8 WATER MANAGEMENT AMONG THE ANCIENT MAYA: DEGREES OF LATITUDE

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The ancient Maya governed their cities heterogeneously, with a variety of management systems. However, the current dominant model for Maya water management provides only one system of governance, making no affordances for the degrees of latitude in water management practiced by the ancient Maya. Other academic disciplines and archaeologists from other regions have moved beyond the centralized, elite-control models reminiscent of Wittfogel's Oriental Despotism. Instead, there is a focus on the role of institutions, collective action, and the interplay among different generative processes on a spectrum from top-down to bottom-up. The ancient Maya provide a unique case study for analyzing water management. They constructed their largest cities in the Classic period away from standing bodies of water, and did not tether their agricultural production to large-scale canal irrigation. Instead, the ancient Maya harnessed rainwater runoff in reservoirs and through agricultural terraces. Previous research at Caracol has highlighted the importance of residential reservoirs for the provisioning of drinking water to the population at large and has showcased the impossibility of elite control over those household resources. Using data from Caracol, Belize this article presents a new framework for understanding the "degrees of latitude" in water management among the ancient Maya.

Introduction

Currently, the primary theory of Maya water management focuses on a monolithic elite with total control over water resources (Lucero 2002, 2006a, b). The ancient Maya constructed their cities away from permanent bodies of surface water. This resulted in many ancient Maya constructing and utilizing reservoirs to provide potable water during the dry season. This paper aims to build upon previous research, incorporating literature describing institutions, collective action, and a more nuanced understanding of generative processes. Through this framework, which I am calling "degrees of latitude", a diversity of water management approaches will be explored.

The ancient Maya utilized politically heterogeneous systems of governance. While similar patterns occur across a variety of cities (Houk 2017:5-10), we still characterize the Maya as one overarching group with great diversity of urban forms (Andrews 1975; Houk 2015; Hutson 2016). Differences in urban planning reflect not only differences in geography and environment (Chase and Cesaretti 2019), but also likely reflect differences in their underlying systems of governance, as at Tikal, Guatemala and Caracol, Belize (Chase, et al. 2019 in press). As such, one overarching theme when studying the governance of ancient Maya cities is that these cities expressed a high degree of latitude in their forms of governance over time.

One fundamental issue when discussing governance of the ancient Maya rests in two of the definitions Mayanists have adopted. Mayanists have conflated the terms elite with top-down and non-elite with bottom-up (see Garrison, et al. 2019:134 for a quick summary). In other disciplines, and in other archaeological regions, researchers have disentangled these terms and utilize the broader concept of generative processes. For example, elites can produce bottom-up coalitions against the ruling administration through collective action, and non-elites can exert top-down control through the construction and enforcement of neighborhood-level community organizations. The spatial level of analysis also matters, with the units of *plazuela*, neighborhood, district, city, and polity (see Chase 2019 in press) all having proven useful at Caracol. Fundamentally, to broaden our analysis of governance for the ancient Maya and increase our relevance to archaeologists of other regions, Mayanists must remember that top-down and bottom-up are not merely synonyms for elite and non-elite, but rather part of a larger concept of generative processes.

Tangential to generative processes, research into collective action has provided archaeologists with a new means of discussing social processes in the past. This body of research has highlighted a peculiarity in the historical assumptions of autocratic rulers and their power. Unintuitive, based on historic city

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data, Blanton and Fargher (2008:14-24) have shown that the more autocratic the form of governance exhibited, the more freedom individual citizens had from its central administration. However, the higher the proportion of tax revenue comprising state revenue, the less freedom citizens experienced from the government, and the more urban services those citizens could, and would, demand (sensu Blanton and Fargher 2016:29-44). Truly autocratic rulers historically utilized sources of revenue outside their polities and ignored the day-to-day activities of their populace (Blanton and Fargher 2012:28-31). This lasted until internal taxation increased and those taxed citizens banded together through collective action to pressure the central administration to provide additional services (see Figure 1). The notion that a ruler could demand high taxes and avoid providing services in return has not actually been observed historically. Collective action involves a dialectic between the governed and the rulership that can result in increased taxation, increased provisioning of services, and increased record keeping – important for administration of the previous two.

