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MEETING 4:

"AGRICULTURE, FOOD AND ENVIRONMENT"

March 18, 2019

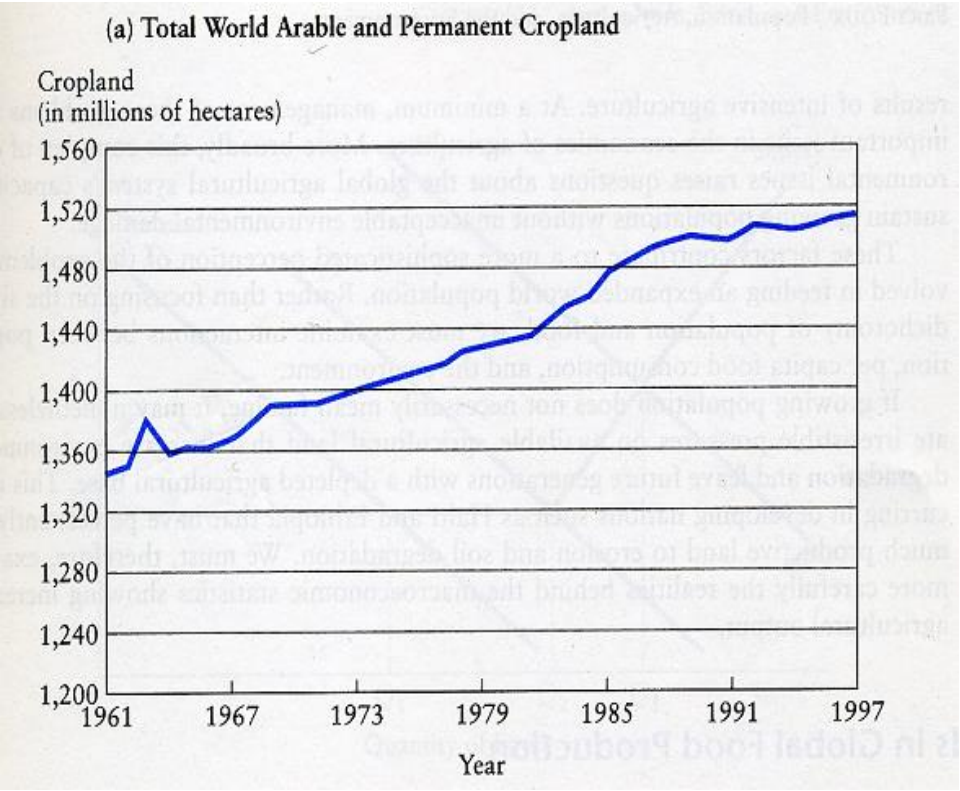
Outline

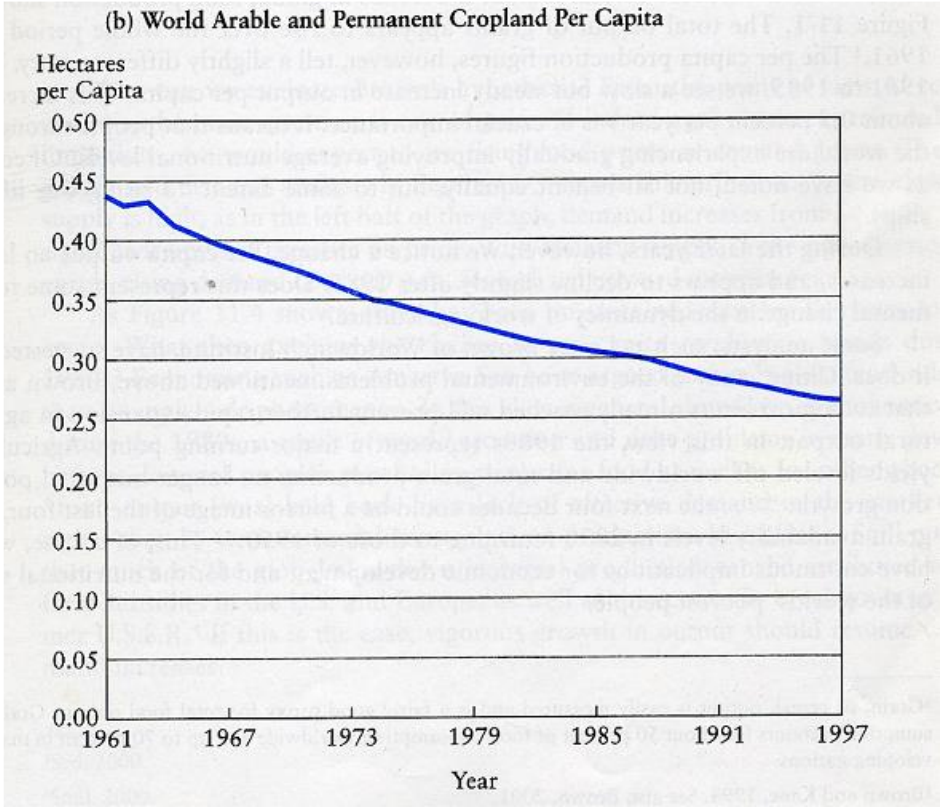
- Feeding the world: population and food supply
- Trends in global food production
- Agriculture’s impact on the environment
- Sustainable agriculture for the future

