Mayan Culture in Mesoamerica:

The Evolution of Agriculture

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The Mayan civilization of Mesoamerica spanned a period of 3.5 millennia from about 2000 BC to its decline in AD 900 and its ultimate demise in the 1500s. This civilization extended to regions of modern-day Mexico, Guatemala, Belize, Honduras, and El Salvador (Coe 2005). What began as a territory of early hunter-gatherers gradually developed into an advanced and diverse civilization. This development occurred through the early hunter period including the archaic period, the pre-classic period, the classic period, and the post-classic period culminating in the colonization of Mesoamerica (Coe 2005). The early hunters period originated over 13,000 years ago and continued until the Ice Age, during which some developments allowed for rudimentary horticulture subsistence methods (Coe 2005). Then, during the preclassic period from 2000 BC to AD 250, the Mayans began establishing farming settlements (Coe 2005). The later centuries of the pre-classic period also saw the rise of significant advancements in technologies and culture, culminating in structures like the Mayan pyramids and stone inscriptions (Coe 2005). Furthermore, the centuries that followed, between AD 250 and 900 witnessed the development of the Mayan calendar and other significant monuments, but unfortunately concluded with the Post-classic period marked by the Spanish conquest (Coe 2005). Throughout these periods, the Mayan civilization demonstrated substantial growth in population indicating that they had a method of sustaining the rising population. This is attributed to their agricultural methods adapted to fit the climates of the highlands and lowlands of the territory.

The highlands of the Mayan territory were high above sea level in a terrain that was characterized by high-altitude volcanoes, both active and extinct (Coe 2005). This area covered a portion of Southern Mexico and a majority of what is now modern-day Guatemala. The conditions in the highlands enabled the crops they planted to avoid competing for nutrients with

other native flora in the region, and the steep terrain and soil content created the perfect environment for generating subsistence during the rainy season (Coe 2005). However, while the highlands were readily adaptable for higher population densities, the land could only be used for 10 years at a time with a break of 15 years in between each rotation (Coe 2005). Research following the trends of the Mayan population in the 1940s indicated that an estimated 2.5 million people lived in the highlands (McBride and McBride 1942). Consequently, the agricultural practices that the Mayans of the highlands followed adapted to the rotation periods of the lands.

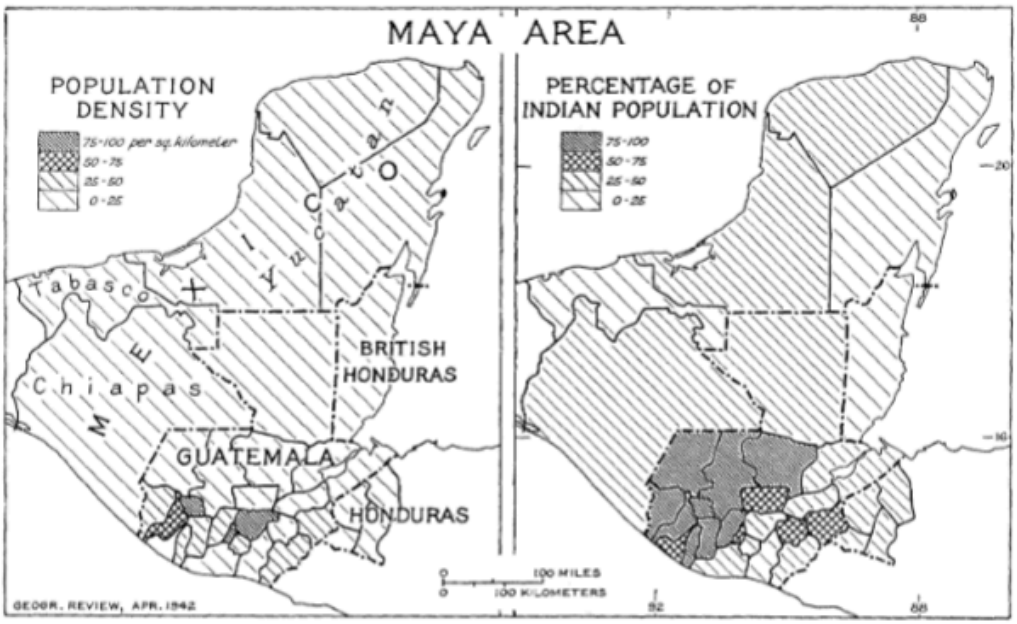

Figure 1. Cartogram showing population density and percentage of Indigenous population in the Maya area *Source:* McBride, George McCutchen, and Merle A. McBride. "Highland Guatemala and Its Maya Communities." Geographical Review 32, no. 2 (1942): 252–68.