Finally, systems of governance can remain static or change over time. Expectations that an ancient city utilized the same water management system from the Preclassic through the Terminal Classic would require a high burden of evidence. However, it is possible. Strong institutions that lasted generations would be required, and we do have historic examples of long lasting intuitions (see Ostrom 1993:1910-1911). A framework to understand water management should incorporate the ability of that system to shift and change or to remain static over time. Utilizing degrees of latitude from top-down to bottom-up and collective to autocratic, my proposed framework presented in this article helps to understand the stasis and shifts in governance and water management over time.

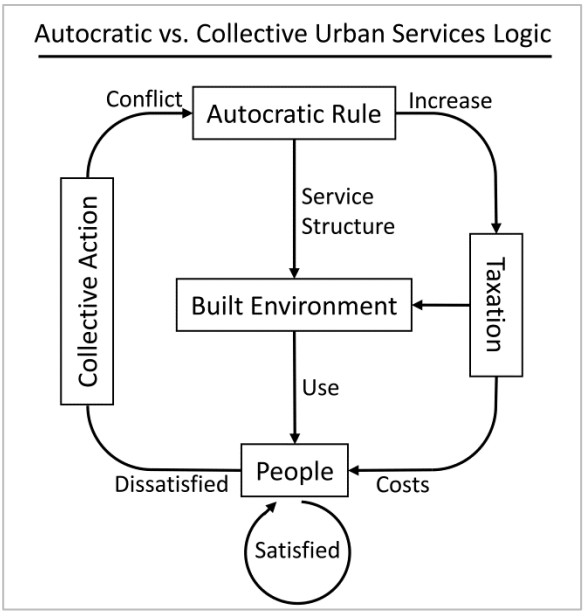

Figure 1. One interpretation for how a system of autocratic rule evolves into a more collective form over time through both an increase in taxes and in state sponsored services manifested through the built environment.

Water Management: Three Touchstones

In any discussion of water management and governance, Karl Wittfogel remains important. His theory built upon the foundation of Marx's concept of Oriental societies and attempted to summarize how strong, autocratic states emerged through the construction and maintenance of water management features (Wittfogel 1957). This theory focused primarily on canals and other irrigation systems, in fact Wittfogel stated in a later publication (Wittfogel 1972:66-67) that the ancient Maya do not fit his original theory due to their focus on provisioning of drinking water and not irrigation systems. The hydraulic hypothesis has been repeatedly tested and disproved through contradiction. Many complex water management systems exist which do not require centralized control (Chase 2016a:892-895; Ertsen and Wouters 2018:13-14; Seefeld 2018:425,430). However, Wittfogel's theory still refuses to die and lingers on (see Obertreis, et al. 2016). In essence the hydraulic hypothesis has proven to be the quintessential zombie of water management research, seeming to repeatedly rise from the grave of defunct ideas to shamble into modern scholarship again and again.

Issues with top-down, centralized water management formed the fundamental research area of Elenor Ostrom (1992, 1993, 2015). Her main concern was the value of bottom-up systems for locally managing resources. Her

research provides a reaction and refutation of Hardin's overstated Tragedy of the Commons (Ostrom 2015:2-7,38-41). Ostrom researched small groups of individuals managing common resources through the creation and maintenance of local institutions, and she recorded failed attempts at non-local control (Ostrom 1992:2-7). In short, Ostrom demonstrated that individuals can create long lasting local institutions without the imposition of elite control.

A third important study for water management provides a warning to archaeologists – the work of Stephen Lansing (Lansing 2007; Lansing and Kremer 1993; Lansing and Vet 2012). In Bali there was a hierarchical system of water temples to manage the irrigation schedule of farmers' rice paddies (Janssen 2007; Lansing and Kremer 1993); however, that system was entirely divorced from the political apparatus (Lansing 2007:50-72). The rulers of Bali and the water temples of Bali left each other alone to heterarchically manage their respective interests. Assuming that we only had archaeological data to work with, could we accurately recreate this system of water management without assigning control of the water to the political apparatus?

Water Management: The Ancient Maya

In the case of Maya water management, we owe our current understanding to a body of literature primarily constructed by two individuals Lisa Lucero (2002, 2006a, b) and Vernon Scarborough (1998, 2003; see also Scarborough and Gallopin 1991; Scarborough and Sierra 2015). Neither attempts to prop up Wittfogel or his arguments, however, the focus of both bodies of literature rests on the absolute power of elites to manage and distribute water as the basis of elite power in society. Scarborough's conceptualization of water management rests on the example of downtown Tikal and its many massive reservoirs. From this dataset, his research focused on the shift from concave to convex watersheds to manage drainage into reservoirs (Scarborough 1998:139-141), and illuminates his labor-tasking concept of slow landscape evolution through iteration by the ancient Maya (Scarborough 2003:13-16).