Feeding the world: population and food supply

- **In the past two centuries, increasingly productive agricultural technology has spurred a significant increase in human population.**
- **Average world per capita food production has risen, not fallen!**
- **Several factors that cast a different light on the issues of population, agriculture and the environment:**
  - **Land use**
  - **Consumption patterns**
  - **Inequalities in food distribution**
  - **Environmental impact of agriculture**

Feeding the world: population and food supply





March 18, 2019

Feeding the world: population and food supply

- **<u>Land Use:</u> Agricultural land has expanded since World War II, however, the expansion has slowed!**
- **The land most suitable for agriculture is already being farmed → the remaining lands are marginal in quality.**
- **Also, urban and industrial encroachment is cutting into agricultural land and available farmland per person is steadily decreasing.**

Feeding the world: population and food supply

- **Consumption patterns: Existing food supplies are distributed according to market demand, which strongly favors upper-income consumers.**

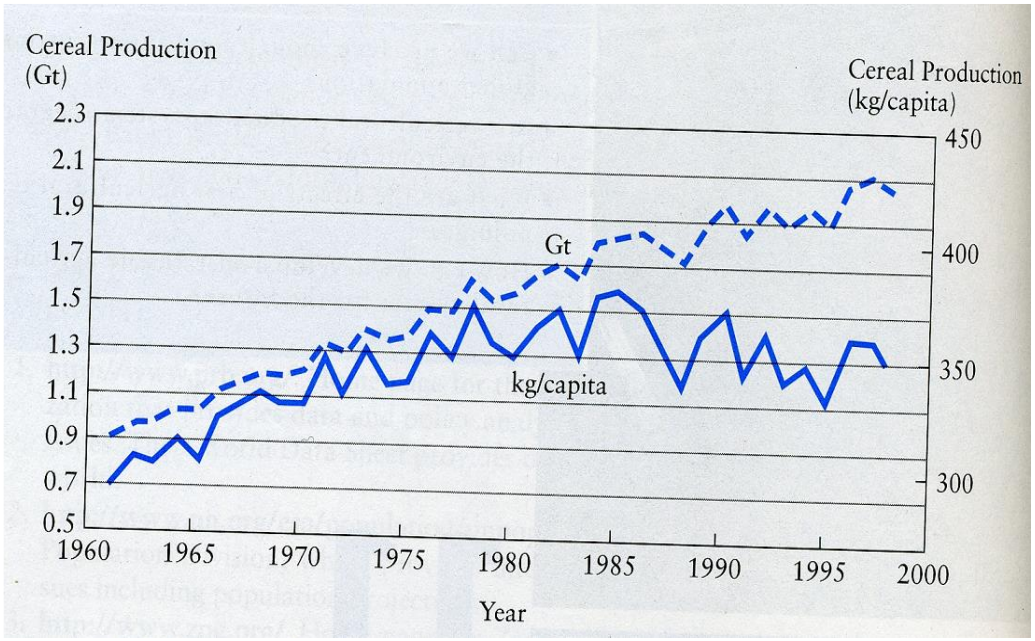
- **For example, per capita grain consumption in the United States is more than three times that in the developing world. WHY??**

