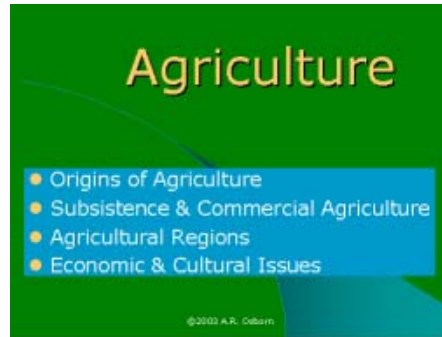


Agriculture



Agriculture: Terms

- ❖ “Agriculture is the deliberate modification of the Earth’s surface through cultivation of plants and rearing of animals to obtain sustenance or economic gain.”
- ❖ “Cultivate” means “to care for.”
- ❖ Any cultivated plant is called a crop.

The Pre-Agricultural World

- ❖ Human beings – or something very like human beings – have been around for several million years.
- ❖ But we’ve only been practicing agriculture for something like 10,000-20,000 years.
- ❖ Before agriculture there was what we call “hunting and gathering.”

Hunters & Gatherers

- ❖ About 0.005% of humanity today (maybe 250,000 people) live an exclusively hunter-gatherer lifestyle (lots of other people hunt or gather occasionally, but it’s not their main way of life).
- ❖ Based on what we know about them, and on archaeological evidence, we can make some statements about what most people did before agriculture:
 - Mostly small groups (less than 50 people); low population density.
 - Gathering is usually much more important than hunting (usually 60% to 80% of the food).
 - In most (not all) societies men hunt and fish, and women gather.
 - Acquiring food usually takes no more than 10% of people’s time.
 - Politics are informal, consensus based; little social stratification; beliefs are animistic.
 - Limited material culture; no permanent settlements.
 - Strong ties to land, but nomadic and mobile.

Origins of Agriculture

- ❖ We can never know where agriculture began – it began in prehistory, and it probably began in more than one place.
- ❖ However, historians, archaeologists, agronomists, geographers and other scholars have worked for over a century trying to determine just where the processes that lead to agriculture – and to civilization – began.

What is “domestication?”

- ❖ Some of the changes that take place when plants are domesticated:
- ❖ Gigantism (bigger seeds or fruits)
- ❖ Loss of seed dispersal mechanisms
- ❖ Loss of bitter or toxic substances
- ❖ Changes in floral structures or pollination schemes
- ❖ Changes in flowering cycle
- ❖ Diversity of form
- ❖ Loss of mechanisms to protect against predators

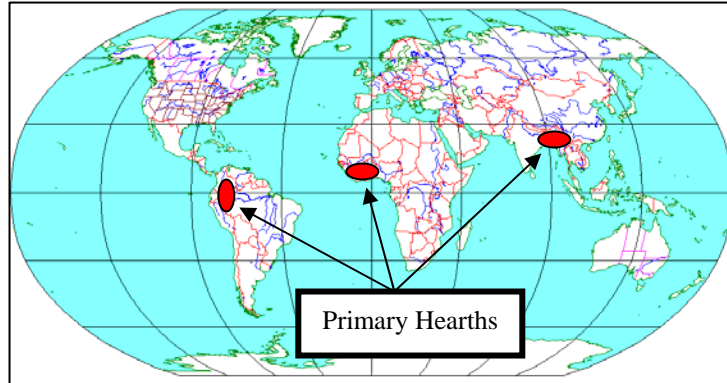
For more information on domestication see: <http://hcs.osu.edu/hcs200/Notes1.htm>

Origins of Agriculture

- ❖ Carl Sauer's theory:
 - Not in response to hunger.
 - Not among nomads.
 - Not in grasslands or river valleys.
 - In places of high environmental diversity.
 - In places of high plant diversity.
 - Beginning with vegetative reproduction (root crops), not grains.
 - Sauer's conclusion: Southeast Asia 14,000-35,000 years ago
- ❖ More conventional theory:
 - As a consequence of gathering seeds, gatherers noted which plants produced best, and began (perhaps accidentally) to care for them.
 - Agriculture began with crops like grains, lentils and possibly dates.
 - Agriculture began in the river valleys – the Tigris & Euphrates, the Nile, the Indus, the Huang He, and the high valleys of Mexico & Peru.
 - More conventional conclusion: Near East 10,000-20,000 years ago

