same crop or domestic animal in different areas. For instance, India's zebu—breeds of domestic cattle—possess humps lacking in western Eurasian cattle breeds, and genetic analyses show that the ancestors of modern Indian and western Eurasian cattle breeds diverged from each other hundreds of thousands of years ago, long before any animals were domesticated anywhere.

That is, cattle were domesticated independently in India and western Eurasia, within the last 10,000 years, starting with wild Indian and western Eurasian cattle subspecies that had diverged hundreds of thousands of years earlier.

LET'S NOW RETURN to our earlier questions about the rise of food production. Where, when, and how did food production develop in different parts of the globe?

At one extreme are areas in which food production arose altogether independently, with the domestication of many indigenous crops (and, in some cases, animals) before the arrival of any crops or animals from other areas. There are only five such areas for which the evidence is at present detailed and compelling: Southwest Asia, also known as the Near East or Fertile Crescent; China; Mesoamerica (the term applied to central and southern Mexico and adjacent areas of Central America); the Andes of South America, and possibly the adjacent Amazon Basin as well; and the eastern United States (Figure 5.1). Some or all of these centers may actually comprise several nearby centers where food production arose more or less independently, such as North China's Yellow River valley and South China's Yangtze River valley.

In addition to these five areas where food production definitely arose de novo, four others–Africa's Sahel zone, tropical West Africa, Ethiopia, and New Guinea–are candidates for that distinction. However, there is some



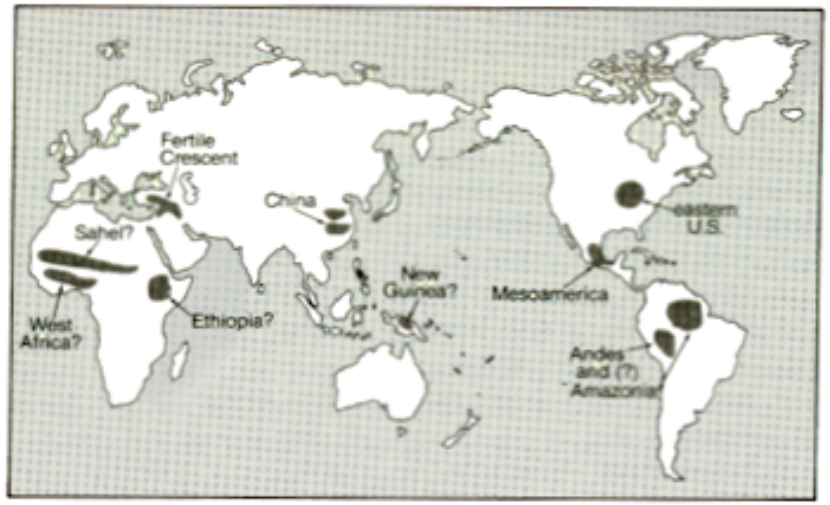


*Figure 5.1. Centers of origin of food production. A question mark indicates some uncertainty whether the rise of food production at that center was really uninfluenced by the spread of food production from other centers, or (in the case of New Guinea) what the earliest crops were.*

uncertainty in each case. Although indigenous wild plants were undoubtedly domesticated in Africa's Sahel zone just south of the Sahara, cattle herding may have preceded agriculture there, and it is not yet certain whether those were independently domesticated Sahel cattle or, instead, domestic cattle of Fertile Crescent origin whose arrival triggered local plant domestication. It remains similarly uncertain whether the arrival of those Sahel crops then triggered the undoubted local domestication of indigenous wild plants in tropical West Africa, and whether the arrival of Southwest Asian crops is what triggered the local domestication of indigenous wild plants in Ethiopia. As for New Guinea, archaeological studies there have provided evidence of early agriculture well before food

production in any adjacent areas, but the crops grown have not been definitely identified.

Table 5.1 summarizes, for these and other areas of local domestication, some of the best-known crops and animals and the earliest known dates of domestication. Among these nine candidate areas for the independent evolution of food production, Southwest Asia has the earliest definite dates for both plant domestication (around 8500 B.C.) and animal domestication (around 8000 B.C.); it also has by far the largest number of accurate radiocarbon dates for early food production. Dates for China are nearly as early, while dates for the eastern United States are clearly about 6,000 years later. For the other six candidate areas, the earliest well-established dates do not rival those for Southwest Asia, but too few early sites have been securely dated in those six other areas for us to be certain that they really lagged behind Southwest Asia and (if so) by how much.

