

Introduction to
Anthropology:
Holistic and Applied
Research on Being
Human

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MODULE 9: DEVELOPMENT OF AGRICULTURE

Development of Domestication

In this chapter, we will explore processes of domestication around the world and examine the rise of the first city-states. It's only in the past 10,000 years or so that people began widespread manipulation of plants and animals as conditions on earth changed after the Ice Age that allowed people to pursue these alterations. As human lives became entrenched in managing domestic plants and animals, the subsequent rise in farming communities and the development of sedentary lifestyles are observed that are like how many people live today.

Following the end of the Pleistocene, the world entered the Holocene epoch (see Module 20: Climate Change). The Holocene is the current interglacial period that we're presently living in. For approximately the last 11,700 years, glacial sheets have retreated north as temperatures rose across the world. With increasing temperatures and melting ice, sea levels began rising, and vegetation began expanding into more northerly latitudes than previously found. These extensive environmental changes correlate with the extinction of the megafauna and substantial changes in human behaviors and activities.

For most of human existence, people were hunter-gatherers. Prior to the Holocene, all humans relied on the natural world for subsistence. Generally, people did not purposefully influence the growth or development of other creatures. Communities were typically mobile, traversing the landscape to find resources and survive in harsh landscapes. Further, they understood annual plant cycles and their environmental tolerances to find and harvest wild plant materials. The densest populations of hunter-gatherers were found in subtropical and tropical zones, where resources were most plentiful.

With the onset of the Holocene and warming conditions, more areas flourished with diverse plant and animal resources. As these resource patches expanded, so did human communities. This led to increases in populations and global-wide distributions of warm-weather plant and animal communities.

Myths About Hunter-Gatherers

Before the development of domestication and agriculture are discussed, a common myth must be dispelled. Hunter-gatherers are often associated with foraging practices, while agriculturalists are described as food-producers. Today there is a myth that, to be a hunter-gatherer, one must constantly be on the move because of general unavailability of resources. Hunter-gatherers are depicted as highly mobile individuals that survive by continually moving between temporary villages and campsites, following animal migrations, or vegetation cycles. Natural resources are depicted as patchy or unpredictable. Foragers are believed to organize themselves into small groups to avoid overtaxing the environment (see Module 10: Sociopolitical Classification).

On the other hand, farmers are depicted as sedentary because it is a year-round commitment to plow the land, tend to seedlings, ensure that herbivorous animals, insects, or weeds do not decimate gardens, harvest the crop, process and preserve the crop, and then prepare the land to continue the process anew. These two opposing depictions of foraging versus producing represent a false dichotomy about subsistence methods and lifestyles. Although it is true that farming requires sedentism and commitment to the land, the opposite is not true of hunter-gatherers. Many

hunter-gatherer groups may have been highly mobile, however, there are several poignant examples of sedentary hunter-gatherers in the archaeological and ethnographic record that demonstrate farming isn't a requisite for sedentism or large-scale societies. These groups include the **Jomon culture** of Japan, or the many groups found in the Pacific Northwest coast of the Americas.

Today, we are biased by our observations of the remaining hunter-gathering groups that still exist in the world. Hunter-gatherer groups that live in the Amazon River Basin, Australian Outback, Kalahari Desert, or Arctic extremes are highly mobile and continually seek out scattered resources from challenging environments. They tend to live in areas that are considered economically low-value, harsh, and marginal. These are places where farming-based communities have little desire to live.

For example, the San are indigenous hunter-gatherers who live in the Kalahari Desert (see Figure 9.1). Today, there are approximately 100,000 people in the San community, but they mainly live in small groups of less than 25 individuals based on geography and language. Their numbers were higher prior to European colonization, but populations have been steadily declining since. San-speaking communities gained international recognition during the 20th century because of the rise of white tourism and immigration, as well as an interest in human origins. The local government limits where the San can live and hunt, restricts their water access, and relocates them in favor of other economic interests. These constraints severely impact traditional ways of life and require continual movement for traditional San foragers.

These examples provide incomplete understandings of foraging lifeways and can bias us regarding the quality of hunter-gatherer lifestyles. Even today, many San groups have significantly more diverse gut microbes than people who subsist on processed foods. Additionally, in the past, some hunter-gatherer groups were able to maintain mostly sedentary lifestyles.



Figure 9.1. Depiction of San elder and family. Image by Martin Junius 2015.



Video 9.1. Check out the video from National Geographic's Hunt with the world's last full-time hunter-gatherers.

Evidence from the archaeological record suggests that, prior to the onset of sedentism and agriculture, hunter-gatherers would have had access to the most favorable environments. Constant travel and relocation wouldn't have been necessary in affluent coastal regions. The Jomon are a group of hunter-gatherers that lived in Japan as far back as 16,000 years ago. They remained hunter-gatherers on the coast until nearly 2,500 years ago, even though many of their neighbors transitioned to rice-based agricultural practices. The Jomon largely defied agricultural practices in favor of marine resources.

The Jomon lived on large piles of shells and bones, called **middens**. The Jomon built these mounded middens to be several feet high, and then built houses and other dwellings on and around the middens to protect themselves from floods, tides, and other coastal concerns. These middens, with the high

calcium content from the shells, preserve organic materials better than the surrounding soils, and permit archaeologists to study the Jomon culture. These preserved artifacts include fragments of mulberry bark clothing, wicker baskets, and harpoons, hooks, needles, and other implements made from bone. These all hint to the rich, maritime-oriented existence of this culture.

