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Sustainable agrarian urbanism: The low-density cities of the Mayas and Aztecs

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ARTICLE INFO

Article history:

Received 10 January 2012

Received in revised form 5 July 2012

Accepted 29 July 2012

Available online 28 August 2012

Keywords:

Maya

Aztec

Urban sustainability

Urban agriculture

Ancient cities

Archaeology

ABSTRACT

Maya and Aztec cities exhibited a distinctive kind of low-density urbanism common in ancient Mesoamerica. The non-monumental components of these cities differed from the high-density ancient and historical cities in the Old World that are often considered the norm for pre-modern urbanism. Distinctive features include the practice of intensive agricultural cultivation within urban settlements, residential zones that were dispersed and unplanned, and the arrangement of houses into spatial clusters that served as urban neighborhoods. The residential areas of Maya and Aztec cities resembled modern peri-urban zones and informal settlements. Because of the benefits of smallholder intensive urban agriculture, cities thrived for many centuries, and some were successful for millennia. On the basis of this longevity, we argue that these were sustainable cities, and their form and dynamics may hold lessons for understanding contemporary urbanization processes.

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Introduction

The dramatically increasing levels of urbanization around the world today generate concern for the sustainability and future situation of cities. Urban problems such as crime, poverty, crowding, malnutrition, access to services, and environmental damage often seem intractable and resistant to change. In order to better understand and address such issues, we suggest that scholars and planners draw from as wide a range of examples and models as possible. Yet much current practice in urban studies avoids comparative and historical perspectives (Bowen, Dunn, & Kasdan, 2010; for comment, see Harris & Smith, 2011), focusing almost exclusively on modern western cities. Furthermore, much of the urban research that is labeled “comparative” limits itself to mega-cities of the past few centuries in the higher latitudes. Urbanization, however, has been a global process for several millennia.

Archaeologists have now excavated and mapped a large sample of ancient cities, revealing a remarkable social and spatial diversity in the configuration of past cities (e.g., Marcus & Sabloff, 2008; Sinclair, Nordquist, Herschend, & Isendahl, 2010). Hence, it is no surprise that urban scholars have started to call for a broader historical and geographical range of comparison and analysis (Nijman, 2007; York et al., 2011). In this paper we take up the call and present the Maya and Aztec cities of ancient Mesoamerica as a distinctive urban type relevant to understanding tropical cities of the modern world.

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Archaeology and low-density urbanism

Maya and Aztec cities were part of the Mesoamerican urban tradition. Mesoamerica is a culture area that covered the region from north-central Mexico to Costa Rica. The Classic Maya (c. AD 250–1000) and the Postclassic Aztec (c. AD 1100–1500) are the best-known and most extensively studied societies of Mesoamerica (Fig. 1), although major cities like Teotihuacan and Monte Alban have also been the targets of considerable archaeological fieldwork. Many Maya and Aztec cities were capitals of polities ruled by hereditary kings. Society was socially stratified, with major distinctions between elites and commoners. Both cultures had written languages, although the range of phenomena covered in surviving texts is quite limited. Wheeled transport and beasts of burden were lacking, which affected urban food supply and commercial exchange. In comparative terms, Maya and Aztec societies shared many traits with the early urban societies of Mesopotamia and Egypt (Trigger, 2003).

In the modern world, most cities have high population densities, and low-density urban settlement is associated with suburban sprawl, typically viewed as a non-sustainable form of urban settlement in the 19th and 20th century cities of the United States (Hayden, 2004). Maya and Aztec cities had low population densities, which has led some scholars to question their urban status. Scholarly definitions of city and urbanism can be divided into two broad approaches: demographic and functional. According to the first approach, cities must have large, dense populations. If so, then the settlements of the Mayas and Aztecs—and many other pre-modern societies throughout Africa, Asia, and Latin America—cannot be

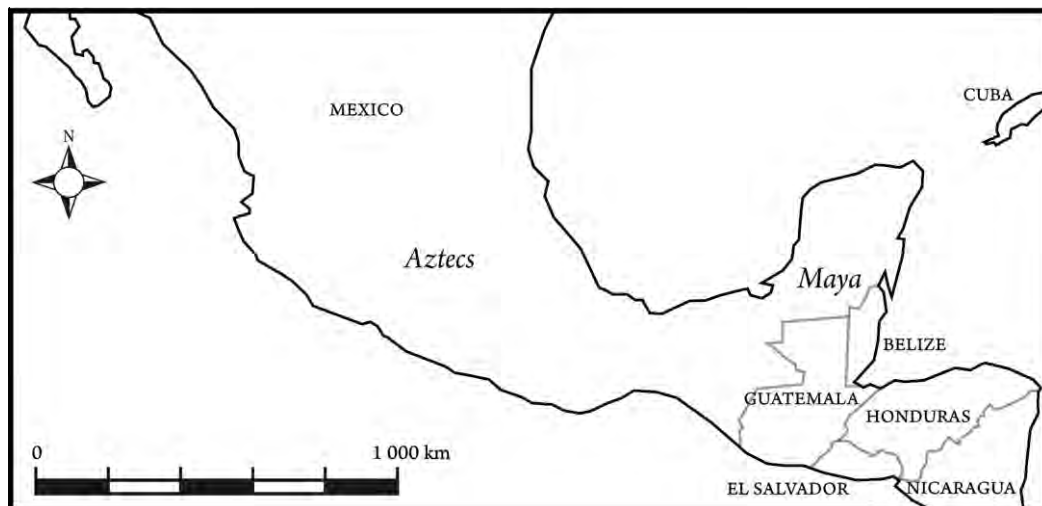


Fig. 1. Map of Mesoamerica showing the regions of focus in this paper (plan by Christian Isendahl).

considered urban in nature (Sanders & Webster, 1988). The functional approach, on the other hand, defines cities and urban not by population size, but by the presence of activities and institutions that affect a wider hinterland (Marcus, 1983). It is only from this perspective that the concept of “low-density urbanism” makes sense. The Maya and Aztec kings ruled extensive polities from their palaces, and the associated temples and markets served a hinterland that extended beyond the immediate settlement. Nevertheless, the rather low populations and densities of these settlements—features which inspired some scholars to deny their urban status (Sanders & Webster, 1988; Willey, 1962)—are striking.

Partly because of the dominance of high-density cities in the western tradition, scholars have been slow to explore the nature of low-density cities in comparative or theoretical terms. This paper is part of a broader effort toward that task. One line of research is spearheaded by Roland Fletcher, who has identified a small group of ancient cities in tropical forest settings (Angkor and other ancient Khmer cities; Bagan, and Anuradhapura in South and Southeast Asia; and the cities of the Classic-period southern Maya lowlands) that share a number of characteristics. These traits include centers with numerous monumental stone temples surrounded by large homogeneous areas of sprawling low-density settlement, with considerable agricultural modification of the landscape (forest clearing and infrastructure construction). Fletcher (2009) calls this phenomenon “low-density agrarian-based urbanism.” The histories of these cities generally form cycles of growth, decline, and reorganization that involve complex social-ecological system dynamics that are not understood in detail in every case. Economic and political growth dependencies seem however to be important factors in eroding long-term urban resilience capacity (Costanza, Graumlich, & Steffen, 2007; Tainter, 1988; Turchin, 2003).