Feeding the world: population and food supply

• **Inequalities in food production: Many low income areas suffer from a nutritional deficit, meaning that between 500 million and 1 billion people receive inadequate nutrition.**

• **Environmental impact of agriculture: As agricultural land use has expanded, more marginal and fragile lands have come under the plow. The result is increased erosion, deforestration, and loss of wildlife habitat. Erosion and depletion of nutrients in the soil mean that a renewable resource is being turned into a depletable resource and soil fertility is being over "mined"!**

Trends in global food production



- From 1961 to 1985…

(increase in output per capita)

- After 1985…

(decline)

Does this represent some fundamental change in the dynamics of world agriculture???

Trends in global food production

Analysts such as Lester Brown (Worldwatch Institute) argues that ecological limits already reached will prevent further rapid expansion in agricultural output.

In this view, the 1980s represent a major turning point:

- Agricultural yields leveled off worldwide and total grain production no longer outpaced population growth.

- This would have enormous implications for economic development and for the nutritional status of the world's poorest people.

Trends in global food production

How can we evaluate Brown's hypothesis?

- From the point of economic analysis, the main question is one of price.

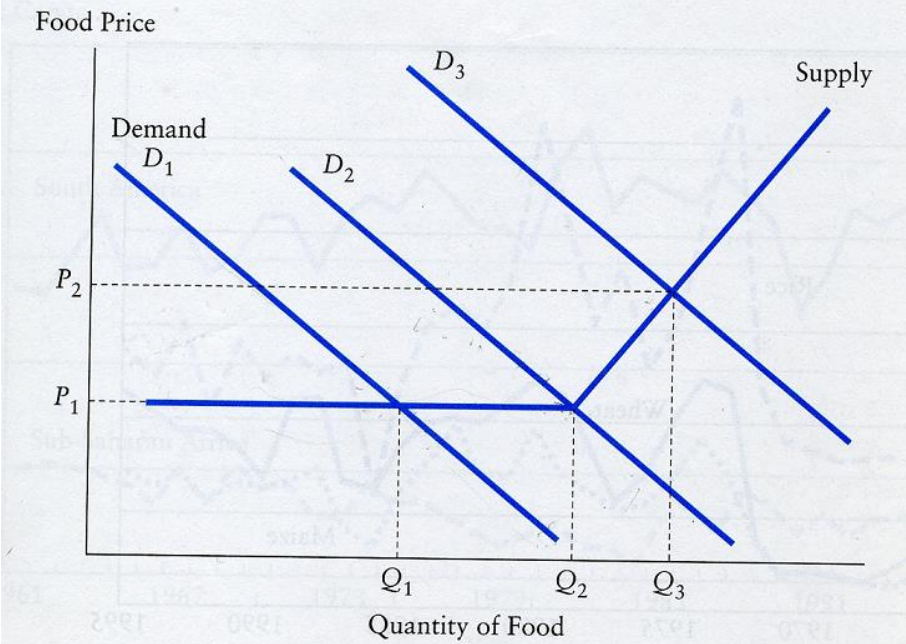


FIGURE 11-3 *Elastic and Inelastic Food Supply*

- where elasticity of supply is high, demand increases from D_1 to D_2 with no significant upward pressure on price.

- With inelastic supply, rising demand (D_2 to D_3) causes a sharp upward move in price.

Trends in global food production

Figure 11.4 below shows there has been no sustained increase in price for cereal crops.

What then explains the change in per capita production trends during the 1980s?