The Jomon were semi-sedentary people. They hunted on land, gathered plants and shellfish, and they fished the coastal waters. These diverse habitats provided a wealth of nutritious foods and resources year-round, which reduced the need for constant movement. People focused more on fishing and coastal resources in the winter and traveled inland during warmer weather. As the shell middens can attest, the oceans were plentiful with shellfish, fish, vegetation, and other marine resources that could be easily collected. Many types of fish can be captured by nets or traps, and shellfish gathered from the shoreline at low tides.

Compared to the high demands and labors of farming, the Jomon had a well-established lifestyle based around predictable marine resources. Further, evidence suggests that the Jomon may have practiced small-scale horticulture, but plant cultivation was never a primary subsistence strategy on the coast.

Transitioning from hunting and gathering to farming requires a substantial shift in behaviors and rhythms of daily life: the tools needed to procure and process resources, the types of activities that must be completed, the layout of habitation and work sites, the times of day when work is completed, and even the duration of work. Therefore, the move to farming represents a significant shift in human history, and it's important to consider the reasoning and incentives that drove people to such drastic changes, particularly when there's evidence that foraging was an effective way of life.

What is Domestication?

Domestication is a biological process during which wild plants and animals are adapted for human use. It is not a quick event; rather, it occurs slowly over generations and results in genetic changes between parent organisms and offspring populations. The resultant domesticated populations interact with humans through a mutually beneficial relationship

and rely upon them for survival. In turn, the domesticated species are selected for a range of desirable traits related to food, labor, wool, medicine, or companionship. In general, plants are selected for larger fruits and edible portions, while animals are selected to be smaller and more manageable in size and are typically herd animals. This process is key in the development of activities such as farming and herding.

Domestication developed independently in several different areas around the world, and this uneven development reflects several traits. As the environments fluctuated into the Holocene period, ice sheets retreated, and warmer climates led to rising sea levels that distributed resources into areas that were once uninhabitable. These changing conditions led to migrations of people into areas where groups were already living. However, as population sizes grew, they began taxing their environments more to support themselves. Initially, people may have been able to simply expand their occupation zones or move to new, plentiful regions when times were tough. Over time, however, resources became scarcer, and with higher numbers of people across the landscape, it became more and more difficult to simply move to a more productive area. These conditions may have primed people to the value of purposeful plant and animal management.

Domestication didn't appear without a precedent. Dogs were domesticated thousands of years earlier during the Pleistocene (see Module 8: Upper Paleolithic and Ice Age), and people were familiar with the types of plant and animals available, their behavior in nature, and growth cycles. People would've been familiar with the seasonal migration and reproductive patterns of common animals. Additionally, people may have recognized that when they threw their trash into midden piles, these areas became more fertile than surrounding sediments and that the same plant remnants that had been discarded the previous year began growing anew in the midden in the next year. Through these types of observations, people may have begun casually planning their future around these types of predictable resources and syncing their schedules to optimize resource yields.

Significantly more plant species than animals have been domesticated over the past 10,000 years. In North America, specifically, researchers hypothesize that many plants were domesticated around 2,000 years ago.

However, some of these were abandoned over time and returned to the wild. Sunflowers and squashes remain important crops today, but few people may realize that weeds like goosefoot (*Chenopodium berlandieri*), sumpweed (*Iva annua*), erect knotweed (*Polygonum erectum*), and maygrass (*Phalaris caroliniana*) were once key plant resources contributing to local palates.

Far fewer animals have been domesticated because they tend to be more labor and resource intensive than plants. Several factors must be considered when attempting to domesticate an animal including diet, growth rate, aggression, and social hierarchies. Herbivorous grazers or omnivorous animals are easier to feed and support than carnivorous animals or herbivores that eat grains or other specialized diets. Grazing herbivores can be sent to wild pastures to find feed, while omnivorous animals can be fed the leftovers that humans or other animals don't eat. Both cases require little intensive work on the part of humans and are fairly inexpensive.

Animals that grow quickly are more ideal for human use. When animals mature faster, then meat, milk, wool, and other byproducts are more readily available for human consumption. Animals that can be bred multiple times within a year are preferable versus seasonal fertility, and in that same vein, animals must be able to breed in captivity. For instance, many predatorial animals are territorial, which allows them to reproduce without disruption, and raise their young without competition or danger from other predators. Animals must also be able to breed in small areas without becoming aggressive and territorial.

On that same note, animals are easier to domesticate if they are calm or easy to herd together. Animals that scatter when agitated are more difficult to manage than those who maintain a pack mentality. When sheep are startled, they flock together, which helps preserve calm and cohesiveness. However, when sheep are separated from the flock, they may become stressed and anxious. This behavior is beneficial to sheep and humans herding these populations. Additionally, some pack animals operate with a social hierarchy, such as wolves. In some situations, humans can usurp the leadership roles to control social animals, such as dogs.