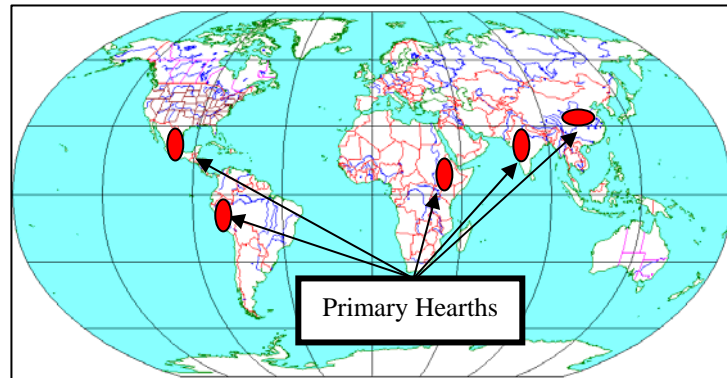
First Vegetative Planting

- ❖ According to Sauer, the earliest vegetative agriculture appeared in Southeast Asia, and probably involved root vegetables like taro and yams, and perhaps tree crops like bananas.
- ❖ Vegetative agriculture then diffused throughout Asia and eventually to the Near East and Europe.
- ❖ Other, perhaps independent inventions took place in Africa (oil palm, yam) and South America (manioc, arrowroot).



First Seed-Based Agriculture

- ❖ Seed-based agriculture began in at least three places according to Sauer:
 - Western India
 - Northern China
 - Ethiopia
- ❖ It diffused quickly from India to the Near East, then to Europe.
- ❖ Seed-based agriculture also developed independently in Mexico and Northern Peru.



Contrasting Theories

- ❖ Your book doesn't mention them, but at least two other people should be included here:
 - Nikolai I. Vavilov (1887-1943)
 - Looked for “centers of diversity,” which he believed were also “centers of domestication.”
 - Collected more than 250,000 seed samples; identified eight agricultural hearths: Southeast Asia; China; India; Turkey-Iran; Mediterranean; Ethiopia; Mexico/Central America; Andes/Brazil/Paraguay.

- Jack R. Harlan (1917-1998)
 - Agronomist and geneticist; actually met Vavilov at a meeting in Washington in 1932.
 - Defined
 - Three “centers”: the Near East, Northern China, and Meso America.
 - Three “non-centers”: S.E. Asia, S. America, and Africa

Subsistence vs. Commercial Agriculture

- ❖ Subsistence and commercial agriculture differ in five ways:
 - PURPOSE (consumption vs. off-farm sales).
 - PERCENTAGE OF FARMERS (majority vs. minority of population).
 - MACHINERY (mostly hand vs. mostly mechanized).
 - FARM SIZE (small vs. large).
 - FARMS AND OTHER INDUSTRIES (mostly isolated vs. highly integrated into regional or global economies).

Subsistence Agriculture: Shifting Cultivation

- ❖ Also known as “slash and burn.”
- ❖ Most common today in tropical areas (**adaptation to poor soils**).
- ❖ Small-scale, no machines.
- ❖ Temporary – short occupation, long fallow period.
- ❖ Crops vary from region to region.
- ❖ Only 5% of the world’s population practice shifting cultivation.
- ❖ Farmers clear land and burn the debris.
- ❖ Poor soils can only support crops for two-three years.



Image source: http://science.nasa.gov/headlines/y2003/16may_biocorridors.htm

Subsistence Agriculture: Pastoral Nomadism

- ❖ Based on herding domesticated animals.
- ❖ **Adapted to dry climates** where other types of agriculture are basically impossible.
- ❖ Mostly in North Africa, Near East and Central Asia.



Image source: <http://www.loc.gov/exhibits/empire/ethnic.html>

- ❖ Choice of animals varies – dromedary camels, sheep and goats in North Africa and Arabia, bactrian camels and horses in Central Asia, etc.
- ❖ Nomads do not just wander around – they usually have precise migration patterns, and a strong sense of territory.
- ❖ Some nomads practice **transhumance**: seasonal migration up and down mountains.

