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In this chapter we use three approaches—distributional, contextual, and configurational (Hirth 1998)—for researching marketplaces at Chunchucmil. Other approaches, such as the spatial approach (Hirth 1998:454) and the regional production-distribution approach (Stark and Garraty 2010) focus on regions and will be presented in chapter 12. Few other archaeology projects at Maya centers can deploy each of these three approaches because the distributional approach requires systematic mapping of large areas beyond the site center and excavation of a large and representative sample of households (Hirth 2010:241). Given preliminary indications that markets played a large role in Chunchucmil's economy (Dahlin and Ardren 2002), the Pakbeh Regional Economy Program (PREP) devoted a large amount of its resources precisely to such an excavation sample (see chapter 3), thus providing a rare opportunity for marketplace research.

Though this chapter gives strong support for the existence of an ancient marketplace at Chunchucmil, we agree with many researchers (Garraty 2009; Garraty and Stark 2010; Hirth and Pillsbury 2013b; Shaw and King 2015; Wilk 1998) that we need to go beyond simply identifying the presence or absence of marketplaces. In this chapter we also attempt to answer questions about the scale of the marketplace at Chunchucmil, the size of its service area, how often it occurred, and the degree to which it was regulated.

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CONTEXTUAL APPROACH

According to Hirth (1998:453), "the contextual approach infers the existence of marketplaces from the presence of cultural features believed to require the provisioning and distribution functions of the market to exist, for example, large cities and full-time craft specialists." From a contextual perspective, data presented in chapters 5 through 10 show how Chunchucmil is an excellent candidate for a market center. As we discuss in greater depth in chapter 12, it is located near a vigorous maritime trade route and had a port site—Canbalam (see also chapter 6)—on this route. We have demonstrated clearly that Chunchucmil was a very large city (chapter 5) located in an area that also had significant rural settlement (chapter 8). Large cities make a marketplace more likely because a vendor will have a better chance to succeed where there is a large-enough population to sustain a high demand for the vendor's products. Marketplaces can also flourish in smaller towns and borderlands (Pohl et al. 1997) but the largest ones with the greatest variety of goods are often found in larger settlements (Blanton 1996). Though economizing logic favors all large cities as marketplace locations, Chunchucmil's extraordinary demography made marketplace exchange unusually critical to its economy. A market was not just likely at Chunchucmil; we argue that Chunchucmil demanded marketplaces for supplying the city and the region with food (see Freidel and Shaw 2000:289 for a discussion of staple food commerce). The land in the Chunchucmil Economic Region (CER) could not have supplied both its urban and rural settlers with sufficient food for everyone. This is partly because the ancient city is located in the driest area of the Maya world (chapters 6 and 7, this volume; Luzzadder-Beach 2000) and the soils are thin and generally of poor quality (chapters 6 and 9). Agricultural resources of the Chunchucmil region were insufficient in the face of high population levels (chapter 9; Sweetwood et al. 2009). We argue that Chunchucmil traded with people 30–100 km to the east (see chapter 13) and with people further away in the Maya highlands and southern lowlands (see chapter 12).

The previous chapter made the case for the production and exchange of "invisible" goods within the CER. Though surplus production of materials such as cochineal, *palo de tinte*, cordage, and roofing thatch left no traces that we could discern in the archaeological record, our excavations within the city have revealed non-perishable evidence for the production/processing of textiles, shell adornments, lithics, and fibers.

Textiles

The recovery of spindle whorls, used to spin thread, indicates that people at Chunchucmil spun thread. Nevertheless, as noted in chapter 10, we found only five spindle whorls, each from a different architectural group. Spindle whorls were also relatively rare at other sites in northwest Yucatán where major excavations have taken place, such as Mayapán (Masson and Peraza Lope 2014:299) and Dzibilchaltún (Taschek 1994:215). Chapter 10 contains additional discussion of the potential cotton industry at Chunchucmil but for present purposes we can safely conclude that we did not locate any architectural groups within the site that specialized in spinning or weaving.

Marine Shell

A total of 1,313 shell artifacts from 94 excavation operations at Chunchucmil were analyzed. An additional 337 shell artifacts have been tabulated from additional excavation operations but have not been analyzed. Approximately one hundred additional shell artifacts remain untallied from a handful of excavation operations. Marine shell is known to have been absent from 56 excavation operations at Chunchucmil.

Of the 1,313 analyzed shell artifacts, 801 were not taxonomically identifiable. This is because most of the shell artifacts consist of small fragments. The average length of the 1,313 shell artifacts is 2.5 cm and the average mass is 2.7 g. Table 11.1 lists the identified shell from Chunchucmil according to family, genus, or species. By far the most common genera are *Strombus* ($n = 216$) and *Busycon* ($n = 77$). The vast majority of the shell from Chunchucmil could be acquired from the west or north coast of the Yucatán Peninsula (E. W. Andrews 1969), both of which are relatively close by. One hundred and seven shell ornaments, either complete or fragmentary, were recovered from excavations at Chunchucmil (see figure 11.1). Most of these ornaments are beads/pendants or disks. In recent excavations at Mayapán (Masson and Peraza Lope 2014:321–325), finished shell objects comprise 12.4 percent of the total shell artifacts (326 of 2,632) whereas at Chunchucmil, finished shell objects comprise 6.5 percent of the total tabulated shell artifacts (107 of 1,650). This relatively large proportion of shell debris suggests that people at Chunchucmil specialized in producing shell ornaments, which was also the case at Mayapán.

Table 11.2 presents the amount of shell in those excavation contexts with the largest amounts of shell, measured in terms of shells per cubic meter of excavation and per kilogram of potsherds. Table 11.2 also compares each context of excavation to the mean by using z-scores. For example, a z-score of 1 indicates one standard deviation above the mean, while a z-score of –0.2 indicates a fifth of a standard deviation below the mean. Masson and Peraza Lope (2014) considered any contexts at Mayapán with a z-score of 1 or above to be locations that produced surplus shell products. When applied to shells per cubic meter of excavation at Chunchucmil,