The next group of areas consists of ones that did domesticate at least a couple of local plants or animals, but where food production depended mainly on crops and animals that were domesticated elsewhere. Those imported domesticates may be thought of as "founder" crops and animals because they founded local food production. The arrival of founder domesticates enabled local people to become sedentary, and thereby increased the likelihood of local crops' evolving from wild plants that were gathered, brought home and planted accidentally, and later planted intentionally.

In three or four such areas, the arriving founder package came from Southwest Asia. One of them is western and central Europe, where food production arose with the arrival of Southwest Asian crops and animals between 6000 and 3500 B.C., but at least one plant (the poppy, and probably oats and some others) was then

TABLE 5.1 Examples of Species Domesticated in Each Area

| Area | Domesticated | | Earliest Attested Date of Domestication |
|---|---|---|---|
| | Plants | Animals | |
| **Independent Origins of Domestication** | | | |
| 1. Southwest Asia | wheat, pea, olive | sheep, goat | 8500 B.C. |
| 2. China | rice, millet | pig, silkworm | by 7500 B.C. |
| 3. Mesoamerica | corn, beans, squash | turkey | by 3500 B.C. |
| 4. Andes and Amazonia | potato, manioc | llama, guinea pig | by 3500 B.C. |
| 5. Eastern United States | sunflower, goosefoot | none | 2500 B.C. |
| ? 6. Sahel | sorghum, African rice | guinea fowl | by 5000 B.C. |
| ? 7. Tropical West Africa | African yams, oil palm | none | by 3000 B.C. |
| ? 8. Ethiopia | coffee, teff | none | ? |
| ? 9. New Guinea | sugar cane, banana | none | 7000 B.C.? |
| ***Local Domestication Following Arrival of Founder Crops from Elsewhere*** | | | |
| 10. Western Europe | poppy, oat | none | 6000–3500 B.C |
| 11. Indus Valley | sesame, eggplant | humped cattle | 7000 B.C. |
| 12. Egypt | sycamore fig, chufa | donkey, cat | 6000 B.C. |

domesticated locally. Wild poppies are confined to coastal areas of the western Mediterranean. Poppy seeds are absent from excavated sites of the earliest farming communities in eastern Europe and Southwest Asia; they first appear in early farming sites in western Europe. In contrast, the wild ancestors of most Southwest Asian crops and animals were absent from western Europe. Thus, it seems clear that food production did not evolve

independently in western Europe. Instead, it was triggered there by the arrival of Southwest Asian domesticates. The resulting western European farming societies domesticated the poppy, which subsequently spread eastward as a crop.

Another area where local domestication appears to have followed the arrival of Southwest Asian founder crops is the Indus Valley region of the Indian subcontinent. The earliest farming communities there in the seventh millennium B.C. utilized wheat, barley, and other crops that had been previously domesticated in the Fertile Crescent and that evidently spread to the Indus Valley through Iran. Only later did domesticates derived from indigenous species of the Indian subcontinent, such as humped cattle and sesame, appear in Indus Valley farming communities. In Egypt as well, food production began in the sixth millennium B.C. with the arrival of Southwest Asian crops. Egyptians then domesticated the sycamore fig and a local vegetable called chufa.

The same pattern perhaps applies to Ethiopia, where wheat, barley, and other Southwest Asian crops have been cultivated for a long time. Ethiopians also domesticated many locally available wild species to obtain crops most of which are still confined to Ethiopia, but one of them (the coffee bean) has now spread around the world. However, it is not yet known whether Ethiopians were cultivating these local plants before or only after the arrival of the Southwest Asian package.

In these and other areas where food production depended on the arrival of founder crops from elsewhere, did local hunter-gatherers themselves adopt those founder crops from neighboring farming peoples and thereby become farmers themselves? Or was the founder package instead brought by invading farmers, who were thereby enabled to outbreed the local hunters and to kill, displace, or outnumber them?

