

**AGRICULTURE**

Which type is sustainable for the biosphere?

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**Types of Agriculture**

- Three Main forms
  - **Traditional Subsistence Agriculture**
  - **Traditional Intensive Agriculture**
  - **Industrialized Agriculture**

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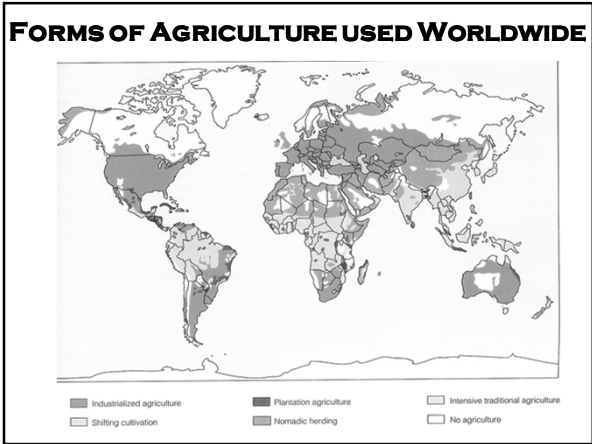
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### **Traditional Subsistence Agriculture**



**Most common form used in developing countries**



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### **Traditional Subsistence Agriculture**

- Uses human labor and draft animals
- Used on
- Contributes 20% of the world food supply
- Produces only enough food for the farm family
  
- agroforestry

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### **Traditional Intensive Agriculture**

- o Uses more human labor and draft animals
  
- o Uses more

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## INDUSTRIALIZED AGRICULTURE

■ Monoculture

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## INDUSTRIALIZED AGRICULTURE

crops and livestock

whole food system: processing and transportation  
10 units fossil fuel = 1 unit food energy

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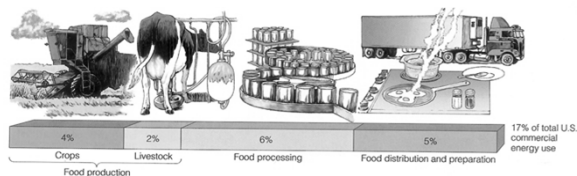
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## Fossil Fuel Consumption of Industrial Agriculture in U.S.

■ Consumes 17% of the energy for the country



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## Green Revolution and the Biosphere



- 1<sup>st</sup> revolution 1950-1970
- 2<sup>nd</sup> revolution 1967 to present
- Gene revolution GMO- present day Frankenstein Foods

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## The Green Revolution

- ▶ Uses primarily monocultures

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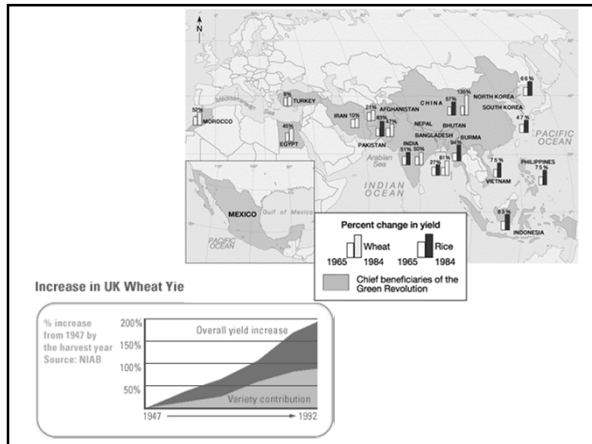
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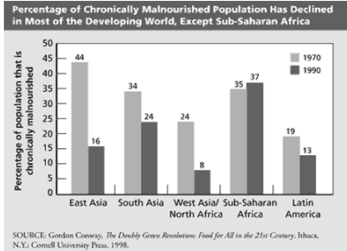
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## The Green Revolution and helping the chronically malnourished



WHY?

**1.2 billion people in developed countries (1/5 the world's population), consume 1/2 the world's grain supply**

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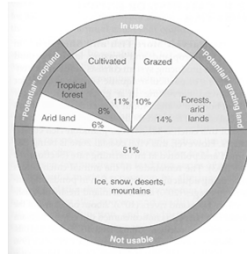
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## Land for crops

- 21% of Earth's surface is in use
- 25% is in the U.S.
- 80% of the land in U.S. was in production by the mid 1970's
- California is the greatest crop resource in the U.S., contributes \$20 billion a year



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## Three Major Food Challenges

- Poverty that leads to malnutrition
- Providing and distributing enough food for the projected 8.9 billion people in 2050.
- Growing sustainably to avoid the depletion and/or degradation of soil and water resources.