Lucero continued to build upon Scarborough's work with a simple question, "… how [do] a few people get others to contribute labor and services without compensating them equally?" (Lucero 2006b:14). From this point Lucero created a complete theory for elite control over water management that highlights how control over and distribution of water in cities, constructed away from easily accessibly surface water, could lead to this acquiescence of elite power. In addition, this theory encapsulates a dynamic evolution from simple political control to fully encompassing all aspects of water control through art, architecture, and ritual. Finally, this theory also provides a reason for the termination of elite control over water through an extended period of drought (Lucero 2006b:183-195). If elite power rests on ritual and political control over water resources, a drought would directly challenge the "mandate from heaven" that the elite have to manage water. This in turn would have led to unprecedented social upheaval as non-elites realized that they had been duped.

My inspiration to contribute to research in water management rests in two interrelated aspects. First, during seasons at the Caracol Archaeological Project, we would often run low, or run out of potable rainwater. The Institute of Archaeology would occasionally need to send a water-truck to haul river water to our camp. If our crew of twenty people could run low on water, then how did a city that housed over 100,000 people manage to survive? Second, the Caracol Archaeological Project had just acquired LiDAR data mapping out 200 square kilometers of Caracol (Chase, et al. 2012; A. F. Chase, et al. 2011; D. Z. Chase, et al. 2011). This dataset naturally fit itself to my inherent question and with this LiDAR data, I tested the model of elite control for Caracol (see Chase 2012:43-45; 2016a:892-894) and found that residential reservoirs are very, very common and would have been incredibly difficult for the elite to manage and control. Needless to say, this has created a data-point at odds with the current body of theory on ancient Maya water management.

Degrees of Latitude

In order to integrate multiple theories of Maya water management, I present the following framework utilizing degrees of

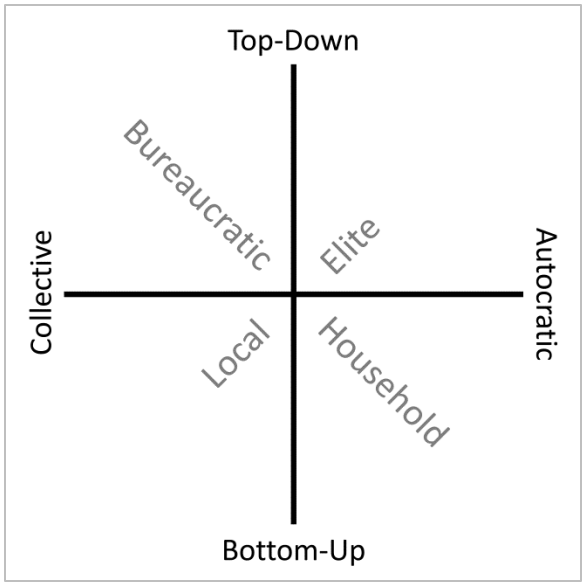

Figure 2. The four labeled quadrants formed from two axes of autocratic to collective and top-down to bottom-up management of water resources.

latitude, which focuses on the two axes of collective action versus autocratic control and top-down versus bottom-up generative processes (Figure 2). Along the axis of collective action to autocratic control, the primary consideration is the ability of the people to band together in collective behavior. To study this, archaeologists can use the built environment to observe the level of resource accessibility, because the more collective action the more localized urban service facility features will be; a revised interpretation of data supporting central place theory (Getis and Getis 1966). More autocratic systems can provide fewer and more restricted services. Along the axis of top-down to bottom-up control, we must remember that these words are not simple synonyms for elite and non-elite. Instead, a top-down generative process indicates that a higher-level authority is dictating actions, while a bottom-up generative process indicates that individuals are banding together to act. Groups of districts can band together in a bottom-up fashion to manage reservoirs, while a neighborhood council could enact strict water use restrictions in a top-down fashion on their constituent households – like a home-owner's association today (see Chase 2019 in press). Location and standardization of reservoirs in addition to the proximity of administrative structures provide clues to these generative processes. These axes provide a means of isolating four separate aspects of water management through the resulting quadrants. However, actual water management systems will fall between these extremes because each axis provides a continuum of values instead of a binary zero or one. The extremes forms of this framework are introduced in the following paragraphs (Figure 2).

