

Collapse of Maya City-States: Environmental, Economic, and Cultural Conditions

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Whether nestled deep within the forests or buried underneath modern Mexico City, the ruins of the Maya and Aztec civilizations have inspired fables, folklore, and fact-seeking. Human sacrifice, colossal temples, and self-mutilation have become synonymous with both the Maya and the Aztecs. Great ruins stand as testament to Maya and Aztec existence—vastness, enormity—but how did they become *ruins*? It seems almost as though the same people who mastered astronomy, built planned cities, perfected language and writing, and worshipped an entire pantheon of long-lived deities vanished into the night. The Maya case was different than that of the Aztec, but the outcome the same. The Maya civilization appears to have collapsed amid proliferation while the young Aztec Empire was vanquished by the sword (and gun) of Spanish invaders. Environmental and population stresses served as the catalyst in weakening both civilizations: to preface a more detailed discussion, “There must have been many more people in Mexico¹ during the Classic² than formerly. There were forty times as many inhabitants of the area than in the Middle Preclassic.”³ In addition to environmental and agricultural pressures, an increasingly stratified society placed economic burdens on non-elites. Religious institutions justified the existence of a detrimental hierarchy: a supposedly mutually-beneficial ‘contract’ existed between rulers and the ruled that exchanged the king’s ability to communicate with the gods (to request rain) for all others supporting and perpetuating his lifestyle.⁴

This paper will explore how the coupling of human-caused stresses on the environment with internally increasing economic pressures contributed to the downfall of the Maya civilization. Several sites will be examined because of the diversity of problems that existed in specific geographies. The Maya will be given focus from many angles: first, the geography and climate will be considered, followed by a section on the city Teotihuacan.

Teotihuacan’s collapse will be deconstructed from both sociological and agricultural perspectives. Likewise, the institutional and environmental factors for Copán’s parallel collapse will be investigated. Finally, the droughts that both Teotihuacan and Copán, among other cities, were subject to are examined as a cause of collapse. Although this paper focuses on the anthropocentric forces that caused the downfall of the Maya, the Aztec, whose empire was very short-lived compared to the longevity of the Maya, will be referenced for colloquial comparisons. The Aztecs offer perhaps a more famous example of how human institutions helped bring about collapse, so when appropriate, they will be referenced to illustrate the problems the Maya both faced and created.

Along with cultural stereotypes come geographic stereotypes. This essay may have ominously begun, *Deep within the Jungles of Mexico*, but that would have been inaccurate. Indeed, many Maya ruins have been swallowed by ‘jungle,’ (i.e. vegetation run amok) but as Diamond points out, ‘jungle’ is another term for ‘tropical rainforest.’⁵ Maya sites, however, are more than a thousand miles from the equator, and were never wet year-round.⁶ The classification for these sites, based upon latitudes between 17° and 22°N, is ‘seasonal tropical rainforest’; this entails a rainy season from May to October, and a dry season from January to April.⁷ Taking this into consideration, “If one focuses on the wet months, one calls the Maya homeland a ‘seasonal tropical forest’; if one focuses on the dry months, one could instead describe it as a ‘seasonal desert.’”⁸ Furthermore, Maya sites are scattered along both the Mexican highlands, dotted with mountains and volcanoes, and the coastal lowlands. The Maya experienced “All the climatic extremes of our globe,”⁹ meaning that “no region...was...truly self-sufficient.”¹⁰

This diversity of climate both geographical and temporal, created agricultural strains once population expanded and population density

intensified. Because population problems began to escalate during the Classic Period, examination of human-caused stresses will begin there. The span of the Maya Classic Period is typically given as AD 250-900. However, construction of the Classic urban center Teotihuacan began long before AD 250, and had been abandoned before the decline of the last Classic cities.¹¹