Subsistence Agriculture: Intensive, Wet Rice Dominant

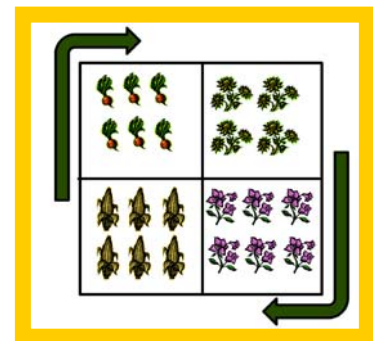
- ❖ Practiced in areas of high population density – East, South and Southeast Asia.
- ❖ Extremely small farms, worked by hand (few or no machines), strongly focused on rice.
- ❖ Rice is unique: it can grow in water (well, in flooded fields), unlike other grains.
- ❖ Where climates are favorable, farmers can double crop – raise more than one crop per field per year.
- ❖ Wet rice (“paddy” or “sawah” grown) cultivation is complex:
 - Rice seed is planted in a nursery, and raised until ready to be transplanted.
 - Fields are prepared and plowed.
 - Fields are flooded.
 - Individual seedlings are planted, individually, in the flooded field.
 - Each plant is cared for individually until harvest, by hand, with special knives.



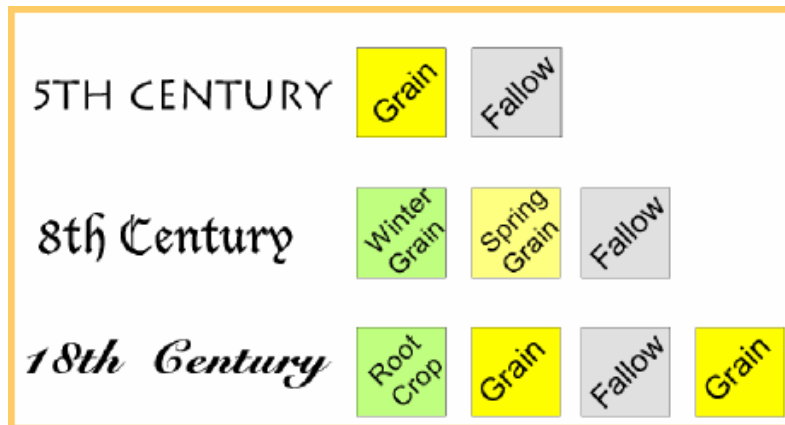
Image source: <http://pubs.usgs.gov/publications/text/tectonics.html>

Subsistence Agriculture: Intensive, Wet Rice Not Dominant

- ❖ This is a very ancient form of agriculture – think of places like Medieval Europe, or rural Latin America, as well as more arid parts of South and East Asia.
- ❖ Widely practiced in areas where climate doesn’t support wet rice.
- ❖ Similar in many ways to areas where wet rice dominates, but emphasizes different crops (wheat, barley, corn, etc.).
- ❖ In these areas farmers practice crop rotation to increase yields.



European Crop Rotation



Commercial Agriculture: Mixed Crop & Livestock Farming

- ❖ Integration of livestock (sheep, cattle, goats, chickens etc.) and crop farming.
- ❖ Most crops raised are fed to animals.
- ❖ Most land is devoted to crops.
- ❖ Most money is generated from animals and animal products.
- ❖ Crop rotation is common.
- ❖ Advantages:
 - Livestock supply manure to fertilize the crops.
 - Workload can be more evenly distributed throughout the year.
 - Less seasonal variation in income.



Image source: http://www.epa.gov/esd/land-sci/trends/eco64/eco64_samp57.htm

Commercial Agriculture: Dairy Farming

- ❖ Dairy products (butter, cheese, etc.) are extremely valuable.
- ❖ Mostly produced in Western Europe, North America, Russia, Australia and New Zealand.
- ❖ Because milk is extremely perishable, dairy operations traditionally located near markets – in the **milkshed**.
- ❖ Today, transportation makes it possible for milk producers to locate hundreds of miles from markets.
- ❖ However, the further from markets, the less likely dairy operations are to produce fluid milk.



Source: http://clinton.senate.gov/issues_agriculture.html

Grain Farming

- ❖ Grains are grasses – wheat, corn, oats, barley, rice, etc.
- ❖ Globally, the most important crop grown is **wheat** – more wheat is exchanged in international commerce than any other grain (much of the world's rice doesn't enter the international marketplace – it's consumed within the producing countries).
- ❖ Wheat is usually produced in areas where it is too dry for mixed farming.
- ❖ The US is the largest grain producing region on earth.
 - Winter wheat region (wheat planted in fall, dormant through winter, grows and is harvested in late spring or summer).
 - Spring wheat region (wheat planted in spring, harvested in late summer).
 - Other wheat regions (Eastern Washington).
- ❖ Other major producers include Canada, Argentina, Australia, France and the UK.
- ❖ Large scale production only became possible in the 19th century, with the development of mechanized agriculture.