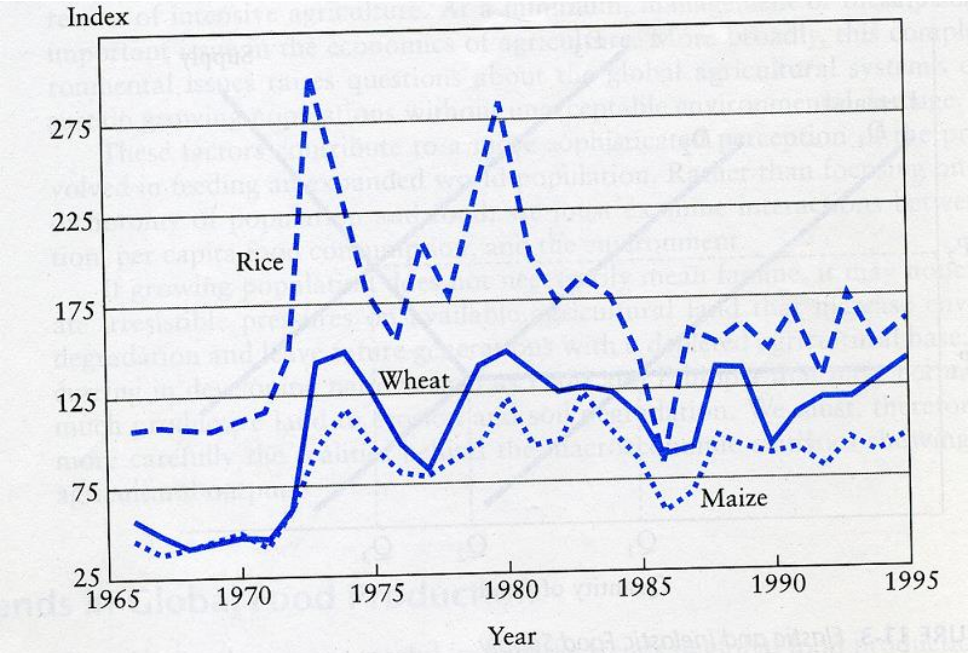


FIGURE 11-4 *U.S. Producer Price Indices for Selected Cereal Crops*
Source: FAO, 1998.

Trends in global food production

-Economists such as Amartya Sen have argued that it is a demand-side rather than supply-side phenomenon.

- In this view, a general slowdown in economic growth during the 1980s, a result of world recession and debt problems in many developing nations, lowered people's purchasing power for food as well as for other goods. Thus food output was held back by a lack of effective demand in the marketplace rather than by environmental constraints on production.

Trends in global food production

The fact that prices are generally stable or declining does not preclude significant environmental impact on food production.

In many developing nations, the poor bear the greatest burden of economic recession, increasing the problem of inequality of distribution. At the same time, the marginal lands farmed by the poor suffer from the greatest damage from erosion and other environmental problems.

Trends in global food production

Land use and equity issues:

The issue of unequal distribution is linked to that of land use. In a market economy, land will generally be used for the highest valued crop as shown below:

Here, land is rated by quality on the horizontal axis.

The vertical axis shows the value of crops grown on the land (crop value index).