In the highlands where large mountainous terrain was common, Mayans used terrace farming to maximize their use of all available land (Turner II 1974). Evidence for this method of agriculture has been found in regions of Belize, Guatemala, Peten, and Mexico (Healy et al. 1983). Research conducted in Caracol, Belize revealed that the Mayan community of the area likely worked continuously on uniform terraces made with walls of limestone (Healy et al.

1983). This research also concluded that there were three primary forms used by the Mayans to construct the terraces. One involved dividing the terrace steps by piling up two sections of large boulders with smaller rocks in between (Healy et al., 1983). As illustrated in Figure 2(a), one pile of boulders would be pressed against the soil of the terrain, and smaller rocks would follow, sandwiched between another large pile of boulders (Healy et al., 1983). The second method involved two piles of rocks, one with smaller rocks and the other with larger boulders (Healy et al., 1983). As depicted in (b) in Figure 2, the smaller rocks would be crowded against the layer of soil on the terrace and the boulders would be piled up in front of it as a barrier (Healy et al.,1983) The last method was similar to the first method (a) because it also had the rock sandwich to separate the terrace layers. The third method is shown in Figure 2 (c), demonstrating that the key difference in this method was the smaller pile of rocks buried within the bottom of the terrace level (Healy et al., 1983). Similar research also attempted to create mathematical measurements necessary for terrace farming. Turner II explained, “Terraces occur on hillsides varying in slope from 4 (degrees) to 47 (degrees). In most instances, slopes exceeding 50 (degrees) are void of terracing. As expected, the distance between embankments is directly related to the degree of slope and, with minor exceptions, decreases as the slope increases. The following distances between terrace embankments have been recorded: 42.24 m at slope angles of from 4 (degrees) to 14 (degrees); 24.10 m from 15 (degrees) to 29 (degrees); and 19.00 m from 30 (degrees) to 47 (degrees)” (Turner II 1974). This evidence of terrace farming in Belize led researchers to conclude that this method of agriculture developed from the Early Classic to Late Classic period, and it maintained a steady and significant rise in population (Healy et al., 1983).

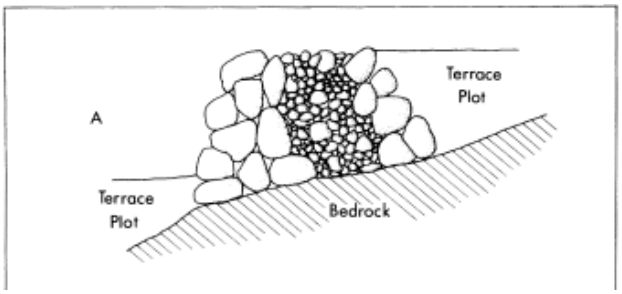

Figure 2 (a). The first method of terrace farming.

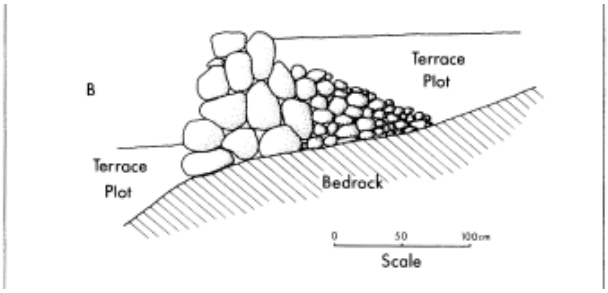

Figure 2 (b). Second method of terrace farming.

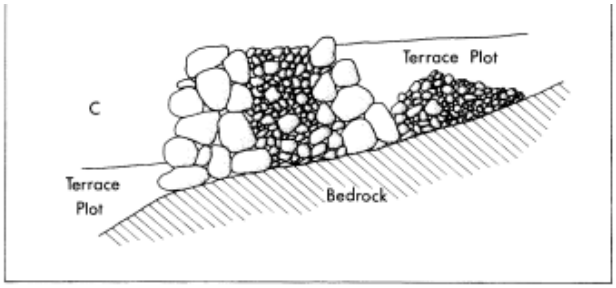

Figure 2 (c). Third method of terrace farming.

Figure 2 a,b,c. Three methods of terrace farming are found in Caracol, Belize.
Source: Healy, P. F., Lambert, J. D. H., Arnason, J. T., & Hebda, R. J. (1983). Caracol, Belize: Evidence of Ancient Maya Agricultural Terraces. Journal of Field Archaeology, 10(4), 397.