We argue that “low-density urbanism” is a broader category that includes many more examples than Fletcher discusses. In Mesoamerica alone, most ancient cities fall into the low-density group. Many of the early cities in South America, Africa, and Southeast Asia can also be characterized as low-density cities. Archaeologists and historians working in these areas have generated considerable information on this ancient urban form, but comparative analysis has only recently begun. One emerging focus in this comparative effort is the identification of urban gardens and orchards (Stark & Ossa, 2007). The farming activity and dispersed settlement in these cities resemble the peri-urban zones that

surround many cities in the developing world today (Simon, 2008), and these features provide a comparative link to modern urban concerns.

Urban agriculture and the sustainability of Mesoamerican cities

Maya and Aztec urbanism can be described as “sustainable” in that cities often flourished for many centuries, even millennia. The longevity of settlements and societies is an important component in many definitions of sustainability (Grant, 2004; Patten & Costanza, 1997), and this is an area where archaeologists can contribute to research on urban sustainability (Smith, 2010b). Maya and Aztec cities were embedded in “agrarian societies” in the normal social science sense of the term: preindustrial state-level societies based on a predominantly agricultural economy. Thus our use of the phrase “agrarian urbanism” is unrelated to some recent proposals (Duany, 2011).

The population densities of Maya and Aztec cities were relatively low, in part because a considerable portion of the urban area was used for farming. Most housing occurred in spatial clusters that served as urban neighborhoods. Residents were incorporated into a social-spatial hierarchy that served for both top-down administration and the expression of bottom-up self-organizational processes among households and neighbors. Maya and Aztec urban farmers were organized in ways that conform to Robert Netting’s (1993) model of smallholder intensive agriculture, and we argue below that this organization provided an important key to the success and longevity of Maya and Aztec urbanism. Although popular images of these societies focus on the Maya collapse and the Spanish conquest of the Aztecs, we believe it is important to emphasize the sustainable organization of their cities and societies, many of which survived far longer than most modern nation-states and urban centers.

The Classic Maya cities managed to thrive in a fragile topical environment for many centuries. Some Aztec cities were cut short after four centuries by the Spanish conquest, but others (including Tenochtitlan-Mexico City) are still vibrant cities today. How did these ancient cities survive for so long? We suggest that their success (or sustainability) derived from two aspects of urban agriculture. First, the fact that they grew crops within the city contributed to long-term social and economic stability. The “tyranny of distance,” referring to the social and economic impact of transportation costs, always affects urban food systems, and it plays a particularly important role in regions like Mesoamerica without

Table 1
Robert Netting's model of intensive smallholder agriculture.

| | |
|---|--|
| 1 | Farms are small and located close to the place of residence |
| 2 | Farms are either owned by individual households, or else there are social customs that allow households to have stable and long-term access to specific fields |
| 3 | Labor is provided by household members |
| 4 | Farmers have detailed and intimate knowledge of local soils, rainfall, crops, and other resources |
| 5 | Cultivation is intensive, which means that considerable labor is invested, leading to high yields |
| 6 | Technology is simple |
| 7 | The land is typically improved by the construction of terraces, walls, canals, or other features that prevent soil erosion and environmental degradation |

wheeled transport or beasts of burden (Bairoch, 1988, pp. 11–16). Urban agriculture assumes a greater significance in this kind of economy (Barthel & Isendahl, in press).

The second and more important feature of urban agriculture was the practice of smallholder intensive cultivation. Netting's (1993) model of smallholder agriculture helps explain the longevity of Maya and Aztec cities. As summarized in Table 1, smallholder agriculture has proven to be a highly successful and sustainable form of agriculture throughout the world. Although his model has rarely been applied to urban settings, in fact it fits the archaeological and historical data on Maya and Aztec cities quite well (Isendahl, 2002).

A major linkage between smallholder cultivation and urban sustainability is the principle of local control. The ability of households and local communities to make decisions about their activities is a crucial part of Netting's model. By living close to their infields and having strong forms of bottom-up community organization, Maya and Aztec urban farmers retained control not only

over their farming, but of other aspects of social life as well. This kind of local control has been hypothesized as one of the traits of urban governance that promotes resilience and sustainability (Leichenko, 2011; Tanner, Mitchell, Polack, & Guenther, 2009).

Bowles and Gintis (2002) explain why local control contributes to the longevity, resilience, and sustainability of communities, including cities. In their discussion of how communities (in the modern world) are often more successful at solving problems than either the state or the market, Bowles and Gintis emphasize the roles of peer monitoring and the pooling of risk. "In contrast with state and markets, communities more effectively foster and utilize the incentives that people have traditionally deployed to regulate their common activity: trust, solidarity, reciprocity, reputation, personal pride, respect, vengeance, and retribution, among others" (Bowles & Gintis, 2002, p. F424; see also Ostrom, 2010). While we cannot observe these features directly at ancient cities, they are implicated in Netting's smallholder model, which is strongly supported for our examples.

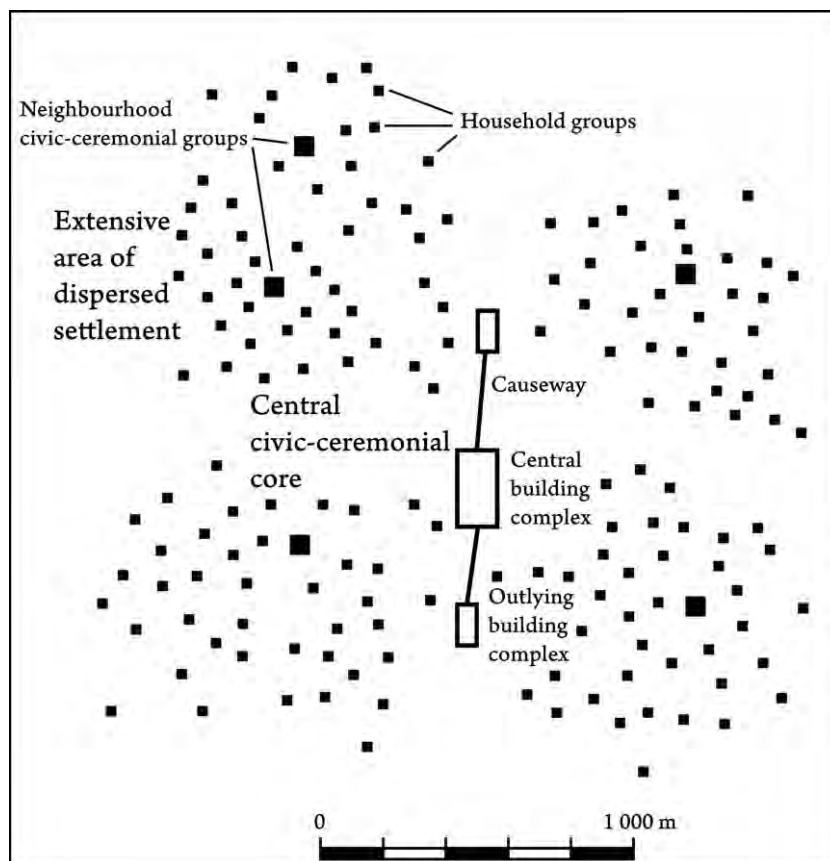


Fig. 2. Schematic model of Maya urban settlements: a civic-ceremonial epicenter of building complexes linked together by causeways, surrounded by dispersedly distributed residential household patio groups that tend to cluster around district or neighborhood administrative centers (modified after Isendahl (2010, Fig. 3)).



