Chapter 11: The Ecology of Food Production

Can We Feed the World?

To answer this we must understand how crops grow and how productive they can be.

- History of agriculture is a series of human attempts to overcome environmental limitations and problems.
  - Each solution creates new problems, with some side effects
  - Multiple pressures on agricultural land
- Large percentage of world's land area is agricultural
  - 38% of total land area (excluding Antarctica)
  - Percentage varies by continent
    - 22% in Europe
    - 57% in Australia
    - 44% in US

Table 11.1 **Land, People, and Agriculture, 2006**

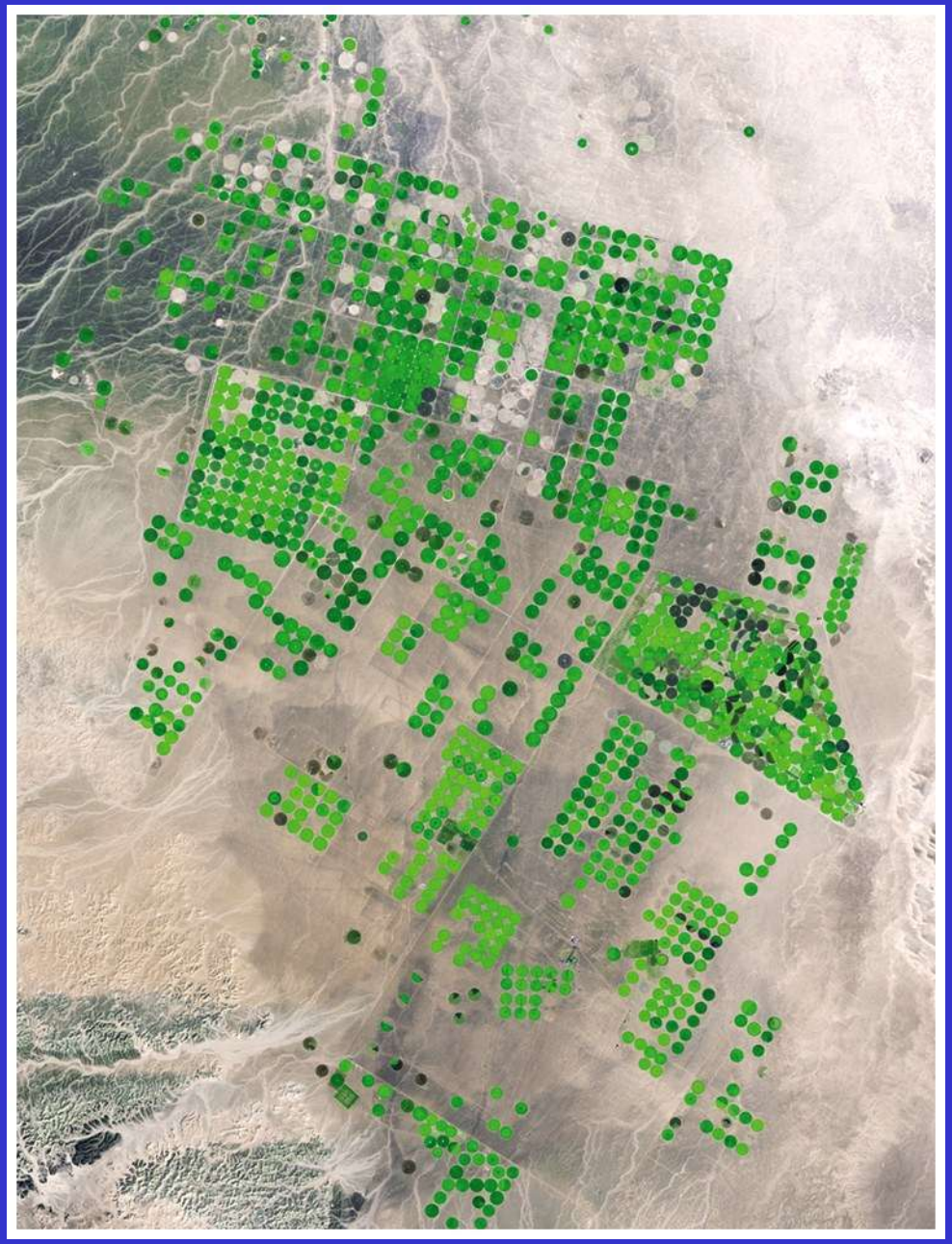
Location	*Total Land Area (sq km)*	*Human Population (Millions)*	*People per Area*	*Crop Area (sq km)*	*Crop Area Per Person (sq km)*	*Crop Land as % of Total Land*
Asia	30,988,970	3,823	123.37	16,813,750	0.044	54%
Africa	29,626,570	850	28.69	11,460,700	0.135	39%
N. and C. America	21,311,580	507	23.79	6,189,030	0.122	29%
S. America	17,532,370	936	53.39	5,842,850	0.062	33%
Europe	22,093,160	362	16.39	4,836,410	0.134	22%
Australia	7,682,300	19	2.47	4,395,000	2.313	57%
World	130,043,970	6,301	48.45	49,734,060	0.079	38%