The more criteria that can be fulfilled, the easier it should be to domesticate an animal. However, considering the hundreds of large mammals that exist across the world, only 14 large mammals have ever been domesticated, including sheep and goat, cow, pig, horse, camel, llama and alpaca, donkey, reindeer, and water buffalo. Dogs are considered separately (see Upper Paleolithic Module), and several smaller domesticated mammals are considered below.

Humans began the purposeful modification of plants and animals more than 10,000 years ago in various parts of the world. These species were selected to provide resources such as food, labor, clothing, medicine, and companionship. Plants were modified to provide larger and more fruits, some herding animals were modified to be smaller and more manageable, and some smaller animals, like chickens, were modified to be larger. By entering into these relationships with domesticated species, humans became embroiled in an infinite feedback loop. As human populations grew, more resources were required to support them. Domestication provided a way to find stable and continual resources. However, these domesticated species were unable to survive on their own and without human intervention. Thus, over time, for people that undertook domestication and agricultural practices, their commitments to these species were reinforced, and hunting and gathering wild resources became less and less feasible.

Centers of Agriculture

Increasing populations and the need for more stable resources may have played a large role in the development of agriculture in many parts of the world. While domestication processes can begin intentionally or unintentionally, **agriculture** represents the intentional establishment of an ecosystem wherein specific plants and animals are cultivated and reared. These domesticated species are isolated from their wild relatives to allow humans complete control over their reproductive behaviors.

Agriculture developed independently in several areas of the world (see Figure 9.2). In many cases, once agricultural practices were established, they spread quickly to new areas and communities. This distribution was facilitated across similar environments, but slower in areas where climate and

environmental conditions were more variable. Although agriculture may seem like the best innovation for human survival, particularly because it's the foundation of today's society, there are some important drawbacks to consider. In fact, Jared Diamond has called agriculture "humanity's worst mistake."

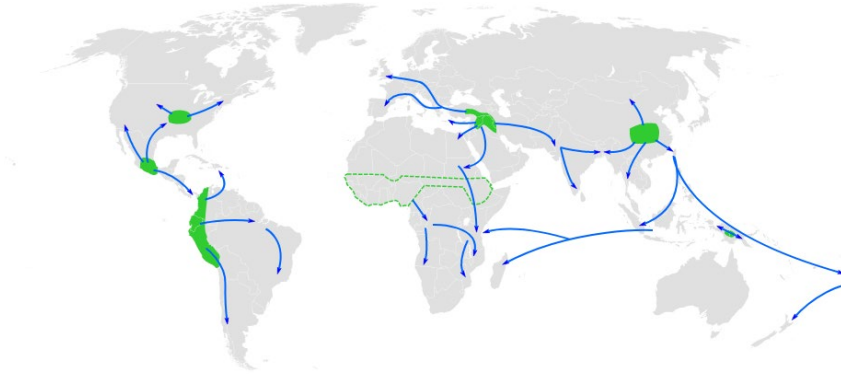


Figure 9.2. Areas where agriculture developed independently around the world. Image from Wikimedia Commons.

Agricultural practices are associated with more sedentary lifestyles and permanent settlements. Because of the efforts required to maintain domesticated species, nomadic practices became untenable for communities dedicated to domestication and agriculture. Instead, people adopted new schedules and rhythms of life, aligning with the seasonality and growth cycles of domesticated plants and animals rather than wild species. Instead of knowing where to hunt or gather, people were now in charge of supporting these species by providing food and protection and then harvesting and processing the species' yields. This significantly increased the workload required to support communities.

Additionally, many groups domesticated only one key crop, which resulted in less dietary diversity and compounded malnutrition in agricultural populations compared to hunter-gatherers. Moreover, the combination of increased populations and sedentary lifestyles led to more crowded communities and intensified disease (see Health and Medicine module), including **civilization diseases**. Furthermore, communities reliant on

agriculture were subject to the whims of nature. In years of drought or extreme flooding, crop yields might be significantly reduced or destroyed, and people may not have had an alternative course of action to resolve these concerns. Yet, despite the drawbacks, agriculture spread and set the foundation for the industrialized world we live in today.

Mediterranean and Southwest Asia

Agriculture first developed in the Fertile Crescent, located in the Levant region of southwest Asia, can be traced back at least 12,000 years (see Figure 9.3), and is known as the birthplace of agriculture. Archaeologically, a shift from primarily using hunting practices (indicated through artifacts like bows, arrows, nets, and traps) towards agriculture (through artifacts like sickles, mortars, and pestles) can be observed. People may have initially adopted horticulturalist practices that focused on cereals such as barley, wheat, and rye, but shifted towards legumes such as chickpeas and lentils more intently over time. Later, animals like goats and cows were domesticated (see Evolution Module about human lactose tolerance). The **Natufian** culture is associated with the first domestication practices in this region.