Fig. 3. Urban epicenter of Uxmal, the Terminal Classic Puuc Maya kúuchkabal (photo by Christian Isendahl).

Classic Maya cities

The Maya lowlands cover about 250,000 km² and form a heterogeneous tropical environment within present-day Mexico, Guatemala, Belize, and Honduras (Fig. 1). The prehistory of the ancient Maya unfolded over several millennia with the development of state polities, urban centers, long-distance exchange networks, advanced technologies, and complex resource management systems by the first millennium BC. The long-term political and economic history of the lowlands suggests a series of regional cycles of growth, decline, and reorganization, with numerous settlements emerging, flourishing, and collapsing during the course of the Middle and Late Preclassic (1000 BC–AD 250), Classic (AD 250–1000) and Postclassic periods (AD 1000–1500). By the end of the Late Preclassic period, the lowlands were politically divided among distinct polities, ranging in size and form from large regional states to city-states and alliances of small-scale polities.

The lifespans of individual Maya urban histories vary greatly; most cities were of relatively long duration (>1000 years) but there were also cities with much shorter lifespans on the order of 200 years. Maya cities of such short duration are rare and occur in regions characterized by boom-and-bust economic histories. These areas saw rapid large-scale colonization associated with maximized unsustainable exploitation of an initially abundant resource (Isendahl, Dunning, & Sabloff, 2011). Insights from complex systems research suggest that the dynamic interaction of multiple factors over spatial and temporal scales conditioned resilience capacity and vulnerability to maintain urban functions in the face of systemic disturbance (Dunning, Beach, & Luzzadder-Beach, 2012). Agriculture in Maya cities did not guarantee urban sustainability, but it was a factor that contributed to urban resilience capacity.

Urban forms and functions

Despite temporal and spatial idiosyncrasies over two millennia, most Maya cities share a basic model of how to organize an urban landscape (Fig. 2). At the center is a civic-ceremonial core complex with buildings and spaces of elite residential, ritual, administrative, and public functions linked together by a network of causeways.

The core complex is surrounded by dispersed urban sprawl of residential household groups that have a tendency to cluster into urban neighborhoods around subsidiary civic-ceremonial complexes. Open spaces of varying size inter-finger with residential building groups and with neighborhood clusters.

This basic spatial structure is evident at the earliest Maya cities, such as Nakbé (1000–400 BC), and by the Late Classic period (AD 600–800) it is found in hundreds of settlements throughout the Maya area including Tikal, one of the largest Maya cities with a civic-ceremonial nodal core that covers some 200 hectares and an estimated urban zone of dispersed settlement extending over up to 120 km² (Harrison, 1999).

In the Puuc region of northwest Yucatan, large-scale urban settlement expansion and substantial population growth took off relatively late, towards the end of the Late Classic, although there is evidence for earlier Puuc Preclassic settlement at for instance Xcoch, Xocnaceh, and Kiuc (Smyth, Ortegón Zapata, Dunning, & Weaver, in press). Urban settlements grew rapidly to make the early Terminal Classic Puuc (AD 800–1000) one of the most densely populated regions of the Maya lowlands. Uxmal is the one of the largest and best-known of the Puuc cities, and its impressive civic core zone (Fig. 3) is a major tourist destination today. The Puuc site of Xuch, although less known, furnishes some of the best data for the spatial organization of activities in residential zones of Maya cities (Fig. 4). Although Xuch was only a mid-sized Maya city, urban sprawl may have extended over as much as 20 km² (Isendahl, 2002, 2006).

At the center of Xuch is a large rainwater reservoir (*aguada*), which played an important economic, political, and symbolic role in the physical transformation and social construction of landscape (Isendahl, 2011). The central civic-ceremonial core is located 500 m to the south on a series of low hills and at the fringes of zones of deep and fertile soils. It consists of several monumental building complexes with pyramids, plazas, altars, and palaces, linked together with an east to west trending causeway system. Subsidiary civic-ceremonial building complexes are spread out in the landscape at Hebech, Xhai-be-Hebech, and Xuch II, and these complexes are surrounded by dispersed household patio groups.