The Mayan lowlands made up what is now the Yucatan Peninsula, shown in Figure 3 (Coe 2005). The rough and inconsistent terrain of the Mayan lowlands varied. Compared to the highlands, some regions of the Mayan lowlands were full of dense vegetation like fruit trees, mahogany trees, and sapodillas in a humid tropical climate (Coe 2005). Others were dry and barren, resembling the Sahara. Since the terrain of the lowlands varied greatly from region to region, scholars concluded that the most accurate place to research in the lowlands was Peten. In 1962, researchers demonstrated that the most reliable measurement of sustainability of the lowlands came from Peten. Here they determined that while the lands used by the Mayans had to

be large enough to practice crop rotation, the rest period between rotations was shorter than usual (Cowgill 1962). The use of the land was crucial to the population's survival. With the land available and the agricultural practices used, the Mayans in the lowlands were able to use a square mile of land to sustain about 100 to 200 people (Cowgill 1962). Within a single family, they would be able to cultivate thirteen acres of crops in one year (Cowgill 1962).

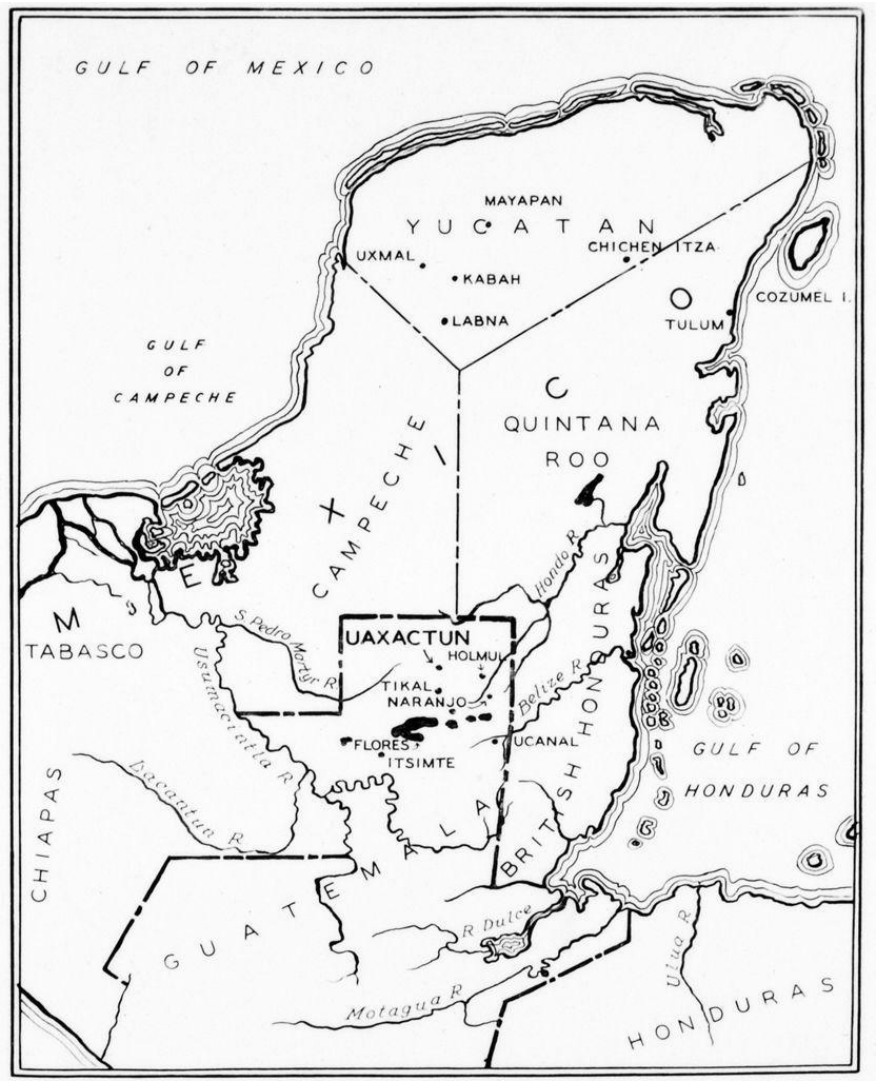

Figure 3. Map of the Yucatan Peninsula
Source: Peabody Museum of Archaeology and Ethnology Collection: Carnegie Institution of Washington, Jstor.