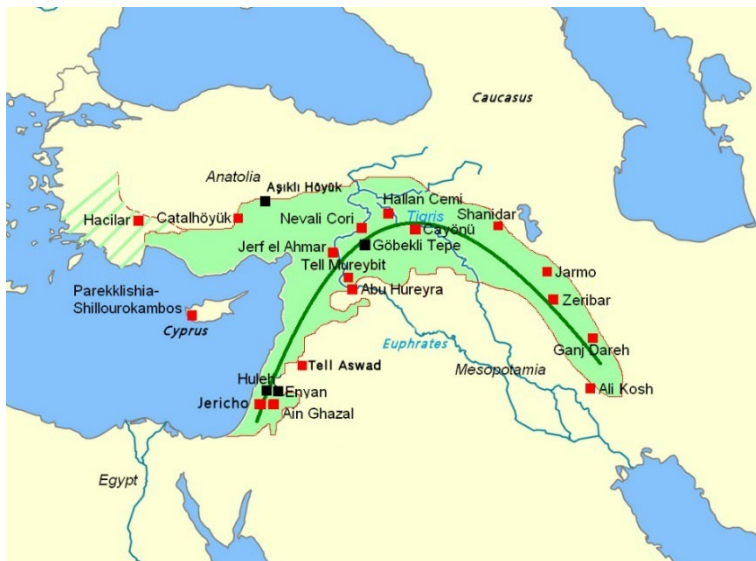


Figure 9.3. Levant region of southwest Asia, depicting the Fertile Crescent. Image from Wikimedia Commons.

The characteristics of the Tigris and Euphrates Rivers influenced the development of agriculture in this region. These rivers converge before emptying into the Persian Gulf, and while the lands are very fertile from river flooding, they're also unpredictable. During good years, up to 100 times more grain could be harvested than bad years. However, during bad years, floods or droughts could destroy an entire harvest. In years of drought, the soil could harden and crack, which made the ground difficult to work. As people shifted to more intense agricultural practices, they settled on hilly areas to promote more even distribution of precipitation. They also began developing plows, irrigation canals, and other techniques to harness water and maintain soil.

The **Ohalo II** site is a pre-Natufian site more than 23,000 years old that provides important insight into early domestication practices in the region. The site was submerged in the Sea of Galilee and only rediscovered in 1989 when water levels were particularly low. The site represents a temporary fishing campsite with oval huts and open-air hearths and provides rare insight into pre-Natufian diets because organic materials found here were well-preserved. Because the site was submerged below the sea, materials were not exposed to oxygen, and decomposition slowed. This allowed researchers to recover and identify more than 150,000 different seed and fruit fragments from more than 140 different species. The occupants of Ohalo II used a wide variety of wild grasses, cereal, flowers, nuts, and legumes. This demonstrated the enduring importance of plant resources through time.

The Natufian culture represents a transitional group that moved from foraging to agriculture practices. They existed roughly between 15,000 and 11,000 years ago and can be considered the ancestors of the first farmers in the region. They lived in semi-sedentary villages with hundreds of people and operated on **seasonal rounds**, moving across the landscape in response to wild animal and plant cycles.

One of the most telling artifacts is the **Natufian sickle**. This short-handled tool was used to cut grain with a unique blade. Instead of one large blade, the Natufian sickle is comprised of multiple flint **microblades** that are inserted along the length of the handle. These microblades are easily replaceable, making this an easy-to-use tool. Importantly from an

archaeological perspective, the flint microblades contain **sickle gloss**, or **silica** residue, from the harvested plants. Natufian sickles are some of the oldest farming implements in the world with sickle gloss. Although this doesn't directly indicate agriculture, it demonstrates the use of cereal grasses in the past.

Other evidence has been found to support the importance of cereal grasses among the Natufian. The **Raqefet Cave Site** in Israel was inhabited by people around 13,000 years ago. The cave site contains more than 30 human remains buried with more than 100 mortars and pestles (see Figure 9.4). Recently, researchers analyzed the starch residue and phytolith content of the mortars and identified malted wheat and barley. In other words, Raqefet Cave contains evidence of brewed cereals to create beer and other fermented drinks. These are believed to have been used in ritual and feasting events and are even hypothesized to have been an impetus for purposeful domestication and agricultural practices in the region.



Figure 9.4. Researcher photographing the Natufian bedrock mortars at Raqefet Cave. Image from Wikimedia Commons.

The **Abu Hureyra** site in Syria provides more direct evidence for agricultural practices. Different groups of people occupied the site through time, which clearly demonstrates the shift from hunting and gathering to a more agriculturally focused existence. The earliest occupations at the site include round structures and the remains of wild plants. However, centuries later, rectangular and geometric structures are present with evidence of domesticated cereals, goats, and sheep. Additionally, the farming settlement is much larger, indicating a larger population.

Human remains from Abu Hureyra further support the idea of agricultural lifestyles and gender-based agricultural roles. Females are believed to have harvested and processed plants as the short-handled sickles would have required kneeling or crouching. Further, processing the cereals with a mortar and pestle requires leaning over the mortar and using your weight to grind the cereals. When compared to male skeletons, squatting facets are more common on women's ankles, indicating higher frequencies and intense periods of squatting and kneeling. Additionally, female skeletons demonstrate higher frequencies of arthritis on the large toes, presumably from balancing and focusing weight against the mortar while processing grains. Furthermore, basketry, such as would be used to store grains, is believed to be a female-oriented task based on the grooves between their front teeth. Among males and females, however, clear evidence of poor dental health is observed in highly worn teeth. This is believed to be related to a monopolized diet of poorly ground and sieved grains, which would have resulted in people eating mixtures of grit and grain.