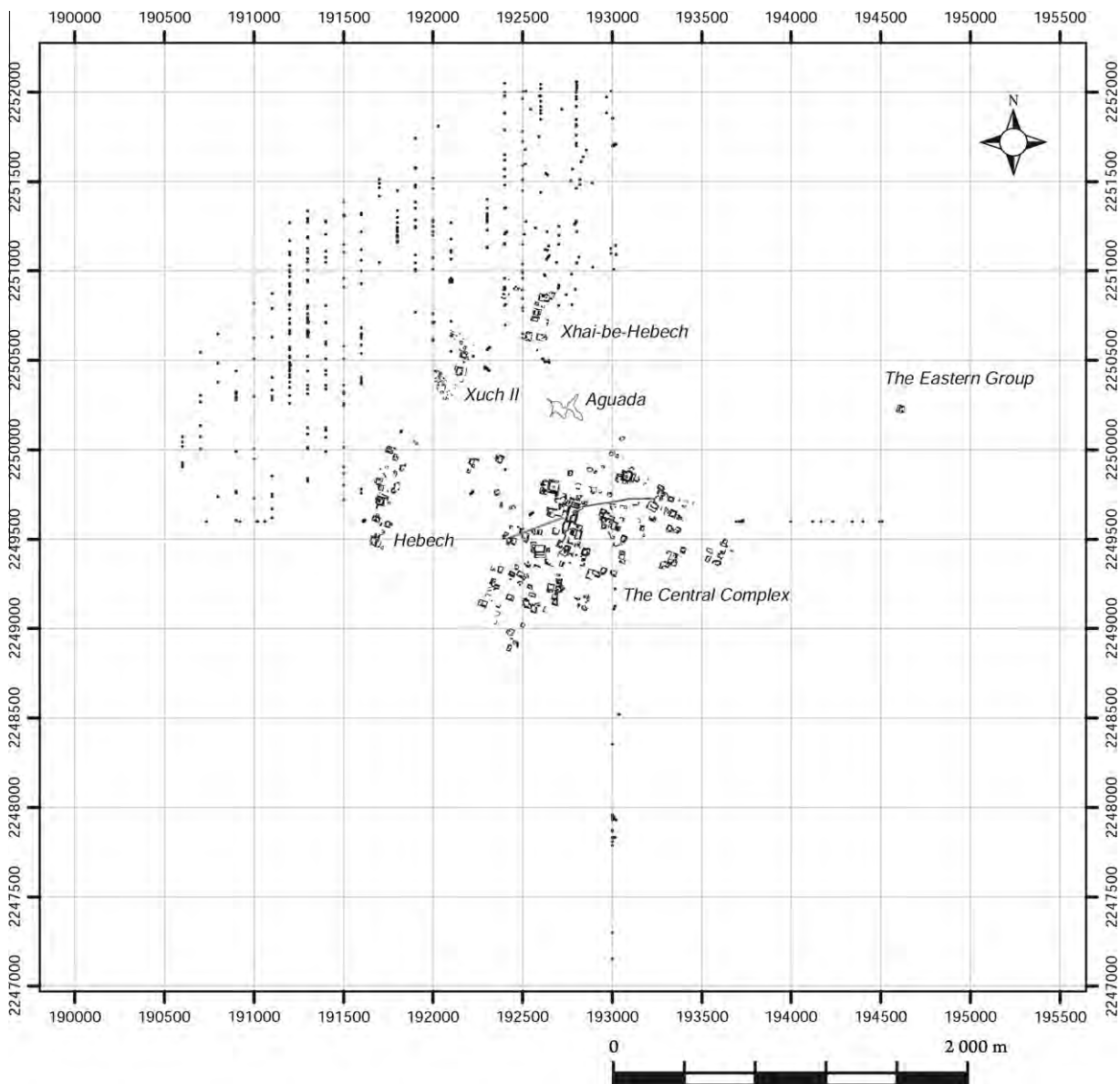


Fig. 4. Plan of Xuch, a Maya city in the state of Campeche, Mexico. The city epicenter with civic-ceremonial buildings partly linked by causeways is in the central sector; Hebech, Xuch II, and Xhai-be-Hebech represent *küchte'elob*, urban districts, each with its own administrative civic-ceremonial sub-center. The dots mark the locations of architectural features that were recorded but not mapped in detail (Isendahl, 2002, map 7.1).

Housing and neighborhoods in the Puuc region

Most Maya commoners lived in patio groups, arrangements of small structures organized around a common open area (Wilk & Ashmore, 1988). In Puuc cities, the archetypal patio group consisted of a quadrangular basal platform constructed from limestone rocks, boulders, and debris elevating the living surface above ground level. A house was built at each side of the platform and an underground water cistern excavated into the platform and the ground underneath, typically with the mouth of the cistern located in the center of the platform (Fig. 5). Each patio group was probably inhabited by an extended family, a household of perhaps 5–10 members. The residential patio group was associated with nearby gardens to form a composite farmstead compound (Dunning, 2004).

At most Maya cities houses and patio groups were arranged into spatial clusters. Smith (2011) develops a formal argument for interpreting these clusters as urban neighborhoods. He reviews a

series of historically- and ethnographically-documented low-density traditional cities in Africa and Latin America and shows that spatial clusters of residences have the same social characteristics as urban neighborhoods. These traits include, “frequent and regular social interaction among residents; shared social characteristics such as ethnic origin or occupation; an administrative role within the city; a ceremonial focus for social integration; and an indigenous term that European visitors translated as neighborhood or a synonym (e.g., ward, *quartier*, *barrio*)” (Smith, 2011, pp. 65–66). On the basis of spatial and contextual similarities between these cases and the Classic Maya clusters, he presents a formal analogy that interprets the latter features as urban neighborhoods. Sometimes nearby neighborhoods are grouped together into a district, which is a larger spatial-social unit with administrative functions (that may be lacking in neighborhoods); see Smith (2010a) for a general discussion of neighborhoods and districts.

Historians and archaeologists have used documents from the early Spanish era to reconstruct the Maya political hierarchy on

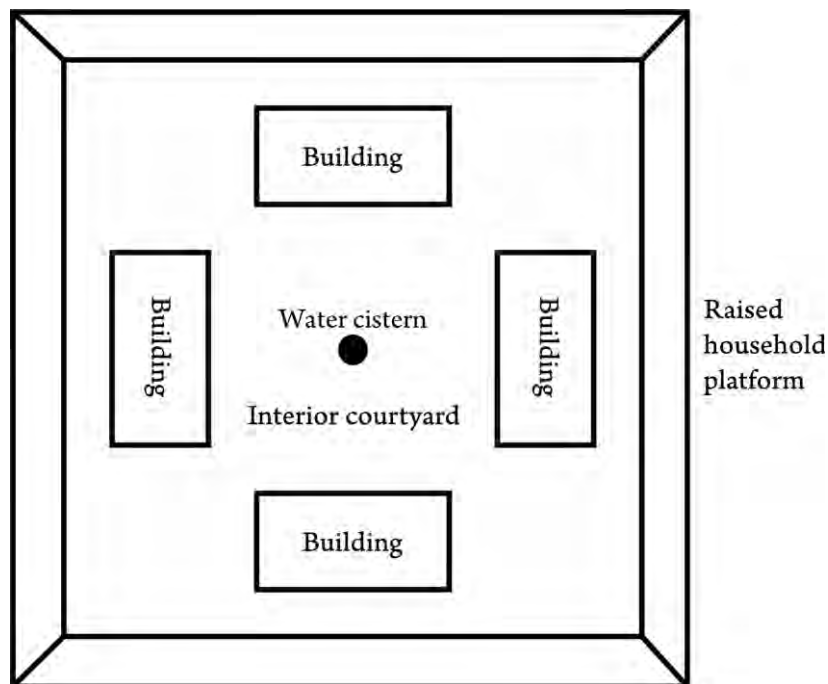


Fig. 5. A schematic model of Classic Puuc Maya residential household patio groups (modified from Isendahl (2010, Fig. 4)).

the eve of Spanish conquest (McAnany, 1995; Quezada, 1993; Roys, 1957). We have generalized this model into a spatial hierarchy of settlement applicable to both the Maya and Aztec cases to help describe their spatial and social organization (Fig. 6). The top three levels correspond to polities or administrative subdivisions of polities.

1. **The polity (*kúuchkabal*).** In the Maya case, the highest level is the overarching polity and principal settlement, governed by a hereditary lord (the *halach uinic*) with a council of rulers of subordinate cities. Uxmal (Fig. 3) was most likely a Puuc *kúuchkabal*.
2. **The city or city-state (*batabil*).** At the next level is a series of subordinate urban communities; in the Puuc region, Sayil and Xuch, among others, fit this category. The *batab* was the chief executive, judicial, and military officer of each urban community. These lords ruled over a local community council and paid tribute to the *halach uinic*.
3. **The district (*kúuchte'el*).** The *batabil* was divided into several districts that contained both elite and commoner residents. Districts were governed by a lineage head (*ah kuch kab*), who assumed a central role in the management of natural resources, and agrarian and commodity production. These officials organized agrarian labor and distributed land and resource rights to household heads (the *ah chun kahilob*) as well as coordinated and controlled payments to the *batab*.

The lower levels of the hierarchy are residential units without explicit administrative functions. The historical sources do not distinguish neighborhoods from districts, and we suggest that the term *kúuchte'el* applied to both levels. Patio groups and houses are discussed above.

Although this hierarchy is typically interpreted as an administrative control structure, there was a considerable amount of social contestation and negotiation between different levels (Scarborough, Valdez, & Dunning, 2003). In this scheme, the district with its leadership and administration stands out as a key sociopolitical institution intermediate between the ruling authorities on the one

hand, and local families and neighborhoods on the other. Crucial activities at this level included the management of resources and the shaping of flows of goods and energy within the agro-urban landscape.