In Egypt it seems likely that the former happened: local hunter-gatherers simply added Southwest Asian domesticates and farming and herding techniques to their own diet of wild plants and animals, then gradually phased out the wild foods. That is, what arrived to launch fwd production in Egypt was foreign crops and animals, not foreign peoples. The same may have been true on the Atlantic coast of Europe, where local hunter-gatherers apparently adopted Southwest Asian sheep and cereals over the course of many centuries. In the Cape of South Africa the local Khoi hunter-gatherers became herders (but not farmers) by acquiring sheep and cows from farther north in Africa (and ultimately from Southwest Asia). Similarly, Native American hunter-gatherers of the U.S. Southwest gradually became farmers by acquiring Mexican crops. In these four areas the onset of food production provides little or no evidence for the domestication of local plant or animal species, but also little or no evidence for the replacement of human population.

At the opposite extreme are regions in which food production certainly began with an abrupt arrival of foreign people as well as of foreign crops and animals. The reason why we can be certain is that the arrivals took place in modern times and involved literate Europeans, who described in innumerable books what happened. Those areas include California, the Pacific Northwest of North America, the Argentine pampas, Australia, and Siberia. Until recent centuries, these areas were still occupied by hunter-gatherers-Native Americans in the first three cases and Aboriginal Australians or Native Siberians in the last two. Those hunter-gatherers were killed, infected, driven out, or largely replaced by arriving European farmers and herders who brought their own crops and did not domesticate any local wild species after their arrival (except for macadamia nuts in Australia). In

the Cape of South Africa the arriving Europeans found not only Khoi hunter-gatherers but also Khoi herders who already possessed only domestic animals, not crops. The result was again the start of farming dependent on crops from elsewhere, a failure to domesticate local species, and a massive modern replacement of human population.

Finally, the same pattern of an abrupt start of food production dependent on domesticates from elsewhere, and an abrupt and massive population replacement, seems to have repeated itself in many areas in the prehistoric era. In the absence of written records, the evidence of those prehistoric replacements must be sought in the archaeological record or inferred from linguistic evidence. The best-attested cases are ones in which there can be no doubt about population replacement because the newly arriving food producers differed markedly in their skeletons from the hunter-gatherers whom they replaced, and because the food producers introduced not only crops and animals but also pottery. Later chapters will describe the two clearest such examples: the Austronesian expansion from South China into the Philippines and Indonesia (Chapter 17), and the Bantu expansion over subequatorial Africa (Chapter 19).

Southeastern Europe and central Europe present a similar picture of an abrupt onset of food production (dependent on Southwest Asian crops and animals) and of pottery making. This onset too probably involved replacement of old Greeks and Germans by new Greeks and Germans, just as old gave way to new in the Philippines, Indonesia, and subequatorial Africa. However, the skeletal differences between the earlier hunter-gatherers and the farmers who replaced them are less marked in Europe than in the Philippines, Indonesia, and subequatorial Africa. Hence the case for population replacement in Europe is less strong or less direct.

IN SHORT, ONLY a few areas of the world developed food production independently, and they did so at widely differing times. From those nuclear areas, hunter-gatherers of some neighboring areas learned food production, and peoples of other neighboring areas were replaced by invading food producers from the nuclear areas-again at widely differing times. Finally, peoples of some areas ecologically suitable for food production neither evolved nor acquired agriculture in prehistoric times at all; they persisted as hunter-gatherers until the modern world finally swept upon them. The peoples of areas with a head start on food production thereby gained a head start on the path leading toward guns, germs, and steel. The result was a long series of collisions between the haves and the have-nots of history.

How can we explain these geographic differences in the times and modes of onset of food production? That question, one of the most important problems of prehistory, will be the subject of the next five chapters.

# Chapter 6: To farm or not to farm

FORMERLY, ALL PEOPLE ON EARTH WERE HUNTER-GATHERers. Why did any of them adopt food production at all? Given that they must have had some reason, why did they do so around 8500 B.C. in Mediterranean habitats of the Fertile Crescent, only 3,000 years later in the climatically and structurally similar Mediterranean habitats of southwestern Europe, and never indigenously in the similar Mediterranean habitats of California, southwestern Australia, and the Cape of South Africa? Why did even people of the Fertile Crescent wait until 8500 B.C., instead of becoming food producers already around 18,500 or 28,500 B.C.? From our modern

perspective, all these questions at first seem silly, because the drawbacks of being a hunter-gatherer appear so obvious. Scientists used to quote a phrase of Thomas Hobbes's in order to characterize the lifestyle of hunter-gatherers as "nasty, brutish, and short." They seemed to have to work hard, to be driven by the daily quest for food, often to be close to starvation, to lack such elementary material comforts as soft beds and adequate clothing, and to die young.

