

## The origins of agriculture: Theories and why it matters

© Copyright Bruce Owen 2006

- Archaeologists think agriculture is a big deal. Why?
  - It is a recent change in the way humans have lived for most of their existence
    - As we saw before, even if you include only anatomically modern *Homo sapiens*, 98% of our duration as a species has been as foragers.
  - so: farming and civilization are both very recent aberrations for the human race.
  - This recent shift to agriculture is interesting not only for its own sake, but also because it seems to be connected to the development of civilization
    - Since both farming and civilization came about very recently, it seems unlikely that this timing would just be coincidental
    - Civilization never appeared in that immensely long span of time *before* people started practicing agriculture
      - so it looks like agriculture was a necessary condition for civilization
  - All the “pristine civilizations” we know of got their subsistence at least in part through agriculture
    - “**pristine** civilization” means one that arose all by itself, without the influence of some other existing civilization
      - as opposed to “**secondary** civilization” or “secondary state”, which is one that arose in a world that was already altered by the presence of a civilization or state
      - in this class, we will focus on what should be the simplest, clearest cases: “pristine” civilizations
    - Some states and near-states have been based on pastoralism
      - but this seems to happen only in situations in which there are already agricultural states in neighboring areas
      - pastoral “civilizations” don’t seem to arise on their own
- **Agriculture** = Activities to artificially increase plant food yields (sowing seeds, clearing forest, weeding, diverting water, fertilizing, etc.)
  - Agriculture provides more food per unit area of land than does foraging
  - That is, you get more food per acre by farming it than by collecting the wild foods on it
    - This allows more people to live in a given area
    - That is, it allows a higher density of people
  - Of course, it takes more labor to farm an acre of land than to collect the wild foods that are naturally there
  - This process of putting more labor per acre *in* to get more product per acre *out* is called **intensification**
    - agriculture is more “intensive” than foraging
      - in that it produces food more per acre, but requires more labor per acre to do so
    - agricultural practices themselves can be more or less “intensive”
      - a “low intensity” form of agriculture might involve just scattering seeds or diverting floodwaters to wet some land
      - fertilizing, irrigating with canals, etc. are “more intensive” forms of agriculture

- because they get more crops per acre
- at the cost of collecting, hauling, and applying the fertilizer, building and cleaning the canals, etc.
- Is farming a good deal, compared to foraging?
  - that is, if you double the labor input, do you at least double the food output?
  - the surprising, empirical answer is, in most cases: no!
  - In fact, agriculture usually requires more labor per unit of food produced than does foraging
    - That is, a farming family has to work more hours per year to provide its own food than a foraging family does
  - The !Kung recognize this as a matter of common sense
    - That is why when Lee (author of the reading on the !Kung) asked the !Kung why they don't farm, one famous reply was "Why should we farm when there are so many mongongo nuts?"
    - They know that they can get the food they need with less work by foraging
- The tradeoff of agriculture is clear if we consider the difference between the yield of food *per acre* and the yield of food *per hour worked*
  - agriculture produces more food per acre
  - but agriculture produces less food per hour worked
  - In a given area, agriculture can produce more food than foraging can, so agriculture can feed more people
    - But each one has to work harder than before to survive
- Foraging is a good deal if there is a lot of land per person, that is, a very low density of people
  - But if there are too many people for the available land, foraging just can't provide enough food
  - so if population gets too high, farming or herding become the only alternatives to hunger
- You often hear the idea that when people switched from foraging to farming, they escaped the pressures of a precarious existence and suddenly had the time to develop "civilized" practices like art, literature, science, and technology
  - but in fact it was the reverse
  - farmers have *less* free time than foragers
  - so we need some more sophisticated explanation for the development of civilization
  - instead of looking at the total or average amount of "free time", maybe we should think about how the free time is distributed in the society
    - *who* has less free time free from subsistence tasks
    - and who has more
- **Sedentism** = living more or less permanently in one place
  - in some particularly good environments, foragers can settle in one place (become sedentary)
  - or have just a few semi-permanent settlements (be semi-sedentary)
    - sometimes seasonal settlements
  - this requires either enough wild food available year-round, or some kind of food that can be collected in great quantities and stored for the off-season