Urban agriculture

The primary reason for the low settlement densities of Puuc and other Maya cities was the presence of considerable agricultural production within residential neighborhoods (Dunning, 1992, 2004; Isendahl, 2002, 2010; Smyth, Dore, & Dunning, 1995). This pattern is similar to early urbanism in many other parts of the tropics, notably the Khmer civilization of Southeast Asia (Fletcher, 2009). Settlement agriculture is a broad category that includes several different kinds of agrosystems, including home or kitchen gardens, larger infields, orchards, and arboriculture. The pattern of informal urban settlement inter-fingering with agricultural sectors has led scholars to describe Maya cities as “green cities” (Graham, 1999), “garden cities” (Chase & Chase, 1998; Dunning & Beach, 2010), and “agro-urban landscapes” (Isendahl, 2010, in press).

In some agro-urban landscapes the empirical support for urban farming is unequivocal—for instance the agricultural terracing that intersperses with residential and civic-ceremonial architecture at Caracol (Chase et al., 2011)—but the evidence for agriculture in Maya cities is in most cases much more subtle and ambiguous. At Sayil, one of the best investigated Puuc Maya cities (Sabloff & Tourtellot, 1991), a homestead garden was identified from analyzing soil phosphate distributions in the central precincts of the city (Dunning, 1989, 2004). At Xuch, settlement, soil, and geochemical data at the landscape-scale reveal a highly diverse environment (Isendahl, 2002, 2010). Fig. 7 shows the values for soil phosphate contents in the soil determined by a field phosphate test strip method in the northwest sector of the site. Consistently high phosphate contents are distributed in sectors of cultivable soils in non-built spaces in between dispersed household patio groups. These can be interpreted as the locations of home gardens managed by individual households, although tenure rights might have been regulated by the larger corporate group of the district, the

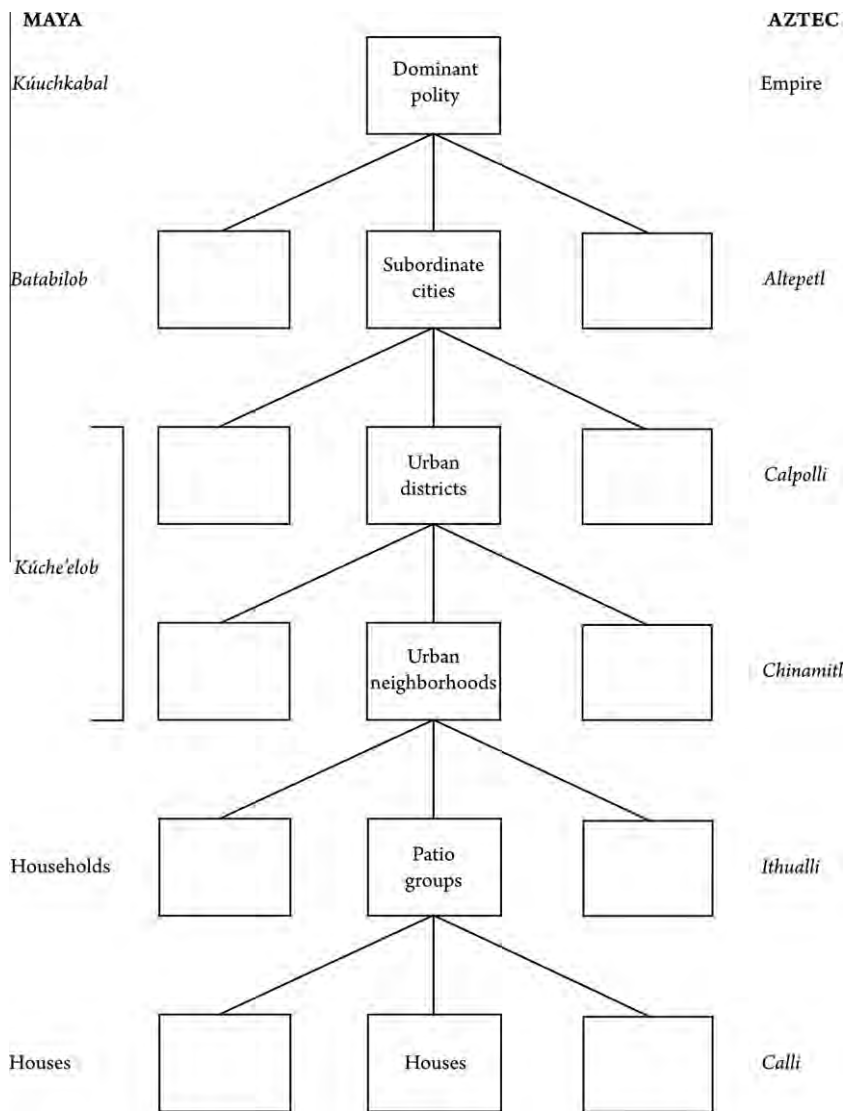


Fig. 6. Political-settlement hierarchy for Maya and Aztec cities (figure by Christian Isendahl and Michael E. Smith; based on Isendahl (2010) and Smith (1993)).

k'uchte'el. Paradoxically, larger tracts of the most suitable agricultural soils are currently low in measurable phosphates (which also demonstrate that recent additions of fertilizers as part of mechanized agriculture in some of these sectors have not skewed results upwards). These sectors are found in urban and rural contexts throughout the mosaic environment of the Puuc zone and were the key resource and economic power base for the Late and Terminal Classic Puuc economy. They probably came under the control of community leadership as the Puuc was colonized on a large scale in the Late Classic period (Dunning, 2004). Soil nutrient deficiencies likely followed from soil over-exploitation grounded in maximizing management strategies.

Isendahl (2010, in press) has argued that the agro-urban landscapes of Classic Maya cities transcend modernist dichotomies of urban versus rural land uses. The production of what was probably a significant share of the total food resource framework within the city is a characteristic rarely associated with cities, ancient or contemporary. The ecosystem services associated with tropical homegardens (Kumar & Nair, 2004) and with more recent and contemporary urban farming (Barthel, Folke, & Colding, 2010) emphasize these spaces as carriers of biodiversity. The persistence of this system through several medium-term cycles of growth and

decline suggests its adaptive capacity over longer, millennial time scales.

Aztec cities

In AD 1519 the Aztec island city Tenochtitlan was a metropolis whose size, grandeur, and bustling activity amazed the conquering Spaniards (Rojas, in press). Capital of an empire of several million subjects, Tenochtitlan conforms to almost any definition of a city. It had over 100,000 inhabitants on 13.5 km² (for a density of 150/ha). Streets and canals were laid out in an orthogonal pattern, dominated by a central ceremonial precinct with towering pyramids and temples. Craft specialists sold their wares in a central open-air marketplace where, according to Hernando Cortés, 60,000 people gathered daily to buy and sell. The city was ringed by intensively cultivated raised fields (*chinampas*) that grew maize and other food crops.