Source: <http://water.usgs.gov/pubs/circ/circ1225/html/cover.html>

Livestock Ranching

- ❖ Ranching is, in some ways, the commercial version of pastoral nomadism.
- ❖ Ranching is a type of commercial agriculture adapted to areas which are too dry for other forms of agriculture.
- ❖ Ranching is not as profitable per acre as farming – if irrigation makes farming possible, ranching usually ends.
- ❖ Cattle ranching in the US:
 - Begins with Columbus's second voyage.
 - Cattle ranching small scale on the East Coast in the 16th, 17th, and 18th centuries.
 - In the 19th century, rapidly expanding cities became a major market for beef.
 - In the Western US, arid areas that couldn't be used for anything else could be used to produce beef cattle – the problem was getting the beef to market.



- The solution – long-distance cattle drives, from rural areas to the nearest railroad.
- By the end of the 19th century, cattle drives were basically over.
 - End of open range.
 - Expansion of railroads.
 - Changes in cattle breeding.
- Cattle ranching changed to mostly fixed location ranching.
- ❖ Some cattle are still raised on ranches, but most on shifting pastures.
- ❖ Many cattle now shipped to **feed lots** for **fattening** near their market.
- ❖ Ranching is also practiced in other developed countries:
 - Spain and Portugal.
 - Argentina, Brazil, Uruguay.
 - Australia.

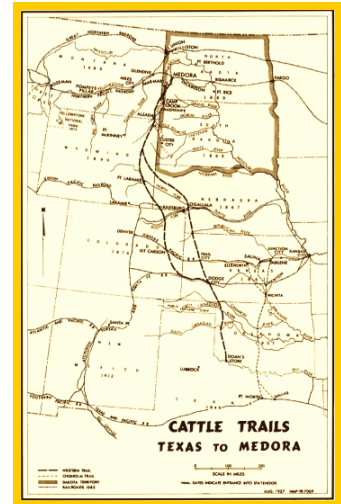


Image sources: <http://www.photolib.noaa.gov/coastline/line0419.htm> ;
<http://sofia.usgs.gov/sfrsf/rooms/nutrients/controls/bmp/>
http://www.cr.nps.gov/history/online_books/hh/thro/throb.htm

Mediterranean Agriculture

- ❖ Adapted to the Mediterranean climate region – places with warm dry summers, and mild wet winters (this is a very odd pattern – most places get plenty of precipitation in summer).
- ❖ Most crops are grown for human consumption – not animal feed.
- ❖ Primary source of the world's olives, grapes, etc.
- ❖ Wheat and other grains also grown in traditional Mediterranean areas (but mostly for local consumption).
- ❖ Animals and animal products of less importance traditionally.



Image source: <http://www.usaid.gov/wbg/asalah.htm>

Truck Farming

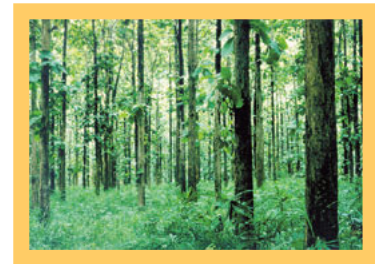
- ❖ Truck farming has nothing to do with trucks or trucking! The word “truck” comes from an old English word meaning “to carry” or “to exchange.”
- ❖ Specialty fruit and vegetable farming – very similar to “market gardening.”
- ❖ Fresh fruits and vegetables – perishable produce.
- ❖ Farmers tend to specialize in a few profitable crops.
- ❖ Traditionally grown near markets.
- ❖ With modern transportation – areas like California's Central and Imperial Valleys, Arizona's Gila River Valley, parts of Texas, Florida, Georgia, etc. have become truck farming areas for the whole country.



Image source: <http://www.montgomerycountymd.gov/content/ded/AgServices/tour2.html>