Source: FAO Statistics 2006 http://faostat.fao.org/faostat/

Note: Data are available for crops until 2003; hence, some population values in this table will differ from those elsewhere in the chapter, which are for 2005.

Can We Feed the World?

- As population grows, the production of agriculture must grow.
  - Food supply is already inadequate for some peoples
  - Increasingly marginal land will need to be put into production
- Food supply also greatly influenced by social disruptions and social attitudes.
- The key to food production in the future
  - Increased production per unit area
    - Requires increased use of water and fertilizers
  - Utilizing marginal lands
  - Increasing risk of environmental damage

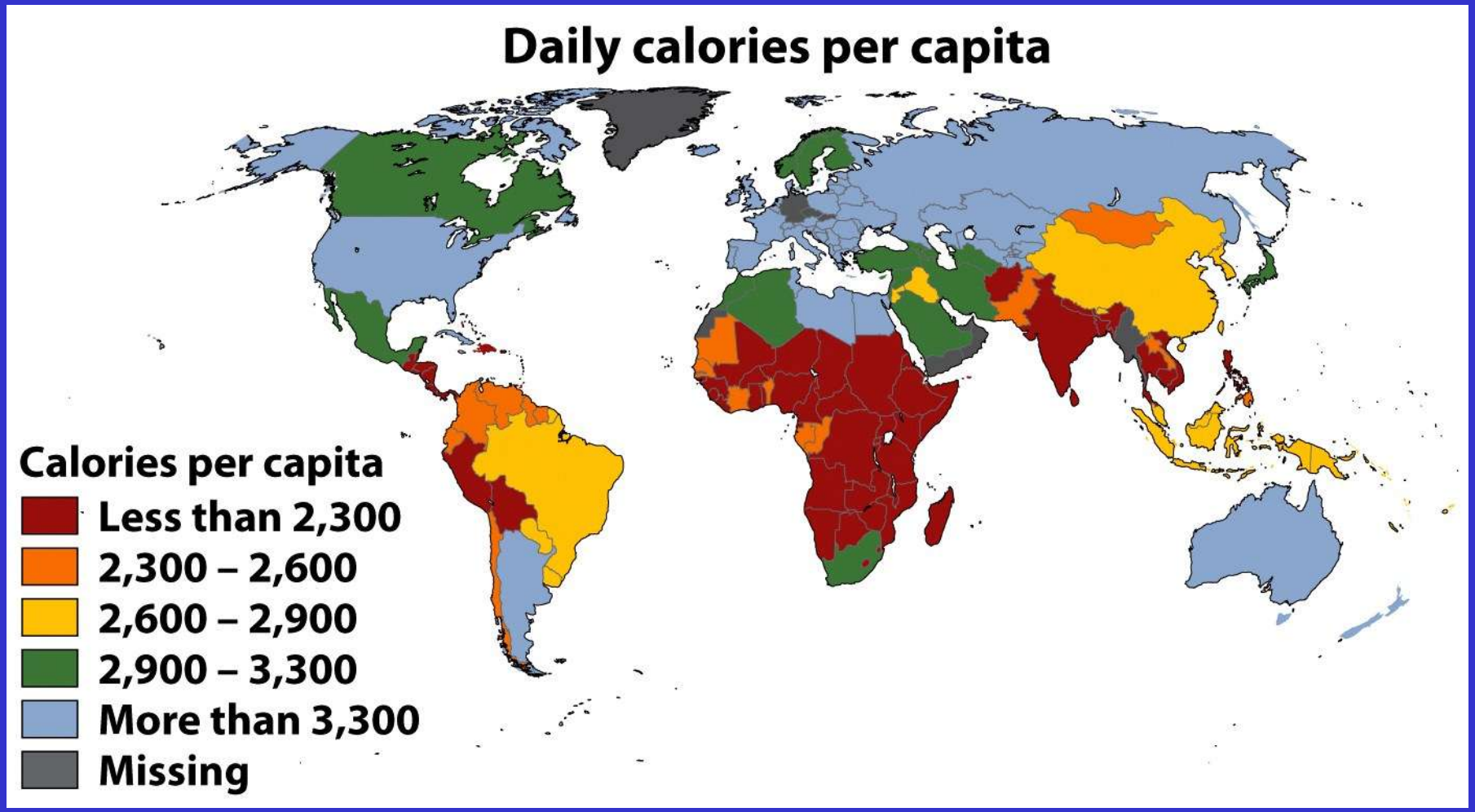


How We Starve

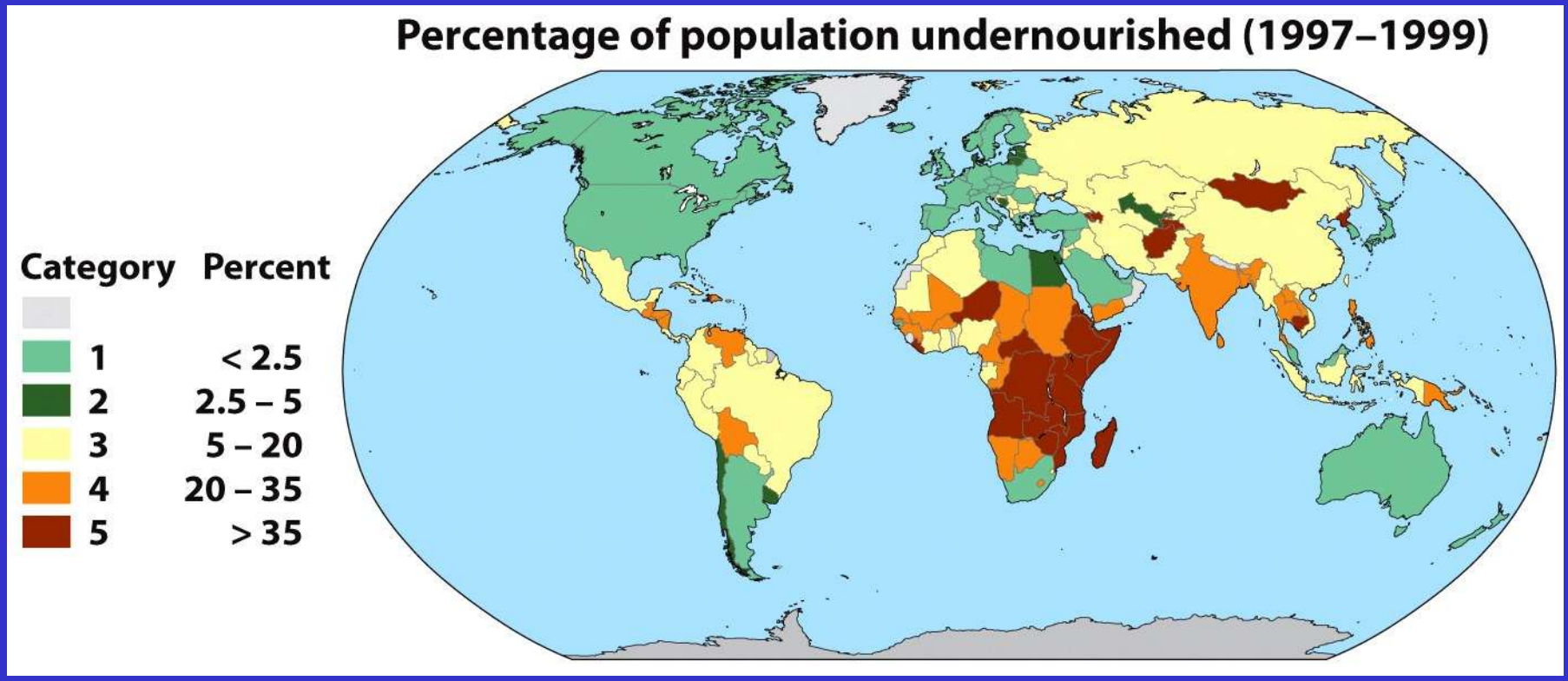
- People “starve” in two ways
  - Undernourishment- lack of sufficient calories in available food, so one has little or no ability to move or work and eventually dies from lack of energy.
  - Malnourishment- lack of specific chemical components of food, such as protein, vitamins, or other essential chemical elements.