Tenochtitlan has far more historical and archaeological documentation than any other Aztec city, and it has received far more attention from scholars. Nevertheless, it was the least typical of Aztec cities. Most Aztec cities were capitals of city-states

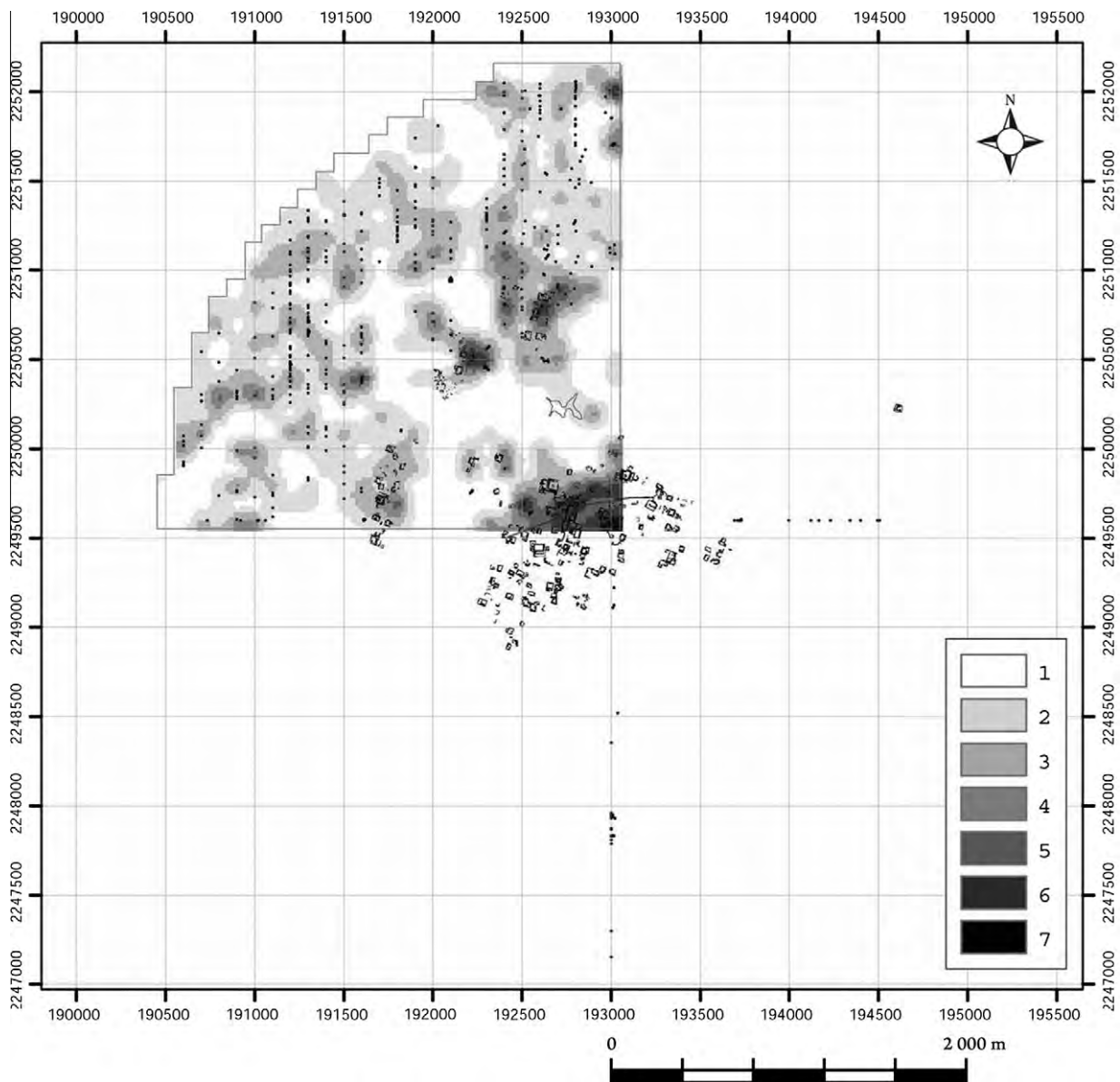


Fig. 7. The distribution of soil phosphates at Xuch; the darker the area, the higher the phosphate content in the soil (Isendahl, 2002, map 9.2).

(*altepetl* in Nahuatl; see Fig. 6), not empires. They were much smaller than Tenochtitlan, with far less economic and political activity. The city-state capital was the most numerous and typical urban form in Aztec central Mexico, and these cities resembled Classic Maya cities in several ways. For these reasons, our discussion focuses primarily on Aztec city-state capitals (Smith, 2008), not Tenochtitlan.

Most Aztec cities were founded in the twelfth century AD by immigrant populations from northern Mexico, although some (such as Tenochtitlan) were founded in the fourteenth century. The maximum lifespan for Aztec cities—prior to Spanish conquest—was therefore slightly more than four centuries (AD 1100–1519). A key demographic feature is that once a city was founded, it continued in use at least until the arrival of the Spaniards; no known Aztec cities were abandoned or destroyed before AD 1519 (Smith, 2008). The Spanish conquest resulted in the destruction and abandonment of some cities, but most were transformed into Spanish colonial cities and are still flourishing today.

Urban forms and functions

The median Aztec city-state capital had a population of 4750 people living in an area of 108 ha (with a median density of 50 persons/ha). Like the Maya cities, Aztec cities consisted of a central planned civic district surrounded by unplanned residential zones. Public architecture in the civic district included a royal palace, a central large temple-pyramid, smaller temples, a ballcourt, and numerous small altars. Most of these buildings were smaller than their earlier Maya counterparts. Aztec city-state capitals show a higher degree of standardization of form and planning of their civic districts than the Classic Maya cities (Fig. 8). One reason for this is that the Aztec kings and their builders deliberately imitated the urban form of Tula, an earlier capital city (AD 950–1150) whose kings and culture (called Toltec) were revered by the Aztecs (Smith, 2008, pp. 71–93).

The urban functions of Aztec cities can be specified in considerable detail using the written documentation from the Spanish conquest and its aftermath, coupled with archaeological findings.

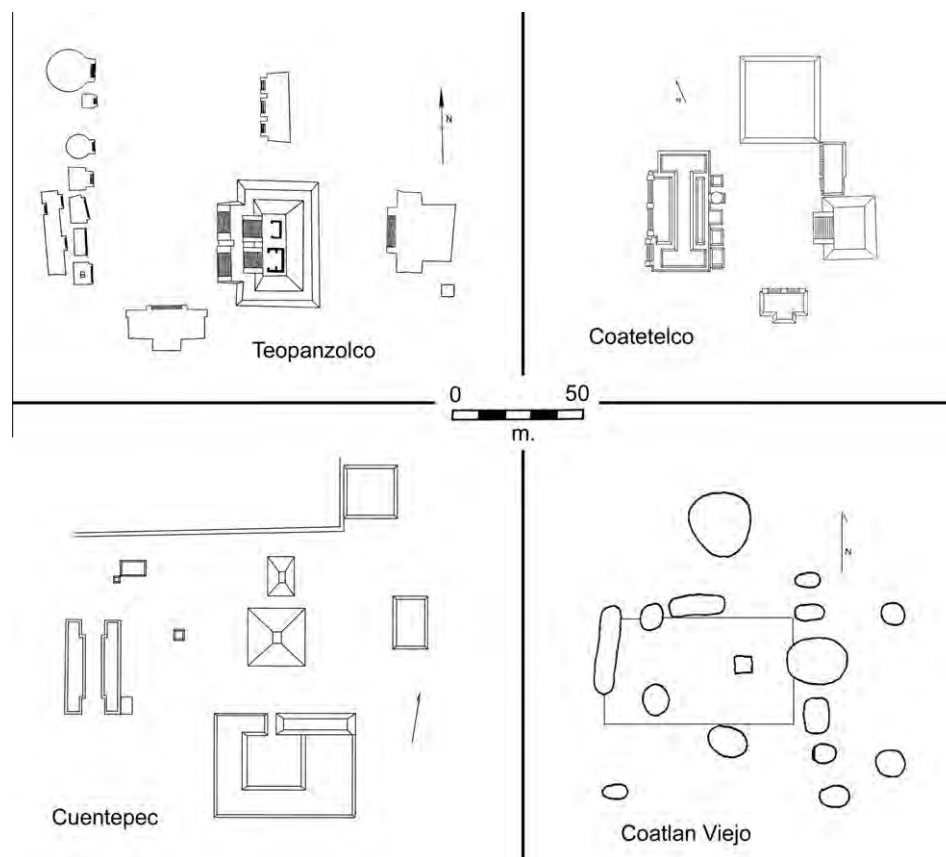


Fig. 8. Plans of urban epicenters of Aztec cities in the state of Morelos. The site of Coatlan Viejo has not been excavated or mapped in detail; the shapes are unexcavated mounds (Smith, 2008, p. 87).