In order to understand what befell the Maya, it is imperative to understand what role Teotihuacan and its citizens played. At its height, Teotihuacan's population may have been 125,000 people, and in AD 550, would have been the sixth-largest city in the world.¹² The metropolis was a planned city: the grid was laid out in the first century by "sophisticated surveyors,"¹³ and the urban center covered 8 sq. miles. The major axis, the Avenue of the Dead, is bisected by another, equally-long avenue, dividing the city into quadrants.¹⁴ Along these avenues are the monumental structures the Pyramid of the Sun, the Pyramid of the Moon, and the Temple of Quetzalcoatl, all of which conform to the orientation of the axes.¹⁵ The interior of the Pyramid of the Sun is filled with more than 41,000,000 cu. ft of sun-dried brick and rubble.¹⁶ These three massive buildings only serve as examples of the type that saturated Teotihuacan.

All religious concerns aside, the sheer amount of this type of architecture weakened the ability for Teotihuacan to sustain itself. As Mary Ellen Miller, a Mesoamerican art historian at Yale University, succinctly observes:

Constant rain and water crises at Teotihuacan probably exacerbated the difficulty of building and maintaining the city. The preparation of lime for mortar and stucco requires vast amounts of firewood to burn limestone or seashells, and the more Teotihuacan grew, the more the surrounding forests were depleted. With deforestation came soil erosion, drought, and crop failure. In response, Teotihuacan may have erected ever more temples...thus perpetuating the cycle.¹⁷

Chris Harman adds that although these structures "would have been ever-present symbols of the power, the permanence and the stability of the state,"¹⁸ they "allowed the ruling class to believe its power was eternal and unquestionable as the movement of the sun and the stars, while reinforcing feelings of powerlessness and insignificance among

the mass of people."¹⁹ Indeed, the self-perpetuating cycle of construction and environmental devastation stemmed from the elite, the commissioners of temples and pyramids. The reasons for these commissions were political: "competition among kings and nobles...led to a chronic emphasis on war and erecting monuments;" these monuments were built "rather than solving...underlying problems."²⁰ The proliferation of conspicuous, propagandist architecture also led to economic malaise by inefficiently allocating both materials and labor.

The rich lords and nobles were not only preoccupied with building the grandest monuments (Not unlike our own society, to put one's name on the biggest or best of something is to make a statement about one's own social superiority). Many Teotihuacanos lived in walled residential compounds, which were further divided into apartments.²¹ These compounds are telling of both social stratification and some kind of commercial segregation: "The differences in construction, decoration, and room size indicate a rather large range of wealth and status...it seems that the compounds were grouped into something like wards based upon kinship and / or commercial interests."²² Coe and Koontz suggest that economic specialization (further implying division of labor) and social planning would have been necessary to coordinate so many compounds. One may further argue that it would have been the monarch that decided a family's trade, as males typically stayed with the family's compound. Perhaps this imposed specialization limited the exchange of information and products.

The nobility, though, ever-interested in self-propagandizing (to legitimate their wealth and power), lived in "larger and more richly decorated residences mainly found grouped around the Avenue of the Dead."²³ Some of these murals are adorned with depictions of the so-called Teotihuacan Spider Woman—the "supreme deity of the Teotihuacanos" and the creator of the universe.²⁴ These depictions may be absent from others' housing for several reasons. First, the nobility may have taken 'ownership' of her, thereby disallowing others from portraying her. Second, the nobility favored depictions of this particular goddess because they aligned themselves with her power. It may have simply been 'inaccurate' for lower classes to paint her. (We think of particular groups aligning themselves with certain patron saints in a Judeo-Christian society.) Because the nobility aligned

with her—and therefore with the origins of their universe—they attempted to affirm their power through the goddess.

The afore-discussed social stratification²⁵ was especially disadvantageous in agriculture and resource allocation for two reasons: first, extreme stratification removed potential farmers from the labor pool, increasing the stress on each farmer to produce enough surplus, and second, the growing bureaucracy intensified population density since these members of society would have no need to leave a particular location to find land suitable for farming. The repercussions of the former problem are numerous.

