

The Geography of Agriculture



The soil is the great connector of lives,
the source and destination of all.
It is the healer and restorer and resurrector.
Without proper care for it we can have no community,
because without proper care for it we can have no life.

Wendell Berry



The Geography of Agriculture



- A Brief History of Agriculture
- Classifying Agricultural Regions
- The Intensity of Land Use and the Von Thünen Model
- Questioning our Agricultural Success





History of Agriculture



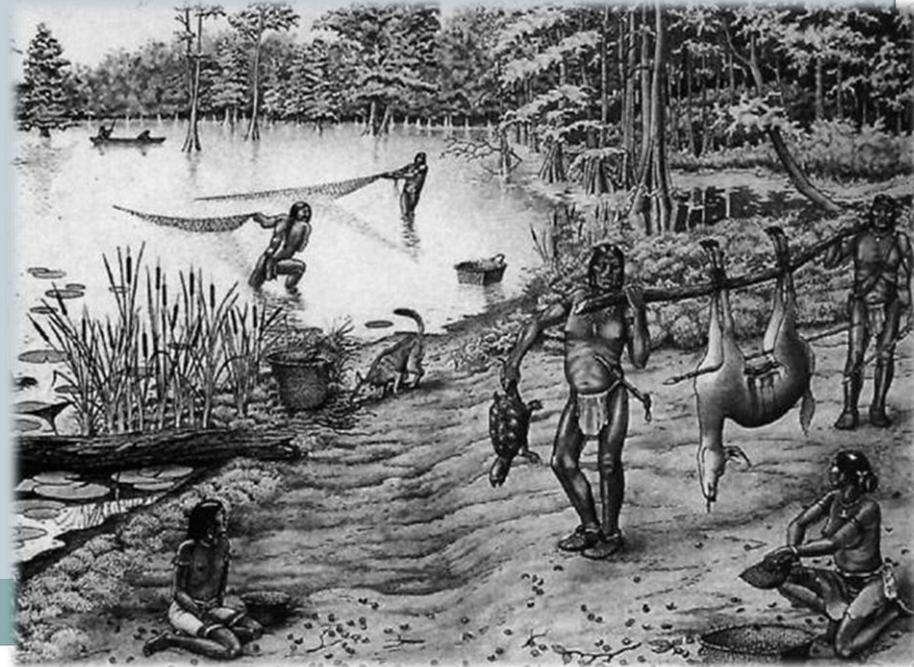
- hunting-gathering
- Agricultural (Neolithic) Revolution
 - domestication of plants and animals
 - diffusion of agriculture
- agricultural industrialization
- The Green Revolution
- modern agribusiness



Hunters-Gatherers



- ...humanity's only economic activity for at least 90% of our existence
- low population densities
- wide variety of natural foodstuffs eaten





Agricultural (Neolithic) Revolution



Domestication of Plants

- **seed agriculture**: Fertile Crescent, western India, northern China, Ethiopia, southern Mexico (11,000 bp)
- **vegetative planting**: Southeast Asia, west Africa, northwest South America (3,000-5,000 bp)
- **Rice, wheat** and **corn** account for more than 50% of population's food calories and were among the first plants domesticated (along with millet, sorghum wheat, rye, barley).



Agricultural (Neolithic) Revolution



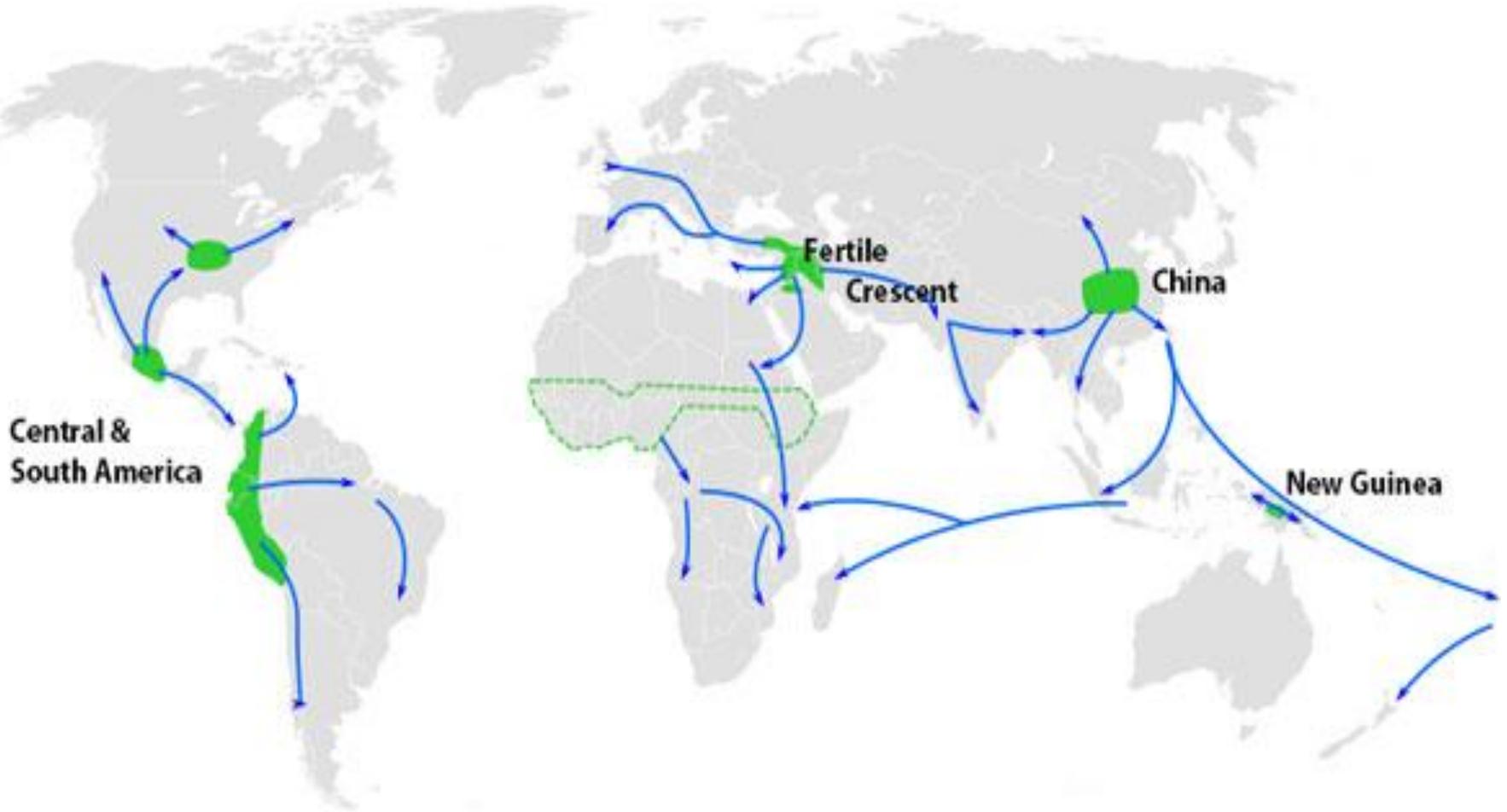
Domestication of Animals

- **dog**: probably first
- **early domesticated animals**: cattle, oxen, pig, sheep, goat, guinea pig, llama
 - vital role of domesticated animals in increase in agricultural production, success and environmental impact
 - relationship of agriculture and domesticated animals to success of particular cultures or languages ... example: Indo-European horsemen





Diffusion of Agriculture

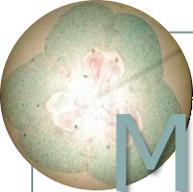




Agricultural (Neolithic) Revolution



- **Primary Effects:**
 - urbanization
 - social stratification
 - occupational specialization
 - increased population densities
- **Secondary Effects:**
 - endemic diseases
 - famine
 - expansionism

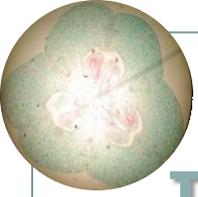


Modern Agricultural Revolutions

Technology allows much greater production (**surplus**) with less human labor ... but has high **social and environmental costs**.

- metal plows, reapers, cotton gin
- tractors (internal combustion engine)
- combines
- chemical pesticides/fertilizers
- hybrid and genetically modified crops





Agribusiness: The Industrialization of Agriculture



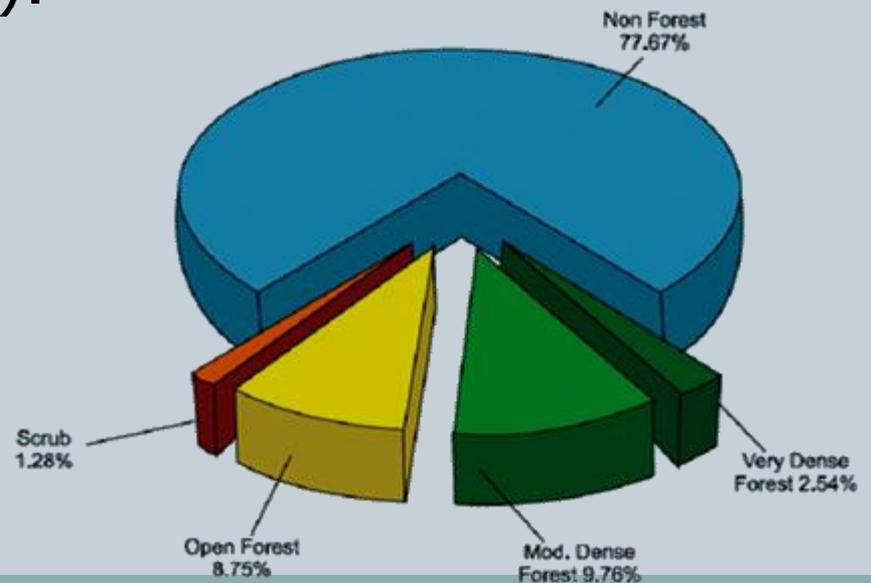
- Modern commercial farming is very **dependent on inputs** of chemical fertilizer, pesticides and herbicides.
- **Oil** is required to make fertilizer and pesticides.
- On average, it takes **10 calories of energy to create 1 calorie of food** in modern agriculture.
- **Small farmers** can't buy the needed equipment and supplies.
- Fewer than 2% of the US population works in agriculture.