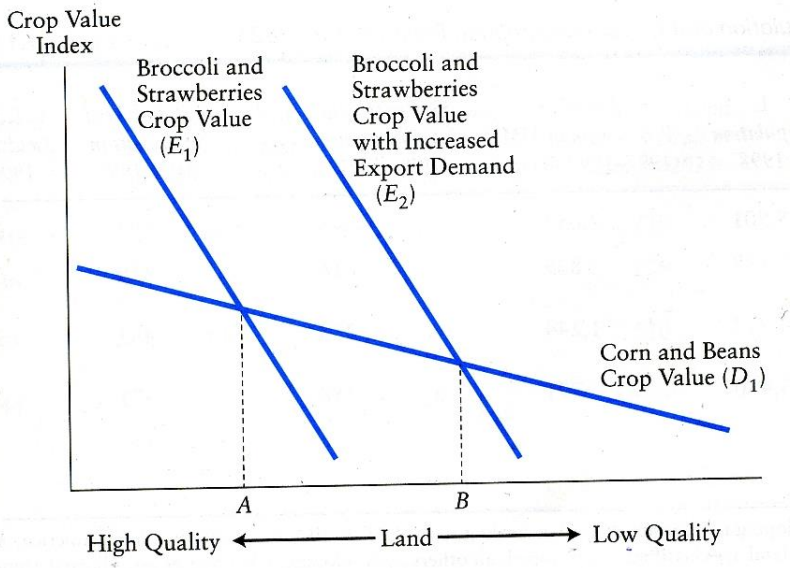


FIGURE 11-6 *Land Quality, Crop Value, and Land Use*

Trends in global food production

TABLE 11-1 *Population and Cereal Consumption Projections for 2025*

Region	1. Population 1998	2. Cereal Production in MMT 1997–1999 Average	3. Per Capita Cereal Consumption in Kg 1995–1997 Average	4. Land Area in Cereals in MHa 1997	5. Cereal Yields in Kg/Ha 1995–1997
World	5,901	2,053	348	692	2,968
Developed Nations	1,188	839	616	229	3,669
Developing Nations	4,713	1,244	285	463	2,687
Developing Nations (excluding China)	3,450	791	258	371	2,134

TABLE 11-1 *(continued)*

6. Projected Population for 2025	7. Projected Total Cereal Requirements in MMT for 2025	8. Projected Per Capita Cereal Consumption in Kg for 2025	9. Projected Land Area in Cereals in MHa for 2025	10. Projected Yield Requirements for Self-Sufficiency in Kg/Ha for 2025
7,810	2,867	367	739	3,879
1,236	761	616	229	3,323
6,575	2,106	320	510	4,129
5,144	1,515	295	424	3,573

Trends in global food production

-In economic terms, the crop value index represents the marginal revenue product of the land, which is equal to the marginal physical product (quantity of a particular crop) times the price of the product.

- For example, in Mexico much land is devoted to growing corn and beans for local consumption. But growing broccoli and strawberries for export produces higher revenues…

Agriculture's impact on the environment

Soil erosion and degradation:

From 30 to 50 percent of the earth's surface is affected by erosion and soil degradation.

Erosion damages crop productivity by reducing the availability of water, nutrients and organic matter; water resources are also degraded by sediments and pollutants associated with erosion. Soil loss rates are typically highest in developing countries.

Agriculture's impact on the environment

The economics of erosion and erosion control:

In many cases, farmers can greatly reduce erosion and soil degradation by crop rotation and fallowing: alternating grain and taking the land out of production every several years.

An ecologically sound soil management policy depends on:

- **the farmer's foresight,**
- **relatively low interest rates**
- **financial flexibility to invest in erosion control today for long-term benefits**

Agriculture's impact on the environment

Fertilizer use:

Today, modern agriculture depends on increased fertilizer use. Increased fertilizer use is clearly associated with higher yields.

Over time, nations tend to shift from traditional agriculture with low fertilizer input to modern agriculture's heavy fertilizer use and high yields.

Environmental effects of fertilizer use:

Modern agricultural techniques rely on a "package" of inputs including fertilizer, pesticides, irrigation, mechanization and high-yielding crop varieties.

Agriculture's impact on the environment

Environmental effects of fertilizer use (continue…):

Fertilizer per hectare serves as what economists call a proxy variable for this whole package: higher use of fertilizer correlates so strongly with higher use of the other inputs that measuring fertilizer use alone gives us a good idea of the degree of agricultural modernization. However, each of these inputs relates to specific environmental problems.

Most fertilizers supply three major nutrients of nitrate, phosphate and pottasium. But a significant proportion of the nutrients applied do not reach the crops but instead into ground and surface water, where they become serious pollutants.

Agriculture's impact on the environment

Environmental effects of fertilizer use (continue…):

In the Mediterranean, large proportions of the sea have suffered severe ecological damage from agricultural runoff pollution , with giant mats of algae blanketing coastlines in the Aegean Sea.

Second, fertilizer production is energy intensive. Modern agriculture replaces solar energy and human labor with energy extracted primarily from fossil fuels. Agriculture accounts for about 3-5 percent of total energy use, although not the major components of energy-related issues but still this percentag is significant , particularly for developing countries who must buy imported energy!

Agriculture's impact on the environment

Pesticide use:

Pesticide use has risen rapidly with the spread of modern agriculture.

