over 50 years old
  - suppose the population growth rate averages 3 percent per annum.
  - at this rate, each generation will be roughly twice as numerous as the preceding generation. This will give a population age profile shaped like a pyramid.





# The dynamics of population growth

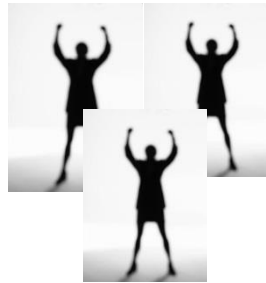




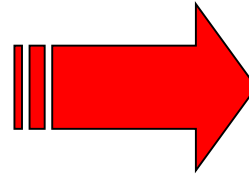
# The dynamics of population growth

... consider the future demographics of Equatoria:

- if this growth rate continues, the population will double every 25 years.



If it is 7 million in 2000



It will be 14 million by 2025, 28 million by 2050 and 56 million by 2075

**No nation can long withstand the environmental and social pressures of such growth!!**



# The dynamics of population growth

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- ...for Equatoria, sooner or later, the growth rate must decline.
  - for this to happen, average **fertility rate** must fall.
- Fertility rate:** is defined as the number of children borne by the average woman during her lifetime.
- the fertility rate in Equatoria must be over 4 children per woman to account for such rapid rates of growth (this is not unusual in the developing world!).



# The dynamics of population growth

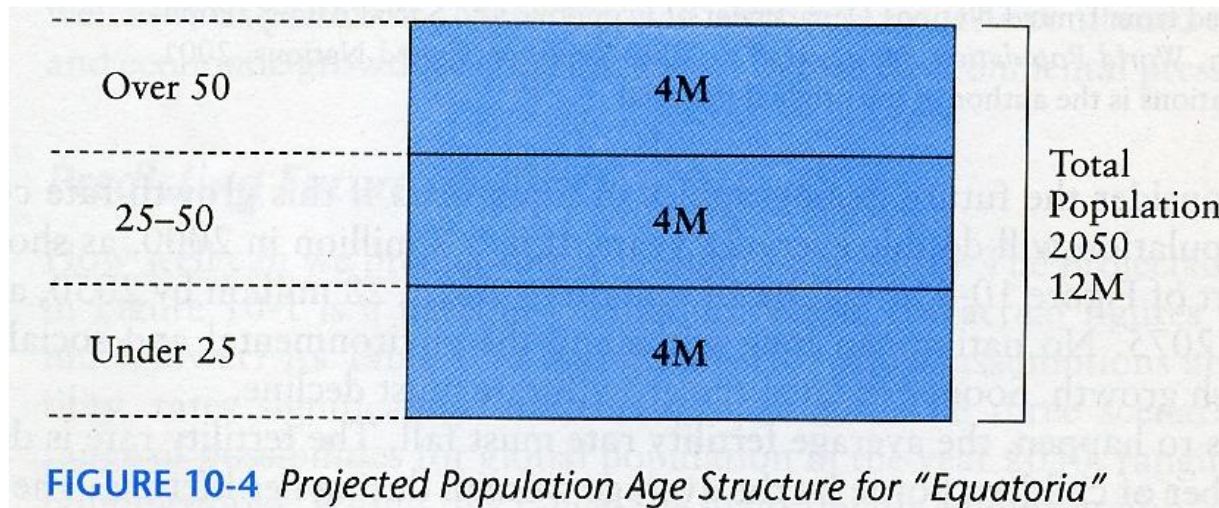
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- Population policies usually seek to achieve a **replacement fertility level**, which is just over 2 children per woman.
- At replacement fertility, each generation will be exactly the size of the preceding one.
- Achieving such a lowered fertility rate usually takes many years.



# The dynamics of population growth

- ... imagine a fantastically effective population policy that would lower fertility to replacement level immediately!
- Equatoria's demographic future would be as shown in the second and third parts of Figure 10-4.



Each new generation would be exactly the size of the last.

The current generation of under 25s, however, is Equatoria's largest ever!

**FIGURE 10-4** Projected Population Age Structure for "Equatoria"



# The dynamics of population growth

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- The next generation of children will be four times as large as the current over-50 generation, meaning that the birth rate will be several times as high as the death rate for another 25 years.
- During the 25 years after that, the birth rate will still be about double the death rate.
- Thus, Equatoria's population will continue to grow for 50 years before it stabilizes!