Forest Cover and Loss



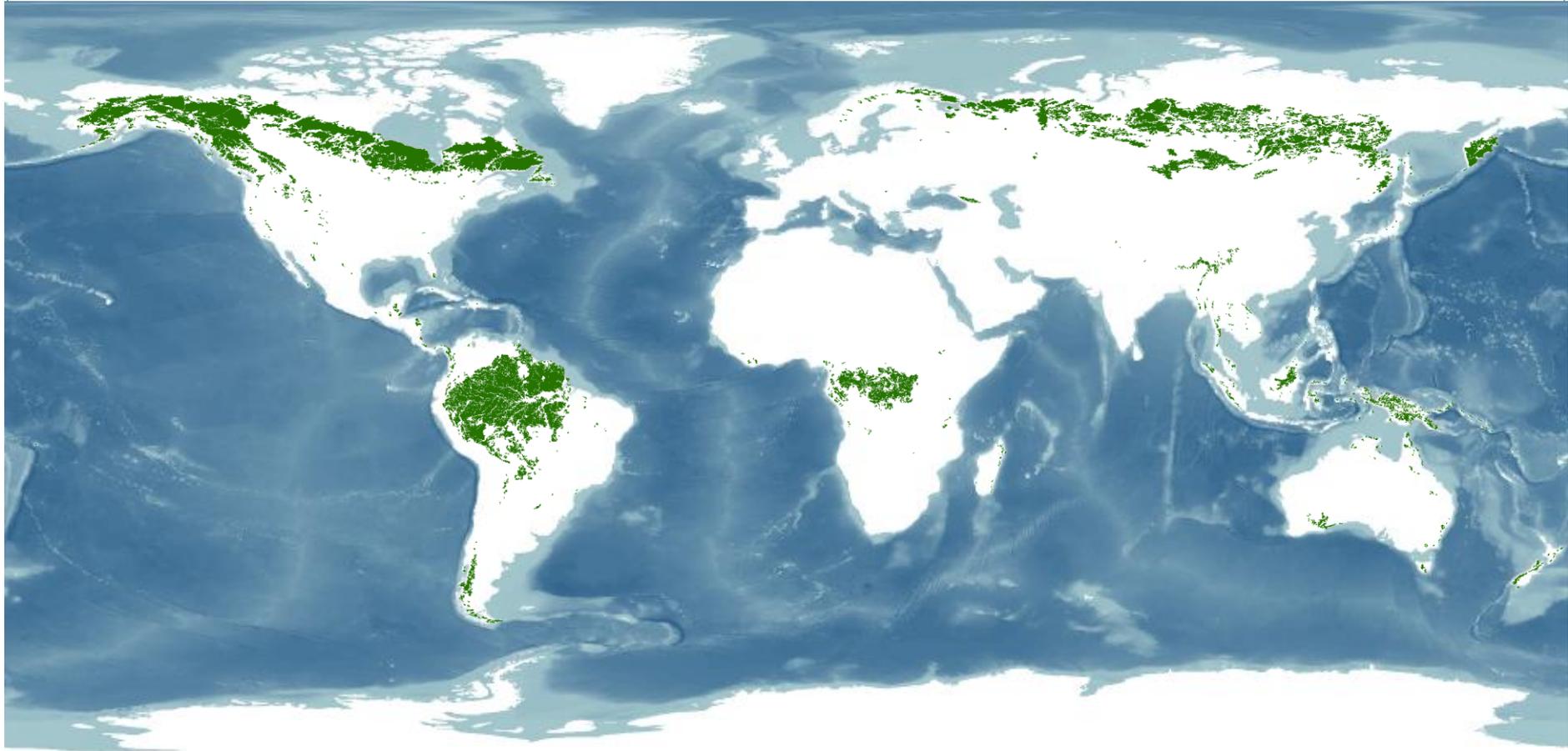
- 8,000 years ago about 50% of the earth was forest. Today about **30% of the planet is forested**.
- That's a total loss of about 40%.
- Many of today's forests are modified by humans (**second- or third-growth**).