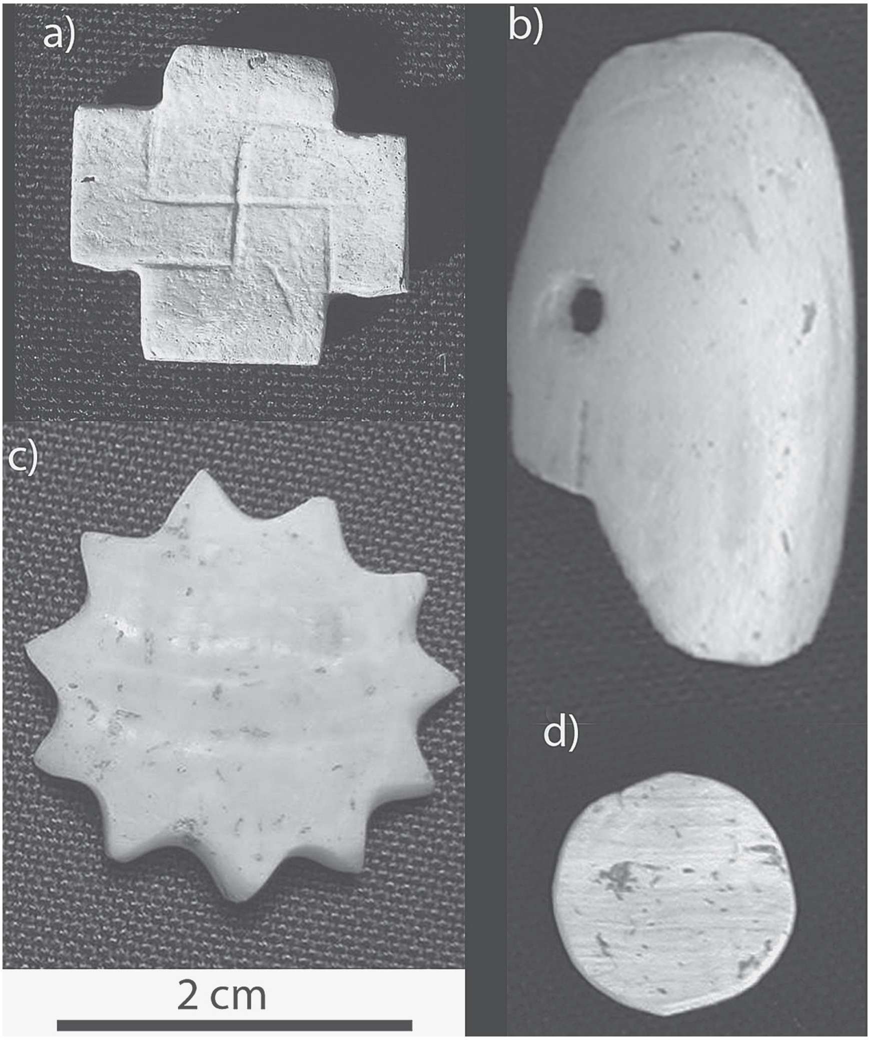

Figure 11.1. Shell ornaments recovered from Chunchucmil: (a) Aak group, midden, Op. 3G2.4; (b) Kaab' group, Str. S2E1–39, 9D4.1–3.2; (c) Aak group, Str. S2E2–23, Op. 9c1.11–1.2; (d) Kaab' group, Str. 38, Op. 9D9–4–3.1.

this criterion identifies five surplus production locales, as opposed to 17 at Mayapán. The high standard deviations seen in table 11.2 partially account for the lower number of qualifying contexts at Chunchucmil. For example, the mean number of shell artifact per cubic meter of excavation is 2.473, while the standard deviation is 9.844. Another factor to keep in mind is the type of excavation. The vast majority of

TABLE 11.1. Quantities of shell artifacts identified to taxa.

Taxa	*Number of shell artifacts*	*Taxa*	*Number of shell artifacts*
Strombus sp.	216	*Trachycardium* sp.	4
Busycon sp.	77	*Cardiidae*	3
Spondylus sp.	29	*Chama* sp.	2
Dinocardium sp.	23	*Dosinia* sp.	2
Oliva sp.	19	*Isognomon alatus*	2
Melongena sp.	17	*Ostrea frons*	2
Chione sp.	13	*Prunum* sp.	2
Anadara sp.	11	*Anomalocardia cuneimeris*	1
Codakia orbicularis	10	ARCIDAE	1
Carditamera floridana	8	*Brachydontes exustus*	1
Strombus or *Busycon*	8	*Cenchritis muricatus*	1
Lunarca sp.	7	*Cittarium pica*	1
Noetia sp.	7	*Conus* sp.	1
Cerithium sp.	6	CYMATIDAE	2
Fasciolaria tulipa	6	*Echinolittorina zicazc*	1
Turbinella sp.	6	*Ficus communis*	1
Arca sp.	5	*Polinicis lacteus*	1
Mercenaria campechensis	5	*Pteria colymbus*	1
Pleuroploca gigantea	5	*Charonia variegata*	1
Tellinidae	4	UNIDENTIFIED	801
		Total	1,313

architectural groups excavated at Chunchucmil received only test pits, as opposed to horizontal excavations. Masson and Peraza Lope (2014) demonstrate that some architectural contexts showed no evidence of surplus shell production when excavated with test pits, but later horizontal excavations at the same contexts revealed strong evidence for surplus production.

Of the five contexts with z-scores of 1 or higher for the number of shells per cubic meter of excavation (Ops. 60/S3W7-D, 36/S2E1-L, 39/S2E1-I, 139/NW transect, and 37/S2E2-J), two also have z-scores of 1 or higher for the number of shells per kg of potsherds—S3W7-D and S2E1-L. Only one other context—Op. 28/N1W2-C—has a z-score above 1 for number of shells per kilogram of potsherds. We consider S3W7-D and S2E1-L to be excellent examples of surplus production. Of 11 test pits

Table 11.2. The 10 excavation contexts at Chunchucmil with the most shells per cubic meter of excavation.

Operation number	*Map label*	*Group type #*	*Pottery (kg)*	*Shell artifacts (n)*	*Shells per m³*	*z- score*	*Shells per kg of pottery*	*z- score*
126	S1W1-F	6	14.73	13	6.83	0.44	0.88	−0.04
35	S3W4-C	8	6.39	14	7.00	0.46	2.19	0.17
81	N2W2-A	10	17.27	12	7.50	0.51	0.70	−0.07
134	S8W1-B	8	18.65	52	9.01	0.66	2.79	0.27
100	N1W2-A	6	74.21	28	10.28	0.79	0.38	−0.12
37	S2E2-J	15	14.22	8	15.27	1.30	0.56	−0.09
139	NW transect	15	4.95	12	18.75	1.65	2.42	0.21
39	S1E1-I	8	8.29	25	38.94	3.70	3.02	0.31
36	S2E1-L	9	1.05	36	58.25	5.67	34.19	5.40
60	S3W7-D	6	13.61	912	97.42	9.64	67.03	10.76
				Mean	2.47	Mean	1.12	
				St. Dev	9.84	St. Dev	6.12	

dug at S3W7-D in 2004, pit H, a 1-x-1-m pit located southeast of the group's main patio, yielded dozens of shells and was expanded to a 10.5-m² exposure in 2005 in order to increase the sample of shells. A total of 912 shells came from the excavations at this group, comprising 55 percent of the 1,650 shells tabulated from the site as a whole. Shells from 14 different genera were identified, though there was only one example from 9 of these genera. The five genera with more than one specimen at S3W7-D include *Strombus* ($n = 178$), *Busycon* ($n = 38$), *Melongena* ($n = 12$), *Codakia* ($n = 6$), and *Turbinella* ($n = 5$). It is interesting to note that no examples of *Spondylus* production debris came from Chunchucmil. Nearly all *Spondylus*-shell artifacts from Chunchucmil came from burials in group S2E2-F/Aak.

Lithics

The amount of obsidian recovered from Chunchucmil (2,716 artifacts, most of which are prismatic blades) is large compared to other Classic-period sites in the northern lowlands (Hutson et al. 2010). Yet we recovered relatively few exhausted cores ($n = 15$) and little debris from core reduction. Three architectural groups yielded more than one core: four from S2E1-G/Kaab', two from N1E1-C/Pich, and two from

S2E2-F/Aak. Since these three groups happen to be the most heavily excavated at Chunchucmil, the presence of more than one core at these groups reflects sample bias as opposed to specialization in blademaking. Thus, we do not believe we have found any locations where people produced surplus blades to trade with other households.

A total of 624 artifacts of chert, chalcedony, and mixtures of chert with other substances (quartz, limestone, etc.) were recovered from Chunchucmil. The vast majority of these artifacts, which we henceforth refer to simply as *chert*, are unretouched debitage (Mazeau and Forde 2004). Only 48 chert artifacts were used as tools, including unifaces, bifaces, and used flakes. In contrast, just one of the three main archaeological projects that have taken place at Mayapán recovered 1,497 bifacial and unifacial tools (Masson and Peraza Lope 2014:369). Chunchucmil's high ratio of obsidian blades to chert tools (approximately 50 to 1) greatly exceeds ratios from other Classic-period sites and even exceeds the overall ratio from Postclassic Mayapán, where obsidian is extremely abundant (over 20,000 artifacts recovered) in both the site core (Escamilla Ojeda 2004) and beyond (Masson and Peraza Lope 2014).

Chert cobbles around Chunchucmil are scarce, small, and of very poor quality (Dahlin et al. 2011). Chert is much more abundant in the Puuc hills, which Landa referred to as a "ridge of flint" (Tozzer 1941:186). Chert quality is not great in the Puuc hills. Though some chert outcrops have large nodules, most nodules are relatively small (12 cm or less) and have calcitic impurities and voids that often result in production failures (Potter 1993). Workshops with chert densities as high as those from Colha, Belize (Shafer and Hester 1983), have been found at the Puuc site of Xkichmook, located 120 km to the southeast of Chunchucmil. Potter (1993) sees a strong possibility that Xkichmook supplied chert to Chichén Itzá and other northern plains sites. Though the Puuc hills contained important centers at the end of the Early Classic, such as Oxkintok and Chac II (Smyth 2006; Smyth and Ortegón Zapata 2006; Varela Torrecilla 1998), Chunchucmil's late Early Classic population dwarfed that of these other sites, suggesting that Chunchucmil could have gained access to Puuc chert by force if necessary. The fact that the people of Chunchucmil did not take much Puuc chert, located as little as 30 km away, suggests that they used other materials, such as semi-silicified limestone, to make axes and other larger bifacal and unifacial stone tools (Dahlin et al. 2011).