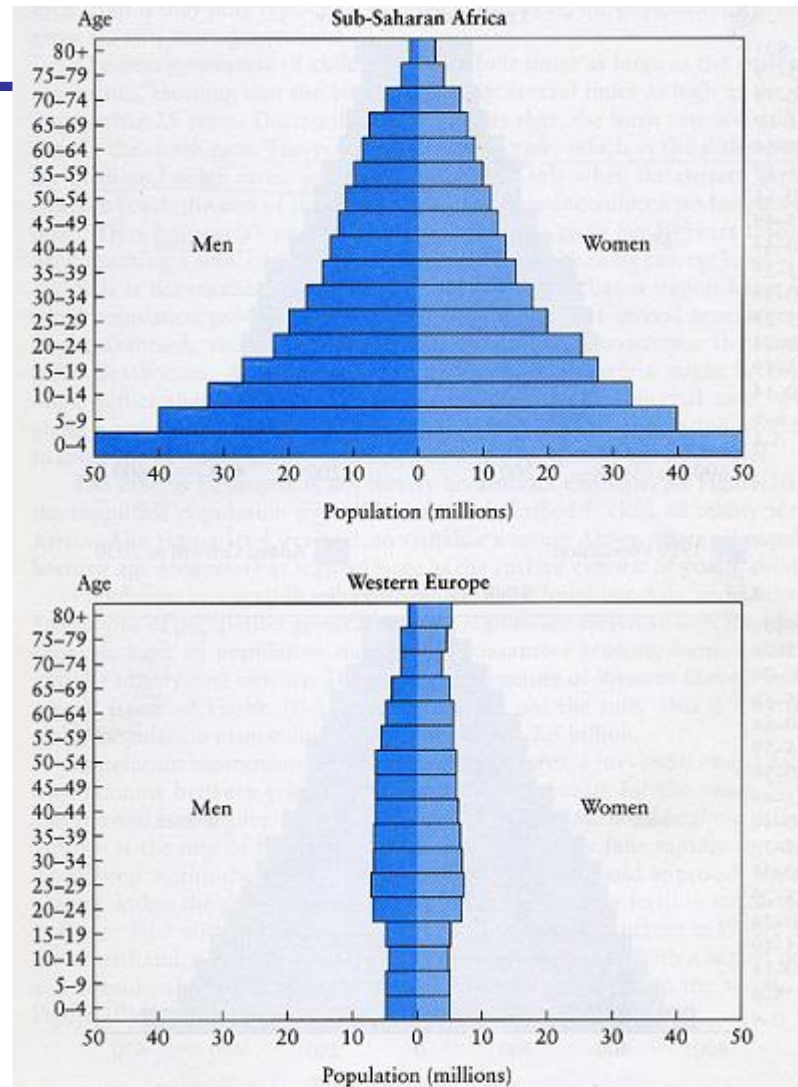
# The dynamics of population growth

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- The story of Equatoria describes the meaning of population momentum.
- When a nation has a history of rapid population growth, continued growth for the next several generations is virtually guaranteed.



# The dynamics of population growth



**FIGURE 10-5** Population Age Structures for Sub-Saharan Africa and Western Europe, 1990

Source: Adapted from Wolfgang Lutz, *The Future of World Population*. Washington, D.C.: Population Reference Bureau, 1994. Reprinted by permission of the Population Reference Bureau.