In both the native Aztec conception and the models of scholars, the most important urban function was administrative; a city was the place where a king lived. Very few (if any) cities existed that were not capitals of city-states. The royal palace was the largest structure in a city. A second important urban function was in the realm of religion. The patron deity worshipped in the main temple–pyramid watched out for the entire polity, not just the capital. People from surrounding towns and villages probably came into town at least once every 20-day month to attend ceremonies at this and other temples.

Aztec cities also had economic functions. Each city had a marketplace, typically in a public plaza, where markets were held either daily or weekly (every 5 days). The extent to which Aztec city-state capitals were settings for crafts varied considerably. Some cases studied by archaeologists, such as Huexotla (Brumfiel, 1980), produced little evidence for craft production beyond spinning and weaving. Other cities, particularly Otumba (Charlton, Nichols, & Otis Charlton, 1991), were production centers with multiple intensive craft industries. Most Aztec cities, including Yauतेpec and Calixtlahuaca, had levels of craft production intermediate between that of Huexotla and Otumba (Smith, 2008, pp. 180–183).

Housing and neighborhoods

In Tenochtitlan and other cities within the Basin of Mexico, Aztec houses were large, multi-room structures inhabited by extended family households. In several provincial areas outside of the basin, houses were small, one-room buildings (Fig. 9). These small houses were typically arranged around patios in a pattern superficially similar to that of Maya, but in the Aztec case each

structure housed an individual nuclear or extended family (as compared to the Maya pattern of one family per patio grouping). Most houses were constructed of adobe bricks or wattle and daub.

The Aztecs used the same term—*calpolli*—for both neighborhood and district. A *calpolli* was a spatially localized group of households that shared a common economic basis. One of the interesting features of the *calpolli* was that it existed in both rural and urban settings. In rural areas, a *calpolli* was a village of farmers. Most land was owned by nobles, who allocated a block of fields to a *calpolli*. A *calpolli* council distributed the land to the member households and organized the collection of rents and taxes. In urban contexts, a *calpolli* was a neighborhood or district whose members often shared a particular occupation. Not all commoners belonged to a *calpolli*. Membership in a *calpolli* gave the member households a level of control over their farming and livelihoods not found in non-member households.

There were two sizes of *calpolli*: a small unit of some 10–20 households and a larger unit of 100–200 households (Carrasco, 1964; Smith, 1993). In Fig. 6 we use the term *calpolli* to refer to the larger size of *calpolli*, and *chinamitl* to refer to the smaller unit. The large *calpolli* were units of taxation and administration; officials known as *calpixque* resided in the *calpolli* and organized corvée labor, tax payments, public services, and other official activities. Documents suggest that each *calpolli* had a central temple, which housed its patron deity, and a school. The town site of Cuexcomate (Fig. 10) was almost certainly a large *calpolli*, with a small central plaza group flanked by an elite residence and a small temple. The settlement consists of several clusters of houses and patio groups which correspond to *chinamitl*. The central cluster contains the civic architecture, and the northern cluster is focused

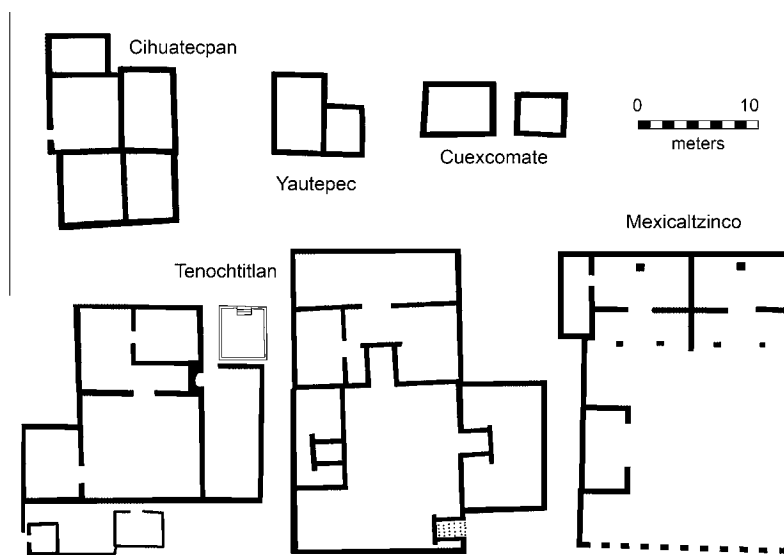


Fig. 9. Aztec commoner houses from a variety of settlements (modified after Smith (2008, p. 164).

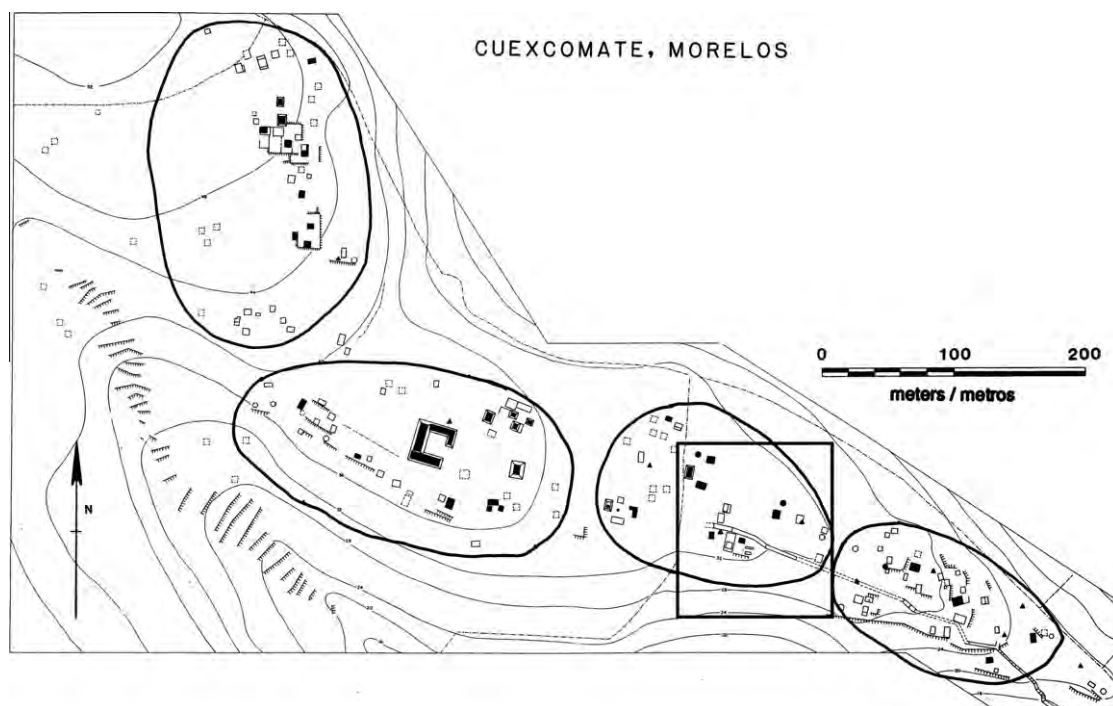


Fig. 10. Spatial clusters of houses at the Aztec town of Cuexcomate. Rectangle shows the area in Fig. 11 (plan by Michael E. Smith).