Plantation Agriculture

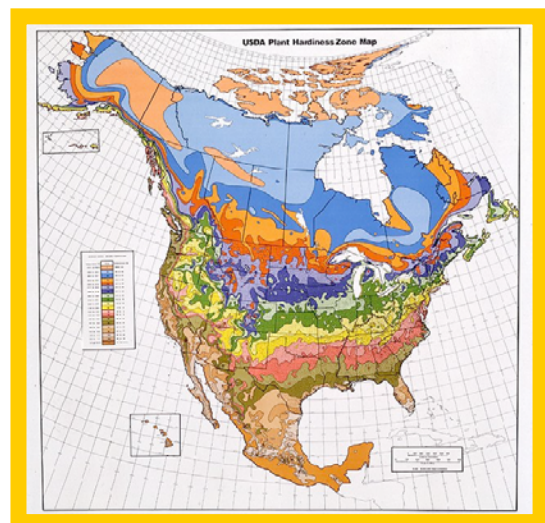
- ❖ Plantations today are almost always in the tropics, less developed countries.
- ❖ Outside, often absentee owners.
- ❖ Local labor may be imported to an otherwise uninhabited area.
- ❖ Crops grown almost exclusively for sale in distant markets – mostly in developed countries.
- ❖ Specialization in one or two crops (for example, bananas, tea, coffee, oil palm, teak, sugar, rubber, tobacco, etc.).



Sources: <http://edcdaac.usgs.gov/glcc/fao/> ; <http://www.photolib.noaa.gov/coastline/line0419.htm>

Agriculture and the Environment

- ❖ Agriculture is severely constrained by
 - Climate
 - Terrain
 - Soil
- ❖ Yes, it's possible to grow tomatoes in Iceland – but it's expensive, and takes sophisticated technology.
- ❖ Agriculture can have a strong – even devastating – impact on the natural environment:



- Slash-and-burn agriculture (if poorly done, can ruin forest lands for years)
- Overgrazing (can cause soil loss, erosion)
- Desertification (agriculture practiced on marginal lands can degrade land, expanding arid areas)
- Irrigation
 - Salinization
 - Waterlogging



Salinization, San Joaquin Valley

Map source: <http://www.usna.usda.gov/Hardzone/index.html>

Salinization image source: <http://www.ars.usda.gov/is/pr/2004/040902.htm?pf=1S>

Agriculture and Economics: Subsistence Agriculture

- ❖ Population growth:
 - A rising population means that subsistence farmers must produce more food.
 - According to Esther Boserup (as discussed in your book), this means that they will use newer, more intensive forms of agriculture to increase yield.
 - Great idea – except that it's not possible in all areas, due to environmental factors.
- ❖ International trade:
 - The idea of talking about “subsistence” and “trade” seems contradictory – but many subsistence farmers do produce cash crops.
 - The most popular (and most profitable): **drugs**.

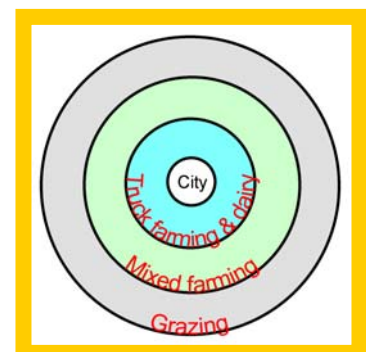


Coca cultivation, Peru

Map source: <http://www.usdoj.gov/dea/pubs/intel/01012/01012.html>

Agriculture and Economics: Commercial Agriculture

- ❖ Market Orientation: The Von Thünen Model
 - In 1826 Johann Heinrich von Thünen noticed something – identical physical characteristics (climate, soil) didn't necessarily mean identical crops.
 - The crops farmers chose to plant were determined by
 - Crop value
 - Cost of transportation



- Von Thünen's model did not take into account any actual site factors – rivers, roads, etc. – but the model can be modified to deal with them.
- The model is still useful – it helps explain why farmers choose the crops they do, where it makes sense to produce low-value bulky commodities, and where it doesn't, etc.
- ❖ Overproduction
 - Commercial farmers suffer from low incomes because they produce too much.
 - In developed countries, modern crop varieties, machines, chemicals, etc. have increased yields enormously – and the greater the supply, the lower the price.
 - Most governments in the developed world have instituted farm policies to either protect domestic producers or limit production.
- ❖ Off-farm migration
 - In many areas of the developed world, it has become difficult to get people to stay in farming regions.
 - This leads to greater dependence on migratory labor, absentee ownership, and consolidation of farms and farming.
- ❖ Loss of crop diversity
 - Replacement of genetically diverse local varieties with hybrid (commercially produced) seed.
 - Loss of unique disease, climate and pest resistance.
 - Loss of genetic resources.



Image Sources: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=545571> (selected maize varieties from Chiapas); http://www.nsf.gov/bio/budget/bio_bdg04/bionarr04.htm (potatoes); <http://www.ars.usda.gov/is/AR/archive/sep98/cons0998.htm> (apples).