With pressure to produce adequate surplus, farmers resorted to slash-and-burn (or swidden) agriculture.²⁶ While this was not their only means of production, this technique quickly devastated the future use of the land. Maya swidden agriculture involved several destructive measures: “forest is cleared and burned, crops are grown in the resulting field for a year or a few years until the soil is exhausted, and then the field is abandoned for a long fallow period of 15 or 20 years until regrowth of wild vegetation restores fertility to the soil.”²⁷ Under ‘optimal’ conditions, “most of the landscape... is fallow at any given time.”²⁸ However, because population density was much higher than what swidden agriculture can support, other measures were undertaken. Some sites employed irrigation systems, terraced hill slopes to retain soil, or fertilizing fields; others, however, including the cities of Copán and Tikal, did not employ these methods.²⁹ Instead, one component of their agricultural approach was “in the extreme omitting the fallow period entirely and growing crops every year, or in especially moist areas growing two crops per year.”³⁰ The inhabitants of such cities, to their detriment, discounted the future use of fertile soil too highly because of stresses for immediate production and consumption.

One may argue that agricultural land was treated as a commons. Despite a vaguely understood residential division, the Maya failed to enforce a system of private ownership of this agricultural property. A noble’s probable *claim* to the land was not successful as more and more inhabitants encroached upon fertile soil. That the proper owner—if there even was one—failed to enforce his property rights would have contributed to the land being used inefficiently. This is because “An owner of a resource with a well-defined property right...has

a powerful incentive to use that resource efficiently because a decline in the value of that resource represents a personal loss.”³¹ When the soil ceases to be excludable, and is treated as a commons, “stability may be the exception rather than the rule, particularly in the face of heavy population pressure.”³² This would have been problematic for the Maya because they coupled undiminished population growth with exploitation of fertile land. As a result, less and less fertile land was brought into production and each yield thereafter was less and less valuable in terms of nutrition. Land would be exploited because no one individual, and therefore society at large, would have any incentive to conserve. Unrestricted access would also mean that no one individual would face the opportunity cost for exploiting and exhausting fertile soil, so no one individual (and therefore nobody) considers it when choosing their course of action. The situation results in the Garrett Hardin-described ‘Tragedy of the Commons,’ in which each person drives net benefits to zero—the opposite of optimization.³³

It would be inaccurate to suggest that the Maya were purposefully neglectful of agricultural consequences. Indeed, intercropping (“growing several complementary species such as maize and beans together”³⁴) supplemented swidden output. Additionally, hydraulic modification of the landscape allowed for irrigation and drained “excess water from saturated soils to allow for better growth.”³⁵ The unpredictability of rain made this technique especially valuable. Ultimately, however, “continued population increases eventually could be accommodated only by intensification.”³⁶ The need for intensification was also partly the fault of the Maya diet. Elite and non-elite alike relied on maize as a dietary staple, but it is low in protein (especially relative to Old World wheat and barley).³⁷ Maya maize agriculture was also less productive than the Aztecs’ chinampas (also referred to by the misnomer ‘floating gardens’), or raised-field agriculture. Mesoamerica lacked large animals (such as cows, pigs, and goats) to supplement maize’s lack of protein, and the humid climate made it impossible to stockpile maize for over a year³⁸—in case of an especially long drought, the previous year’s surplus would be useless.

This monarchical system failed to achieve an efficient allocation of resources in the face of population surges and scarce fertile land. The population pressures meant that lands previously set aside to lay fallow were brought into use too soon

or too frequently. Greed among the aristocracy led to peasants needing to farm more in order to satisfy both their own needs and the demands of rulers for tribute. Intertemporal inefficiency is evident in the quick abandoning of acidic hillside soils. As Tietenberg and Lewis note, "Dynamic efficiency balances present and future uses of a depletable resource by maximizing the present value of the net benefits derived from its uses. This implies a particular allocation of the resource across time."³⁹ However, future demand was not considered when bringing all possible land into use.