How We Starve

- Food emergencies affected 34 countries worldwide at the end of 20th century
  - Africa has the most acute food shortages
  - Food distribution major problem
  - World food aid does not meet all the caloric need of people
- Best solution is to increase local production


Daily calories per capita
Calories per capita
Less than 2,300
2,300 – 2,600
2,600 – 2,900
2,900 – 3,300
More than 3,300
Missing

Percentage of population undernourished (1997–1999)

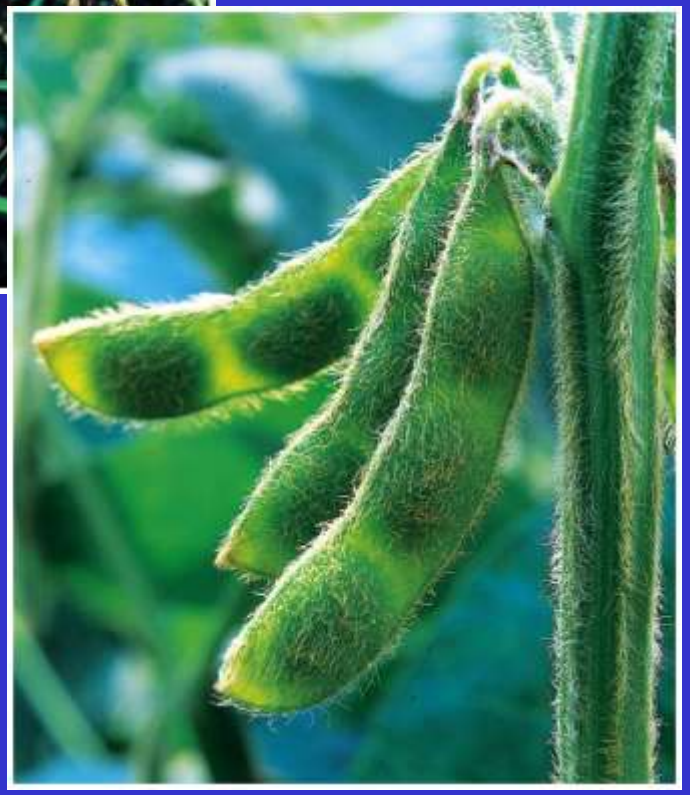


What We Eat and What We Grow

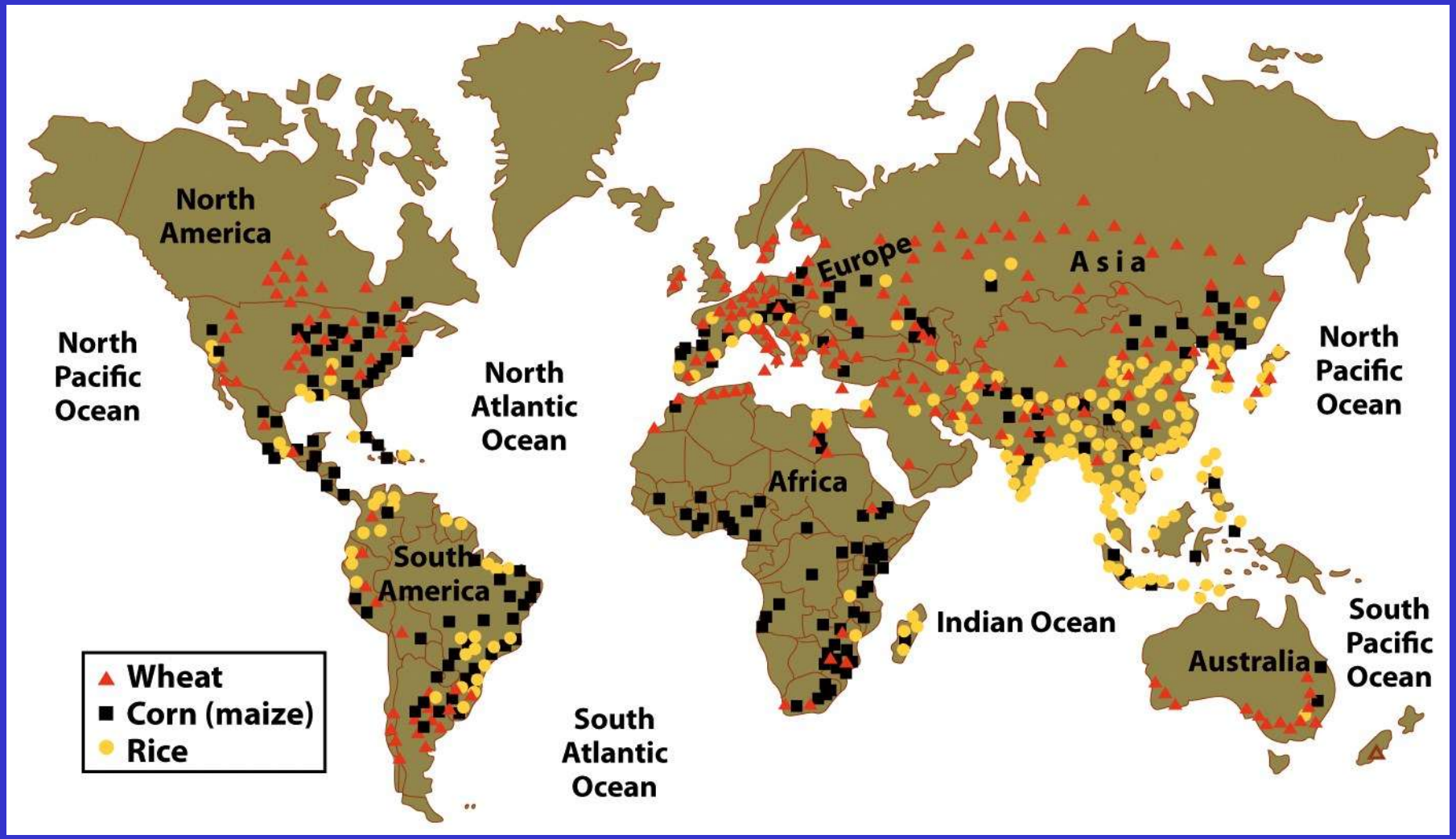
- Of Earth's ½ million plant species
  - Only about 3,000 agricultural crops
  - 150 species cultivated on large scale
  - Most of world's food provided by 14 crop species
  - 6 provide 80% of the total calories