Total Forest Cover 21.05%



The World's Forests



 intact forest landscapes

 original forest cover

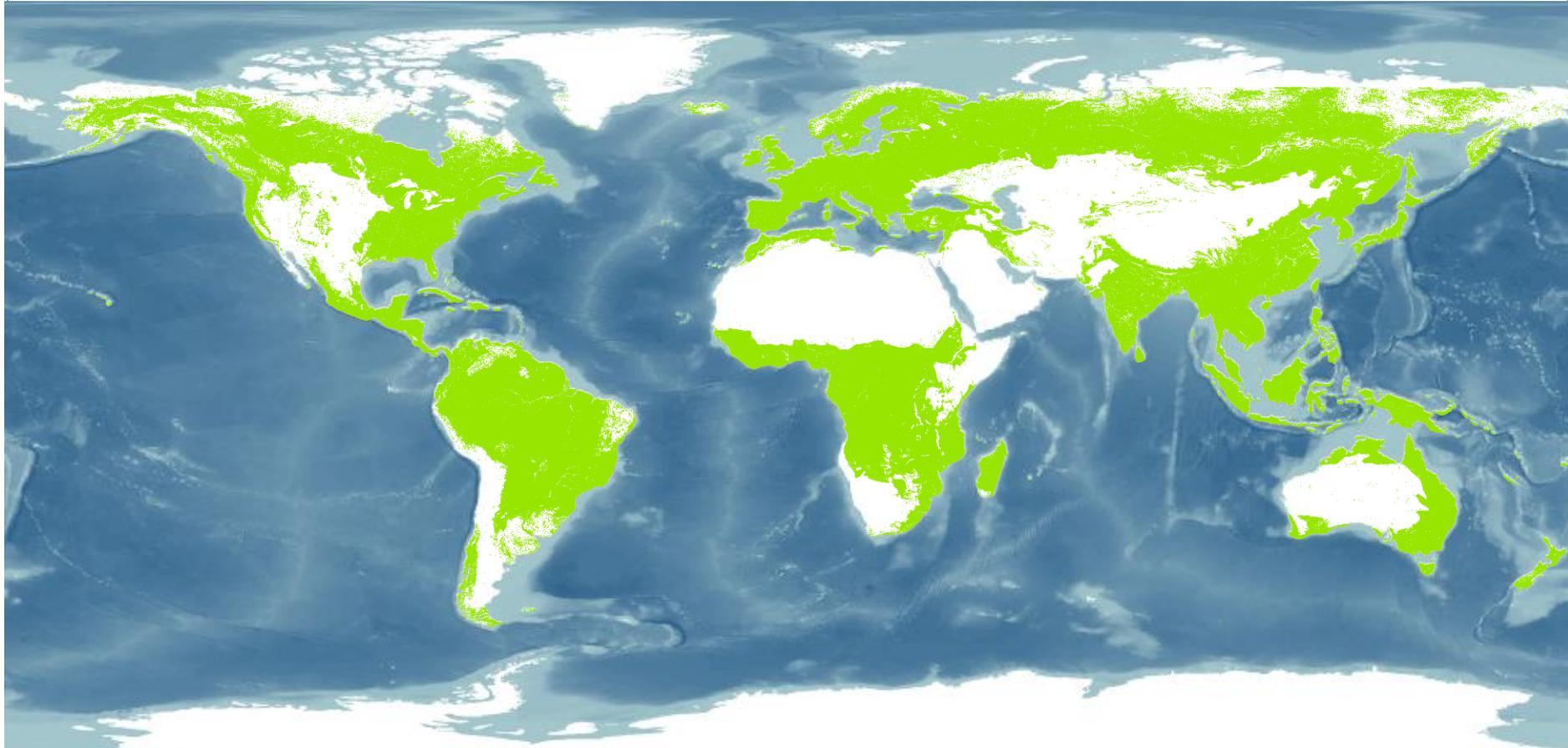
 formerly forest, now croplands

 formerly forest, now pasture

 tropical deforestation



The World's Forests



 intact forest landscapes

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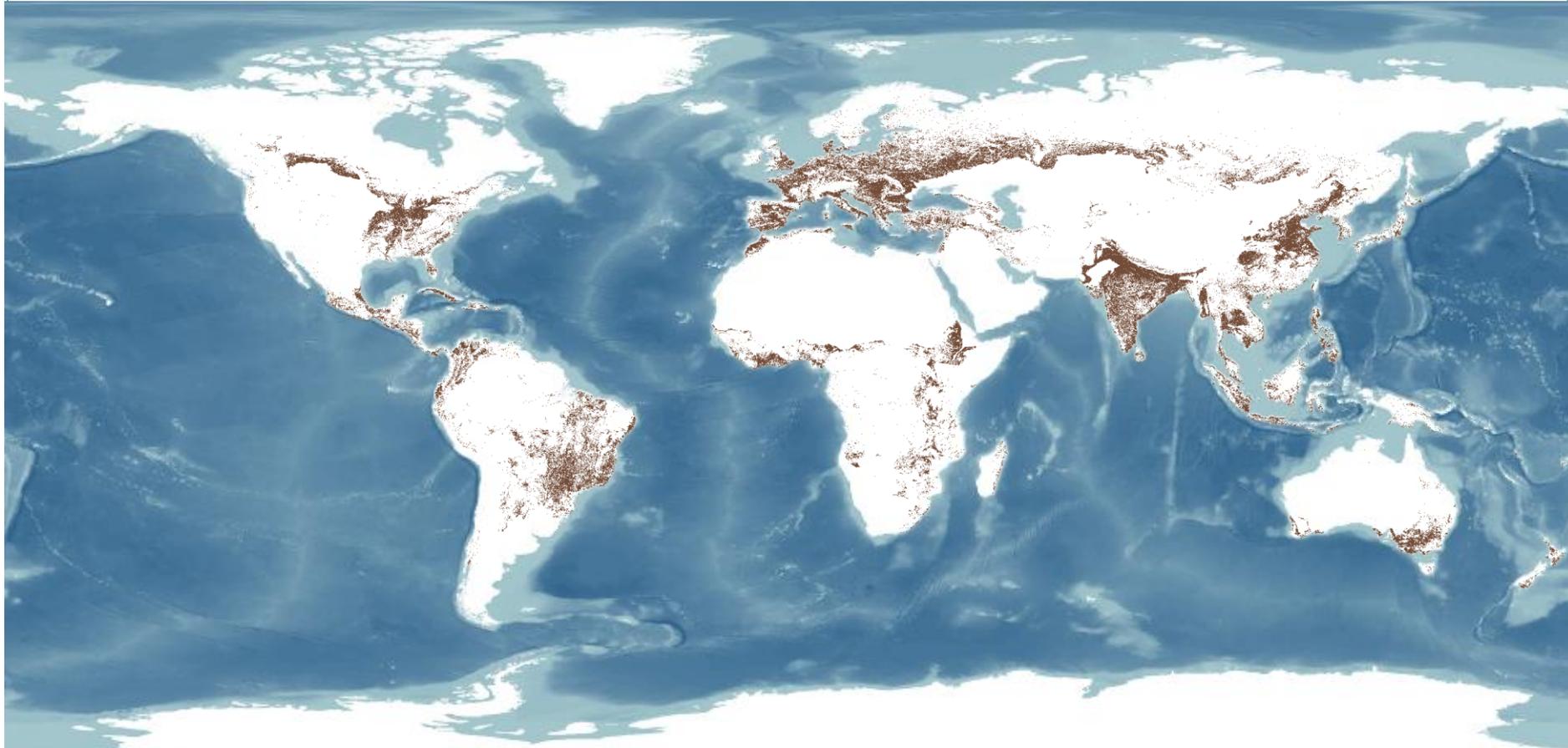
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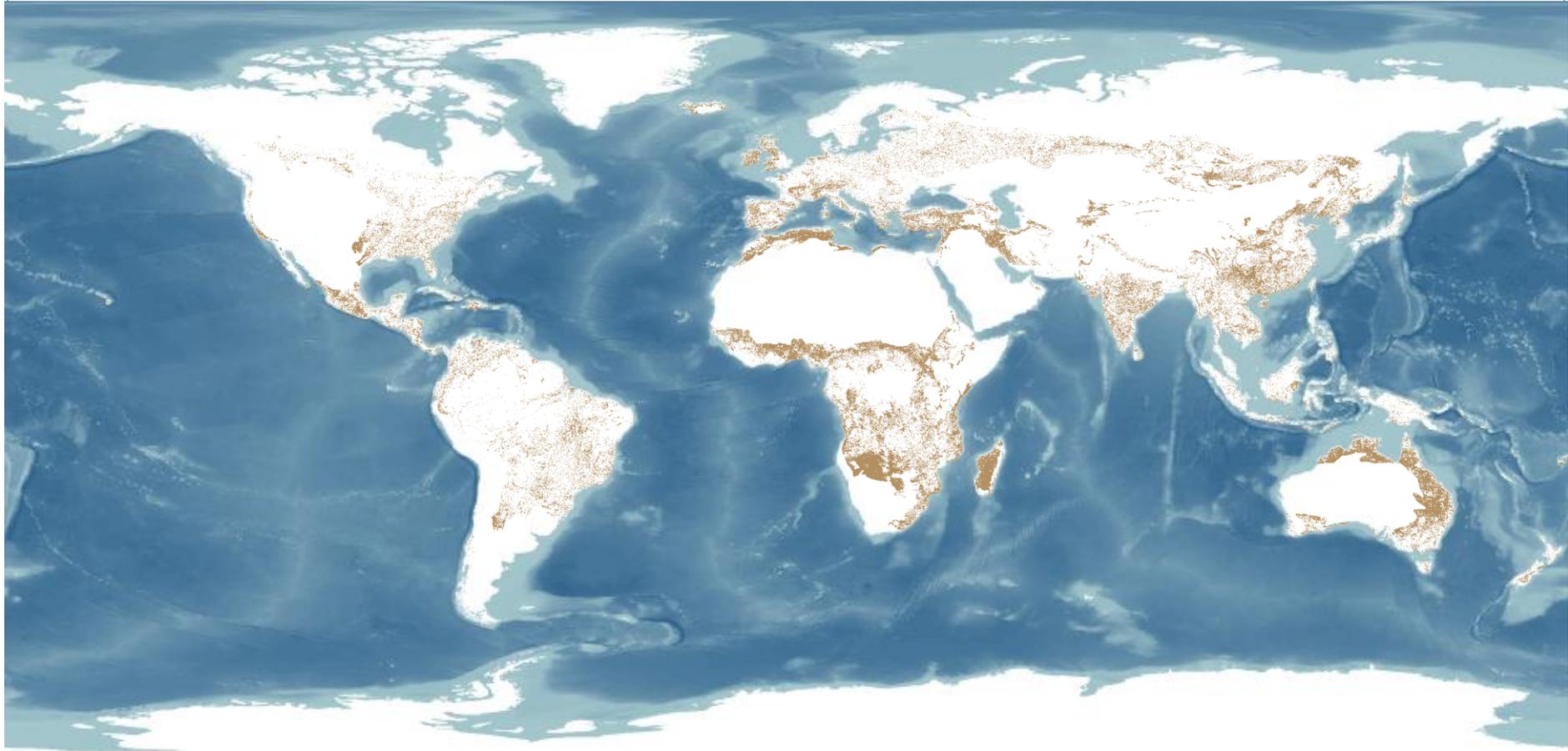
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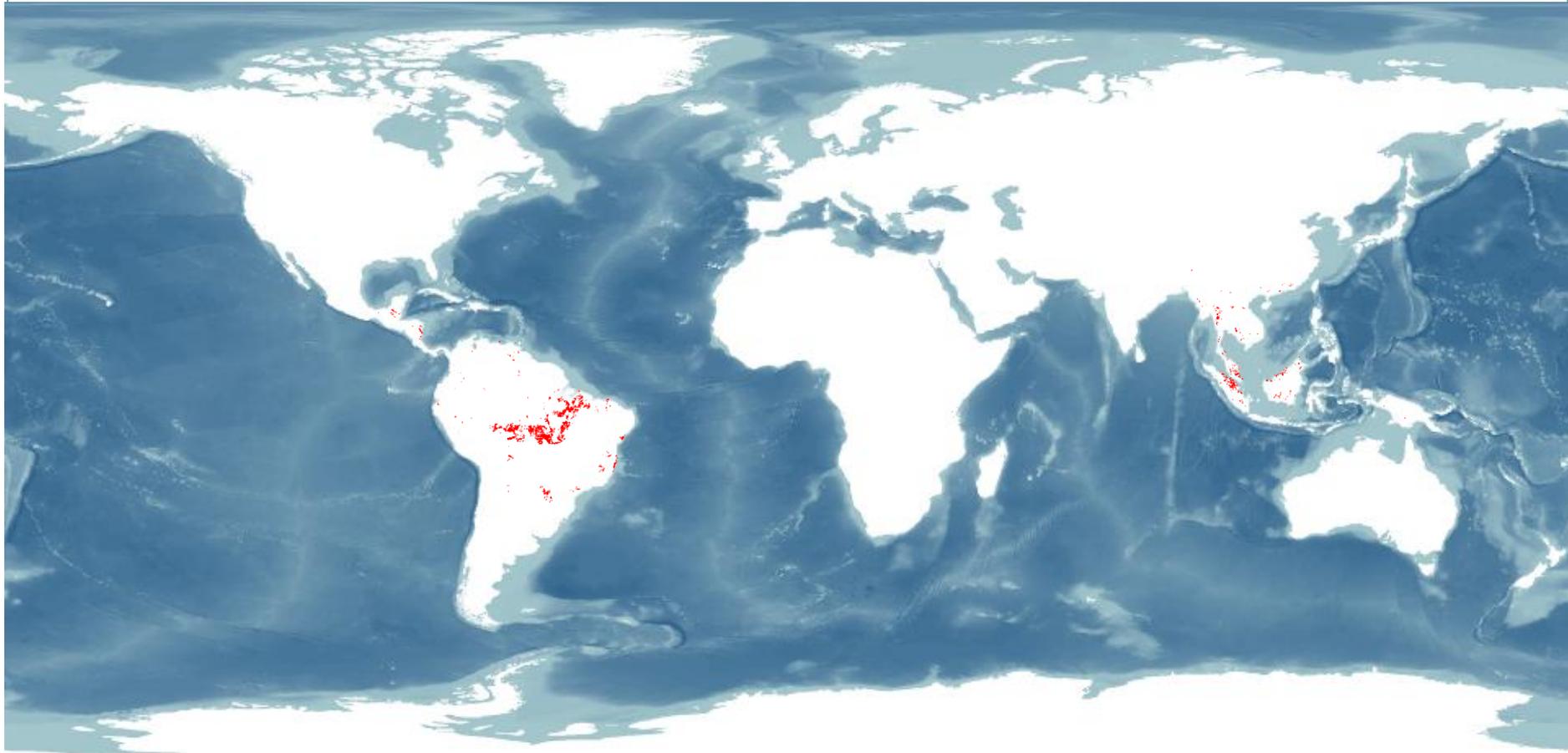
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Classifying Agricultural Regions



- shifting cultivation
- pastoral nomadism
- intensive subsistence agriculture
- mixed crop and livestock farming
- dairy farming
- grain farming
- livestock ranching

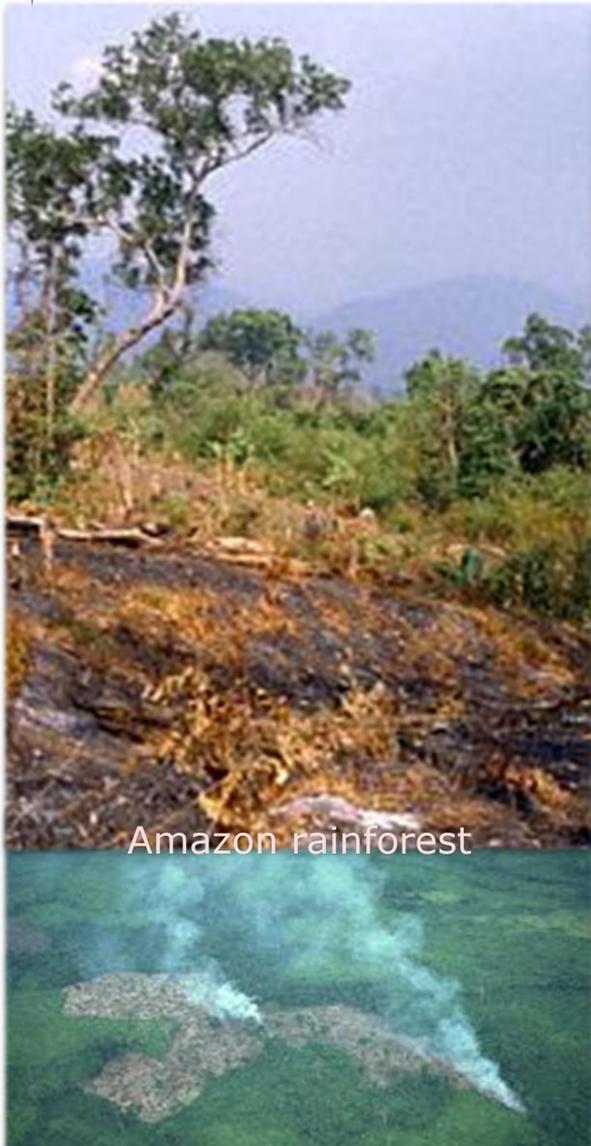


Shifting Cultivation



Vegetation **slashed** and then **burned**. Soil remains fertile for 2-3 years. Then move to another plot and start over.

- **where:** tropical rainforests, Amazon, Central and West Africa, Southeast Asia
- **crops:** upland rice (SE Asia), maize and manioc (S America), millet and sorghum (Africa)
- **declining** due to encroachment of ranching and logging



Amazon rainforest



Pastoral Nomadism



...the breeding and herding of domesticated **animals** for subsistence

- **where:** arid and semi-arid areas of North Africa, Middle East, Central Asia
- **animals:** camel, goats, sheep, cattle
- **transhumance:** seasonal migrations from highlands to lowlands
- Most nomads are being **pressured into sedentary life** as land is used for agriculture or mining.