In addition to adapting to the land, the Mayans in the lowlands had to adapt their tools to make the most of the terrain. For instance, the lowlands lacked natural water sources such as lakes, and even though it did have cenotes (Tz'onot) formed by sinkholes from collapsed caves to collect water, the cenotes were rare and not easily accessible (Coe 2005, Figure 4). To sustain a population, the regions of the lowlands would need to have some sort of fresh water source for the people and the crops. Without a natural source of freshwater, the Mayan population created a solution to this challenge. Specifically for the Yucatan Maya, that solution was the chultun (Chultunob), a man-made, bottle-shaped water reservoir that the Maya dug into the limestone to catch and store rainwater (Coe 2005, Figure 5). The people of Puuk for instance, relied on chultun constructed by the Maya by excavating and constructing thousands of underground bottle-shaped cisterns (Bronson 1966). While the primary function of these Chultunob was as a source of fresh water for drinking and irrigation, some studies suggest that someChultunn may have been used as sweat baths, food cellars, and alcohol production (Gray 2000). Another adaptation for agriculture in the lowlands includes the use of steel instead of stone for tool material (Cowgill 1962). Using steel axes and adzes instead of limestone tools allowed for more efficient cultivation of crops and land (Cowgill 1962; Pohl, et al. 1996).

Figure 4. Original description "Mar. 1952. Looking down into the east half of Cenote to structure & stairway to water supply."
Source: Peabody Museum of Archaeology and Ethnology Collection: Carnegie Institution of Washington

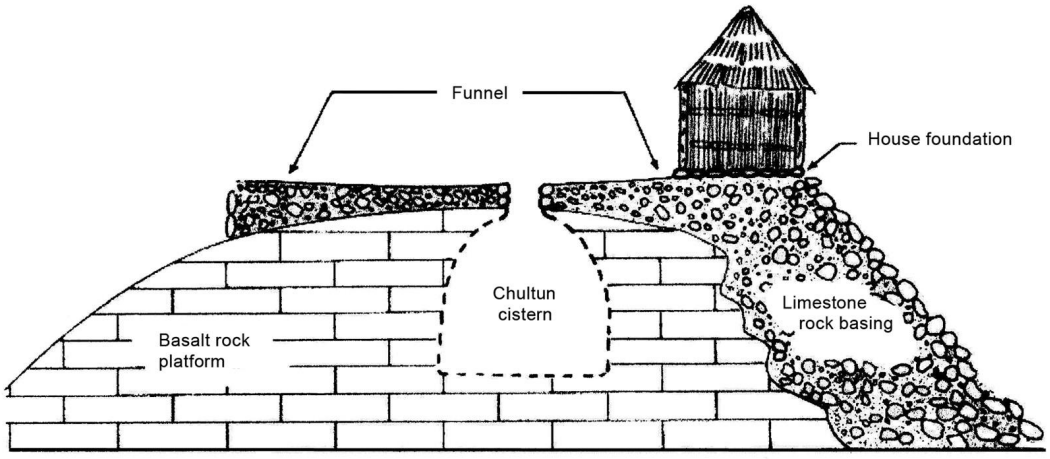

Figure 5. Diagram of a chultunob system in a Mayan civilization.
Source: Website, https://www.latinamericanstudies.org/chultun.htm

As researchers have shown, the various land qualities of the Mayan empire led to numerous agricultural developments that would allow maximum use of the land. The Mayans

adjusted their methods of farming to different regions. For instance, Swidden farming, also known as slash-and-burn agriculture, was common in the wetlands to clear out the vegetation for a farming plain (Turner II 1974). The leftover ashes would create a nutrient-rich soil that would be maintained using methods of crop rotation (Turner 1981; Pohl et al., 1996). The rest periods for the lowlands varied depending upon the vegetation of the area. In Peten, the rest period for the rotations was about four years, a considerably low rest period compared to the average of fifteen to twenty years in other lands (Cowgill 1962). However, the rotation periods varied by region and were dependent on how long it took for the forest to regrow after it had been cut down (Cowgill 1962). Regardless of the difficulties of Mayan swidden farming, researchers concluded that this method of agriculture allowed the Mayan population to thrive and develop into a larger society (Dumond 1961; Cowgill 1962). Swidden farming has been established to be the preferred method of using the land in a tropical environment without depleting the land of its nutrients (Russel 1988).