on a small shrine or temple; the other two clusters consist entirely of domestic structures.

Urban agriculture

Several Aztec cities have furnished evidence for agricultural activities within the urban area, and it can be inferred that these patterns were widespread. The best-known evidence concerns the presence of intensively-cultivated raised fields (*chinampas*) throughout large parts of the imperial island capital Tenochtitlan (Calnek, 1976). The most spatially extensive form of intensive agriculture in Aztec central Mexico was the cultivation of narrow fields on stone terraces. Some city-state capitals were built on slopes

covered with such terraces, and in these urban settings the terraces were used for both house sites and cultivation (Smith et al., in press). Many smaller Aztec settlements (towns and villages) were also constructed in close association with agricultural terraces (Evans, 1990).

The town site of Cuexcomate is particularly important in the study of demography, agriculture, and urban form because it is one of very few Aztec sites that have been mapped in its entirety. Fig. 11 shows a portion of the site in which terraces and other stone features were mapped completely by Smith. House groups are situated on a ridge top, and the slopes below them were extensively terraced. These terraces are very irregular in form, suggesting that they were built by individual households without central planning.

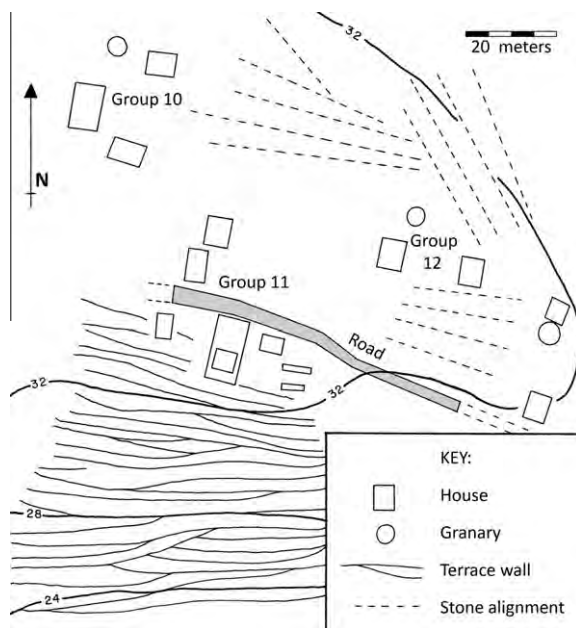


Fig. 11. Agricultural terraces and stone alignments in one sector of Cuexcomate (plan by Michael E. Smith).

In the open spaces among houses and patio groups members of Smith's project mapped long linear alignments of stone (Smith, 1992). Although the functions of these have not been determined, it is likely that they were part of an infield cultivation system.

In terms of settlement configuration and population density (55 persons/ha) Cuexcomate is very similar to Aztec city-state capitals. There was considerable open space in nearly all of these cities, many of which incorporated sloping areas that were terraced. Technical analyses at several of these sites confirm the use of the terraces for cultivation. Thus it is logical to infer that much of the open space within cities and towns was devoted to agricultural production. The Aztec period witnessed one of the largest demographic surges of the Precolumbian New World, leading to overpopulation and food shortages (Smith, 2012, chap. 3). Nearly all available land was brought under cultivation, both in the countryside and within settlements.

Implications

Archaeological and historical research on the cities of the Maya, the Aztec, and other peoples of ancient Mesoamerica provides information on a distinctive urban tradition of the ancient world. We suggest that this information is relevant to an understanding of modern cities and contemporary processes of urbanization in at least three realms.

Cities are characterized by a diversity of urban forms and processes

While the existence of a broad diversity in city form and urban processes is probably obvious to many urban scholars, we think this point may need special emphasis. History and comparison document two important kinds of urban variability. First, cities and urban phenomena exhibit considerable variation around the world and through history. Maya and Aztec cities provide just one example of a distinctive pre-modern urban tradition (the Mesoamerican tradition); many others existed as well. Second, cities can be highly variable within a given urban tradition. Although Maya cities, for example, shared certain characteristics, they were far from uniform and it is misleading to talk of a "typical" Maya

city. Research on these and other pre-modern cities expands our knowledge of urbanism, and can give scholars, planners, and officials a broader range of options to consider in thinking about cities in the contemporary world.

Urban agriculture is nothing new

Urban agriculture has become a major topic of research in both western cities and cities in the developing world. Many writers argue as if this is entirely a new phenomenon (e.g., Redwood, 2008), while those who do acknowledge the existence of urban agriculture in ancient cities provide superficial accounts with little data (e.g., Castillo, 2003). In fact, it appears that farming in urban contexts was quite widespread around the world through history and prehistory (although systematic comparative research has yet to be done). Beyond the Maya and Aztec cases described above, urban agriculture was practiced in other Mesoamerican cities (Stark & Ossa, 2007), and it has also been documented in such diverse ancient settings as Angkor (Fletcher et al., 2008), Egyptian cities (Wilkinson, 1998), and early Constantinople (Ljungkvist, Barthel, Finnveden, & Sörlin, 2010). The residential zones of many early tropical low-density cities resemble the peri-urban areas that surround contemporary cities in the tropical world today (Simon, 2008). A broader perspective on the forms and roles of ancient urban agriculture can help scholars understand urban farming and peri-urban issues today.

These were sustainable cities

Popular and scholarly concern with ancient cities and their social contexts tends to emphasize their more exotic or spectacular elements (e.g., towering Khmer temples or Aztec human sacrifice), and this fascination extends to their demise or collapse (e.g., Diamond, 2004). Most Classic Maya cities, for example, were abandoned as the Maya social-ecological system reorganized, and writers such as Jared Diamond (2004) ask what was wrong with Maya society that led it to collapse. Yet the Classic Maya cities flourished for many centuries before their abandonment in the ninth century AD. Tikal flourished for more than three times the current lifespan of Washington, DC. By objective standards of longevity, Tikal and other Maya cities were far more "sustainable" than most contemporary mega-cities, whose persistence for another four centuries may stretch the imagination.

Archaeologists and historians are increasingly able to decipher the properties, conditions, and processes that contributed to ancient urban survival and expansion over long periods of time. We suggest that the resulting knowledge will prove useful in understanding the current context and future trajectories of contemporary cities.

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