In reality, only for today's affluent First World citizens, who don't actually do the work of raising food themselves, does food production (by remote agribusinesses) mean less physical work, more comfort, freedom from starvation, and a longer expected lifetime. Most peasant farmers and herders, who constitute the great majority of the world's actual food producers, aren't necessarily better off than hunter-gatherers. Time budget studies show that they may spend more rather than fewer hours per day at work than hunter-gatherers do. Archaeologists have demonstrated that the first farmers in many areas were smaller and less well nourished, suffered from more serious diseases, and died on the average at a younger age than the hunter-gatherers they replaced. If those first farmers could have foreseen the consequences of adopting food production, they might not have opted to do so. Why, unable to foresee the result, did they nevertheless make that choice?

There exist many actual cases of hunter-gatherers who did see food production practiced by their neighbors, and who nevertheless refused to accept its supposed blessings and instead remained hunter-gatherers. For instance, Aboriginal hunter-gatherers of northeastern Australia traded for thousands of years with farmers of the Torres Strait Islands, between Australia and New Guinea. California Native American hunter-gatherers traded with Native American farmers in the Colorado River valley. In addition, Khoi herders west of the Fish River of South Africa traded with Bantu farmers east of the Fish River, and continued to dispense with farming themselves. Why?

Still other hunter-gatherers in contact with farmers did eventually become farmers, but only after what may seem to us like an inordinately long delay. For example, the coastal peoples of northern Germany did not adopt food production until 1,300 years after peoples of the Linearbandkeramik culture introduced it to inland parts of Germany only 125 miles to the south. Why did those coastal Germans wait so long, and what led them finally to change their minds?

BEFORE WE CAN answer these questions, we must dispel some misconceptions about the origins of food production and then reformulate the question. What actually happened was not a discovery of food production, nor an invention, as we might first assume. There was often not even a conscious choice between food production and hunting-gathering. Specifically, in each area of the globe the first people who adopted food production could obviously not have been making a concious choice or consciously striving toward farming as a goal, because they had never seen farming and had no way of knowing what it would be like. Instead, as we shall see, food production evolved as a by-product of decisions made without awareness of their consequences. Hence the question that we have to ask is why food production did evolve, why it evolved in some places but not others, why at different times in different places, and why not instead at some earlier or later date.

Another misconception is that there is necessarily a sharp divide between nomadic hunter-gatherers and sedentary food producers. In reality, although we frequently draw such a contrast, hunter-gatherers in some productive

areas, including North America's Pacific Northwest coast and possibly southeastern Australia, became sedentary but never became food producers. Other hunter-gatherers, in Palestine, coastal Peru, and Japan, became sedentary first and adopted food production much later. Sedentary groups probably made up a much higher fraction of hunter-gatherers 15,000 years ago, when all inhabited parts of the world (including the most productive areas) were still occupied by hunter-gatherers, than they do today, when the few remaining hunter-gatherers survive only in unproductive areas where nomadism is the sole option.

Conversely, there are mobile groups of food producers. Some modem nomads of New Guinea's Lakes Plains make clearings in the jungle, plant bananas and papayas, go off for a few months to live again as hunter-gatherers, return to check on their crops, weed the garden if they find the crops growing, set off again to hunt, return months later to check again, and settle down for a while to harvest and eat if their garden has produced. Apache Indians of the southwestern United States settled down to farm in the summer at higher elevations and toward the north, then withdrew to the south and to lower elevations to wander in search of wild foods during the winter. Many herding peoples of Africa and Asia shift camp along regular seasonal routes to take advantage of predictable seasonal changes in pasturage. Thus, the shift from hunting-gathering to food production did not always coincide with a shift from nomadism to sedentary living.