Subsistence Agriculture



...**self-sufficiency** farming in which the farmers focus on growing enough food to feed themselves and their families

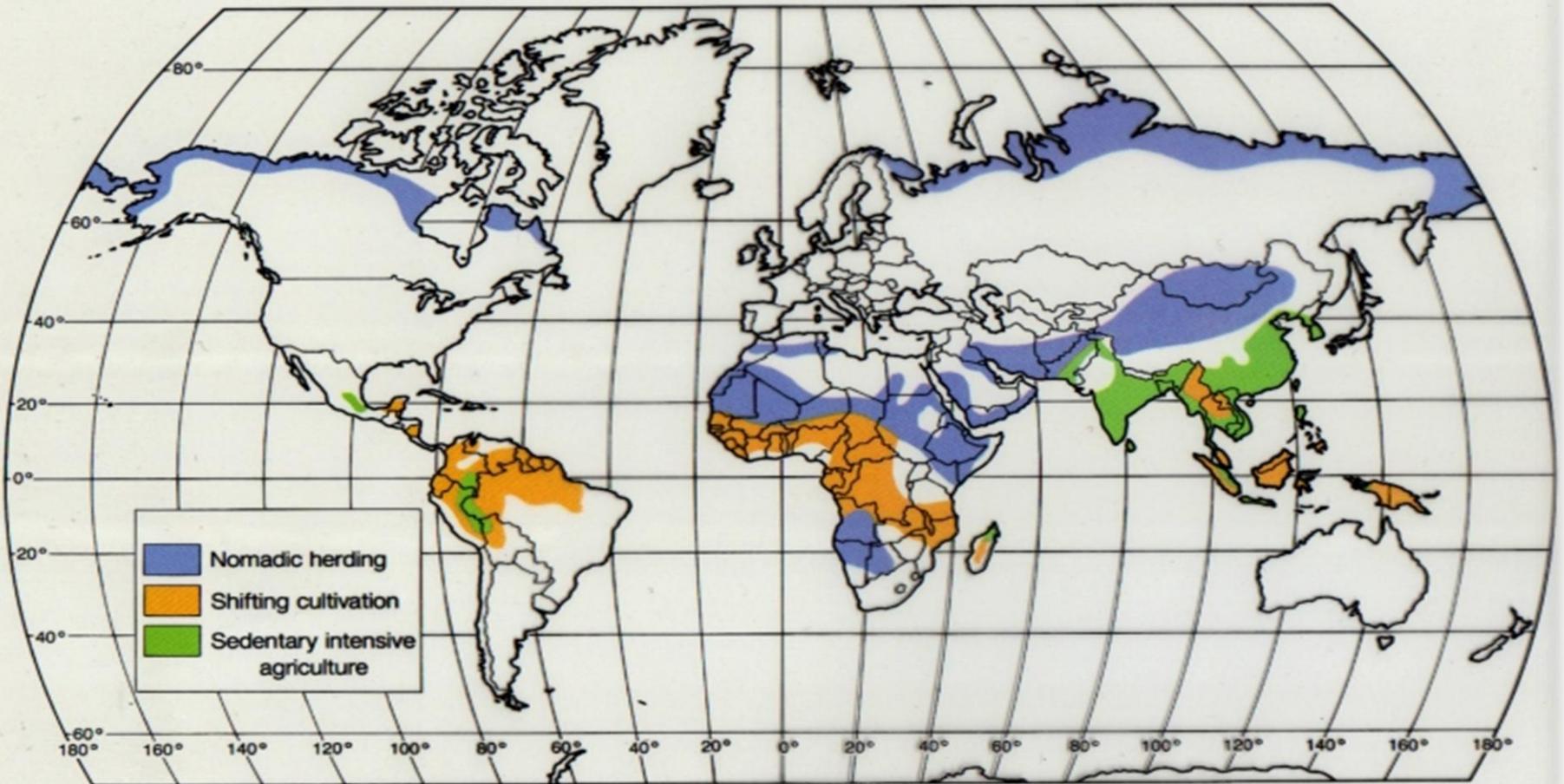
The output is mostly for local requirements with little or no surplus for trade. The typical subsistence farm has a range of crops and animals needed by the family to feed and clothe themselves during the year.



subsistence farms, China



Subsistence Agriculture Regions





Intensive Subsistence Agriculture

Wet Rice Dominant

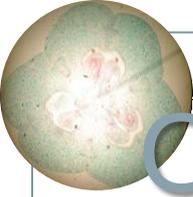
- **where:** SE Asia, E India, SE China
- **very labor intensive** production of rice, including transfer to sawah or paddies
- **most important source** of food in Asia
- grown on **flat or terraced land**
- **Double cropping** is used in warm winter areas of south China and Taiwan.



Bali rice fields



Thai rice farmers



Classifying Agricultural Regions



Commercial Agriculture

- mixed crop and livestock farming
- dairy farming
- grain farming
- livestock ranching
- Mediterranean agriculture
- truck farming

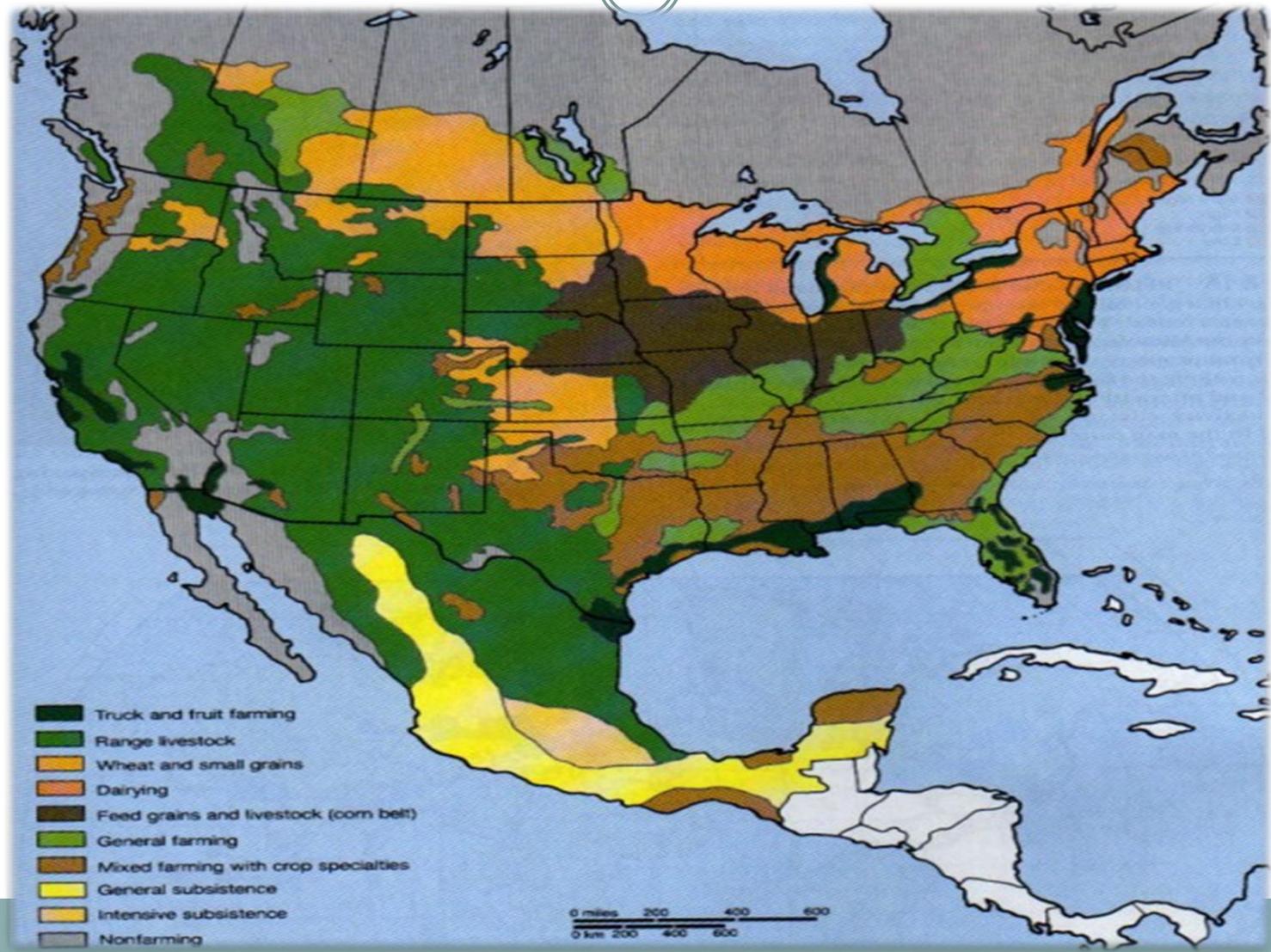


North Dakota potato and wheat fields





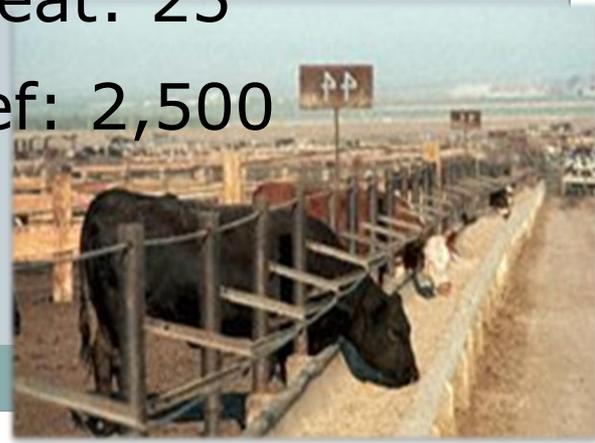
Classifying Agricultural Regions





Mixed Crop and Livestock Farming

- **where:** Ohio to Dakotas, centered on Iowa; much of Europe from France to Russia
- **crops:** corn (most common), soybeans
- In US 80% of product is fed to pigs and cattle.
- highly **inefficient** use of natural resources
 - pounds of grain to raise 1 lb beef: 10
 - gallons of water to grow 1 lb wheat: 25
 - gallons of water to raise 1 lb beef: 2,500





Dairy Farming



- **where:** near urban areas in northeast US, southeast Canada, northwest Europe
- **Locational Theory:** butter and cheese more common than milk with increasing distance from cities and in West
- **milk shed:** historically defined by spoilage threat, refrigerated trucks changed this





Grain Farming



- **where:** worldwide, but US and Russia predominant
- **crops:** wheat
 - winter wheat: Kansas, Colorado, Oklahoma
 - spring wheat: Dakotas, Montana, southern Canada
- **highly mechanized:** Combines, worth hundreds of thousands of dollars, migrate northward in the US, following the harvest.





Livestock Ranching



- **where:** arid or semi-arid areas of western US, Argentina, Brazil, Uruguay, Spain and Portugal
- **history:** initially open range, now sedentary with transportation changes



Environmental effects:

- **Overgrazing** has damaged much of the world's arid grasslands (< 1% in US remain).
- **Destruction of the rainforest** is motivated by Brazilian desires for fashionable cattle ranches.