In contrast to the obsidian assemblage, which is dominated by prismatic blades, Chunchucmil's chert assemblage is quite diverse and bears witness to a great variety of manufacturing techniques and strategies (Mazeau and Forde 2004). Since chert artfiacts are distributed relatively evenly across the site and since the total number of chert artifacts is minuscule compared to sites where surplus production of chert tools has been documented (e.g., Shafer and Hester 1983), we conclude that we have not found any specialized chert tool manufacturing at Chunchucmil.

Fiber Processing

Though we have not located any lithic workshops, Chunchucmil had a relatively large amount of prismatic blades compared to northern lowland sites (Hutson et al. 2010) and there are several architectural groups with many more blades than their neighbors. For example, a fourth of the entire assemblage of obsidian comes from a single residential group—S2E2-G/Aak—which is one of six architectural contexts where the number of obsidian artifacts per kilogram of pottery is at least one standard deviation above the mean. (The other groups are, from most obsidian to least, S5W6-G/Op. 116, S7W6-B/Op. 104, N3W2-P/Op. 63, N1W5-F/Op. 93, and N3/W2-K/Op. 64.) These groups probably used prismatic blades to produce a surplus of some other product. To determine what these blades might have been used for, Hutson undertook a microscopic use-wear analysis of blades from S2E2-G and blades from an assortment of architectural groups with much less obsidian and found that most blades in the sample analyzed from S2E2-G had wear patterns suggesting the slicing of coarse fibers (Hutson et al. 2007). This wear pattern was far less common in the architectural groups that did not appear to produce surplus goods with obsidian blades (see chapter 10). *Agave* is an excellent candidate for the coarse fiber in question given that it grows very well in northwestern Yucatán. As discussed in the previous chapter, *agave* hearts may have been an important food at Chunchucmil, and people may have worn clothes made of *agave* fibers. Reeds used to make baskets are also good candidates for the coarse fiber that was processed at S2E2-G.

In summary, of the two features that, according to Hirth, require the provisioning and distribution functions of a market, the evidence for Chunchucmil's status as a large city is indisputable but the evidence for craft specialists is not nearly as strong. Though we lack compelling evidence for full-time specialization, the existence of marine-shell adornment makers and fiber workers, combined with the probable specializations in perishable goods discussed in the previous chapter, suggest the existence of occupational heterogeneity and a complex economy.

CONFIGURATIONAL APPROACH

Following the configurational approach, we attempt to locate actual marketplaces based on (1) the spatial configuration of marketplaces and other features found within them, (2) the kind of access features that facilitate marketplace exchange, and (3) chemical residues from perishable materials deposited at marketplaces (see also Shaw 2012). In this section we use all three lines of evidence to make the case that Chunchucmil had a single major marketplace located in what we call Area D (see figure 11.2). The site may also have had smaller marketplaces that we have not been able to detect.

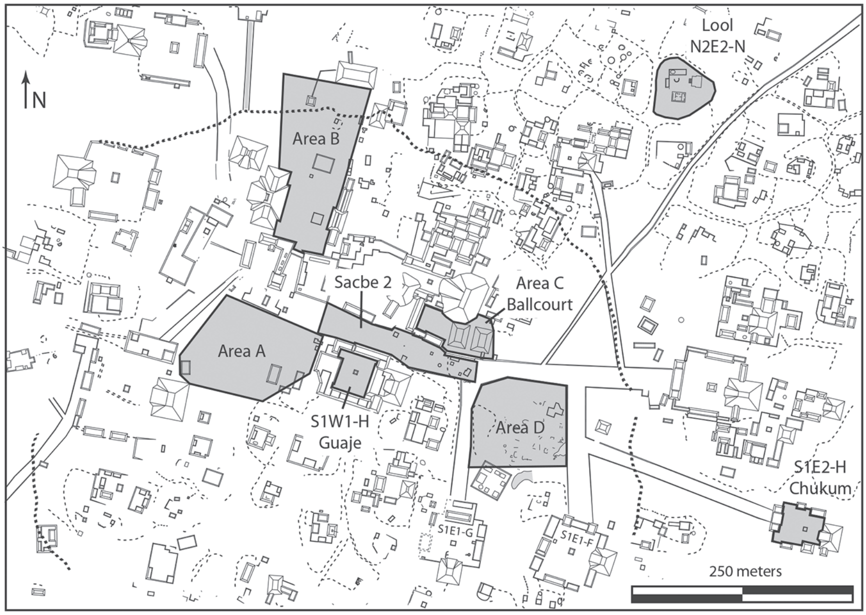

Figure 11.2. Map of the Chunchucmil site center showing some of the locations of areas (shaded) tested geochemically.

Spatial Configuration and Other Marketplace Features

Marketplaces can vary tremendously in terms of size, shape, and other features. At the time of European contact, the Yucatec Maya used the same word (*k'iwik*) for "plaza" and "marketplace" (Barrera Vásquez 1980). Thus, Mayanists tend to identify formal plazas or broad open spaces as candidates for marketplaces. To our knowledge, all spaces in the Maya area for which promising evidence of marketplace activity has recently been presented—for example, Plaza V at Trinidad de Nosotros (Terry et al. 2015), Plaza A of Group D at Cobá (Coronel et al. 2015), Plaza II of Motul de San José (Terry et al. 2015), the West plaza of Maax Na (Shaw and King 2015), the Chiik Nahb Acropolis at Calakmul (Martin 2012), the East Plaza at Tikal (Jones 2015), the north part of the East Plaza at Buenavista (Cap 2015), the Caracol Causeway termini (Chase and Chase 2014), the Lost Plaza at Xunantunich (Keller 2006), Plaza A of Ceibal (Bair 2010), and the square K open space at Mayapán (Masson and Peraza Lope 2014])—cover at least 0.2 ha each. Nearly all of these spaces are naturally or artificially flat, not counting buildings located in them. Ceremonies of various sorts probably took place in marketplaces, but plazas onto which massive temples face are less likely to have hosted marketplaces and more likely to have been restricted to the performance of ceremonies and rituals (Dahlin et al. 2007:370; Shaw 2012:131). Marketplaces can run on a daily basis, like the Tlatelolco marketplace in Late Aztec Central Mexico (Blanton 1996) or can run much less frequently in a place that is also used for other functions (e.g., Coronel et al. 2015). Both kinds of markets are common in Mesoamerica today (Dahlin et al. 2007, 2010). Marketplaces that do not run every day will probably not leave permanent architectural traces. In markets that take place day after day in the same location, administrators or vendors might build durable stalls. This would result in architectural features such as the arcade-like stone buildings in the East Plaza of Tikal (Jones 1996) or the rows of small buildings on the Chiik Nahb Acropolis at Calakmul (Carrasco Vargas, Vásquez López, and Martin 2009; Tokovinine and Beliaev 2013).

At Chunchucmil, three kinds of spaces may have hosted markets: formal plazas delimited on their sides by buildings, small open spaces in the residential core, and large open spaces at the site center. The patios in Chunchucmil's quadrangles are the only formal plazas that exceed 0.2 ha but they do not make good candidates for marketplaces because they have large temples and central altars (suggesting dedicated ritual spaces), they are not easily accessible (see below), and their chemical signatures do not accord well with marketplace expectations (see below).

In Chunchucmil's residential core there are about 20 small open spaces (Hutson 2016). These were not paved or artificially modified, and do not pertain to any architectural complexes. Though they usually cover less than 0.2 ha and are therefore smaller than any other marketplaces discussed recently in the Maya world, some markets in the contemporary Maya world today take up less than 0.2 ha. We did not excavate in any of these spaces but distributional data presented below suggest that trade in obsidian and ceramics took place at a single, central marketplace as opposed to multiple neighborhood marketplaces.