From southwest Asia, agriculture is believed to have spread into North Africa and Europe by process of **diffusion**. Egypt demonstrates a clear connection to southwest Asian agricultural developments, and the Nile River plays prominently into the spread of agriculture to this region. The Nile River is a north-flowing river that extends more than 4,100 miles before emptying into the Mediterranean Sea.

Unlike the Tigris and Euphrates Rivers, the Nile River floods on a predictable cycle. Even the flooding is predictable, there is not always enough water to support agriculture on its own. Therefore, early Egyptians developed more elaborate irrigation techniques than seen in southwest Asia. These

methods allowed them to control and conserve floodwaters using canals and reservoirs. People were also able to trap alluvial silts and use them to fertilize and nourish agricultural plots. These techniques led to a highly effective agricultural system that, ultimately, may have helped facilitate the development of increased social complexity and practices like pyramid building.

Thousands of years before pyramid constructions and other well-known features of Egyptian civilization, Egypt was home to the oldest-known industrial-scale fermentation sites. Like the mortars at the Raqefet Cave site, evidence of fermented grains were found in hundreds of vessels unearthed at the **Abydos** site. The production capacity of this site is so staggering that, today, a stadium of 40,000 people would all be able to enjoy a pint from the Abydos development.

The oldest evidence of domestication is found in southwest Asia and diffusing later into Europe and Africa. Wild plants have been important to people for over 20,000 years in the region, and cereal grains and goats were among the first and most important domesticates. Sickles, mortars, and pestles became more common in the archaeological record, and several sites attest to the use of fermentation processes as a means of preserving and enjoying cereal yields.

China and East Asia

Agriculture developed independently in two different areas of China starting around 9,000 years ago. East Asian environments were much cooler and drier in relation to southwest Asia, and different types of plants were domesticated, particularly, millet and rice. These plants were domesticated in two major river systems: the Yellow and Yangtze River Valleys (see Figure 9.5).



Figure 9.5. Depiction of the Yellow (top blue line) and Yangtze (bottom blue line) Rivers in China. Image from Wikimedia Commons.

The Yellow River is known as the cradle of Chinese civilization. It is the second longest river in China, extending nearly 3,400 miles in length before emptying into the Yellow Sea. Geography and habitats are variable along the river, with the most fertile and arable sediments being found towards the mouth of the river. However, the river is also more turbulent in this region, frequently flooding the surrounding areas with silt-laden soils. The course of the river has changed numerous times over the past 4,000 years, and this has led to the mouth of the river shifting significantly (up to 500 miles) over this time.

These conditions were conducive to the domestication of millet. Two different types of millet, foxtail (*Setaria italica*) and broomcorn (*Panicum miliaceum*), were domesticated and used as traditional cereal crops. Millet is a drought-tolerant cereal with small seeds. It uses a type of C4 photosynthesis that is more water efficient than C3 plants and combats the effects of photorespiration. While most plants use C3 photosynthesis, millet instead

consists of complex carbohydrates and takes longer to digest than grains with simple carbohydrates like wheat.

Once the domesticated C4 plant became a staple in human diets, it was much more abundant than its wild counterpart. Because millet is one of the few C4 plants present in East Asian archaeological contexts, it can be used to support interpretations of when herbivorous animal domestication occurred. When humans domesticate an animal, animals may forage less for wild sources as humans take on the responsibility of feeding and caring for the animal. Therefore, domesticated herbivores may exhibit noticeably different diets (C4 heavy) than their wild counterparts (C3 heavy).

Researchers examined botanical and zooarchaeological data from two archaeological sites in northern China: one approximately 7,500 years old and one around 6,000 years old. Domesticated millet and bioarchaeological remains, including human, dog, and pig skeletal remains, were identified at both sites. **Isotopic** analyses of the human, dog, and pig bones were used to determine whether animals subsisted on wild or cultivated diets. At the oldest site, only human and dog remains demonstrated C4 dietary contributions, but at the younger site, pig remains also exhibited a significant C4 signature. The authors interpreted this to mean that the occupants of the older site were hunters who supplemented their diets with millet, but later peoples embraced domestication and agricultural lifestyles. In other words, this corresponds with what is known of dog and pig domestication in this region. Dogs were domesticated much earlier and have been dependent on human-provided food sources for much longer. Isotopic signatures suggest that pigs foraged for wild resources initially, but eventually, humans began caring for and feeding them domesticated millet and other foods.

The Yangtze River is the longest river in Asia, extending more than 3,900 miles in length before emptying into the East China Sea. The Yangtze River delta is a rich, fertile area with a milder climate than the Yellow River to the north. This climate is suitable for agricultural practices, and in good times, multiple crops can be harvested annually. However, this region experiences an irregular precipitation cycle, mandating the use of irrigation measures to facilitate agricultural practices during times of drought or flood. Despite these factors, nearly half of China's crops are produced in this region today.

Rice was the main crop domesticated in the Yangtze River Valley and is one of the most important domesticated crops in the world today. Around 10,000 years ago, there is evidence that people attempted to move wild rice from waterlogged areas to dryer conditions, presumably to provide more predictable growing conditions. There is also an increase in farming implements.

Rice has unique growing conditions as it favors flooded or water-saturated environments, and farming rice requires different steps than other major domesticates. Seedlings are often started in stable soils and transplanted to puddled soil around 2-5 weeks later. Puddling soils stabilizes moisture and prevents erosion. Subsequently, seedlings are flooded to increase soil fertility and depress disease and weed growth. Unlike other crops, which require plot rotations or fertilization to allow fields to replenish nutrients, rice can grow in the same locations each year.