Raised fields and planting platforms were also common in the wetlands in areas that were too prone to flooding (Turner II 1974). In tropical areas where the soil drains poorly, flooding could affect the area for months at a time (Turner II 1974). The solution used by the Maya was piling up the soil into a small mound of soil that could not be completely covered in water (Turner II 1974). These platforms were man-made features “created by transferring earth to raise an area above the natural terrain” (Turner II and Harrison 1981). For the Mayans, evidence for this form of agriculture was first discovered in the Rio Candelaria basin and later identified in the areas of southern Belize and Quintana Roo, Mexico (Turner II and Harrison 1981). These studies revealed the anthropologists studying the regions of the Mayan lowlands found “at least two distinctive ground patterns are prevalent: quadrilateral shapes in paired rows (Figure 2) and

quadrilateral to amorphous shapes in sectional or group patterns (Figure 3)" (Turner and Harrison 1981). The size and shape of these fields suggest that the Mayan civilization strived to maintain an intense agricultural society and a rising population.

Figure 6. (Fig 2.) Ground pattern created by raised fields in Belize.
Source: L, T. B., & Harrison, P. D. (1981). Prehistoric Raised Field Agriculture in the Maya Lowlands. Science, 213(4506), 399–405.

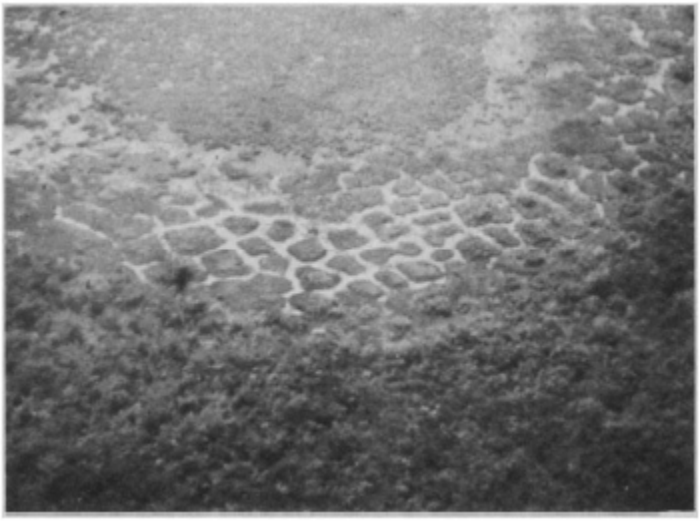

Figure 7. (Fig 3.) Ground pattern created by raised fields in Pulltrouser Swamp, Belize.
Source: L, T. B., & Harrison, P. D. (1981). Prehistoric Raised Field Agriculture in the Maya Lowlands. Science, 213(4506), 399–405. JSTOR.

While the Mayans used various agricultural techniques throughout the region, it is clear that the Primary objective of these advancements was to sustain their growing population. As the population increased so too did the demand for agriculture. Numerous studies have examined how the Mayan population was affected by the changes in agriculture. For instance, a study by Alfred H . Siemens on terrace farming along the Calendaria River concluded that the advancements in agriculture created a province of about ten thousand people (Siemens 1983). Just within Itzamkanac, the capital of the Acalan province, the population rose to about four thousand people, and it was surrounded by about 75 villages (Siemens 1983).

Figure 8. Original caption: View southward across a portion of the Candelaria floodplain.

Source: Siemens, Alfred H. "Wetland Agriculture in Pre-Hispanic Mesoamerica." *Geographical Review* 73, no. 2 (1983): 166–81.

Similarly, geographer B.L Turner II calculated the population capacity for the regions of Campeche and Quintana Roo, both sustained with terrace farming. He first stated the size of these terraces, “Tens of thousands of relic terraces crisscross the hillsides of southern Campeche and Quintana Roo, encompassing an area exceeding 10,000 square kilometers” (Turner II 1974). From this Turner attempted the possible quantity of the population concluding that about twenty-eight to eighty-five people per square kilometer or about seventy-three to two hundred and twenty per square miles resided in the area (Turner II 1974).