A top-down, autocratic system indicates **elite control** over water. In the most extreme form, think of Immortan Joe from the film *Mad Max: Fury Road* (Miller 2015). In that society, the totalitarian ruler maintains his authority by providing the only source of water. In a less apocalyptic version, Lucero's (2006a) model of elite power also fits this category where the elite have total control over monumental reservoirs and preserve power through water provisioning and rituals. In addition, this form of water management may also be brittle and prone to issues in cases of failure as at Kohl Kher (Lustig, et al. 2018:209-210). In any case, these examples of water management systems exhibit the highest degree of elite power and management from the top-down with the lowest level of collective action.

A top-down, collective system indicates **bureaucratic control,** a system managed from the top to facilitate the service needs of the populace. In the case of water management this could manifest as a widely distributed system of large reservoirs with associated administrative structures. The bureaucratic nature of this system would be entailed by the official recordkeeping required to manage individual water use and accessibility. In a sense, this is also the closest form to water management examples from Southeast Asia (Iannone 2015:265; Marajh 2015:19-22). In this context, the temples and the ruling elite maintained heterarchical control over water management practices after the initial distribution of "unproductive lands" to "religious institutions and lay elites" (Iannone 2016:193-194,197.201-192). In a more modern sense, this could by any system of state controlled water management where stakeholders have a strong say in water use.

A bottom-up, autocratic system indicates **household control** where the elite do not in any

way manage water resources. Instead, groups of households or neighborhoods temporarily band together to construct reservoirs that are managed by household groups, kin groups, or individual households. Since the collective groups are not integrated, the expectation would be to see widespread distribution of reservoirs potentially with, but more likely without, standardization. In essence, the ruler simply does not tax his populace enough to manage this service as a higher order polity function and individuals, but more likely households, take up the slack. This may be the most likely system of management for the residential reservoirs at Caracol, given the lack of standardization in reservoir size and form (Chase 2016a:Figure 6).

A bottom-up, collective system indicates **local control** with the creation of strong institutions to enforce water management rules and norms. Reservoirs would be located close to water users and not concentrated near central administrative architecture; however, local administrative structures could exist potentially similar to a mat house (see Cheek 2003; Fash, et al. 1992). This system would be emblematic of strong local institutions (see Ostrom 2015:50-55,92). For example, the Hohokam of Central Arizona created a huge network of canals and these canal systems even survived megaflood events, indicating strong local institutions that outlasted environmental disasters (Caseldine 2018 unpublished). However, simply creating institutions at the local level would be insufficient; these local-level systems would still require a great deal of continued collective action to perpetuate these institutions over generations.

In sum, these four quadrants of: elite control, bureaucratic control, household control, and local control provide four dramatic examples of using degrees of latitude to consider different methods of water management (Figure 2). One caveat is that, this system does not inherently factor time into its analysis. Governance systems can change over time, and the archaeological record provides the physical evidence of the longue-durée with a palimpsest landscape of that occupational history. Using this framework, I contextualize a potential shift in water management practices at Caracol in the following section.

Caracol's Water Management Over Time

Caracol occupies a landscape lacking in year-round surface water (Chase and Chase 1987:1-2). Instead the population focused on the construction of monumental and residential reservoirs (Chase 2016a:892-894) and agricultural terraces (Chase and Weishampel 2016) for water management. The people who lived at Caracol relied primarily on seasonal rainfall to provide all of their water needs.

At Caracol, monumental reservoirs exist solely in association with other monumental architecture. In addition, not every district node contains a monumental reservoir (Chase 2016b:Table 2). The vast majority of water would have been provided by the plentiful residential reservoirs (Chase 2016a:892-894). In other words, Caracol's built environment is almost completely unlike that of Tikal (see Chase and Cesaretti 2019; Chase, et al. 2019 in press). At Tikal, the epicentral reservoirs would have provided most of the potable drinking water (Gallopin 1990:85-91). While residential reservoirs have been identified at Tikal (Weiss-Krejci and Sabbas 2002:344-352), thus far they do not appear to be as common at Tikal as they are at Caracol. Although, future analysis of new LiDAR data may change this interpretation (see Canuto, et al. 2018).