Large open spaces in the site center are visible in figure 5.1 (Areas A, D, E, F) and figure 11.2. Dahlin et al. (2007) showed that Area D had been artificially leveled (mostly by adding dirt and stone fill to low spots) at the beginning of the Classic period. Area D therefore differs from Areas A, B, E, and F, which have uneven surfaces, and is a stronger candidate for a marketplace. Like the East Plaza of Tikal or the Chiik Nahb Acropolis at Calakmul, Area D also had stone buildings. Absent at all other open spaces in the Chunchucmil site center, rows of barely visible rock alignments and rock concentrations that approximate the size of market stalls protrude from the Area D ground surface (figure 11.3). Excavation of 382 m^2 in Area D located 18 discrete rock piles or alignments, averaging 3–5 m per side. Given the size of these potential stalls and their dense packing, as many as 500 would have fit in Area D. Area D also contains within it a public well and reservoir, both of which would have been necessary amenities for public gatherings at a marketplace.

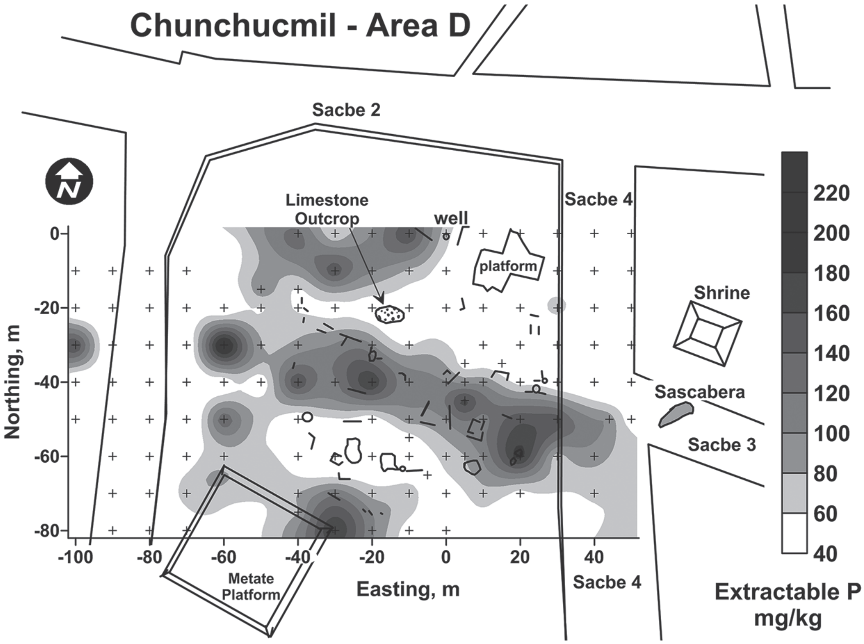

Figure 11.3. Area D, the marketplace, showing *sacbes*, rock alignments, soil-sample locations, and the spatial distribution of phosphorus (P) concentrations.

Should marketplace exchange leave an artifact signature? Items traded at contact-era marketplaces in Yucatán include, but are not limited to, salt, fish, cloth and clothing, copal, wax, honey, flint, slaves, cacao, stone beads, and feathers (Tozzer 1941:94–97). Additional items sold at the Classic-period Chiik Nahb marketplace at Calakmul include pottery, corn, atole, tamales, needles, textiles, and tobacco (Martin 2012). With the exception of certain kinds of food, these items were brought to the marketplace not to be used and discarded on the spot but to be exchanged and taken elsewhere. Therefore, they should not enter the archaeological record at the marketplace itself. Several authors (Cap 2015; Hirth 2009b; Keller 2006; Shaw 2012:132–134) have suggested, however, that some final production steps of traded items took place at marketplaces and that these production steps would leave behind non-perishable debris such as lithic debris from end-stage reduction. Such debris, except perhaps microdebris trampled into floors (Hirth 2009b:93), would likely be swept away (Dahlin et al. 2010:368), perhaps to the edge of the plaza. If the plaza were used for other purposes on other days, debris with hindrance potential would certainly be removed after market day. Keller (2006:613–616) considers accumulations of chert and obsidian debris at the edge of the Lost Plaza, a possible marketplace at Xunantunich, as the residue of lithic production in a market setting. Although it is possible that lithic debris might be found in limited spots within or at the edge of a marketplace, we do not see the presence of this debris as a necessary aspect of marketplaces, since production in household contexts is the norm in the Maya area. For reasons discussed in the previous section (see also Dahlin et al. 2011), lithic production debris is rare at Chunchucmil. Not surprisingly, excavations in Area D at Chunchucmil did not recover lithic macro- or microdebris. Other kinds of debris, inferred indirectly from chemical residues, were abundant and patterned in ways that we would expect of a marketplace (Dahlin et al. 2007), as we discuss below.

Marketplace Accessibility

People should be able to get to marketplaces easily. At least three features enhance marketplace accessibility: (1) central location; (2) connections to transportation arteries that easily link the major areas of the city and the hinterland (Hirth 1998:453); and (3) multiple entrances. The best candidate for a marketplace at Chunchucmil—Area D (figure 11.2)—meets each of these expectations. Area D is located in the middle of the site center. Most other potential marketplaces in the Maya area are also centrally located, though Caracol may have had a series of marketplaces three or more kilometers from the site core, located at the termini of causeways radiating from the site center (Chase and Chase 2014).

Regarding transportation arteries, Chunchucmil's site center exhibits precisely the kind of access features predicted by the configurational approach. Major *callejuela* pathways extend from the site center to the edges of the site, like spokes of a wheel emanating from the axle (Hutson 2016). At the site center, some of these pathways feed into open spaces while others feed into the system of *sacbes* that links all the important architectural complexes (figure 2.5). Area D is bounded by three *sacbes* (2, 4, and 5) and is fed by two others (1 and 3; figure 11.2), making it extremely accessible.

Regarding entrances, Area D appears to be unrestricted. Though it is possible that there were perishable barriers in the past, there are no observable thresholds. Whereas entrance into other centrally located formal plazas, such as those of the S1E1-G and S1E1-F quadrangles, each within 100 m of Area D (figure 11.2), requires passing through one of the buildings that line each of these plazas' sides, one can get into Area D simply by stepping off the *sacbe*. Makeshift stalls might have even overflowed onto the *sacbes*, as Chase and Chase (2014:242) report for the Ramonal marketplace at Caracol. Thus, looking at spatial criteria alone, Area D is easily the best candidate for a marketplace at the site. Some have noted that entrances should be limited so that administrators can control access or even charge an entrance fee (Shaw 2012:128). The apparent lack of any bottlenecks into

Area D suggests that administrators wanted to encourage as many people to come to the market as possible.

Soil Chemistry

Geochemical analyses of archaeological soils and floors from a broad variety of contexts (kitchen gardens, residential structures, temples, plazas, etc.) have helped in prospection for ancient features such as middens and have provided evidence of ancient human activities that included disposal of waste, sweeping of debris, food preparation and consumption, mineral crafting, rituals, and market exchange (Anderson et al. 2012; Craddock et al. 1985; Dahlin et al. 2007, 2010; Hayes 2013; Hutson and Terry 2006; Luzzadder-Beach et al. 2011; Oonk et al. 2009; Parnell et al. 2001; Parnell, Terry, and Nelson 2002; Parnell, Terry, and Sheets 2002; Terry et al. 2000). Geochemical analyses figure prominently in our attempts to locate marketplaces. Plaza soils and floors absorb and retain phosphorus (P) and certain trace elements in the floor matrix. As foodstuffs were processed, consumed, and disposed, the phosphate and trace element constituents released from the organic matter became fixed in the particle matrix of the soil or floor (Barba 1986; Barba and Ortíz 1992; Middleton 1998; Middleton and Price 1996; Parnell et al. 2001; Terry et al. 2000). Metallic residues from the crafting of stone and mineral pigments for painting were also fixed on soil particles (Holliday and Gartner 2007; Parnell, Terry, and Nelson 2002; Parnell, Terry, and Sheets 2002; Wells et al. 2000). Geostatistical analysis of the patterns of soil chemical residues in public plazas and open spaces within several ancient Maya cities has helped to identify chemical concentration patterns associated with marketplace and other economic exchange activities (Dahlin et al. 2007, 2010). The public and household spaces at Chunchucmil have been the focus of a number of geochemical analysis studies of ancient Maya activities (Bair and Terry 2012; Dahlin et al. 2007, 2010; Hutson et al. 2009; Hutson and Terry 2006). In this section we review previously published geochemical analyses and new, unpublished geochemical data from a number of plazas and large open spaces in the Chunchucmil site center, including Area D.