In disregarding future uses of and demand for fertile land, the 'sustainability criterion' was also not met. The 'sustainability criterion' states that "future generations should be left no worse off than current generations. Allocations that impoverish future generations, in order to enrich current generations, are, according to this criterion, patently unfair."⁴⁰ It is safe to assume that the later generations were neglected (no matter if it was intentional or not) because at any given moment, at maximum populations, no land was left out of production in order to preserve its inherent net benefits for later use. Disregarding a resource's future net benefits to the detriment of future uses indicates inefficient intertemporal allocation.

This may have been the result of government inefficiencies. A monarchical system would not necessarily seek to harmonize marginal cost with marginal benefits, particularly in the presence of a potentially rent-seeking noble class. After all, the basis for government failure is improper incentives.⁴¹ Inefficient allocation of resources did not affect the ruler the same way it would the farmer exploiting the land. In a stringently separated social order, the monarch would not have the proper incentive himself to enforce property rights so long as he was fed. Unaware of the long-term repercussions of ignoring soil exploitation, he may have viewed *maximum*, as opposed to *optimal*, planting and harvesting as the most appealing.

The environmental consequences of exhaustive agriculture are especially evident in Copán.⁴² Copán's ruins lie in western Honduras; during the Classic period, its geography was divided into five areas of flat land which was surrounded by steep hills.⁴³ Between the fifth century and AD 750-900, population grew steeply,⁴⁴ forcing inhabitants from fertile valleys to the hills by 650. However, hill sites were cultivated for only a century because hill slopes eroded and leached nutrients, and because, "those

acidic infertile hill soils were being carried down into the valley and blanketing the more fertile valley soils, where they would have reduced agricultural yields."⁴⁵ The reasons for hillside erosion were not entirely agricultural. Entire pine forests were cleared: most felled trees were "burned for fuel, while the rest were used for construction or for making plaster."⁴⁶ It was the vogue among the elite to use copious amounts of plaster to coat buildings.

The tale of the elite at Copán sounds very similar to that of the elite at Teotihuacan. Incidentally, written records indicate that as early as AD 426, relatives of Teotihuacan elites came to Copán,⁴⁷ between 500 and 650, Teotihuacan's central temple precinct was burned and the city sacked⁴⁸—incidents surely not unrelated to the inability for the elite to provide security and prosperity. Relatives of these elites, then, fled to Copán just in time to repeat their habits elsewhere. Indeed, just as at Teotihuacan, "Construction of royal monuments glorifying kings was especially massive between A.D. 650 and 750,"⁴⁹ and after 700, nobles erected palaces of their own. This is important because these nobles (and the stratification they represented) and their palaces (which could accommodate up to 250 people⁵⁰) only inflicted more pressure on the productive non-elite. By 800, the last monumental structures were built, a brief 100 years since nobles began the practice. That incessant building and problematic erosion occurred simultaneously is not coincidence, as the elite's demand for luxury products (such as plaster for buildings) furthered deforestation.

It appears that Copán's elite did not exploit the environment without personal consequence: the repercussions of their consumption indirectly brought about their exodus. Because of the poor condition of agricultural fields in the hills, along with the dramatic decrease in rainfall caused by deforestation, people returned to farm the valleys. However, total populations were higher than when the valleys alone were occupied, so this left peasants fighting for the best land, if any land.⁵¹ Like in Teotihuacan, the king's luxuries were justified because he promised to bring rain and prosperity⁵² through his communication with the gods. But because the king and nobles failed to provide, the elite were ousted: "the last we hear from any Copán king is A.D. 822,"⁵³ by 850, the royal palace was set aflame.