# The dynamics of population growth

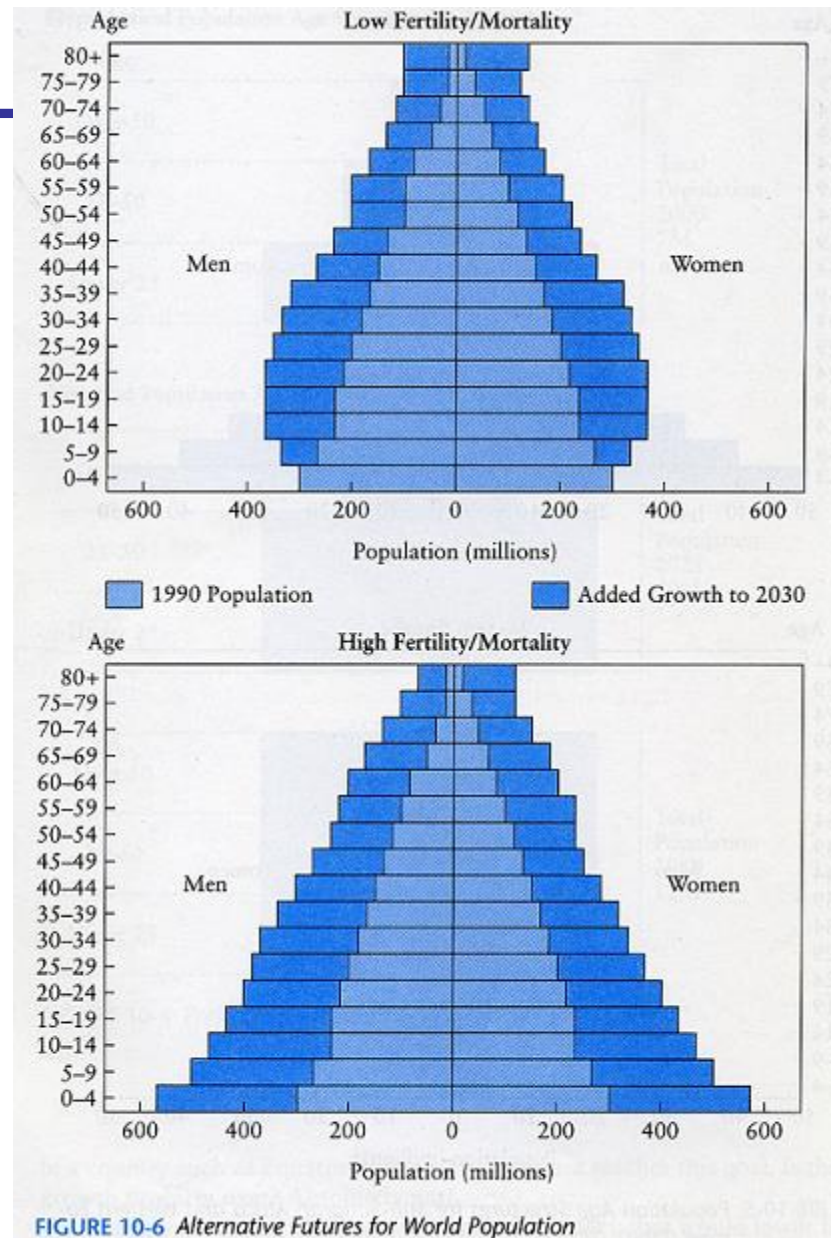
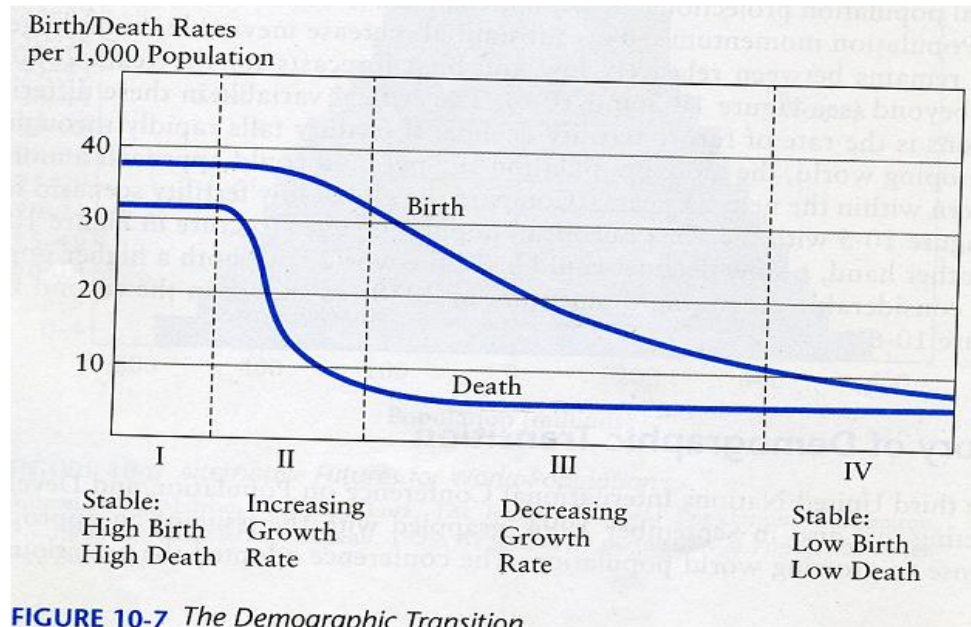


FIGURE 10-6 Alternative Futures for World Population



# The theory of demographic transition

- What can an environmental or ecological economics analysis tell us about population policy?
- Relationship between population and economic growth rests on western European experience. Western Europe's situation is considered the final stage of the **demographic transition** from high to low birth and death rates.





# The theory of demographic transition

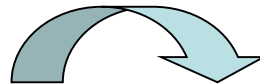
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## • Population Growth Impact...

-Is population a good or bad thing for the country as a whole?

- if resources are abundant, the nation's leaders may welcome this idea. However,

- a large labor force promotes rapid economic growth and helps in taking advantage of unexploited resources and new technology together with its own limitations!



...similar to European history?