Mediterranean Agriculture



- **where:** areas surrounding the Mediterranean, California, Oregon, Chile, South Africa, Australia
- **climate:** summer dry season
- **landscape:** mountainous
- **crops:** olives, grapes, nuts, fruits and vegetables, winter wheat
- **California:** high quality land being lost to suburbanization, initially offset by irrigation

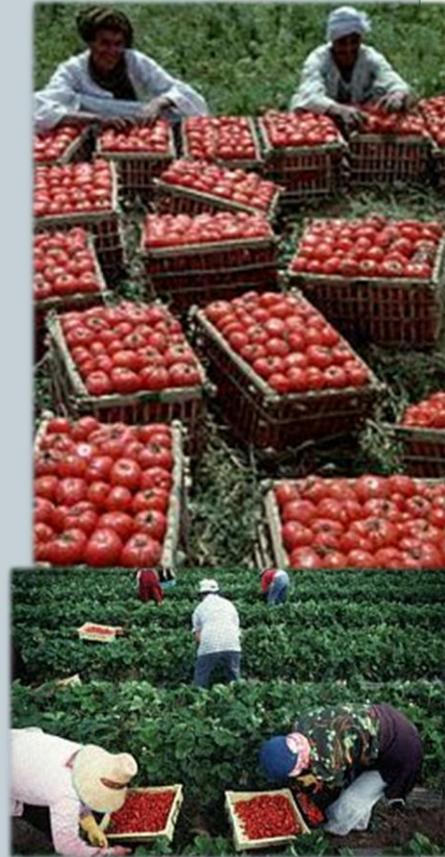




Truck Farming



- ...commercial gardening and fruit farming
- **where:** US Southeast, New England, near cities around the world
- **crops:** high profit vegetables and fruits for wealthy urban populations – apples, asparagus, cherries, lettuce, tomatoes, etc
- **mechanization:** Truck farming is highly mechanized and labor costs are further reduced by the use of cheap immigrant (and illegal) labor.
- **distribution:** situated near urban markets





Plantation Farming

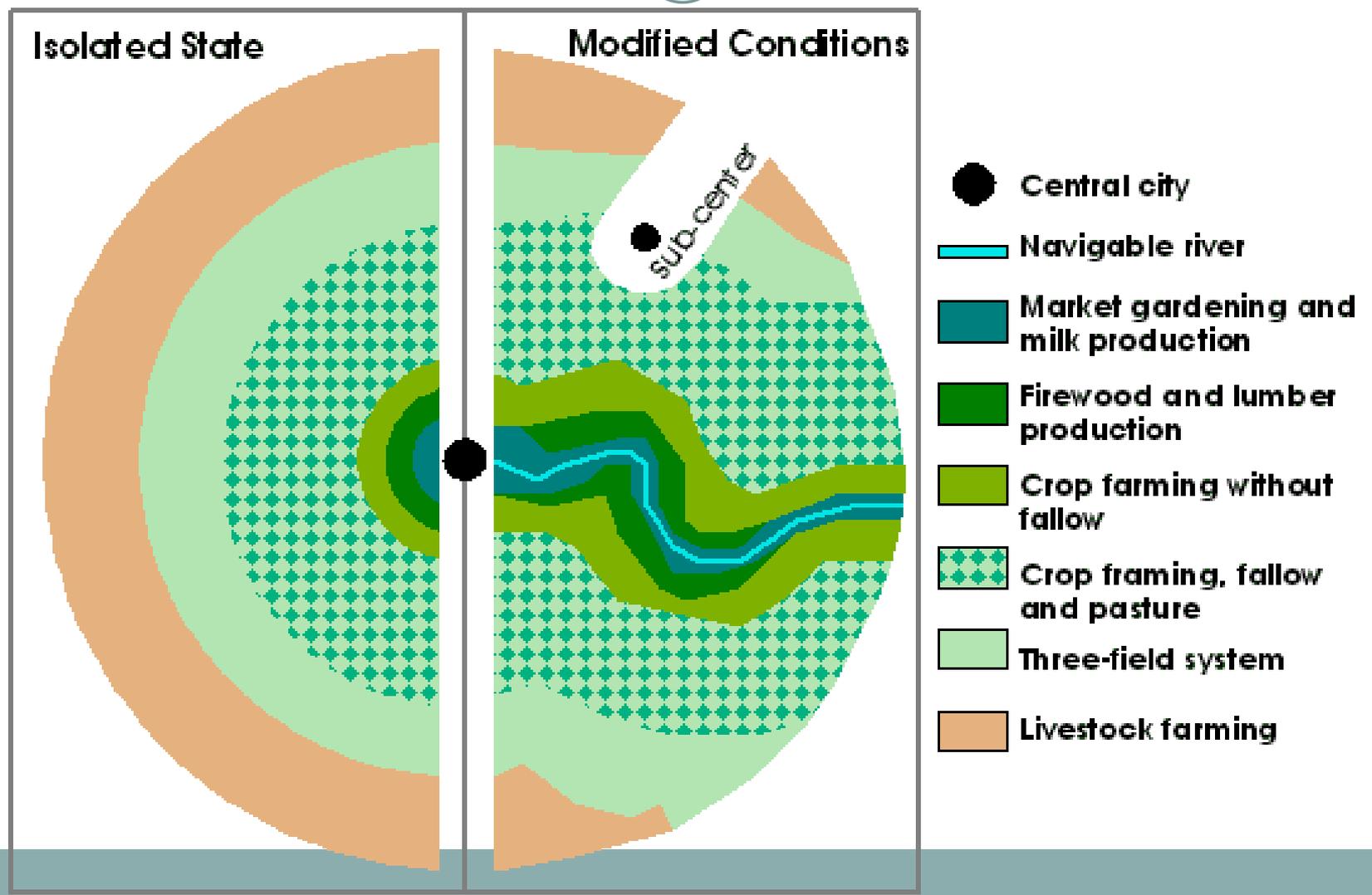


- **large scale mono-cropping of profitable products** not able to be grown in Europe or US
- **where:** tropical lowland periphery
- **crops:** cotton, sugar cane, coffee, rubber, cocoa, bananas, tea, coconuts, palm oil
- There are potential **environmental and economic problems** with this type of agriculture.





Von Thünen: Start of Location Economics and Analysis (1826)





Von Thünen Model



- ...model of **agricultural land use**
- ...based on the following **limiting assumptions**:
 - The city is located **centrally** within an Isolated State which is **self sufficient** and has no external influences.
 - The Isolated State is surrounded by an **unoccupied wilderness**.
 - The land of the State is completely **flat** and has **no rivers or mountains** to interrupt the terrain.
 - The **soil quality and climate are consistent** throughout the State.
 - Farmers in the Isolated State **transport their own goods** to market via oxcart, across land, directly to the central city. Therefore, there are no roads.
 - Farmers act to **maximize profits**.



Von Thünen Model



- In an Isolated State with the foregoing statements being true, Von Thünen hypothesized that a **pattern of rings around the city** would develop. There are four rings of **agricultural activity** surrounding the city.
- **Dairying and intensive farming** occur in the ring closest to the city. Since vegetables, fruit, milk and other dairy products must get to market quickly, they would be produced close to the city. (This was before refrigerated oxcarts.)
- **Timber and firewood** would be produced for fuel and building materials in the second zone. Before industrialization (and coal power), wood was a very important fuel for heating and cooking. Wood is very heavy and difficult to transport so it is located as close to the city as possible.





Von Thünen Model



- The four rings of agricultural activity surrounding the city:
 - The third zone consists of **extensive field crops** such as grains for bread. Since grains last longer than dairy products and are much lighter than fuel, reducing transport costs, they can be located further from the city.
 - **Ranching** is located in the final ring surrounding the central city. Animals can be raised far from the city because they are self-transporting. Animals can walk to the central city for sale or for butchering.
 - Beyond the fourth ring lies the **unoccupied wilderness**, which is too great a distance from the central city for any type of agricultural product.



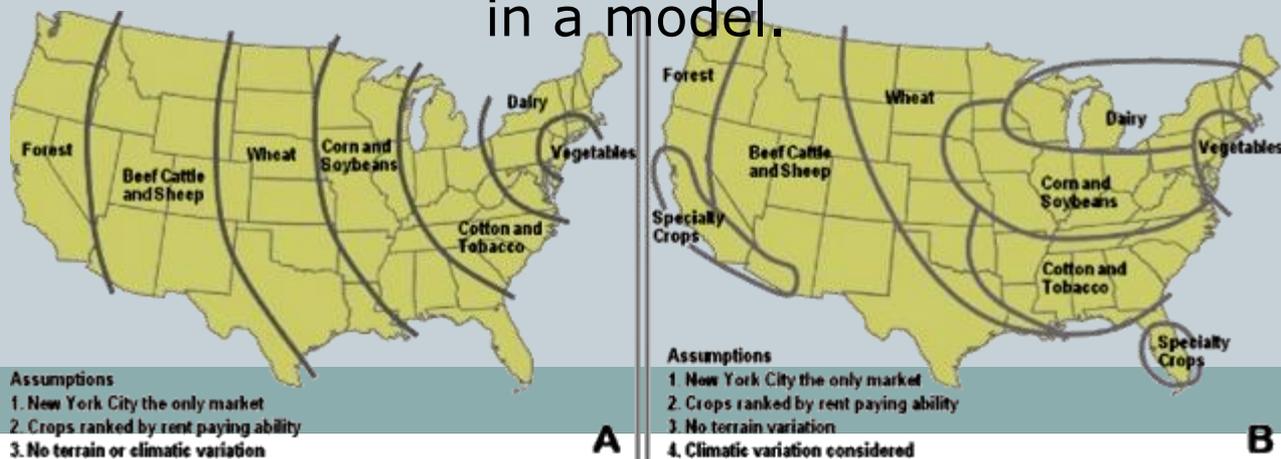
Von Thünen Model



Even though the Von Thünen model was created in a time before factories and railroads, it's an important model in geography. The Von Thünen model is an excellent **illustration of the balance between land cost and transportation costs**. As one gets closer to a city, the price of land increases.

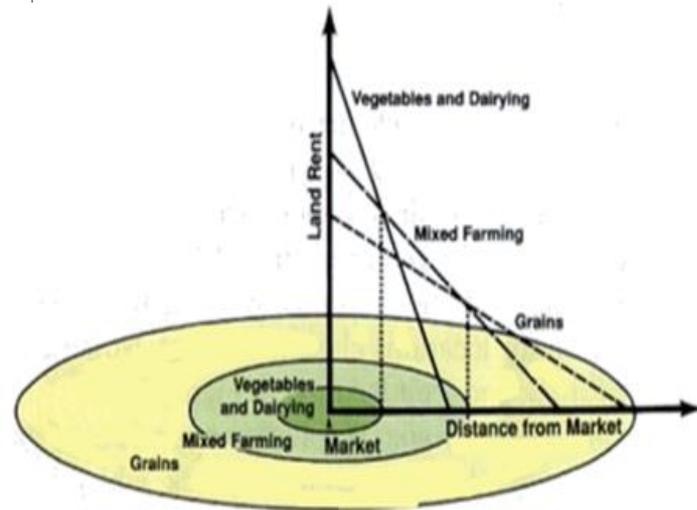
The farmers of the Isolated State **balance the cost of transportation, land and profit** and produce the **most cost-effective product** for market.

Of course, in the real world, things don't happen as they would in a model.