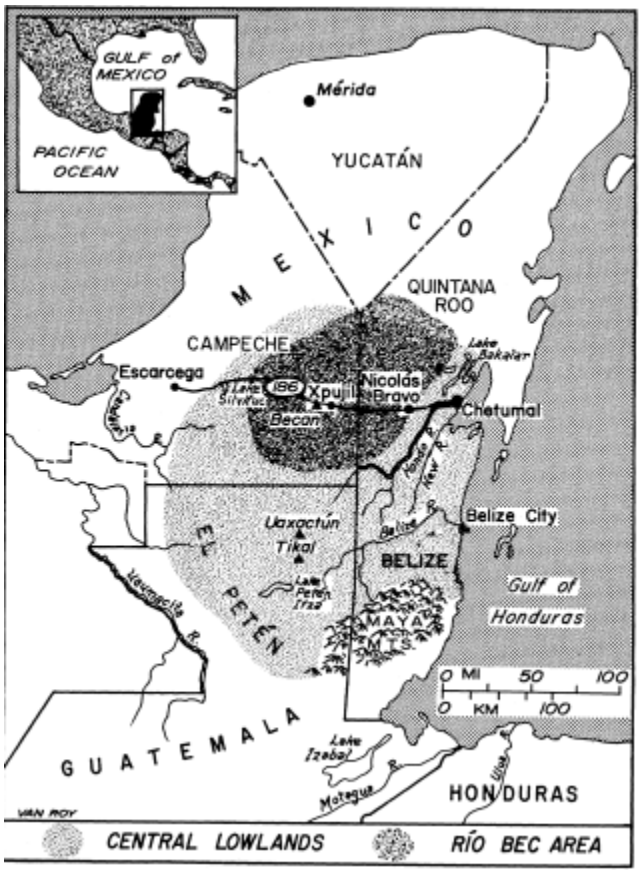

Figure 9. Map of the Mayan Lowlands

Source: Turner, Billie Lee. "Prehistoric Intensive Agriculture in the Mayan Lowlands: Examination of relic terraces and raised fields indicates that the Ro Bec Maya were sophisticated cultivators." Science 185, no. 4146 (1974): 118-124.

Even more research focused on the population of Tikal, calculating a total population of about 11,000 people residing in the area and about 2,400 people living in a square kilometer (Bronson 1966). His conclusions were based on the average amount of milpa that could sustain the population. A single square mile of milpa can support an average of sixty people, so a twenty-mile radius of the land of Tikal should have supported about 75,000 people (Bronson 1966). However, adjusted calculations concluded that only about three-fourths of the region was arable, so the more accurate estimate would have been about 56,000 people in a twenty-mile radius of land (Bronson 1966).

While the study of Mayan agricultural practices provides crucial insights into this remarkable civilization, researchers face significant challenges. First, it is difficult to find and study materials that have degraded over time due to the environment. This limits the physical evidence researchers have to study the Mayan civilizations. Second, analyzing and interpreting the evidence can be difficult if there is a lack of written records that could be examined and a lack of contextual information for those records. Furthermore, it is difficult to conduct research on the research available because of the sparse findings and lack of current information. These limitations affect the ability to examine the complexity of ancient agricultural systems and highlight the need for continued research approaches.

The agricultural innovations of the Mayan civilization represent a remarkable testament to human adaptability and agricultural ingenuity. Throughout their expansive territory, spanning diverse landscapes from the highlands of Guatemala to the lowlands of the Yucatan Peninsula, the Maya developed sophisticated agricultural techniques that allowed them to sustain and grow their population across multiple ecological zones. The agricultural strategies employed by the Maya were far more complex than simple subsistence farming. Terrace farming showed an

advanced understanding of soil conservation and land management. In the lowlands, the development of chultunob water collection systems and raised field platforms revealed the civilization's ability to surpass environmental challenges.

Furthermore, population data from various Mayan regions illustrates the efficiency of these agricultural techniques. From Tikal to Itzamkanac, archaeological and historical research suggests that Mayan agricultural methods could support population densities of 60 to 220 people per square mile—a remarkable achievement for pre-industrial agricultural societies. The ability to cultivate crops in challenging terrains, including flood-prone wetlands and volcanic highlands, demonstrates the Mayans' deep knowledge and innovation.

Moreover, these agricultural innovations were not isolated technological achievements but integral to the broader Mayan social and cultural framework. The ability to consistently produce agricultural surplus supported the development of strong social structures, architecture, and advanced mathematical knowledge. Agricultural productivity was intimately linked to the Mayans' broader cultural and technological achievements. The methods developed by the Maya, including terrace farming, raised field platforms, water management systems, and advanced crop rotation techniques, represent an ingenious approach to environmental management. While the ultimate decline of the Mayan civilization remains a subject popular among scholars, their agricultural innovations provide profound insights into human adaptability and ecological understanding. In essence, the Mayan agricultural system stands as a powerful reminder of human creativity, adaptability, and the potential for sustainable ecological interaction. Their techniques offer valuable lessons for contemporary agricultural and environmental challenges, demonstrating that innovative, context-specific solutions can transform seemingly inhospitable landscapes into productive, life-sustaining environments.

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