This example of Copán's collapse is more correctly described as the collapse of Copán's elite

and the collapse of a lifestyle enjoyed without regard to the non-elite or the environment. Although the deforestation that caused upwards of 41% of the peak population⁵⁴ to move back into the valley resulted in somewhat of a Malthusian population crash, Copán did not experience complete abandonment until A.D. 1250. Indeed, in 950, long after the end of a highly stratified society, the population was about 15,000, "or 54% of the peak population of 27,000."⁵⁵ These numbers suggest that it was the demands of the elite for both agricultural surplus and luxury items that sent people to exploit the infertile hills. Second, they also suggest that once the elite were ousted, the population in the valley returned to the optimal number of people that the land could healthily sustain. Coe and Koontz suggest a combination of causes for the depopulation of Maya sites. Some people would have been famine casualties. Some simply left the city, abandoning organized society and seeking refuge in other regions. Further yet, depopulation was realized because of high infant and child mortality.⁵⁶ After 1250, "The reappearance of pollen from forest trees thereafter provides independent evidence that the valley became virtually empty of people, and that the forests could at last begin to recover."⁵⁷

To preface the discussion on water sources and droughts as protectors from and catalysts for collapse (respectively), it must be noted first what an intricate system of cities—*independent entities*—Maya sites have proven to be. There was no one unified 'Maya Empire' so the exact parameters of collapse(s) are somewhat amorphous. In some instances, "What collapsed quickly during the Classic collapse was the institution of kingship,"⁵⁸ as evidenced by Copán. Additionally, the vastness of the Classic period meant that some cities, like Teotihuacan, had begun the process of depopulation before other cities had been settled. However, what is known is that after AD 800, Mesoamerica saw "the disappearance of between 90 and 99% of the Maya population...and the disappearance of kings, Long Count Calendars, and other complex political and cultural institutions."⁵⁹ No matter the soil-exhausting agricultural techniques, the deforestation, or the social tensions, there were other geological features and events that contributed to Maya collapse.

The Maya heartland frequently cycled between wet and dry conditions. Although the beginning of the Early Classic period is determined by the proliferation of social and political

phenomena (i.e. royal dynasties and complex calendrical systems), the cause of said proliferation may be attributed to the return of non-drought conditions, which also occurred around 250 AD.⁶⁰ Indeed, drought conditions returned around the beginning of the Late Classic period, 600 AD, when rulers from Palenque sought to expand their borders. As previously mentioned, 800 AD witnessed the beginning of the population crash that would last for approximately the next century and a half. Based on radiocarbon-dated layers from lake sediment cores and other paleoecological and climatological data, the myth of 'The Drought' of 800 was actually four droughts, with the latter three occurring in the decade of 810-820, again in 860, and finally, in 910.⁶¹ Inscribed dates on stone monuments indicate that collapse dates coincide with these drought dates,⁶² and in terms of specific cities, "It would not be at all surprising if a drought in any given year varied locally in its severity, hence if a series of droughts caused different Maya centers to collapse in different years, while sparing centers with reliable water supplies such as cenotes, wells, and lakes."⁶³

In drought scenarios, geological variation plays an important role. The Maya region was divided into the highlands in the south and flatlands further north. Although there is a supply of freshwater under much of the Maya region, only the northern cities would have low enough sinkholes, or cenotes, to access this water.⁶⁴ Even in northern cities where cenotes did not exist, wells could be dug up to seventy-five feet deep.⁶⁵ The southern cities were disadvantaged not only for their lack of wells and cenotes but also because the topography is littered with karst, "a porous sponge-like limestone terrain where rain runs straight into the ground and where little or no surface water remains available."⁶⁶ Although the southern Maya ameliorated this unfortunate terrain by plugging it to create reservoirs, this method would be for naught in the face of repeated droughts. Although the city of Tikal created reservoirs ample enough to sustain 10,000 people for eighteen months,⁶⁷ starvation would have been problematic because crops would require rainwater, not reservoir water; additionally, the second drought lasted for a decade, during which time these immodest stores of water would have been consumed before the drought began its second year. As Diamond notes:

The area most affected by the Classic collapse was the southern lowlands, probably... [because] it was the area with the densest population, and it may also have had the most severe water problems because it lay too high above the water table for water to be obtained from cenotes or wells when the rains failed. The southern lowlands lost more than 99% of their population in the course of the Classic collapse.⁶⁸

Although no data is available to compare Classic withdrawal rates of surface water and groundwater versus rainfall and recharge rates, it may be inferred that the population strains led to greater exploitation of already-scarce water supplies. Reservoirs may also have been treated as an open-access resource, meaning each member of society has equal access to the water but with every incentive to use as much as possible for himself—thus causing an inefficient allocation of water. Tietenberg and Lewis note, “Tapping an open-access resource will tend to deplete it too rapidly.”⁶⁹ Using cenotes and reservoirs

as open-access resources would exacerbate the severity of droughts, leading to quicker onslaught of drought-induced famine and thirst and ultimately, depopulation.

Depopulation never resulted in the complete disappearance of the Maya. However, by the time of the Mexica (Aztec) emergence several centuries later (Tenochtitlan was founded approximately in the mid-fourteenth century), the grandeur of Maya city-states survived as nothing more than a myth. One song began, “And they called it Teotihuacan / because it was the place / where the lords were buried.”⁷⁰ No matter its deforestation and exploitation of reservoirs and agricultural land, Teotihuacan served as a model city, albeit an abandoned one. However, more than ruins survive. Teotihuacan, along with the numerous other Maya city-states (both known and unknown), is a didactic ghost: Malthusian population crashes have been attributed to human activity. Once the pressures exerted on the environment become too great, it is the societal and institutional structures that must be sacrificed.

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Endnotes

¹ While Maya and Aztec excavations span present-day Mexico, Belize, Guatemala, Nicaragua, and Honduras, this paper discusses primarily sites in Mexico.

² The Classic period is broadly defined as 250-900 AD. Some scholars further divide the period, with 250-600 being the Early Classic, and 600-900 the Late Classic. However, use of the term ‘Classic’ correlates to when the Maya were inscribing Long Count dates on monuments which pertain to a well-defined, systematic calendrical system). The widespread use Long Count dates, architecture with corbelled vaults, and ruler portraiture constitute the beginning of the Classic period. Around 600, rulers in the western city of Palenque furthered the scope of Maya territory, marking the transition to Late Classic. For this paper’s intents and purposes, the term ‘Classic’ will suffice. More specific dates are provided as relevant.

³ Michael D. Coe and Rex Koontz, *Mexico: From the Olmecs to the Aztecs*, 5th ed. (New York: Thames & Hudson, Inc., 2002), 102.

⁴ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 167.

⁵ *Ibid.*, 160.

⁶ *Ibid.*

⁷ *Ibid.*

⁸ *Ibid.*

⁹ Michael D. Coe and Rex Koontz, *Mexico: From the Olmecs to the Aztecs*, 5th ed. (New York: Thames & Hudson, Inc., 2002), 12.

¹⁰ *Ibid.*, 13.

¹¹ *Ibid.*, 101.

¹² Mary Ellen Miller, *The Art of Mesoamerica: From Olmec to Aztec*, 4th ed. (London: Thames & Hudson, 2006), 70-71.

¹³ Michael D. Coe and Rex Koontz, *Mexico: From the Olmecs to the Aztecs*, 5th ed. (New York: Thames & Hudson, Inc., 2002), 106.

¹⁴ *Ibid.*

¹⁵ *Ibid.*

¹⁶ *Ibid.*, 106-107.

¹⁷ Mary Ellen Miller, *The Art of Mesoamerica: From Olmec to Aztec*, 4th ed. (London: Thames & Hudson, 2006), 70-71.