Dahlin et al. (2010) summarized the soil geochemical analysis of gridded soil and floor samples from seven locations at the Chunchucmil site center. These locations include the main patios within two quadrangles (Groups S1W1-H/Guaje and S1E2-C/Chukum; see chapter 3 for a definition of quadrangles), a patio associated with Chunchucmil's ballcourt (Area C), the surface of Sacbe 2, Area D, and two open areas neither neatly bounded nor affiliated with a particular architectural group (Areas A and B; figure 11.2). The surface areas, configurations, and extractable P concentrations of these spaces are listed in table 11.3. Given the presence of

Table 11.3. Extractable phosphorus (P) data and characteristics of a variety of public plazas, *sacbeob,* and household spaces at Chunchucmil, Yucatán.

Location	*Area (ha)*	*Small structures*	*Mehlich P concentrations (mg/kg)*			*Patterning of high P levels*
			Minimum	*Maximum*	*Average*	
Control soils			4	6	5	
Sacbe 2 eastern end	0.7	yes	7	96	22	Off edges and behind structures
Sacbe 2 western end	0.04	no	7	58	16	Off edges
Area B	2.6	yes	4	45	9	Plaza edges
Area C & Ballcourt	0.08	no	7	163	20	One plaza corner
Area D (marketplace)	1.5	yes	8	272	57	Plaza center parallel to sacbe
Lool houselot	0.41	yes	7	151	20	Edge of patio
Guaje quadrangle	0.17	no	3	24	11	Corner of patio
Chukum quadrangle	0.28	no	4	47	16	Corner of patio

bedrock outcrops, thin soils, modern disturbance, and uneven terrain in Area A, we did not extract P from soil samples taken in this area, deciding instead to focus our resources on the other areas. Most samples taken from the enclosed patios in the two quadrangles had P levels below 20 mg/kg. The only notably high spot (P = 47 mg/kg) was found in the southwest corner of S1E2-C/Chukum. Similar P concentration and distributions were found in Area C, the ballcourt.

The highest P concentration (P = 163 mg/kg) in Area C was located between the ballcourt and the base of the largest pyramid at the site (Dahlin et al., 2010). With the exception of a test pit in the center of its alley, we have not excavated the ballcourt. Several thoroughly excavated ballcourts (Fox 1996; Hutson et al. 2015; Lohse et al. 2013) in other regions have yielded evidence of feasting, usually behind the ballcourt. High P concentrations are one of many lines of evidence for feasting residues, but such concentrations could also result from the dumping of organic matter not generated by feasts. The high P concentration at the Chunchucmil ballcourt comes from a single sample at the west edge of the northern end zone, a tight space of perhaps 5-by-5 m, bounded to the south, north, and west by pyramid edges. It is unlikely that this cramped and not particularly accessible space was part of a marketplace. The P concentrations along Sacbe 2 were generally highest off the edges of the *sacbe* and behind Terminal Classic houses built on the *sacbe*. This pattern suggested waste disposal over the edge of the *sacbe* and in middens behind houses. Phosphate concentrations in Area B were very low (avg 8.7 mg/kg) and the highest concentration was at the edge of a structure.

Given the mapping and excavation data presented earlier for Area D, it may come as no surprise that geochemical analysis strongly suggests that Area D was a marketplace. The concentration isopleths of Mehlich extractable P and chelate (DTPA) extractable trace metals in the plaza floor were reported by Dahlin et al. (2007). The maximum concentrations of P were in the central portion of the Plaza (figure 11.3). The most notable pattern of soil P in the suspected marketplace plaza consisted of highly elevated levels of extractable P (100–272 mg/kg) in a band running through the central portion of the built-up plaza (figure 11.3). This band of elevated P is parallel to both Sacbe 3 to the east, and with rows of small rock alignments and low rock piles found protruding above ground surface. Excavations showed the rock alignments were not part of retaining walls holding plaza fill. Instead, they were placed directly onto the plaza's floor and served as foundations for small ephemeral structures (Dahlin et al. 2010). A band of extraordinarily elevated phosphates aligned with rock features that resemble market stalls matches very well with marketplace signatures recorded from an ethnoarchaeological study of a twentieth-century open-air marketplace with dirt floors in Antigua, Guatemala (Dahlin et al. 2007). More specifically, areas of food preparation and service had the highest reading of P within the Antigua market. We conclude that the band of elevated phosphates visible in figure 11.3 pinpoints the ancient food-marketing and food-service area.

The trace elements contained in foodstuffs include Fe, Cu, Mn, and Zn. It is likely that food materials were the major sources of P and Zn enrichment in activity areas associated with food but mineral ores and pigments marketed and used by the Maya also contained Fe, Cu, and Mn. These mineral-based materials were likely used and traded at locations separate from the foodstuffs. Phosphorus and trace elements have limited solubility in the soil and their geospatial distributions provide useful information on ancient human activities related to marketing of food and mineral substances. The concentrations of DTPA extractable Fe ranged from 6 to 103 mg/kg with a level of 98 mg/kg adjacent to the small rock outcrop in the north central portion of the plaza. The average concentrations of Fe (27 mg/kg) in samples from the marketplace plaza were 35 percent greater than the average values of the Lool houselot (N2E2-N/Op. 13) and Sacbe 2 (20 mg/kg). Average concentrations of DTPA extractable Zn in the soil of the marketplace (3 mg/kg) were 30 percent greater than those of Lool and Sacbe 2.

The emerging technology of portable X-ray fluorescence (pXRF) analyses of total element concentrations is finding application in archaeological soils and floors (Coronel et al. 2014; Davis et al. 2012; Hayes 2013). Samples from the northern two-thirds of Area D were retrieved from storage and subjected to pXRF analysis of total element concentrations (Coronel et al. 2014). Concentration isopleths of total Zn and total Fe of the northern portion of Area D are shown in figures 11.4 and 11.5, respectively. The concentration isopleths of pXRF total Zn shown in figure 11.5 are similar to those of Mehlich extractable P (figure 11.3). The highest levels of total Zn appeared in the center of the plaza aligned with Sacbe 3 and the rows of stones. The correlation coefficient of Mehlich P compared to total Zn was highly significant ($r = 0.601$; $p < 0.01$). The correlation matrix of the comparisons of selected extractable and total element concentrations in the floor of Area D is shown in table 11.4. Dahlin et al. (2007) reported that the correlations between Mehlich P and DTPA extractable Zn were not significant ($r = 0.069$) in the samples from Area D but that there was a highly significant correlation between Mehlich P and DTPA Zn in the floor of the open-air marketplace at Antigua ($r = 0.407$; $p < 0.01$). We have compared concentrations of Mehlich extractable P and both DTPA extractable Zn and pXRF total Zn in a number public plazas at ancient Maya sites. There were highly significant correlations between P and extractable or total Zn on the floors of proposed market plazas at Caracol (Horlacher 2013), Kiuic (Horlacher 2013), Mayapán (Terry et al. 2015), Cobá (Coronel et al. 2015), Motul de San José (Bair and Terry 2012), and Ceibal (Bair 2010). There were no significant positive correlations between P and extractable Cu, Mn, Fe, or Pb at any of these plazas. However, at the central plaza of the contemporary village of Telchaquillo, Mehlich P was significantly correlated with DTPA extractable and pXRF total forms of Fe and Zn. The patterns of high P, Zn, and Fe concentrations are found adjacent to a limestone outcrop that is the site of contemporary butchering and meat sale activities in the plaza (Coronel et al., 2014). It is interesting that a limestone outcrop appears in the Chunchucmil Area D surrounded with soils of high P, Fe, and Zn (figures 11.3, 11.4, and 11.5, respectively).