The Americas

The Americas represent another area where domestication developed independently. North America, Mesoamerica, and South America each include different domesticated species. However, several factors distinguish American domestication practices from the Old World, including the number and type of species domesticated and the reasons for domesticating them.

Unlike southwest Asia and China, where one or few major **founder** crops were domesticated, peoples in the Americas relied on many cultivated crops. As mentioned above, plants went through cycles of domestication and abandonment in North America. While sunflowers and squashes remain important crops today, many others are unknown or generally considered weeds. Additionally, hardy plants that were not as labor intensive were selected for domestication in the Old World. This includes plants such as potatoes, tomatoes, and prickly pear. Finally, some of the domesticated species are not food sources, such as bottle gourds and chili peppers, suggesting that people were motivated by other reasons to domesticate.

Mesoamerica

Mesoamerica is a tropical area with sedimentary (primarily limestone), igneous, and volcanic bedrock. Most of the lowlands contain limestone, and although there are many tropical rainforests and jungles in this area, there is little surface water available. Because of the karst geography, there are many caves, underground waterways, and **cenotes**. People have been living in this region for over 10,000 years, including the **Mayan**. The Mayan are renowned for their art, astronomy, and religion, but they were also prolific farmers.

Many plants were domesticated in this region, including bottle gourds, maize, squash, and bean. Bottle gourds were one of the first plants to be domesticated around 10,000 years ago. However, they were not used for food. Instead, bottle gourds were used as containers, fishing floats, musical instruments, and other items. Bottle gourds are native to Africa and Asia and were domesticated in these areas, and there is debate about when, how, and which species of the gourds arrived in the Americas.

Maize, one of the most well-known domesticates, was domesticated from small, wild **teosinte** around 9,000 years ago. However, the two are so dissimilar in appearance, it took researchers years to identify the wild **progenitor**. Teosinte plants have long branches, each bearing multiple small ears of ten kernels. In fact, each teosinte plant can have hundreds of ears. Maize plants typically have two short branches with one ear each that bears hundreds of kernels.

Initially, maize was a supplement or luxury food in elite diets. However, the food became more commonly used and widely available within communities around 3,000 years ago. Today, maize is one of the most important economic food resources and an alternative energy source throughout the world.



Video 9.2. Check out the video from The Smithsonian discussing the secret behind the ancient Maya's agricultural prowess.

However, maize lacks two vital amino acids needed to make protein and has been associated with iron deficiency and associated skeletal pathologies. Originally, it was not a staple crop. It was only after the combination of maize with other domesticates, particularly squash and beans, that maize became a dietary staple. The three sisters—squash, maize, and beans—are described as a triad of power foods because they are complementary, providing all amino acids and a nutritious food source. They were domesticated at different times over 8,000 years, and it wasn't until around 2,000 years ago that all three cultivates were available together. They are even planted together, with the beans adding nitrogen back into the soil to fertilize corn and squash. The corn stalks provide support for the climbing bean vines, and the squash's broad leaves protect the beans.

Chili peppers (*Capsicum annuum*) were domesticated more than 6,500 years ago. However, unlike other domesticated plants described above, chili peppers by themselves are not major dietary contributors. Instead, they are used to season food and provide medicinal and health benefits.

Several animals are worth mentioning, particularly because they were not primarily domesticated for food. Mayan diets largely consisted of cultivated plants and wild animals, but domesticated animals were valuable for rituals, ceremonial feasts, and sacrificial offerings. Their fur, feathers, bones, and other products were fashioned into clothing, headdresses, jewelry, musical instruments, medicines, and other tools. These domesticates include hairless dogs, stingless bees, and turkeys.

Hairless dogs, also known as Xoloitcuintli, were domesticated around 3,500 years ago. These can be identified even in the archaeological record because the genetic mutation that results in a hairless dog also results in the loss of premolar dentition. This dog is depicted in artwork and associated with mythology as guides to the underworld.

Turkeys, domesticated around 2,000 years ago, were prized because their meat and eggs are major sources of protein, and their feathers were employed extensively for decorative purposes. Stingless bees were domesticated around 3,000 years ago and used by both the Aztecs and Mayans. More than 15 species of stingless bees were domesticated. Unlike other bees, they have no stingers and instead defend by biting predators. These bees store honey in wax storage containers, not in honeycombs. Bees were kept within towns and affixed to the outside of houses. Although they yield relatively low quantities of honey, it is exceptionally sweet with a citrus flavor that was prized and used in rituals and medicines.

South America

In South America, hardy plants such as potato, cotton, tomato, and manioc were among the more well-known domesticates. Several of these plants are in the *Solanaceae* family of Nightshades, and many of these plants have toxic alkaloids that make them dangerous for human consumption. Potatoes are specifically emphasized here because more than 40 varieties of potatoes were developed in South America.

First domesticated around 10,000 years ago in the Lake Titicaca region, most potato varieties that exist today can be traced back to the Andean Mountains of southern Peru. The highlands of South America are rocky, harsh, and active volcanoes (linked to geologic faults) are found along the mountain range. As a result, earthquakes, floods, and landslides are common risks. Additionally, temperatures can fluctuate between freezing and hot extremes over a few hours and, because of the high elevation, the air is thin.