Another supposed dichotomy that becomes blurred in reality is a distinction between food producers as active managers of their land and hunter-gatherers as mere collectors of the land's wild produce. In reality, some hunter-gatherers intensively manage their land. For example, New Guinea peoples who never domesticated sago palms or mountain pandanus nevertheless increase production of these wild edible plants by clearing away encroaching competing trees, keeping channels in sago swamps dear, and promoting growth of new sago shoots by cutting down mature sago trees. Aboriginal Australians who never reached the stage of farming yams and seed plants nonetheless anticipated several elements of farming. They managed the landscape by burning it, to encourage the growth of edible seed plants that sprout after fires. In gathering wild yams, they cut off most of the edible tuber but replaced the stems and tops of the tubers in the ground so that the tubers would regrow. Their digging to extract the tuber loosened and aerated the soil and fostered regrowth. All that they would have had to do to meet the definition of farmers was to carry the stems and remaining attached tubers home and similarly replace them in soil at their camp.

FROM THOSE PRECURSORS of food production already practiced by hunter-gatherers, it developed stepwise. Not all the necessary techniques were developed within a short time, and not all the wild plants and animals that were eventually domesticated in a given area were domesticated simultaneously. Even in the cases of the most rapid independent development of food production from a hunting-gathering lifestyle, it took thousands of years to shift from complete dependence on wild foods to a diet with very few wild foods. In early stages of food production, people simultaneously collected wild foods and raised cultivated ones, and diverse types of collecting activities diminished in importance at different times as reliance on crops increased.

The underlying reason why this transition was piecemeal is that food production systems evolved as a result of the accumulation of many separate decisions about allocating

time and effort. Foraging humans, like foraging animals, have only finite time and energy, which they can spend in various ways. We can imagine an incipient farmer waking up and asking: Shall I spend today hoeing my garden (predictably yielding a lot of vegetables several months from now), gathering shellfish (predictably yielding a little meat today), or hunting deer (yielding possibly a lot of meat today, but more likely nothing)? Human and animal foragers are constantly prioritizing and making effort-allocation decisions, even if only unconsciously. They concentrate first on favorite foods, or ones that yield the highest payoff. If these are unavailable, they shift to less and less preferred foods.

Many considerations enter into these decisions. People seek food in order to satisfy their hunger and fill their bellies. They also crave specific foods, such as protein-rich foods, fat, salt, sweet fruits, and foods that simply taste good. All other things being equal, people seek to maximize their return of calories, protein, or other specific food categories by foraging in a way that yields the most return with the greatest certainty in the least time for the least effort. Simultaneously, they seek to minimize their risk of starving: moderate but reliable returns are preferable to a fluctuating lifestyle with a high time-averaged rate of return but a substantial likelihood of starving to death. One suggested function of the first gardens of nearly 11,000 years ago was to provide a reliable reserve larder as insurance in case wild food supplies failed.

Conversely, men hunters tend to guide themselves by considerations of prestige: for example, they might rather go giraffe hunting every day, bag a giraffe once a month, and thereby gain the status of great hunter, than bring home twice a giraffe's weight of food in a month by humbling themselves and reliably gathering nuts every day. People are also guided by seemingly arbitrary cultural preferences, such as considering fish either delicacies or taboo. Finally, their priorities are heavily influenced by the relative values they attach to different lifestyles-just as we can see today. For instance, in the 19th-century U.S. West, the cattlemen, sheepmen, and farmers all despised each other. Similarly, throughout human history farmers have tended to despise hunter-gatherers as primitive, hunter-gatherers have despised farmers as ignorant, and herders have despised both. All these elements come into play in people's separate decisions about how to obtain their food.

AS WE ALREADY noted, the first farmers on each continent could not have chosen farming consciously, because there were no other nearby farmers for them to observe. However, once food production had arisen in one part of a continent, neighboring hunter-gatherers could see the result and make conscious decisions. In some cases the hunter-gatherers adopted the neighboring system of food production virtually as a complete package; in others they chose only certain elements of it; and in still others they rejected food production entirely and remained hunter-gatherers.