In summary, the configurational lines of evidence for the argument that Area D was a marketplace amount to a slam dunk. Area D's location, its links to *sacbes* and pathways, and its lack of barriers make it the most central, accessible, and unrestricted place in the site center. This would be perfect for attracting as many buyers and sellers as possible. The area itself was made to be quite inviting as a market place, given its large size, its smooth, artificially leveled surface, and the availability of water. Mapping, excavation, and geochemical analyses revealed what appear to be market stalls aligned in rows with sharp and closely corresponding patterns of phosphate build-up resembling a modern market in Guatemala. Finally, our positive identification of Area D as a marketplace gets a boost from the fact that the same

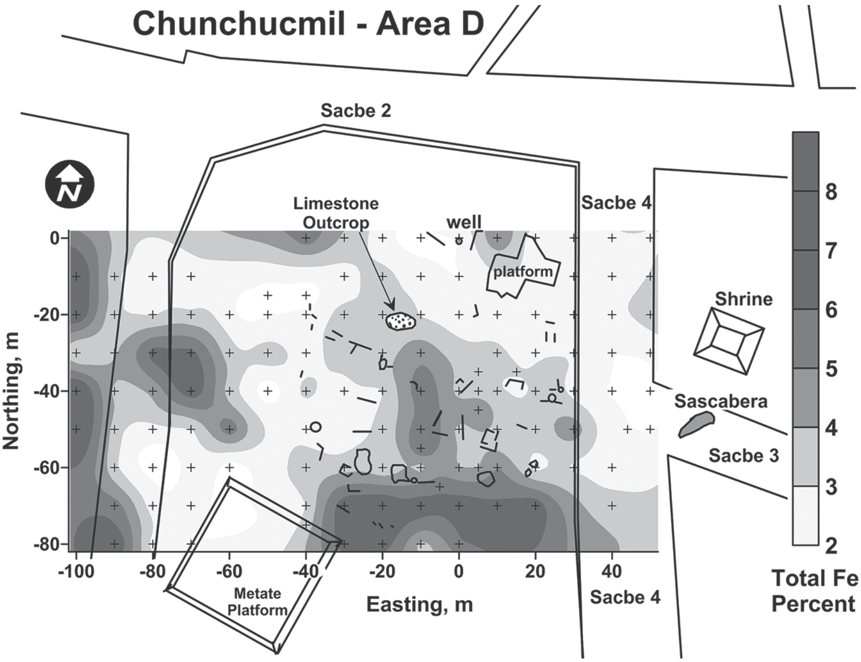

FIGURE 11.4. Area D, the marketplace, showing *sacbes*, rock alignments, soil-sample locations, and the spatial distribution of iron (Fe) concentrations

set of methods did not provide strong evidence for marketplaces in other potential locations of commerce in the site center. Stated differently, our result from Area D is not simply a case of "always finding what you're looking for." These other areas are not artificially raised, do not have evidence of stalls, and lack strong chemical signatures of a marketplace. Nevertheless, occasional buying and selling may have taken place beyond Area D, perhaps when the city celebrated major events, drawing additional crowds from far away.

DISTRIBUTIONAL APPROACH

Hirth's distributional approach to identifying a marketplace assumes that when a good is available at a marketplace, it should have a broad distribution across the site (Hirth 1998, 2010; see also Masson and Freidel 2012; Shaw 2012; Stark and Garraty 2010). As long as households have the means to purchase that good, archaeologists should find that differences in wealth and/or power among consumers do not skew the distribution of that good. This does not necessarily imply that marketed

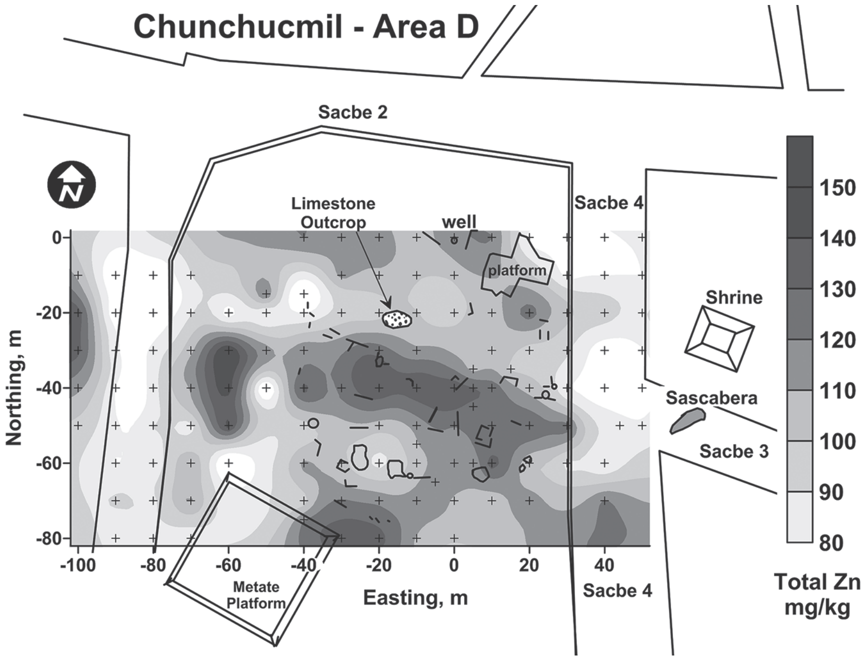

Figure 11.5. Area D, the marketplace, showing *sacbes*, rock alignments, soil-sample locations, and the spatial distribution of zinc (Zn) concentrations.

goods are distributed evenly across all households in the site or region. For example, households that need more of a particular tool for specialized production will have more of that tool. Thus, the distributional approach does not locate a marketplace directly, but infers it by showing that the distribution of goods at a site matches what we would expect if they were sold at a marketplace. Garraty (2009) has bolstered this approach in Mesoamerica by showing that the distribution of goods in an area known to have major marketplaces does indeed match what would be expected in Hirth's model. We await test cases showing that the distribution of goods in societies that definitely lack markets does not meet the expectations of the distributional approach (M. E. Smith 1999). Distributional approaches have been applied at other Maya sites (Braswell and Glascock 2002; Eppich and Freidel 2015; Halperin et al. 2009; Masson and Freidel 2012; Chase and Chase 2014), though in some cases the number of households sampled is small.

We use data on the distribution of obsidian and luxury pottery to explore whether these goods were distributed by market exchange at Chunchucmil and, if so, how far into Chunchucmil's hinterland this exchange reached. Obsidian entered the site

Table 11.4. Correlation matrix of the comparisons of selected extractable and total element concentrations. Significance of regression coefficient (*r*) is denoted by * = $p < 0.05$ or † = $p < 0.01$

	pXRF Total element					*DTPA extractable*			
	Ca	*Mn*	*Fe*	*Cu*	*Zn*	*Cu*	*Fe*	*Mn*	*Zn*
Mehlich P	−0.097	0.121	0.008	0.456†	0.601†	0.044	0.011	−0.187	0.000
Total Ca		−0.542†	−0.763†	−0.055	−0.567†	0.078	0.033	−0.107	0.130
Total Mn			0.601†	0.180	0.406†	−0.027	0.018	−0.080	−0.084
Total Fe				−0.180	0.409†	−0.207*	−0.127	0.071	−0.140
Total Cu					0.578†	0.044	−0.003	−0.058	0.062
Total Zn						−0.016	−0.034	−0.071	−0.013
DTPA Cu							0.774†	0.083	0.288*
DTPA Fe								−0.027	0.021
DTPA Mn									0.311†

in the form of slightly reduced polyhedral cores. Since blade-production debris was found in a small number of household contexts (see above), some mechanism must have functioned to move blades from the few producers to the multiple consumers. Blades may also have been made at the marketplace. Luxury pottery from the Early Classic consists of polychromes—Timucuy and Tituc—or thin wares—Chencoh, Acu, and Kochol groups (Varela Torrecilla 1998). We found no pottery-production locales (no kilns, no waster sherds), so we do not know who made luxury pots. We presume that at least some of Chunchucmil's pottery was made on site, but we do not know where (see chapter 4). If producers or merchants sold blades and fancy pots at Chunchucmil's central marketplace, we would find these products spread relatively evenly across the site (Hirth 1998).