- sedentary foragers are usually highly specialized on one or a few very productive wild resources in specially favored places
- like acorns in some parts of California
- salmon on the Pacific northwest coast
- in less-ideal environments, agriculture allows people to become sedentary, and creates reasons for them to do so
  - farmers *can* settle because
    - agriculture can provide enough food in a limited area that the food is not exhausted before the next season replenishes it
      - so people don't have to move in order to get food
  - farmers are *encouraged* to settle because
    - fields must be tilled, weeded, irrigated, harvested, etc., which requires people to be there at many different times during the year
    - harvests produce a lot of food at once, which has to be stored for eating later
      - staying near the stored food is easier than carrying it around
    - stored food, fields, canals, etc. may need to be defended
- Effects of agriculture and sedentism
  - Agriculture and sedentism tend to lead to population growth
  - Both tend to increase fertility for biological reasons
    - Increased carbohydrate consumption from agricultural crops may keep women's body fat levels high enough year-round that they do not go through periods of infertility
      - foragers often get very lean during the season of scarcity (it varies in different regions), which reduces female fertility
      - this is an effect familiar to female runners and dancers
    - Less mobile mothers may have fewer spontaneous abortions
    - Less mobile mothers don't have to carry their small children constantly, encouraging them to stop breast feeding sooner
      - Fertility is reduced while nursing
      - So shortening the period of breast feeding shortens the period of reduced fertility
      - Making the mother more likely to get pregnant again sooner and have more children over the course of her lifetime
    - Since the mother does not have to carry her infant around while foraging, farming makes it practical for a woman to have more than one infant at a time, allowing larger families
      - mothers are not forced to take measures to prevent having another infant while a previous one is still small
      - such as abstinence rules, contraceptive measures, induced abortions, or infanticide, all of which were practiced by at least some foragers
  - Agriculture also provides economic incentives to want more children
    - Farming creates a greater demand for labor, that is, kids to help with the work
    - So farmers generally want to have large families, and the population tends to grow
- This population growth may push people further into agriculture

- if they are intensive foragers, the population may outgrow what the wild resources can support
  - in order to avoid shortages, they may start encouraging the wild plants they specialize in to grow, through burning, planting, diverting water, weeding, etc.
- if they are farmers, population growth may push them into more intensive farming
  - in order to produce enough for the rising population, they focus more and more on farming, less and less on foraging
- Eventually they are locked in
  - population rises above what wild resources can support
  - people can't give up farming without causing hardship
  - So the shift to farming may become a one-way change
  - there is no going back without unacceptable disaster
- Agriculture and sedentism have surprising effects on nutrition and health
  - early agriculture often focuses on one or a few of the most productive crops
    - so most early farmers had less varied diets than foragers
    - and often poorer nutrition overall
  - more carbohydrates lead to more dental caries (cavities), abscesses, etc. - serious matters before modern dentistry
  - more labor leads to more arthritis, back and knee problems, etc.
  - living in permanent villages creates new problems of sanitation (waste disposal, insect infestation, etc.) that encourage disease
  - living in larger, denser groups aids the spread of epidemic diseases
  - overall, settled agricultural lifestyles typically increased biological stress on people
    - and often decreased lifespan
    - more children were produced, but they had more ailments and tended to die younger
    - in theory, these two trends could cancel each other out
      - but the observed pattern is that in most cases, the increased birth rate outweighed the reduced survivorship, and the net effect was a population increase
- Agriculture and sedentism have cultural effects, too:
  - Sedentism allows accumulation of material goods: storage of goods and food
    - thus the origins of rich and poor people and classes
    - so sedentism makes economic stratification possible
    - accumulation is not limited to a single generation, either; land and goods can be inherited
      - mobile foragers also inherit, but the goods involved are minimal and mobility limits accumulation
      - more fortunate families may accumulate wealth over generations
        - allowing greater economic stratification
        - and the formation of economic classes and aristocratic families
- Agriculture and sedentism allow the production and storage of **surplus**: food or other goods beyond the needs of the producer
  - surplus production is possible for at least some foragers, but since mobile foragers generally cannot store or transport much surplus, they don't generally produce it

- surplus production makes it possible to support craftspeople and other specialists who do not produce all (or any) of their own food
  - Harvey Weiss called this "the beginning of the big rip-off"
- the existence of surplus and people who don't produce all their own food creates a whole new arena for social arrangements that may become very complex. Consider:
  - Successful farmers might use their surplus to support servants
  - Farming families might want to pool some of their surplus as insurance for bad times or to support work on community projects, defense, etc.
    - There will have to be ways to keep track, distribute, decide who gets what, etc.
  - If some people trade surplus for goods or services, how will the inevitable disagreements, debts, etc. be handled?
  - Some people might try to encourage or coerce others to produce surplus to support them, like chiefs, priests, warriors...
- Agriculture allows larger groups to live together
  - because farming produces more food in a given area, more people can live there permanently
  - people have to interact with a larger number of others
  - the kinship system becomes inadequate to structure interactions
    - since you can't keep track of so many relationships
  - so people start using other criteria to determine how to interact with people they encounter
    - such as social status, class, rank
    - this is the beginning of more complex social organization
  - greater likelihood of conflicts
    - because more people are interacting with each other
    - and because people can't defuse problems by simply moving away
    - encourages the development of institutions for conflict resolution (chiefs, religious authorities, courts, etc.)
- Settled people with goods are easier to raid, threaten, conquer, control, tax
  - unlike mobile foragers, settled people have goods that people may want to take by force
    - especially settled agriculturalists, who have improved fields, stored crops, etc.
    - so raids or warfare become possible
    - so sedentary people may need to defend themselves
  - settled farmers are easier to coerce and extract production from, because they are stuck in one place and have goods that can be taken from them
  - stored (usually agricultural) surplus makes it possible to support some people to carry out such coercion (a chief's thugs, armies, the IRS, etc.)
    - and also to defend against it
  - this vulnerability, surplus, and accumulation of wealth help make power hierarchies possible
- Agriculture and sedentism made these changes, many of which are steps towards "civilization", possible.
  - But they did not necessarily *cause* civilization to arise
    - they just made civilization possible, while among mobile foragers it was not.