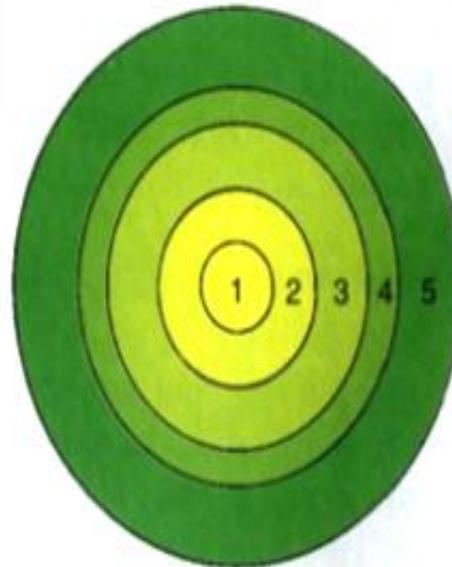


Von Thünen Model



Transport gradients and agricultural zones.

1. Dairying and market gardening
2. Specialty farming
3. Cash grain and livestock
4. Mixed farming
5. Extensive grain farming or stock raising



(a)



(b)



The Green Revolution in Agriculture



- ...refers to the development and adoption of **high yielding cereal grains** in the less developed world during the 1960s, 1970s and 1980s ... Very large short-term gains in grain output allowed food supplies to grow faster than populations (until very recently).
- Green Revolution History
- Acreage and Yield Trends
- Technical Problems
- Ethical Issues



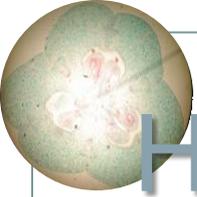


Green Revolution



- Gains were made by:
 - **dwarf varieties**: Plants are bred to allocate more of their photosynthetic output to grain and less to vegetative parts.
 - Planting in **closer rows**, allowed by **herbicides**, increases yields.
 - Bred to be **less sensitive to day length**, thus **double-cropping** is more plausible.
 - Very sensitive to inputs of **fertilizer** and **water**.





History of the Green Revolution



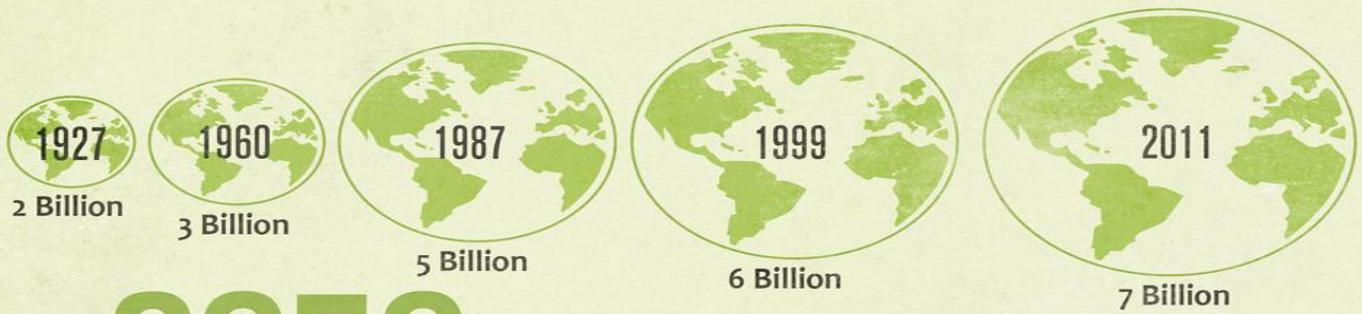
- 1943: Rockefeller Foundation begins work on **short stature hybrid corn** in Mexico.
- 1960s: **Hybrid strains of rice, wheat and corn** show great success in SE Asia, Latin America.
- 1970: Head of Mexican corn program, **Norman Borlaug**, wins Nobel Peace Prize.
- 1990s: Growth in food supply continues but **slows to below the rate of population growth** as the results of unsustainable farming practices take effect.



The Global State of Agriculture



POPULATION IS EXPANDING & FOOD PRODUCTION **MUST** RISE



[Launch Full Infographic](#)

GLOBAL FOOD PRODUCTION MUST INCREASE **70%** BY 2050 TO MEET OUR NEEDS.



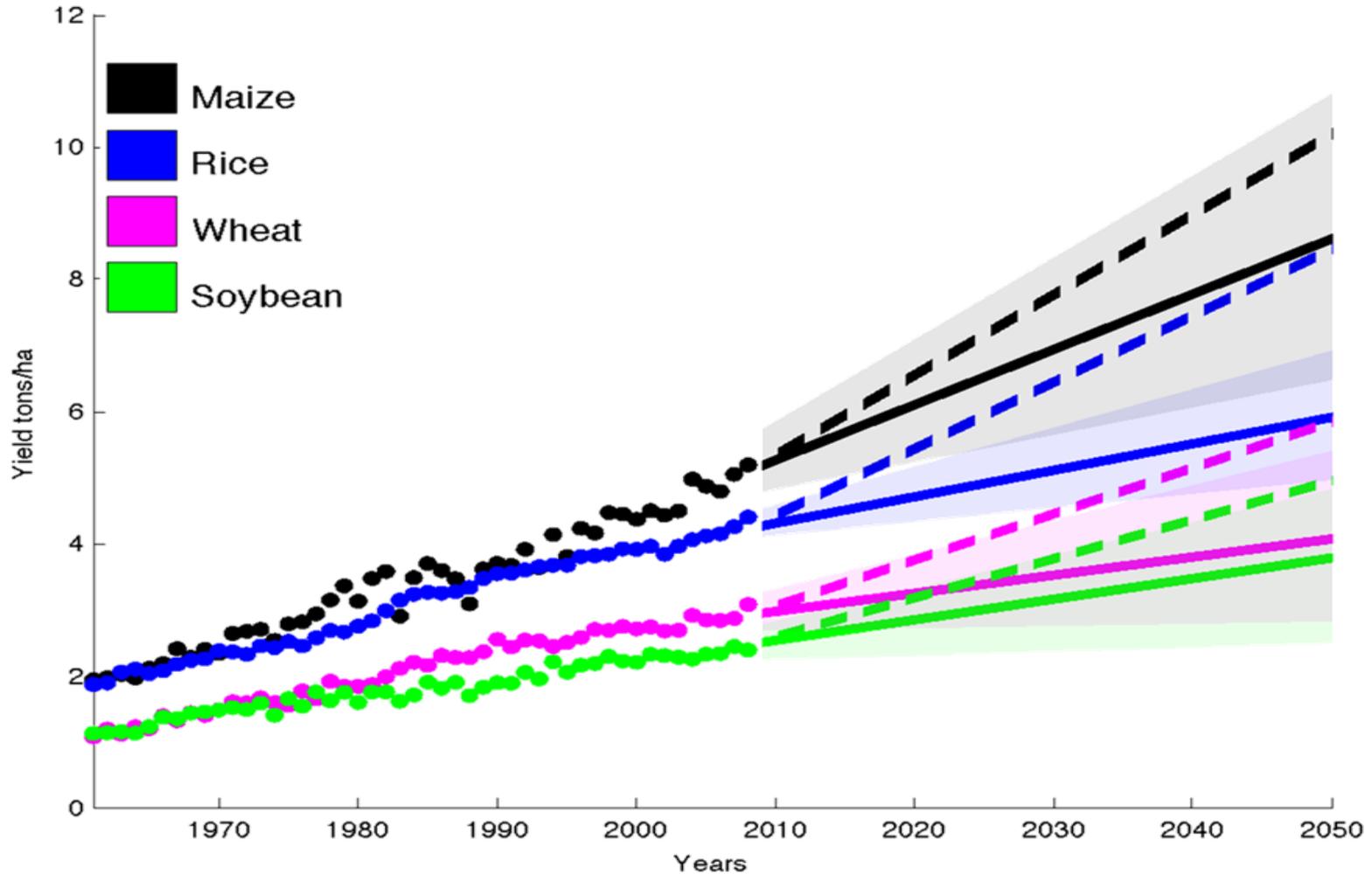
Annual Cereal production must rise by **42%**.



Annual beef production must rise by over **100%**.