# The theory of demographic transition

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- **Does this picture fit into real world???**
- Currently, developing nations' experiences differ from Europe's:
  - Every decade, the developing nations add population equal to the entire population of Europe and Russia.
  - The currently developed nations have exploited the global environment's waste absorption capacities. The developing world obviously will not have these options!
  - Factors that contribute to fertility decline may be present in some nations but absent in others
  - The rapid economic growth that accompanied population growth in Europe has occurred in some parts of the developing world but not in others.



# The Population Growth and Economic Growth

- What does economic theory say about population?

Cobb-Douglas production function:

$$Q_t = A_t K_t^\alpha L_t^\beta$$

economic output      a given state of technology      capital stock      labor force

where,  $t$  is a particular time period,  $\alpha$  and  $\beta$  are parameters related to the productivity of capital and of labor.

- The values of  $\alpha$  and  $\beta$  are assumed to be fractions of zero and one: if  $\alpha + \beta = 1$  then, the function shows **constant returns to scale**. This means that if labor and capital inputs were both doubled, output would also double.



# The Population Growth and Economic Growth

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- ...suppose that we increase only one factor, labor???
  - output will also increase, but by a smaller proportion than the increase in labor input.
  - if labor is roughly proportional to total population, **per capita output** will decline.
  - as more and more labor is added **the law of diminishing returns** comes into play, giving smaller output boosts for each additional unit of labor input.
  - Thus, in a simple economic model, population increase alone would yield **falling living standards!!**



# The Population Growth and Economic Growth

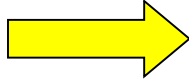
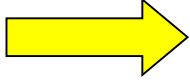
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- This is a result of **capital shallowing**, which means that each worker has less capital to work with and is thus less productive.



# **Ecological perspectives of population growth**

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- **Standard economic perspective**  **no limitations on population or output growth.**
- **Ecological approach**  **is based on the concept of carrying capacity, which implies some limits to the population that can occupy a certain region.**
- **Can human population escape the logic of carrying capacity? Certainly, we have successfully stretched its limits!**
  - **use of artificial fertilizers to increase agricultural outputs,**
  - **fossil fuel and nuclear energy provide far more power for industrialization than any solar energy.**





# Ecological perspectives of population growth

- This means more than 6 billion people can live on a planet that a century ago supported only slightly more than 1 billion.
- However, this expansion of carrying capacity carries significant **ecological cost**. The extraction of large quantities of fossil fuels and mineral stocks causes environmental degradation both in production and through the waste products generated.
- Some of the wastes and pollutants are cumulative; their negative environmental effects build up over time:
  - **GREENHOUSE EFFECT!**



# Ecological perspectives of population growth

- Ecologists Paul and Anne Ehrlich identified three major areas in which current economic activities are systematically undermining the planet's long-term carrying capacity:

- **Erosion and degradation of topsoil**

*Annually, 24 billion tons of topsoil losses around the world.*

- **Overuse and pollution of fresh water supplies**

*Reaching critical levels in China, India and parts of the former Soviet Union*

- **Loss of biodiversity**



# Ecological perspectives of population growth

- The impact of population, affluence and technology:

We can conceptualize the interrelationship of population, economic growth and environment in an equation known as

**IPAT:**

$$I = P \times A \times T$$

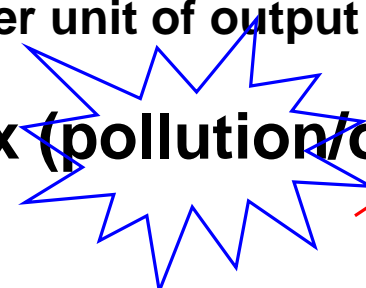
I = environmental impact (units of pollution)

P = population

A = affluence measured as output/person

T = technology variable measuring pollution per unit of output

~~(population)~~ x ~~(output/population)~~ x ~~(pollution/output)~~





# Population policies for the twenty-first century

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- In recent years, the population policy discussion has shifted.
- Past debate was dominated by the conflict between “optimists” who saw no problem in increasing population and “pessimists” who predicted catastrophe!
- Now, elements of consensus are emerging.
- Most analysts accept that increasing population places extra stress on the environment and resources and there is broad agreement that slower population growth in the future is essential.
- How will we accomplish this?



# Population policies for the twenty-first century

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- Nations have sometimes attempted to control population growth by government compulsion (i.e. China) : conflict in human rights!
- Nancy Birdsall (1984) has studied most effective population policies. Focused on the link between high fertility and poverty and the resulting negative social and environmental outcomes. A range of policies that can help both to slow population growth and to improve economic efficiency:
  - promotion of education and other social programs,
  - improvement in the status of women,
  - improved nutrition and health care



# Population policies for the twenty-first century

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- All these policies tend to lower fertility rates, and Birdsall identifies them as **winwin** policies that benefit both the economy and the environment through voluntary moderation of population growth.