Hirth distinguished marketplace exchange from redistribution and reciprocity by analyzing access to obsidian and foreign and luxury ceramics at Xochicalco. He divided Xochicalco's excavated households into two categories, elite ($n = 14$) and ordinary ($n = 60$) and then used ANOVA to determine how evenly these artifacts were distributed between the two categories (for a distributional study that quantifies variability among domestic contexts using a statistical measure of diversity, see Garraty 2009). Hirth argued that in redistribution, elites control access to a good, keep a lot of that good for themselves, and then pass a smaller portion of it to households that have given them loyalty, labor, or surplus products. If obsidian or foreign ceramics are distributed evenly between the elite and non-elite households, the F-statistic for ANOVA will be low. If there is a high probability that there is a significant difference in access to these goods among elite versus ordinary households, the F-statistic will be higher. Hirth found low values for F in his samples. This meant that household wealth had no effect on exchange, thus suggesting that redistribution was not the main form of exchange for these goods. Hirth also noticed that houses across the site had access to obsidian from multiple workshops. This eliminates reciprocity since in reciprocity we would only expect houses to have obsidian from their nearest workshop. Reciprocity is not a particularly efficient form of exchange and goods distributed via reciprocity usually have a limited spatial distribution across a site (Hirth 1998).

When Hirth's paper came out, we expected that most obsidian at Chunchucmil circulated through redistribution. Obsidian was a low cost, utilitarian commodity at Terminal Classic Xochicalco (Hirth 1998:461), and this was also the case in the northern Maya lowlands during the Terminal Classic at Chichén Itzá (Braswell and Glascock 2002) and the Postclassic at Mayapán, where "obsidian was not prohibitively expensive and could be obtained without restriction in the marketplace" (Masson and Peraza Lope 2014:349). Yet research in the Maya area has suggested that obsidian in the late Early Classic was a wealth good controlled by elites and not readily accessible to commoners (Aoyama 2001a, 2001b; Stoltman 1978; Rice 1984). Aoyama infers this at Early Classic Copán from the distribution of production debris and the fact that elites had greater access to obsidian. Rice (1987:80) concludes that "as wealth, obsidian procurement and distribution may have been a narrowly guarded perquisite of high status, the stone being obtained for purposes of making offerings on ceremonial occasions." If obsidian were a ceremonially restricted wealth good at Early Classic Chunchucmil, we would expect to find very little of it beyond Chunchucmil's quadrangles and elite residences. Clark (2003:52–53) has challenged Aoyama's conclusion that elites redistributed obsidian (and gained power from it) at Early Classic Copán and suggests instead that marketplace exchange could explain the distribution of obsidian (see also Stark and Garraty 2010:51).

Even if the obsidian was not controlled by elites In the Maya region during the Early Classic, obsidian could have been a high-cost good for reasons of both supply and demand. Regarding supply, nearly all of Chunchucmil's obsidian came from the El Chayal source, located far away (670 km as the crow flies) in lands not controlled by Chunchucmil (see chapter 12 for more information on obsidian sourcing and trade routes). Thus, acquiring obsidian was a complex logistical undertaking and steady access to it in times of distant political upheaval could not be guaranteed. It may in fact be the case that Chunchucmil's seventh-century collapse was tied to the intensified warfare and rivalry between southern lowland polities at this time (see chapter 13). Regarding demand, obsidian's superior sharpness makes it highly desirable, especially in an area with poor chert resources. Let us presume that, despite its potential as a high-cost good, obsidian was not a narrowly guarded perquisite of high status, despite the suggestions of Rice (1987) and Aoyama (2001a, 2001b), and therefore could have been available for sale at a marketplace. Though available for purchase to all, obsidian might not have been distributed evenly across the site. Access to obsidian, as a high-cost good, may have varied with purchasing power. Thus, even with market distribution, the distribution of obsidian might have been skewed toward rich people. Thus, marketing and redistribution models introduce a problem of equifinality (Stark and Garraty 2010:51). When households of different purchasing power seek an expensive good at a marketplace, households with greater wealth will end up with more obsidian. This dovetails with the expectation of a redistributive system since redistribution replicates status hierarchies (Masson 2002a:7–8).

Excavations across Chunchucmil provide the data to determine whether the distributions of obsidian and luxury pottery conform to patterns we would expect from marketing, redistribution, or reciprocity. As discussed in chapter 3, PREP project members placed excavations in 167 architectural contexts at the site. These contexts include 161 groups and a *sacbe* in the 9.3-km^2 polygon and five groups located on the transects. Though all of these groups received test pits, seven of the groups in the 9.3-km^2 map were excavated horizontally. These include groups N1E1-C/Op. 9a (the Pich group), S2E2-F/Op. 9c (the Aak group), S2E1-G/Op. 96 (the Kaab group), S2E3-L/Op. 9h (the Chiwool group), S2E2-C/Op. 10 (the Muuch group), N2E2-N/Op. 13 (the Lool group), and S1E1-H/Op. 15 (the marketplace). In addition, five groups (three of which were excavated horizontally) each received about 100 pits measuring 50-by-50 cm. Of these 167 excavated architectural contexts, 141 received excavations substantial enough to be included in the analysis. By substantial, we mean that at least six 1-by-1-m test pits were dug, or in cases with fewer than six pits, excavations yielded large quantities of sherds (always over 4 kg). This comprises a 9.5 percent sample of the approximately 1,477 architectural groups mapped at the site. Eleven of these 141 contexts were Late and Terminal Classic type 6 platforms (chapter 3, this volume; Magnoni 2008) and were therefore dropped from the current study to ensure contemporaneity of the contexts.

Following Hirth's example, we divided the remaining 130 contexts into categories that we thought would best represent different wealth levels. The highest wealth category included architectural groups with monumental pyramids (group types 1 and 2, as well as some examples from group types 4 and 5; see table 3.1). Twelve of the 15 groups in this category are quadrangles. Though the large temples in these groups suggest ritual activities serving larger sections of the population, excavations of the Pich quadrangle/N1E1-C (see chapter 5), indicate that these groups were also residences. The other three categories of architectural contexts consist of residential groups with one or more houses often facing onto one or more patios. These groups are not purely residential, because they tend to contain gardens, work areas, and shrines for the veneration of ancestors. These three categories include small groups with five or fewer stone platforms ($n = 64$), medium-sized groups with six to 10 stone platforms ($n = 38$), and large groups with 11 or more stone platforms ($n = 13$). We initially thought that these three group sizes would correspond roughly to wealth levels because patio groups with more buildings tend to have more residents, implying greater wealth and greater control of labor and resources (Netting 1982). These three categories roughly correspond to group types 8, 9, and 10 (see table 3.1), but they have been expanded in the following way: any group from types 12, 13, 14, 15, and 16 that has five or fewer structures was combined with groups from type 8, any group from types 12, 13, 14, 15, and 16 that has between six and 10 structures was combined with groups from type 9, and any group from types 12, 13, 14, 15, and 16 that has 11 or more structures was combined with groups from type 10 (see chapter 3 for more information on types of groups). All but 11 of the groups in these three categories are encircled by low stone walls. As noted in chapter 2, we refer to such encircled groups as *houselots*.

Table 11.5 shows the numerical data and statistics regarding quantities of obsidian and luxury pottery for each of the four architectural categories. Following Hirth, we used ANOVA to see if there were significant differences in the variance between the categories (see also Eppich and Freidel 2015). Table 11.5 quantifies obsidian in three ways and quantifies luxury pottery as a percentage of total pottery by mass. Although the differences between the three kinds of houselots are quantitative, the differences between the monumental groups and houselots are probably also qualitative. Therefore table 11.5 presents F-statistics for just the three categories of houselots as well as F-statistics for houselots and monumental groups.