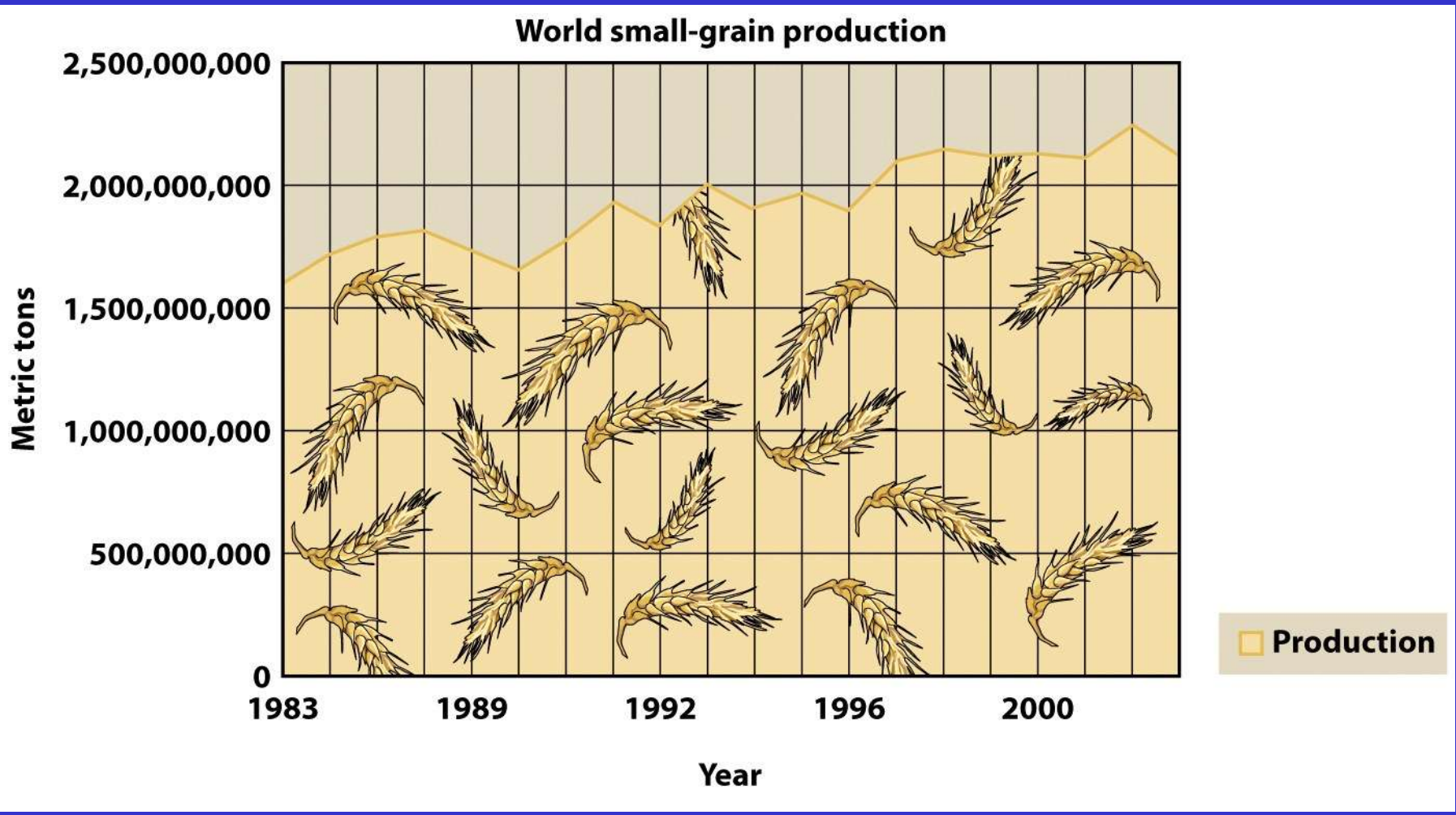
Wheat

Rice



Soybeans


North America
Europe
Asia
North Pacific Ocean
North Atlantic Ocean
North Pacific Ocean
Africa
South America
Indian Ocean
South Pacific Ocean
Australia
South Atlantic Ocean
Wheat
Corn (maize)
Rice