- Pesticides may effect agricultural workers directly (pesticide poisining),

- Residues in food affect consumers

- Pesticides affect ecosystems

Agriculture's impact on the environment

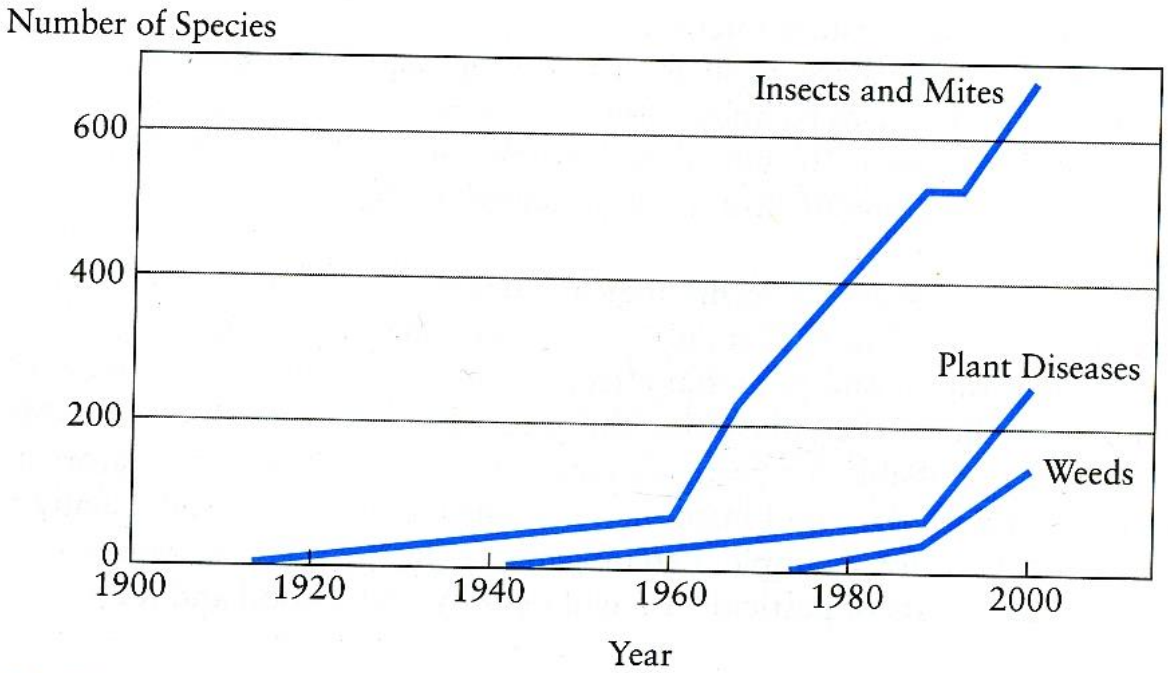


FIGURE 11-9 *Increase in Resistant Pest Species in the Twentieth Century*

Source: Adapted from Gary Gardner, "Preserving Agricultural Resources," in Brown et al., *State of the World 1996*. Washington, D.C.: Worldwatch Institute, 1996. Reprinted by permission of Worldwatch Institute.

Sustainable agriculture for the environment

Ecological analysis offers us a different understanding of the relationship between agriculture and the environment.

Rather than seeing agricultural production as a process of combining inputs (including land, water, fertilizer and pesticides) to maximize output, the ecological economist would argue that agriculture is a process of intervention in the natural biophysical cycles responsible for plant growth. These include the carbon cycle, nitrogen cycle, water cycle, and similar cycles.

Sustainable agriculture for the environment

In a natural state, solar energy drives these cycles. Traditional agriculture departs little from these cycles. Modernized agriculture relies on extra inputss of energy, water, nitrogen and synthetic chemicals. This gives higher yields, but creates imbalances in all the natural cyclical processes. Modern agriculture expands carrying capacity but only at the cost of increasing ecological stresses.

Both the economic and ecological perspectives can influence our definiton of sustainable agriculture.

Sustainable agriculture for the environment

A sustainable agricultural system should produce a stable level of output without degrading the environmental systems that support.

In economic terms, this means no significant uninternalized externalities, user costs, or excessive use of common property resources.

Production techniques such as organic fertilization from recycled plant and animal wastes, crop rotation and intercropping grains and legumes help maintain the soil's nutrients balance. The use of reduced tillage, terracing, fallowing and agroforestry (planting trees in and around fields) help to reduce erosion.