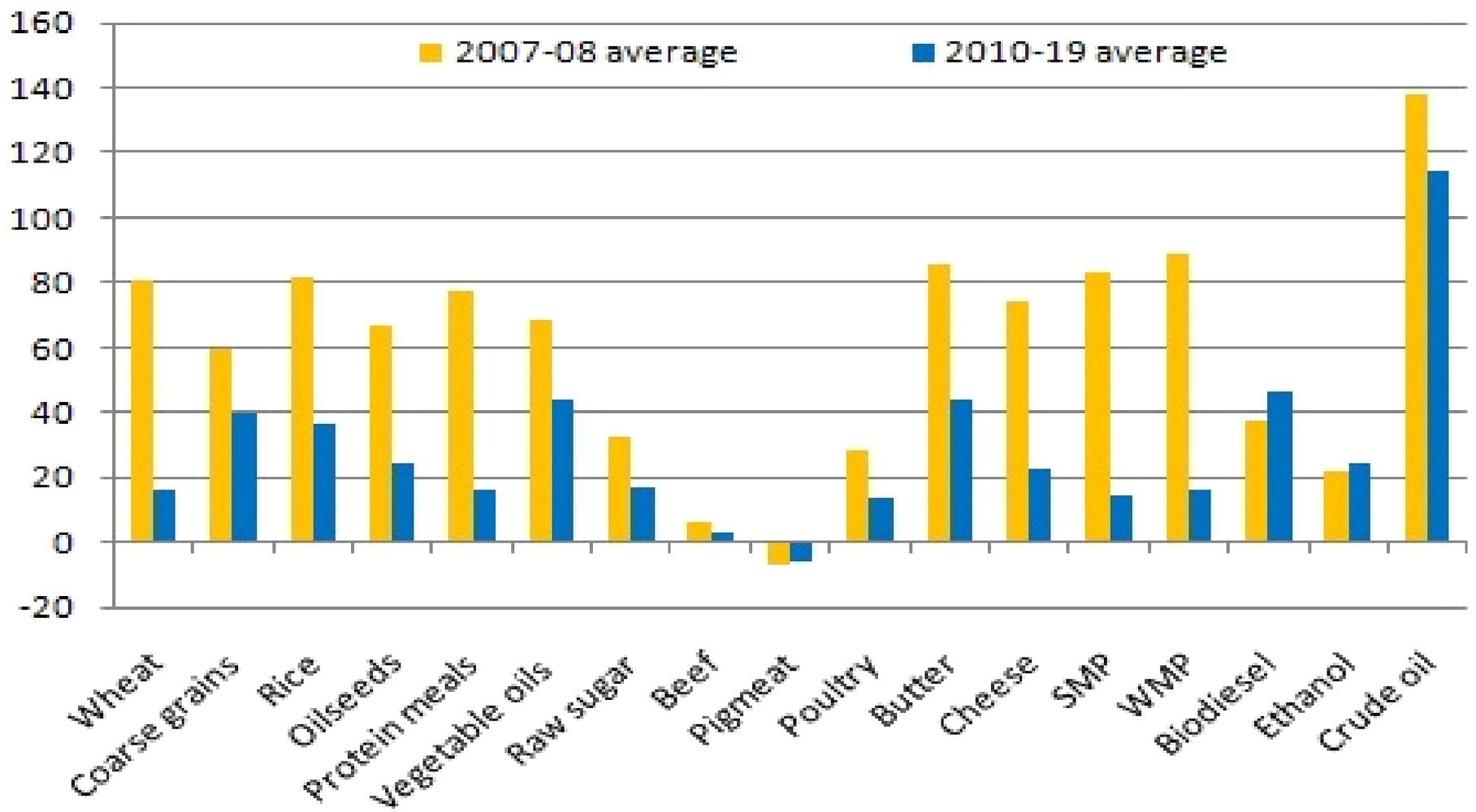


Acreeage and Yield Trends



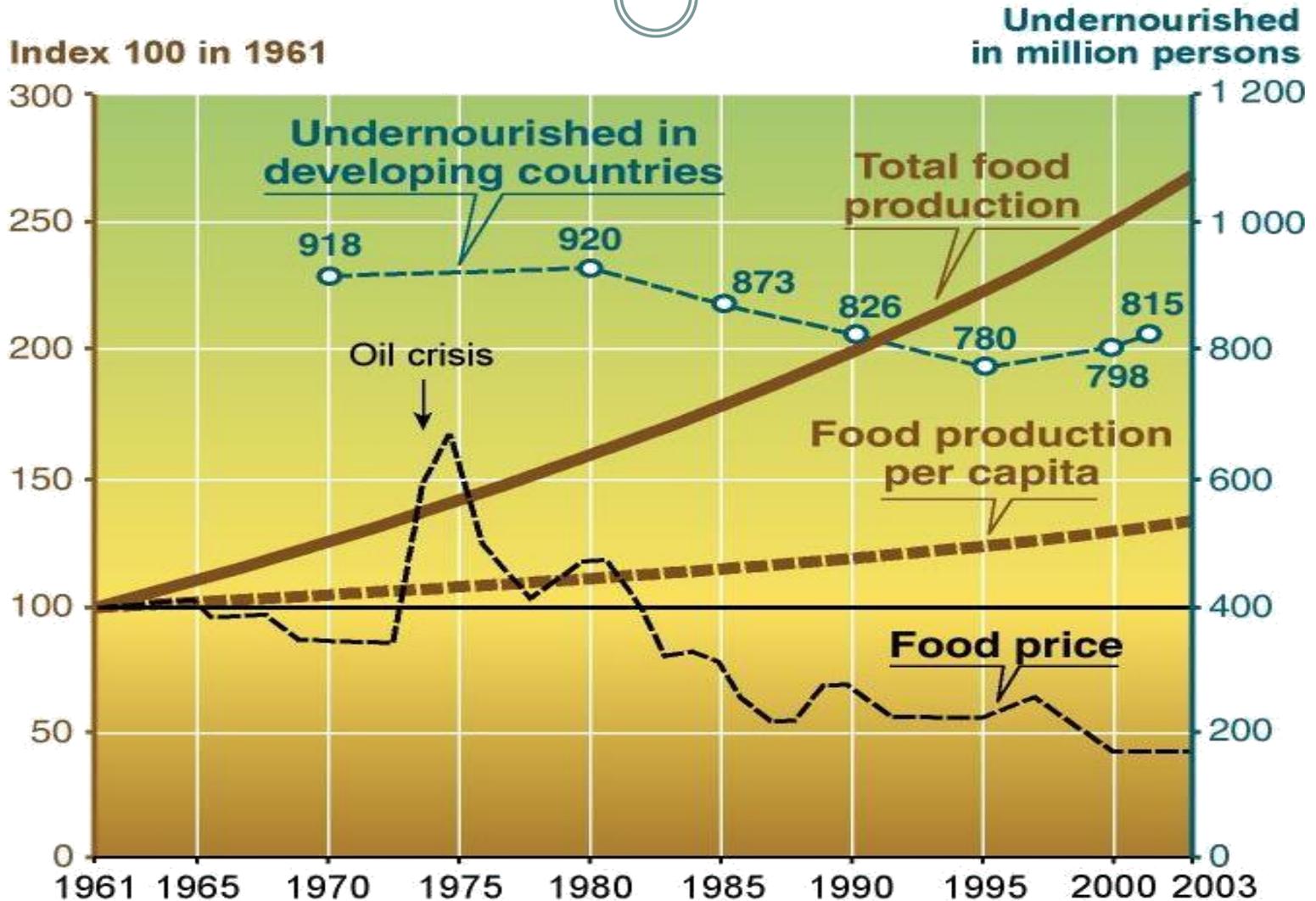


World Agricultural Production





Undernourishment



Sources: FAOSTATS, SOFI, Millennium Ecosystem Assessment



FAO Food Price Index

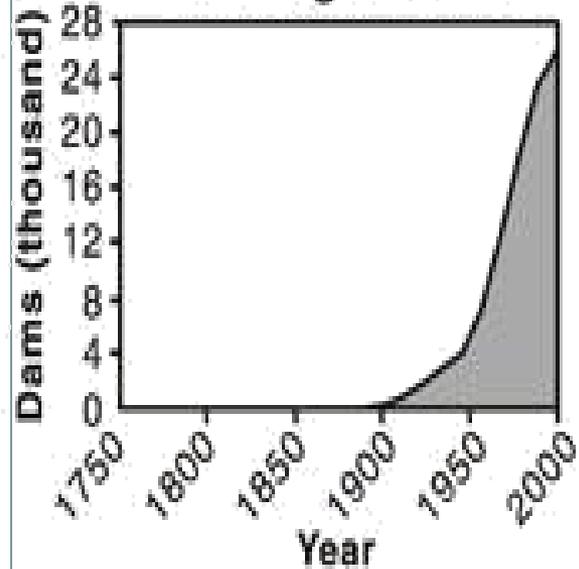




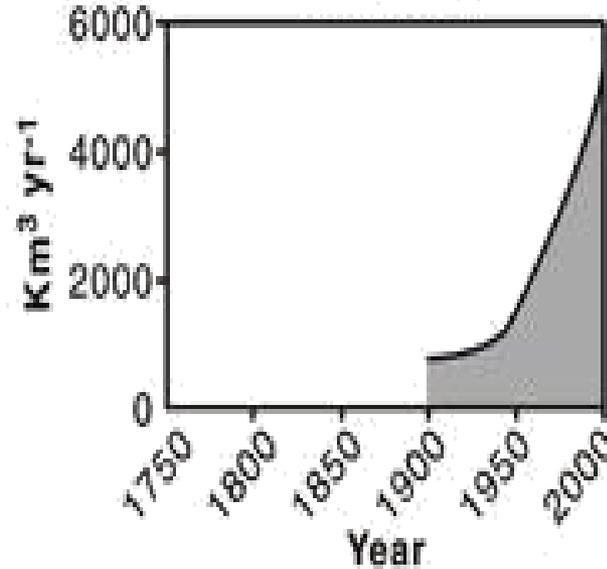
Water and Fertilizer Use



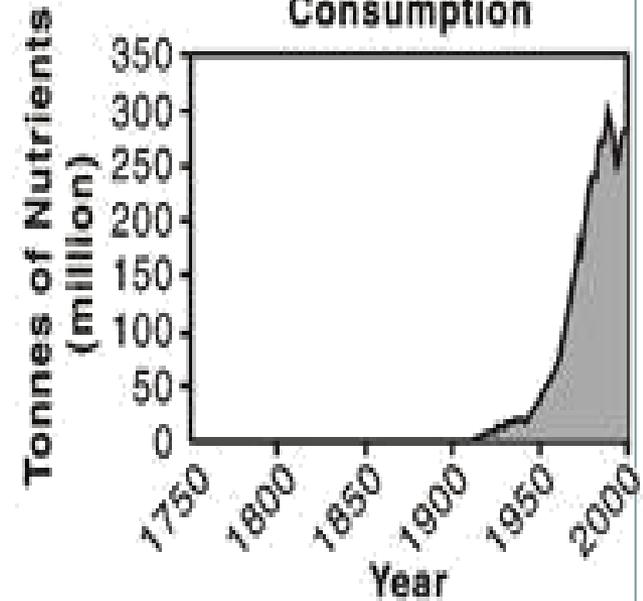
Damming of Rivers



Water Use

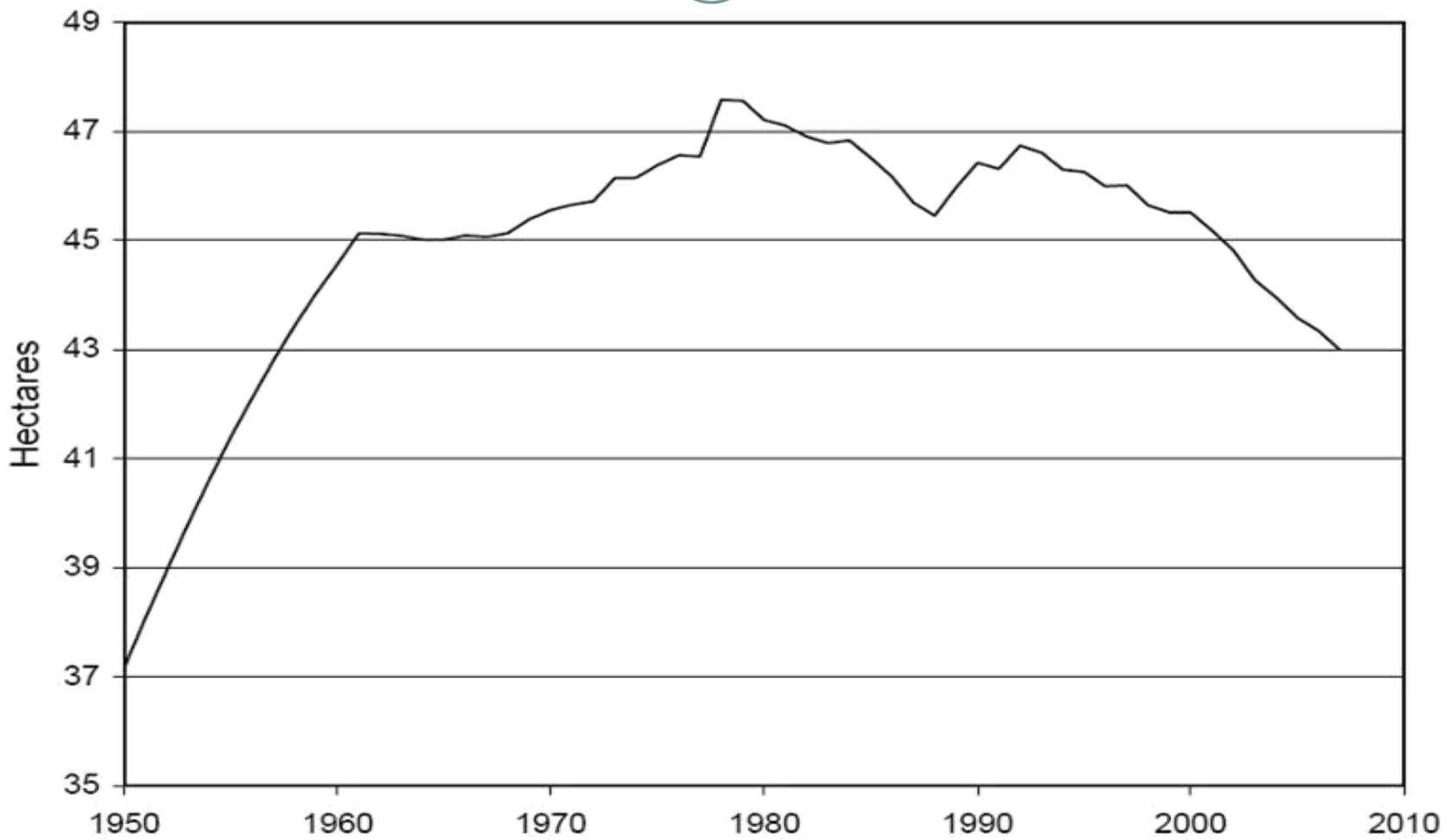


Fertiliser Consumption





World Irrigation Per Thousand People



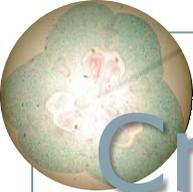
Source: Worldwatch, FAO, UNPop



Technical and Resource Limitation Problems



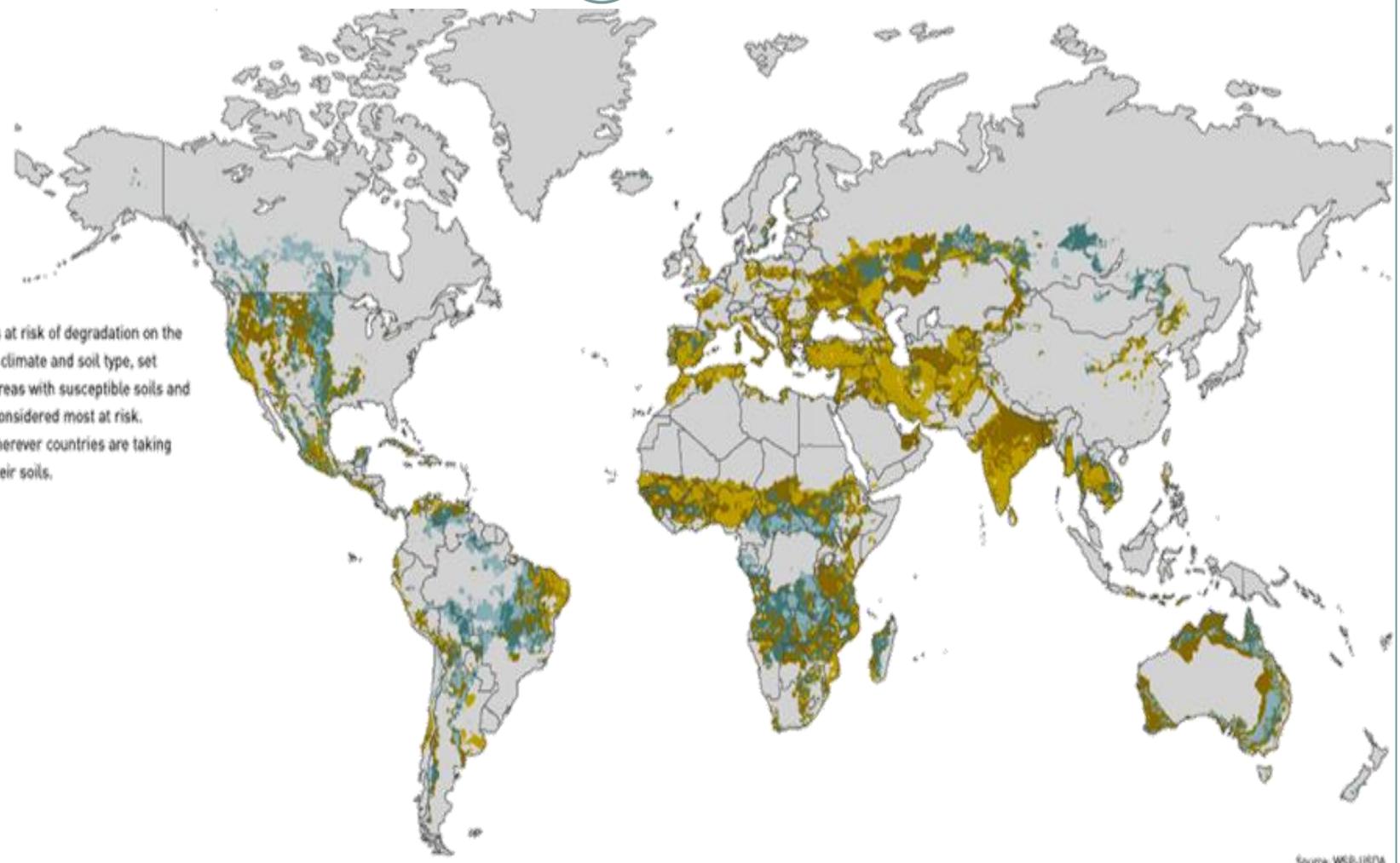
- heavy use of **fresh water**
- high dependence on **technology and machinery** provided/sold by core states
- heavy use of **pesticides and fertilizer**
- reduced genetic diversity resulting in increased **blight vulnerability**
- questionable overall **sustainability**



Croplands at Risk of Degradation



- Very high risk
- High risk
- Moderate risk
- Low risk



The map shows cropland areas at risk of degradation on the basis of susceptibility owing to climate and soil type, set against population densities. Areas with susceptible soils and high population densities are considered most at risk. However the risk is reduced wherever countries are taking active measures to preserve their soils.



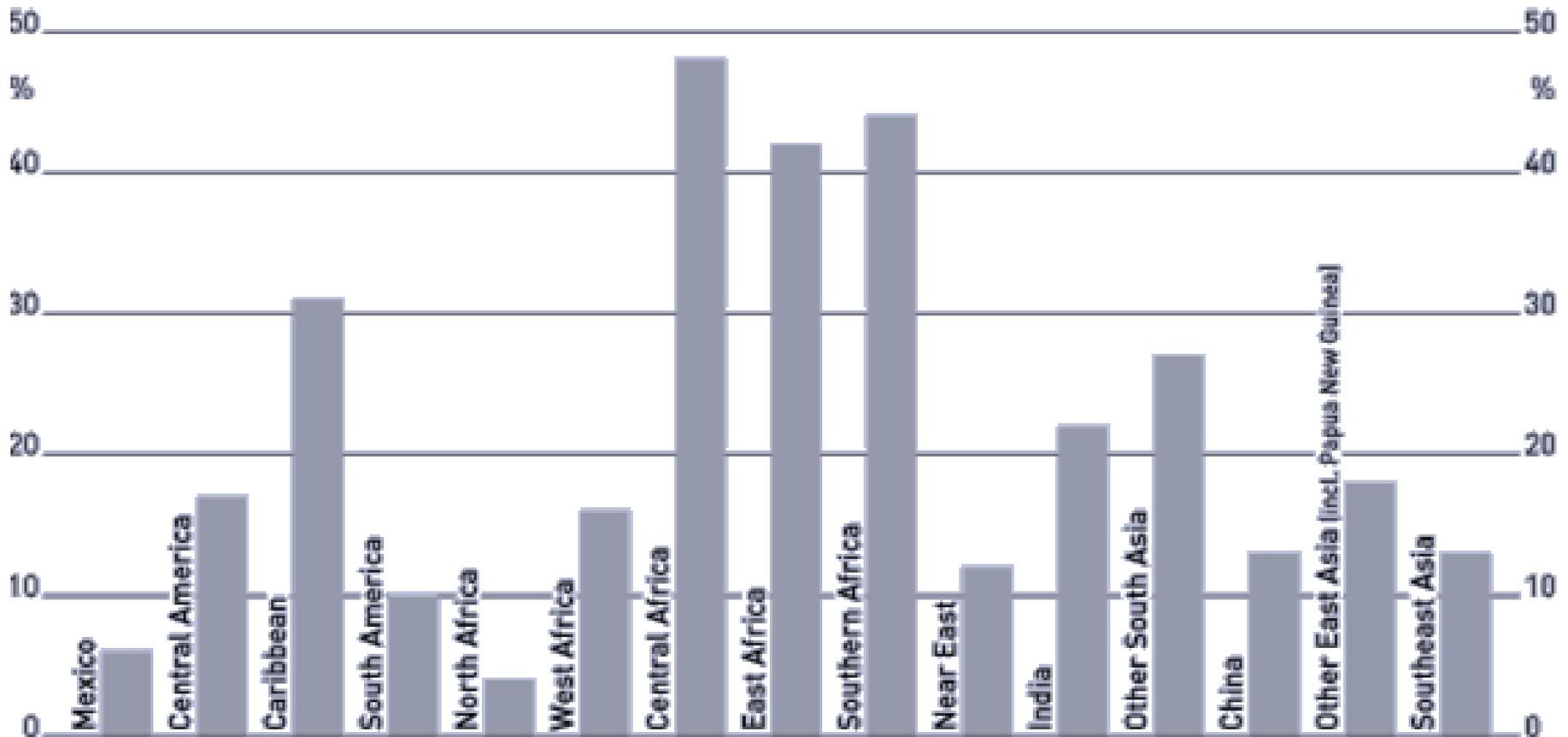
Ethical Issues



- Starvation of many prevented but extra food could lead to **higher birth rates**.