Despite these environmental concerns, potatoes have thrived here. Potatoes are hardy plants that are frost tolerant and able to survive in harsh climates and poor soils. However, they are naturally bitter and can be toxic if eaten in high quantities. People worked around these issues in several ways, resulting in the high number of varieties that

exist today. First, bitter potatoes were selected against, which resulted in numerous varieties of non-bitter potatoes.

Alternatively, people attempted to ameliorate the effects of bitter potatoes through different methods of processing or eating potatoes. In some cases, a chaco or pasa (quecheca or Aymara) sauce was made from a local clay that neutralized the toxins in potatoes. The negative clay particles counteracted the positive potato toxins, therefore, the toxins didn't enter the bloodstream. This clay sauce tradition can be traced back more than 2,500 years and may have developed based on observations of animals such as parrots, vicunas, and guanacos; all of which eat clay in the wild. Another method used to neutralize the toxins includes freeze-drying potatoes to make chuno or potato jerky. In this case, potatoes are laid out overnight and allowed to freeze. In the morning, the potatoes are trampled into a mush and then processed through cold or running water to leach out toxins. The potato is dried again into chuno, and it can be eaten safely and stored for several months.



Video 9.3. Check out the video from Great Big Story discussing Andean potato farming today.

Conclusion

In summary, domestication occurred independently in various parts of the world after the onset of the Holocene epoch. As environments changed and became favorable for large populations, people began purposefully modifying the environments around them for predictable access to foods, medicines, tools, ritual items, and other types of resources.

Domesticated species were chosen based on the culture and needs of the people, and a wide range of species have been modified all over the world throughout the past few thousand years. As reliance on domesticated species increased, many communities around the world have adopted more sedentary

practices in response, which has led to the highly sedentary societies most groups live in today.

Review Questions

- **T/F.** All domestication events around the world can be traced back to Mesopotamia.
- **T/F.** Prior to the development of agriculture, people lived relatively harsh lives with limited resource availability in marginal environments.
- **T/F.** The microblades of Natufian sickles contain silica residues of harvested cereal grains.
- **T/F.** Isotopic analysis of C4 signatures can be used to identify people and animals with domesticated plant diets.
- **T/F.** The three sisters—maize, beans, and squash—provide people with all required amino acids for a healthy diet.

Discussion Questions

- What are some disadvantages of domestication and agriculture?
- Why does the transition from foraging to producing represent a major shift in human behavior? How do the lifestyles and settlements of HG differ from agriculturalists?
- Who are the Jomon, and why are they important?
- What makes New World domesticates different than their Old World counterparts?

Activities

1. **Domestication Quiz:** Go to https://serc.carleton.edu/s/integrate/food_supply/1135 and scroll down to the short quiz at the bottom to check your ability to ID the global location in which each domesticate originated. Then, pick one of the domesticates on the list (or another) and research when it was domesticated and how it has been further artificially selected since then.
2. **Domesticating a Dandelion:** Ponder how you might be able to domesticate a dandelion. This will entail some web research on dandelion anatomy and edible/medicinal uses. Consider the different traits of the common dandelion and what part of the plant is edible and what parts of this particular plant have been used as food (e.g., dandelion greens and dandelion wine made from the flowers—can you think of or research others uses?). How would you select for more useful traits? Has domestication of dandelions already occurred in our suburban lawns and school yards? What other common plants are not currently domesticated, but which might be? (Modified from <https://global.oup.com/us/companion.websites/9780199947591/sr/ch12/stud/>)
3. **Diet and Domestication:** Three hypothetical archaeological sites were excavated. Use the following site descriptions, food remains in Table 1, and the websites to answer the questions.
 - **Site A** contains several large features, or soil stains, in the ground that contain ash, animal bone, and charcoal. Archaeologists interpreted these features as cooking hearths. No other evidence of features or structures was observed. Analysis of the bone and burned plant remains from the site indicated the presence of the species listed in Table 1.
 - **Site B** contains several hearth features and some large, deep features containing animal bone and ceramic artifacts. The large features were interpreted as underground storage pits. Additionally, the crumbling foundations of several thick walls from old structures were revealed during excavations. Analysis of the bone and burned plant remains from the site indicated the presence of the species listed in Table 1.
 - **Site C** contains several hearth and storage features. Additionally, numerous small round features were identified around the hearths. Based on the number, size, and placement of these small features,

archaeologists interpreted them as post holes where wooden poles once stood to support temporary structures. Analysis of the bone and burned plant remains from the site indicated the presence of the species listed in Table 1.