For example, hunter-gatherers in parts of southeastern Europe had quickly adopted Southwest Asian cereal crops, pulse crops, and livestock simultaneously as a complete package by around 6000 B.C. All three of these elements also spread rapidly through central Europe in the centuries before 5000 B.C. Adoption of food production may have been rapid and wholesale in southeastern and central Europe because the hunter-gatherer lifestyle there was less productive and less competitive. In contrast, food production was adopted piecemeal in southwestern Europe (southern France, Spain, and Italy), where sheep arrived

first and cereals later. The adoption of intensive food production from the Asian mainland was also very slow and piecemeal in Japan, probably because the hunter-gatherer lifestyle based on seafood and local plants was so productive there.

Just as a hunting-gathering lifestyle can be traded piecemeal for a food-producing lifestyle, one system of food production can also be traded piecemeal for another. For example, Indians of the eastern United States were domesticating local plants by about 2500 B.C. but had trade connections with Mexican Indians who developed a more productive crop system based on the trinity of corn, squash, and beans. Eastern U.S. Indians adopted Mexican crops, and many of them discarded many of their local domesticates, piecemeal; squash was domesticated independently, corn arrived from Mexico around A.D. 200 hut remained a minor crop until around A.D. 900, and beans arrived a century or two later. It even happened that food-production systems were abandoned in favor of hunting-gathering. For instance, around 3000 B.C. the hunter-gatherers of southern Sweden adopted farming based on Southwest Asian crops, but abandoned it around 2700 B.C. and reverted to hunting-gathering for 400 years before resuming farming.

ALL THESE CONSIDERATIONS make it clear that we should not suppose that the decision to adopt farming was made in a vacuum, as if the people had previously had no means to feed themselves. Instead, we must consider food production and hunting-gathering as alternative strategies competing with each other. Mixed economies that added certain crops or livestock to hunting-gathering also competed against both types of "pure" economies, and against mixed economies with higher or lower proportions of food production. Nevertheless, over the last 10,000 years, the predominant result has been a shift from hunting-gathering to food production. Hence we must ask: What were the factors that tipped the competitive advantage away from the former and toward the latter?

That question continues to be debated by archaeologists and anthropologists. One reason for its remaining unsettled is that different factors may have been decisive in different parts of the world. Another has been the problem of disentangling cause and effect in the rise of food production. However, five main contributing factors can still be identified; the controversies revolve mainly around their relative importance.

One factor is the decline in the availability of wild foods. The lifestyle of hunter-gatherers has become increasingly less rewarding over the past 13,000 years, as resources on which they depended (especially animal resources) have become less abundant or even disappeared. As we saw in Chapter 1, most large mammal species became extinct in North and South America at the end of the Pleistocene, and some became extinct in Eurasia and Africa, either because of climate changes or because of the rise in skill and numbers of human hunters. While the role of animal extinctions in eventually (after a long lag) nudging ancient Native Americans, Eurasians, and Africans toward food production can be debated, there are numerous incontrovertible cases on islands in more recent times. Only after the first Polynesian settlers had exterminated moa and decimated seal populations on New Zealand, and exterminated or decimated seabirds and land birds on other Polynesian islands, did they intensify their food production. For instance, although the Polynesians who colonized Easter Island around A.D. 500 brought chickens with them, chicken did not become a major food until wild birds and porpoises were no longer readily available as food. Similarly, a suggested contributing factor to the

rise of animal domestication in the Fertile Crescent was the decline in abundance of the wild gazelles that had previously been a major source of meat for hunter-gatherers in that area.

A second factor is that, just as the depletion of wild game tended to make hunting-gathering less rewarding, an increased availability of domesticable wild plants made steps leading to plant domestication more rewarding. For instance, climate changes at the end of the Pleistocene in the Fertile Crescent greatly expanded the area of habitats with wild cereals, of which huge crops could be harvested in a short time. Those wild cereal harvests were precursors to the domestication of the earliest crops, the cereals wheat and barley, in the Fertile Crescent.

Still another factor tipping the balance away from hunting-gathering was the cumulative development of technologies on which food production would eventually depend-technologies for collecting, processing, and storing wild foods. What use can would-be farmers make of a ton of wheat grains on the stalk, if they have not first figured out how to harvest, husk, and store them? The necessary methods, implements, and facilities appeared rapidly in the Fertile Crescent after 11,000 B.C., having been invented for dealing with the newly available abundance of wild cereals.