- **Life expectancy** in less developed states increased by 10 years in less than two decades (43 in 1950s to 53 in 1970s).
- **Dependency on core states** and **rich-poor gap** increased.
- **Wealthy farmers and multinational companies** do well; small farmers become wage laborers or unemployed, dependent.
- More at risk? More people **malnourished/starving** today than in 1950 (but lower as a percentage).
- US spends \$10,000,000,000 / year on **farm subsidies**, damaging farmers and markets in LDCs.



Undernourishment in the Developing World



Note: Undernourishment in the industrialized world averages less than 2.5%, with most of this in the countries in transition of Eastern Europe and the former USSR.

Source: FAO.



Agricultural Success?



“Our incredible successes as a species are largely derived from this choice, but the biggest threats to our existence stem from the same decision.”

-Jared Diamond, 1999

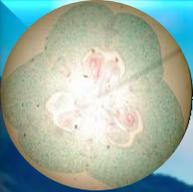




Agricultural Success?



- emergence of **new human diseases** from animal diseases (smallpox, measles)
 - **Dense urban populations** allow spread/persistence of disease.
- **lower standard of living** for many people
 - archaeological evidence of serious **malnourishment** among early farmers
- many modern **impoverished** and malnourished farmers
 - famine virtually nonexistent in hunter-gatherer societies
- increased **susceptibility to plant blights** and increased **dependence on complex economic systems**
- **environmental degradation**
 - topsoil loss (75% in US), desertification, eutrophication, PCBs in fish, problems with DDT and other pesticides



The End