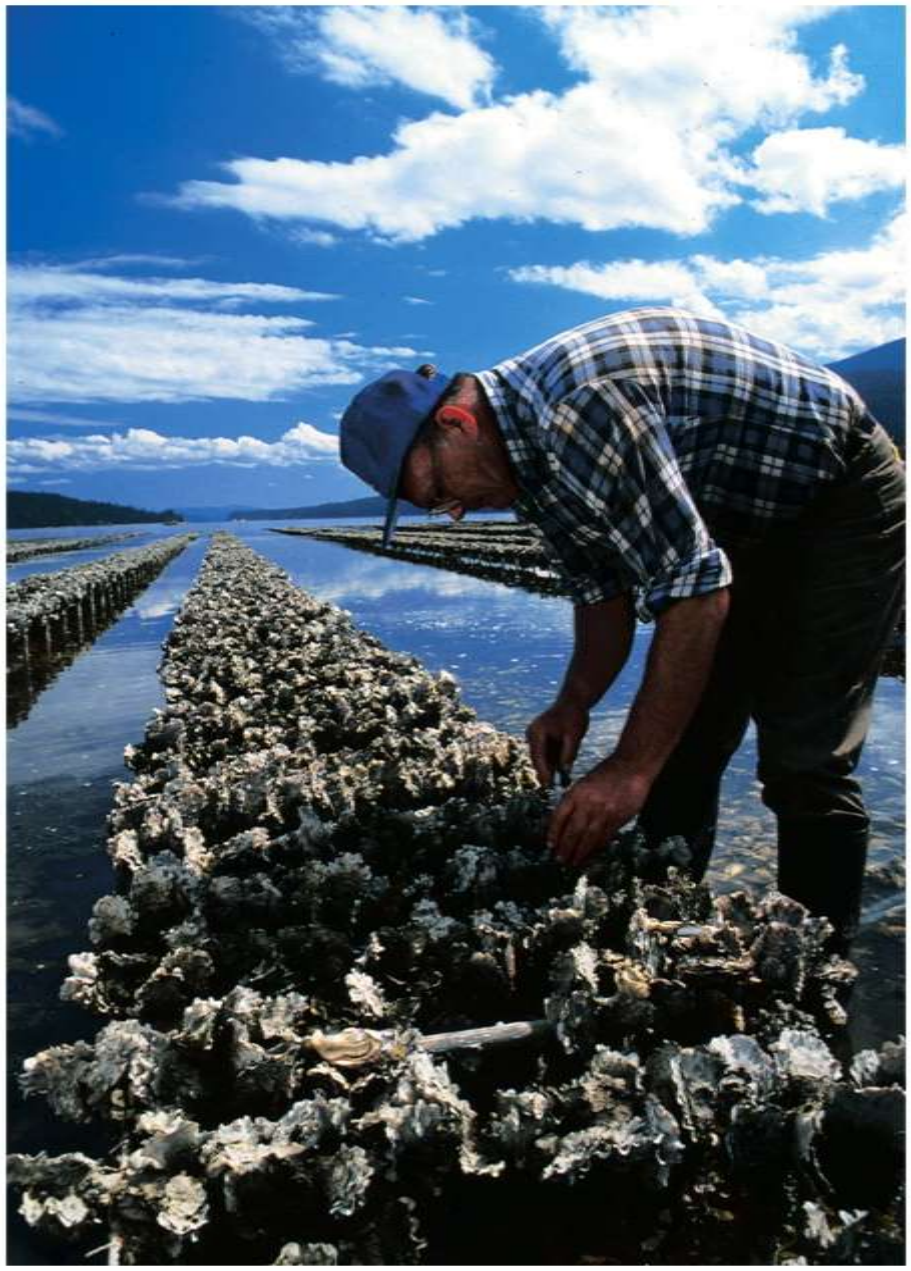

World small-grain production
2,500,000,000
2,000,000,000
1,500,000,000
1,000,000,000
500,000,000
0
Metric tons
1983
1989
1992
1996
2000
Year
Production

Aquaculture

- Most marine and freshwater food obtained by hunting.
  - Not sustainable
- Aquaculture- the farming of food in aquatic habitats
  - Important protein source

Aquaculture

- Extremely productive on a per-area basis
  - Flowing water brings food into the pond from outside
  - Can exploit multiple niches in the pond
  - May be able to utilize waste products (treated sewage)
- Mariculture- the farming of ocean fish.
  - Also increasing production of oysters and mussels



Limiting Factors

- High-quality agricultural soil has
  - All the chemical elements required for plants
  - A physical structure that lets air and water move freely
  - Retains water well
  - Mixture of soil particle size

The Future of Agriculture

- Three major technological approaches to agriculture
  1. Modern mechanized agriculture
  2. Resource- based agriculture
     - Organic food production
  3. Bioengineering

History of Agriculture

1. Resource-based agriculture and what we now call organic agriculture were introduced about 10,000years ago.
2. A shift to mechanized, demand-based agriculture occurred during the Industrial Revolution of the 18th and 19th centuries.
3. A return to resource-based agriculture began in the 20th century, using new techniques.
4. Today there is a growing interest in organic agriculture as well as use of genetically engineered crops.
5. Better irrigation techniques could improve crop yield and reduce overall water use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MT PI FL
40 30 20
Kg/ha
PSBRc-52
NO FERTILIZER N

Climate Change and Agriculture

- Climate change can increase or decrease yield
  - Likely to decrease as areas with good soils also have suitable climate for agriculture
- Climate change may increase evapotranspiration.
  - Irrigation and water supply becoming a bigger problem