Those inventions included sickles of flint blades cemented into wooden or bone handles, for harvesting wild grains; baskets in which to carry the grains home from the hillsides where they grew; mortars and pestles, or grinding slabs, to remove the husks; the technique of roasting grains so that they could be stored without sprouting; and underground storage pits, some of them plastered to make them waterproof. Evidence for all of these techniques becomes abundant at sites of hunter-gatherers in the Fertile Crescent after 11,000 B.C. All these techniques, though developed for the exploitation of wild cereals, were prerequisites to the planting of cereals as crops. These cumulative developments constituted the unconscious first steps of plant domestication.

A fourth factor was the two-way link between the rise in human population density and the rise in food production. In all parts of the world where adequate evidence is available, archaeologists find evidence of rising densities associated with the appearance of food production. Which was the cause and which the result? This is a long-debated chicken-or-egg problem: did a rise in human population density force people to turn to food production, or did food production permit a rise in human population density?

In principle, one expects the chain of causation to operate in both directions. As I've already discussed, food production tends to lead to increased population densities because it yields more edible calories per acre than does hunting-gathering. On the other hand, human population densities were gradually rising throughout the late Pleistocene anyway, thanks to improvements in human technology for collecting and processing wild foods. As population densities rose, food production became increasingly favored because it provided the increased food outputs needed to feed all those people.

That is, the adoption of food production exemplifies what is termed an autocatalytic process — one that catalyzes itself in a positive feedback cycle, going faster and faster once it has started. A gradual rise in population densities impelled people to obtain more food, by rewarding those who unconsciously took steps toward producing it. Once people began to produce food and become sedentary, they could shorten the birth spacing and produce still more people, requiring still more food. This bidirectional link between food production and population density explains

the paradox that food production, while increasing the quantity of edible calories per acre, left the food producers less well nourished than the hunter–gatherers whom they succeeded. That paradox developed because human population densities rose slightly more steeply than did the availability of food.

Taken together, these four factors help us understand why the transition to food production in the Fertile Crescent began around 8500 B.C., not around 18,500 or 28,500 B.C. At the latter two dates hunting–gathering was still much more rewarding than incipient food production, because wild mammals were still abundant; wild cereals were not yet abundant; people had not yet developed the inventions necessary for collecting, processing, and storing cereals efficiently; and human population densities were not yet high enough for a large premium to be placed on extracting more calories per acre.

A final factor in the transition became decisive at geographic boundaries between hunter–gatherers and food producers. The much denser populations of food producers enabled them to displace or kill hunter–gatherers by their sheer numbers, not to mention the other advantages associated with food production (including technology, germs, and professional soldiers). In areas where there were only hunter–gatherers to begin with, those groups of hunter–gatherers who adopted food production outbred those who didn't.

As a result, in most areas of the globe suitable for food production, hunter–gatherers met one of two fates: either they were displaced by neighboring food producers, or else they survived only by adopting food production themselves. In places where they were already numerous or where geography retarded immigration by food producers, local hunter–gatherers did have time to adopt farming in prehistoric times and thus to survive as farmers. This may have happened in the U.S. Southwest, in the western Mediterranean, on the Atlantic coast of Europe, and in parts of Japan. However, in Indonesia, tropical Southeast Asia, most of subequatorial Africa, and probably in parts of Europe, the hunter–gatherers were replaced by farmers in the prehistoric era, whereas a similar replacement took place in modern times in Australia and much of the western United States.

Only where especially potent geographic or ecological barriers made immigration of food producers or diffusion of locally appropriate food producing techniques very difficult were hunter–gatherers able to persist until modern times in areas suitable for food production. The three outstanding examples are the persistence of Native American hunter–gatherers in California, separated by deserts from the Native American farmers of Arizona; that of Khoisan hunter–gatherers at the Cape of South Africa, in a Mediterranean climate zone unsuitable for the equatorial crops of nearby Bantu farmers; and that of hunter–gatherers throughout the Australian continent, separated by narrow seas from the food producers of Indonesia and New Guinea. Those few peoples who remained hunter–gatherers into the 20th century escaped replacement by food producers because they were confined to areas not fit for food production, especially deserts and Arctic regions. Within the present decade, even they will have been seduced by the attractions of civilization, settled down under pressure from bureaucrats or missionaries, or succumbed to germs.