- ¹⁸ Chris Harman, *A People's History of the World*. (London: Verso, 2008), 82.
- ¹⁹ *Ibid.*
- ²⁰ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 160.
- ²¹ Michael D. Coe and Rex Koontz, *Mexico: From the Olmecs to the Aztecs*, 5th ed. (New York: Thames & Hudson, Inc., 2002), 111.
- ²² *Ibid.*
- ²³ *Ibid.*, 112.
- ²⁴ *Ibid.*, 113.
- ²⁵ Although Teotihuacan's stratification in particular was examined, social hierarchy was not limited to that city. Therefore, this section will look at social stratification in general as it pertained to all Classic-era Maya sites.
- ²⁶ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 163.
- ²⁷ *Ibid.*
- ²⁸ *Ibid.*
- ²⁹ *Ibid.*
- ³⁰ *Ibid.*
- ³¹ Tom Tietenberg and Lynne Lewis, *Environmental and Natural Resource Economics*, 8th ed. (Boston: Pearson Education, Inc., 2009), 66.
- ³² *Ibid.*, 74.
- ³³ Dr. David Wishart, Class lecture, February 16, 2009.
- ³⁴ Robert J. Sharer with Loa P. Traxler, *The Ancient Maya*, 6th ed. (Stanford: Stanford University Press, 2006), 642.
- ³⁵ *Ibid.*, 647.
- ³⁶ *Ibid.*, 649.
- ³⁷ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 164.
- ³⁸ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 164.
- ³⁹ Tom Tietenberg and Lynne Lewis, *Environmental and Natural Resource Economics*, 8th ed. (Boston: Pearson Education, Inc., 2009), 93.
- ⁴⁰ *Ibid.*, 98.
- ⁴¹ *Ibid.*, 82.
- ⁴² Teotihuacan's dominance pervaded the kingdom of Copán, which adopted Teotihuacan stele and monument symbolism, to minimally cite the metropolis's influence. (Coe 119)
- ⁴³ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 168.
- ⁴⁴ *Ibid.*
- ⁴⁵ *Ibid.*, 169.
- ⁴⁶ *Ibid.*
- ⁴⁷ *Ibid.*, 168.
- ⁴⁸ Mary Ellen Miller, *The Art of Mesoamerica: From Olmec to Aztec*, 4th ed. (London: Thames & Hudson, 2006), 86.
- ⁴⁹ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 168.
- ⁵⁰ *Ibid.*, 169.
- ⁵¹ *Ibid.*, 170.
- ⁵² *Ibid.*
- ⁵³ *Ibid.*
- ⁵⁴ *Ibid.*, 169.
- ⁵⁵ *Ibid.*, 170.
- ⁵⁶ Michael D. Coe and Rex Koontz, *Mexico: From the Olmecs to the Aztecs*, 5th ed. (New York: Thames & Hudson, Inc., 2002), 120.
- ⁵⁷ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 170.
- ⁵⁸ *Ibid.*, 171.
- ⁵⁹ *Ibid.*, 172.
- ⁶⁰ Jared Diamond, *Collapse*. (New York: Penguin Group, 2005), 173.
- ⁶¹ *Ibid.*, 173-174.
- ⁶² *Ibid.*, 174.
- ⁶³ *Ibid.*
- ⁶⁴ *Ibid.*, 162
- ⁶⁵ *Ibid.*
- ⁶⁶ *Ibid.*
- ⁶⁷ *Ibid.*
- ⁶⁸ *Ibid.*, 175.
- ⁶⁹ Tom Tietenberg and Lynne Lewis, *Environmental and Natural Resource Economics*, 8th ed. (Boston: Pearson Education, Inc., 2009), 227.
- ⁷⁰ Michael D. Coe and Rex Koontz, *Mexico: From the Olmecs to the Aztecs*, 5th ed. (New York: Thames & Hudson, Inc., 2002), 120.