- Some foragers specializing in unusually rich resources (like salmon on the northwest coast of the US, or acorns in California) were sedentary and lived in relatively large villages, even without agriculture
  - Yet none of these developed states or “civilizations”
- settled farmers were around for thousands of years before “civilizations” emerged
- So sedentism, and even agriculture, are apparently necessary steps, but not sufficient ones, for the appearance of civilization
- Something else must be needed, too
- What we want to know about the origins of agriculture
  - Basic facts
    - Where and when agriculture began
    - With what crops
  - Explanation: How and why did people start farming?
    - Why did agriculture seem like a good deal at the time?
    - That is, what processes, pressures, etc. led people to start farming and eventually to depend on it in any given case?
- This means we will be looking at the beginning and spread of the **Neolithic**
  - **Neolithic**: two meanings
    - 1. A stone tool technology that emphasizes grinding, rather than flaking
      - This results in a more durable cutting edge (although not as sharp)
      - good for axes needed to cut trees to clear farmland in forested places like Europe
    - 2. More importantly for us, the period in which agriculture came into use and was the main source of food
      - so called because in many places, ground-stone tools came into use at about the same time as agriculture became important
      - so they serve as a convenient marker and term for early agricultural periods
- There are several ways we can recognize the advent of agriculture in the archaeological record
  - **Domestication** = genetic modification of a wild plant or animal due to human involvement with its reproduction
    - Not necessarily intentional - but a plant or animal is not domesticated unless it has evolved under human influence
    - If we can identify remains of domesticated plants or animals (ones that differ from wild forms), we have direct evidence of agriculture or pastoralism
  - Fields (indicated by furrows, ditches, regularly placed small mounds, etc)
    - Rarely preserved, but occasionally we get lucky
  - Lots of tools used for agricultural tasks (smaller quantities might just have been used for specialized foraging)
    - Hoes or digging tools (identifiable by form and rounded wear)
    - Sickles used for harvesting grain (identifiable by sickle gloss)
    - Grinding stones used for grinding grain
  - Large, permanent settlements are a strong hint that people were supported by agriculture, but not proof in themselves

- Storage structures for crops
  - again, specialized foragers might have these to a lesser extent
- Canals (usually only once agriculture is well established and intensified)
- How could domestication happen?
  - Example: a possible process of domestication of wheat (other grains may have been similar)
    - wild wheat
      - seeds have brittle rachis [RAY-kis] (attachment to the stem), so they fall off easily
      - seeds are narrow and have a rounded point that lets them penetrate cracks in the ground
    - people start collecting wild wheat, probably by pushing a basket up to the heads of wheat and giving them a tap to make the ripe seeds fall into the basket
      - those seeds that happen to have a more brittle rachis fall off the stems more easily.
      - Plants that happen to have a slightly tougher rachis lose fewer seeds to the harvesters.
      - These seeds that are NOT harvested are the ones that remain to naturally sow the next generation of plants
    - this process selects for plants with a tough rachis, gradually producing a kind of wheat more like the domesticated form, in which the seeds stay on the head and have to be removed by threshing
      - this evolution of the plants is caused unintentionally by people
    - an increasing fraction of the seeds do not fall off easily when ripe, and are less successful at working their way into the soil because they were less pointed
      - so the wheat becomes less effective at sowing itself naturally
    - as the seeds stick more tightly to the head, people shift their harvesting method
      - they used sickles to cut off and collect the whole head, and then later thresh (beat) the heads to knock the seeds off
      - this allows more effective harvesting of most of the wheat
    - between the reduced effectiveness of the wheat at sowing itself, and the efficient harvesting of most of the seeds, the wild stands do not replenish themselves well
      - so people start “helping” the wheat by sowing part of the harvest
        - the seeds are those that stayed on the heads long enough to be collected by threshing
        - so the wheat is still growing from seeds with a tough rachis
    - eventually people start intentionally selecting seeds to sow that have the desired qualities: fat, large grains
      - now the evolution of the plants is intentionally guided by people
      - the result is domesticated wheat, with large grains that tend to stay on the head
  - the details are still being evaluated, but something like this is probably right
  - similar processes of unintentional selection followed by intentional breeding are thought to have happened with other domesticates, both plants and animals