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### Crops

- 30,000 plant species can be eaten
- 14 plants & 9 animal species account for 90% of our food
- 3 grain crops; wheat, rice, corn, supply 50% of the calories people consume daily
- 2 out of 3 people survive primarily on grain
- Developing countries with 1/2 of the world's population produce only 4% of the annual grain production
- North America, Australia, and New Zealand are the major exporters of grain

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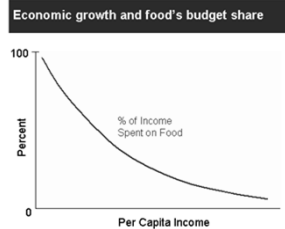
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### The cost of food

- ❖ 10-12% in the U.S. due to subsidizing
- ❖ 18% Japan
- ❖ 40-70% Developing countries



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### Undernutrition (Chronic hunger) vs. Malnutrition

- \* 1 out of every 6 people in developing countries suffer from this condition
- \* In 2005 6 million children died from this cause (16,400 a day!)
- \* In the United States 35 million people suffer from undernutrition

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## The Hidden Costs of Industrial Ag




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**In the last 40 years food production has doubled, agricultural production systems have expanded, with significant impacts on natural resource base**

- **AMOUNT OF AGRICULTURAL LAND GOING OUT OF PRODUCTION EACH YEAR DUE TO SOIL EROSION IS ABOUT 20 MILLION HECTARES, APPROXIMATELY 40% OF THE WORLD'S CROPLAND IS NOW DEGRADED.**
- **14% OF TOP SOIL HAS BEEN LOST**
- **IRRIGATED AGRICULTURE CONSUMES ABOUT 70% OF FRESH WATER USED BY HUMANS; RESULTING IN SALINIZATION, LOWERING OF WATER TABLES, WATERLOGGING, CULTURAL EUTROPHICATION, AND DEGRADATION OF WATER QUALITY, WITH SUBSEQUENT IMPACTS ON ECOLOGICAL SYSTEMS AFFECTING FISHERIES AND WETLANDS. (MISSISSIPPI DEAD ZONE)**

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### IMPACTS CONTINUED

- **CONTRIBUTES ABOUT 30% OF THE GLOBAL EMISSION OF GREENHOUSE GASES RESULTING FROM HUMAN ACTIVITY**
- **MONOCULTURE CONTRIBUTES TO A SIGNIFICANT LOSS IN BIODIVERSITY.**
- **DEFORESTATION RATES HAVE REACHED ALMOST ONE PERCENT PER YEAR IN SOME REGIONS, LEADS TO INCREASED CO<sub>2</sub>**
- **ACCUMULATION OF TOXIC METALS AND TOXIC ORGANIC COMPOUNDS- KESTERSON WILDLIFE REFUGE, CLOSED IN 1985 IN THE SAN JOAQUIN VALLEY, MORE ON THIS LATER..**

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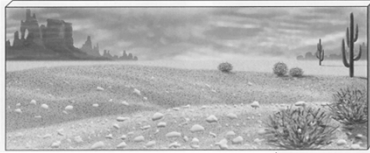
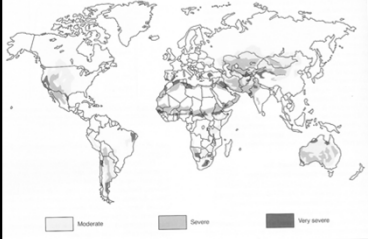
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<b>Causes</b> Overgrazing Deforestation Erosion Salinization Soil compaction Natural climate change		<b>Consequences</b> Worsening drought Famine Economic losses Lower living standards Environmental refugees
		<h2 style="margin: 0;">Desertification</h2> <p style="margin: 0;">Can be caused by poor agricultural practices</p>

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### GMO foods...The starlink story

- ✱ *First introduced in 1998 in the U.S.*
- ✱ *Bt corn is corn that has been genetically modified to express insecticidal toxins derived from the bacterium *Bacillus thuringiensis* to kill lepidopteran pests feeding on these plants.*
- ✱ *the Bt toxin is released into the rhizosphere soil in root exudates from Bt corn.*



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- ✱ *The insecticidal toxin remains active in the soil, where it binds rapidly and tightly to clays and humic acids.*
- ✱ *The bound toxin retains its insecticidal properties persisting in various soils for at least 234 days*
- ✱ *In laboratory studies, caterpillars of the monarch butterfly were killed as a result of feeding on milkweed that had been artificially contaminated with pollen from transgenic corn that expressed the gene from *B. thuringiensis**
- ✱ *kurstaki, and green lacewings, which are insect predators of insect pests, were killed by ingesting European corn borers (*Ostrinia nubilalis*) reared on Bt corn*

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**SOLUTION?**

- *Natural System Agriculture-  
being studied at Kansas University*
- *Polyculture*
- *Perennial use-reduces profit for  
agrobusiness*
- *Organic fertilizers- improve chemical and  
physical characteristics of soil*
- *Organic Farming*

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**Aquaculture**

**70% of the fish supply is Oceanic  
99% is from plankton rich coastal waters**

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