So far, these interpretations are based on a palimpsest landscape. However, the construction sequence of district nodes at Caracol is fairly well understood. With that in mind, the initial set of three district nodes (Downtown Caracol/Epicentral Caracol, Hatzcap Ceel, and Cahal Pichik) contain the largest monumental reservoirs and the only reservoirs at Caracol with surface areas over 1000 square meters (see Chase 2016b:Table 2). At least at the foundation of urban settlement at Caracol, monumental reservoirs must have been important. While the long-term occupation probably means that these reservoirs were subsequently expanded, they likely existed during this foundational time period. The next class of reservoirs follows in some of the subsequent expansion of district nodes at Caracol; however, the final set of district nodes added to the city contain no additional reservoirs, and the size of monumental reservoirs at districts declines over time (Chase

2016b:Table 2). Finally, we have clear evidence that by the end of the site's occupation, residential reservoirs were fairly common (Chase 2016a:892-894).

With the previously stated facts in mind, I propose that Caracol experienced shifts in water management over time. While the central administration never placed all of the monumental reservoirs in the downtown, like the administration of Tikal did, Caracol's water managers did construct monumental reservoirs at several districts. While these reservoirs would have been maintained until the collapse of Caracol, they would have experienced changes in governance as additional residential reservoirs were constructed. In contrast to Tikal, Caracol's monumental reservoirs appear to be much more accessible. For example, the two monumental reservoirs in downtown Caracol are located near causeway entrances and no surviving architecture indicates any restriction of access (Chase 2016b:Figure 3). In short, we have an overarching trajectory of water management at Caracol that likely started with elite control and shifted over time to be more collective and more bottom-up as smaller monumental reservoirs were constructed in outlying district nodes. This change may correlate with the rise in symbolic egalitarianism (Chase and Chase 2009; Chase and Chase 2017:215-216), another manifestation of strong collective action. Then, monumental reservoir construction waned as the residences at Caracol built their own reservoirs, which have no architectural evidence that they were managed at a neighborhood level. Instead it appears that by the abandonment of Caracol, the non-elite had full managerial control over their own water resources, which may have been complemented by surviving monumental reservoirs to mitigate larger droughts as an urban service. This is similar to the observation of coexisting elite and non-elite water management practices elsewhere (Seefeld 2018:425,430). This final integrated system includes both a top-down, collective management of the monumental reservoirs and bottom-up, autocratic management of household reservoirs (see Figure 3). Future research would include more comparative examples and methods for quantification of where case-studies fall along both axes.

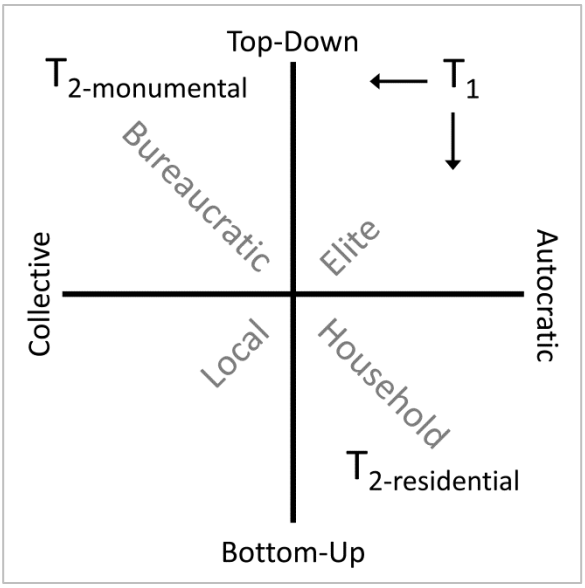

Figure 3. Caracol's water management system changed over time from a focus on monumental reservoirs during the Preclassic/Early Classic (T1) to a system of bureaucratic management of monumental reservoirs and household management of residential reservoirs by the Late Classic/Terminal Classic (T2).

Conclusion

The refocusing of water management presented here is a first attempt at standing on the shoulders of giants. Degrees of latitude provides a short-hand framework for classifying separate water management systems of governance by focusing on four dramatic sub-domains: elite control, bureaucratic control, household control, and local control. It must be remembered that these domains are not meant to be absolute categories, but rather exist along two axes with full spectra from autocratic control to collective action and from bottom-up to top-down management.

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