Site A	Site B	Site C
Deer	Domestic cow	Deer
Gazelle	Domestic pig	Raccoon
Wild Goat	Domestic chicken	Bird
Rodent	Deer	Turtle
Bird	Domestic lentil	Fish
Fish	Domestic chickpea	Domestic maize
Baobab	Domestic soybean	Acorn
Berries	Berries	Berries
Tubers	Domestic wheat	Wild knotweed
Wild wheat	Domestic barley	Wild barley

- A. Examine the site descriptions. Which of these sites do you think represent sedentary villages? Explain your answer.
- B. Examine the food remains listed in the tables. What is the percentage of domesticated foods at each site? The following websites can help you identify domestic vs wild plants:
- C. https://s3.amazonaws.com/KA-share/BigHistory/KU7.1.1_AG_CIV_Infographic.pdf
- D. <https://theconversation.com/i-spent-three-days-as-a-hunter-gatherer-to-see-if-it-would-improve-my-gut-health-78773>
 - a. Site A:
 - b. Site B:
 - c. Site C:
- E. Based on your responses to questions 1 and 2, interpret the lifestyles that may have been practiced by residents of each site (e.g., hunter-gatherer vs agriculturalist). Do these sites conform to your ideas of hunter-gatherer or agricultural lifestyles?
 - a. Site A:
 - b. Site B:
 - c. Site C:
- F. Select **one** of these sites and create a menu item for a restaurant using the available food resources in Table 1. Describe the menu item. Which of the five basic food groups are represented (fruit, vegetable/legume, dairy, meat, and grain)?

- G. How do these sites food remains vary from your own dietary practices? Consider differences in food availability, procurement, preparation, and general nutritional diversity.

Key Terms

Abu Hureyra: A site in Syria occupied 13,000 to 9,000 years ago that provides evidence of agricultural practices and lifestyles.

Abydos site: Site where one of the oldest-known industrial-scale fermentation sites, located in Egypt, was unearthed. Evidence of fermented grains were found in hundreds of vessels. The site was occupied for over five millennia, with the earliest known graves dating to 4,000 to 3,500 BC.

Agriculture: The intentional establishment of an ecosystem wherein specific plants and animals are cultivated and reared. These domesticated species are isolated from their wild relatives to allow humans complete control to manipulate their reproduction behaviors.

Cenote: A natural pit or sinkhole typically caused by the collapse of limestone, resulting in a pool or exposed groundwater at the bottom. These are commonly found in Central America, especially in Yucatán, Mexico.

Civilization disease: Illnesses or diseases that did not exist in hunter-gatherer and non-Westernized populations and that reflect profound changes in diet and lifestyle during recent human history.

Diffusion: Gradual spreading of cultural practices to new regions over time.

Domestication: A slow biological process where wild plants and animals are adapted for human use.

Founder crops: Eight plant species domesticated by early Holocene farming communities in southwest Asia to form the basis of systematic agriculture in the Middle East, North Africa, India, Persia, and eventually Europe; einkorn wheat, emmer wheat, barley, lentil, pea, chickpea, bitter vetch, and flax.

Holocene: The geologic epoch beginning at the end of the Pleistocene, or roughly the last 11,700 years and continues through today. This period of relative warmth may be an interglacial and is the period of most of the human past in North America.

Isotopic analysis: Identification of an isotopic signature using the ratios of certain stable isotopes and chemical elements within organic and inorganic compounds, such as bones. This can be used to determine where an individual or animal came from, what environment they grew up in, and what their diet was like.

Jomon culture: A group of semi-sedentary hunter-gatherers that lived in Japan as far back as 16,000 years ago. They remained hunter-gatherers on the coast until nearly 2,500 years ago, favoring marine resources, even though many of their neighbors transitioned to rice-based agricultural practices.

Maize: One of the most well-known domesticates, was domesticated from small, wild **teosinte** around 9,000 years ago. Plants typically have two short branches with one ear each, bearing hundreds of kernels.

Mayan: A civilization of people renowned for their art, astronomy, religion, and farming, occupying parts of Mesoamerica for over 3,000 years roughly between 2,000 BC and the 1500s.

Microblades: A small, narrow blade that is less than 1.2 centimeters (0.5 in.) long, made from wedge-shaped cores by means of pressure flaking.

Midden: Predominantly deposits of shell, with bone and other discarded materials, constructed and used by humans.

Natufian culture: Is associated with the first domestication practices in southwest Asia and represents a transitional group that moved from primarily foraging to agriculture practices. They can be considered the ancestors of the first farmers in the region, existing roughly between 15,000 and 11,000 years ago.

Natufian sickle: A short-handled farming tool with numerous stone microblades used to cut grain.

Ohalo II site: A pre-Natufian site more than 23,000 years old that provides insight into early domestication practices in southwest Asia.

Potatoes: A tuber domesticated in South America. More than 40 species exist today.

Progenitor: An ancestor or parent from which a person, animal, or plant, is descended or originates from.

Raqefet Cave site: A Natufian site in Israel inhabited around 13,000 years ago with evidence of the importance of cereal grasses among the Natufian.

Seasonal rounds: A pattern of movement each year across the landscape to different resource-gathering areas in response to wild animal and plant cycles.

Sickle gloss: The silica residue found on blades used to harvest plant materials.

Silica: A compound mineral in plants that increase their strength and harvest.

Teosinte: The progenitor of maize; plants have long branches, each bearing multiple small ears of ten kernels. Each plant can have hundreds of ears.

Suggested Readings

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Videos

[Hunt With the World's Last Full-Time Hunter-Gatherers | National Geographic - YouTube](#)

[The Secret Behind the Ancient Mayan's Agricultural Prowess - YouTube](#)

[The Farmer Growing 400 Different Kinds of Potatoes - YouTube](#)