The results in table 11.5 show that there is almost no difference in access to obsidian and luxury pottery among the three categories of houselots. These results resemble those produced by Masson and Freidel (2012) for Tikal. We look first at obsidian. We should note that our analysis of obsidian strays from Hirth's because we do not quantify obsidian source data per architectural group. We skipped this step because El Chayal obsidian dominated all contexts. Whether the quantities of obsidian are measured by count or mass, or as a proportion to kilogram of ceramics

TABLE 11.5. Quantities of fine pottery and obsidian recovered from excavations in four common architectural groups at Chunchucmil.

	Monumental groups (n = 15)	*Large houselots (n = 13)*	*Medium houselots (n = 38)*	*Smallhouselots (n = 64)*	*F for houselots*	*P-value*	*F forhouselots and monumental groups*	*P-value*
Grams obsidian to kg pottery		0.95	1.27	1.70	0.828	0.439	1.241	0.298
Standard deviation	0.57	0.72	1.61	2.72				
Grams obsidian to m^3 excavation	1.02	2.58	2.15	2.34	0.366	0.694	1.423	0.239
Standard deviation	1.18	3.57	3.64	1.51				
Obsidian artifacts per m^3 excavation	1.50	3.89	3.97	3.38	0.268	0.766	1.509	0.215
Standard deviation	1.67	2.59	3.20	4.78				
% fine pottery	1.62	0.87	0.89	0.96	0.051	0.950	1.560	0.203
Standard deviation	1.20	0.48	0.69	1.47				

or cubic meter of excavation, the F-statistics are low and the high *p*-values show that the small differences among the categories are far from being statistically significant. Student's *t*-tests confirm that differences in the houselot means for obsidian are not significant. When monumental groups are included in the analysis, the F statistics climb, but they do not reach a level of statistical significance; *t*-tests show that monumental groups have significantly *less* obsidian than houselots. When obsidian is quantified as a ratio to ceramics, only the difference in means between monumental groups and small houselots is significant ($t = -2.77$, $p = 0.002$, df = 77). When quantified the other two ways, which are admittedly not as informative, *t*-tests between monumental groups and each of the three houselot categories show statistically significant differences.

In summary, the data clearly suggest marketplace distribution of obsidian as opposed to reciprocity or redistribution. In the redistribution model, we would expect the most obsidian in the monumental groups, the second most in the large/rich houselots, and less obsidian in the final two categories. This is decisively not the case: the poorest houselots have just as much obsidian, if not more, than other houselots. This suggests that obsidian was not a wealth good and that people had open access to obsidian at a marketplace. Though some houselots have more obsidian than others, these houselots are spread evenly across the site, as seen in figure 11.6. This eliminates reciprocity as a mechanism for the distribution of obsidian since the inefficiencies of reciprocity predict a limited spatial distribution across the site. The lower quantities of obsidian in pyramid groups may be the product of a sampling error since we did not excavate special deposits in the largest groups. At Tikal and Quiriguá, special deposits contain the lion's share of obsidian (Moholy Nagy 1989; Sheets 1976). However, Moholy Nagy (1997) argues that obsidian in special deposits at Tikal does not necessarily mean that the obsidian was consumed in the architectural compound where the special deposit is located. Such obsidian could have been brought from other compounds at the site. Finally, quadrangles may have had less need for obsidian. In other words, the suite of domestic and workshop activities involving obsidian, such as processing of maguey fiber, woodworking, and so on that took place in other architectural contexts may not have occurred as often at monumental groups.

The data in table 11.5 indicate that there is almost no difference in access to luxury ceramics among small houselots, medium houselots, and large houselots. The mean amounts of luxury pottery per group are very similar and the F-statistic is very low. Monumental groups, on the other hand, have more luxury pottery than houselots. The F-statistic is still not high enough to be significant, but *t*-tests between monumental groups and residential houselots have *p*-values of between 0.056 (monumental groups compared to small houselots) and 0.021 (monumental groups compared

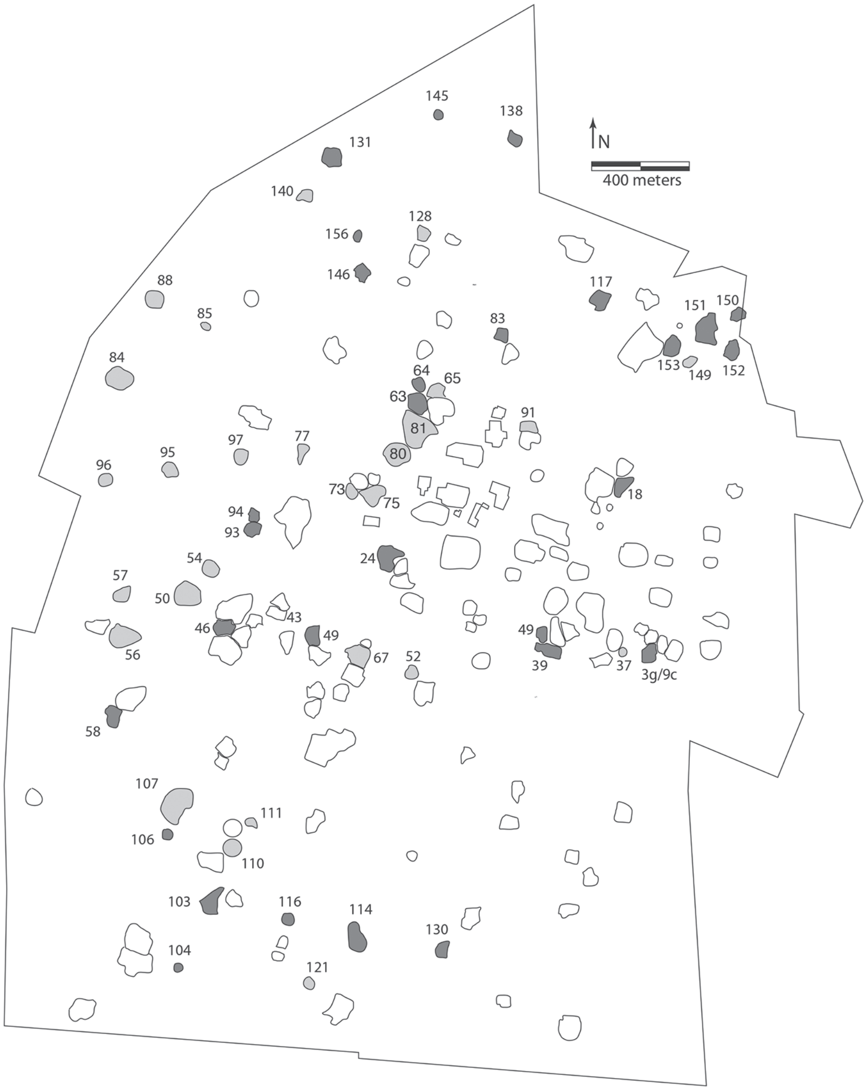

Figure 11.6. Map of Chunchucmil showing the distribution of excavated architectural contexts with high quantities of obsidian (the top quartile, shaded darkly) and low quantities of obsidian (the bottom quartile, shaded lightly).

to large houselots). Such low *p*-values mean that the chances that the differences in access to luxury pottery between monumental groups and the three other kinds of groups are due to pure chance range between 1 in 20 and 1 in 50. This leads us to conclude that these differences are real and not just an artifact of sampling error or some other specious process.

Thus, just like the obsidian data, the data on luxury pottery support marketplace distribution. Houselots of all three wealth grades had equal access to luxury pots. At the same time, monumental groups had greater access to luxury pottery. Though this would at first suggest redistribution, this slightly uneven distribution could still occur if luxury pottery were available at a marketplace. Here we run into the problem of equifinality as discussed above. A good that is available at a marketplace may not be distributed evenly if it is a high-cost item, because only wealthy consumers can afford to consume it frequently. Or, a good that is available at a marketplace may not be distributed evenly if certain types of consumers simply have greater demand for it. Both of these conditions might explain why there is more luxury pottery at the monumental groups: monumental groups were the wealthiest in terms of access to labor but they also may have had a greater demand for luxury pottery if they were hosting more celebrations or serving food to important guests.

In conclusion, distributional data support the presence of a marketplace. Nevertheless, there is substantial variation in access to obsidian within the four architectural categories examined. We see this variation in the large standard deviations seen in table 11.5 and in the fact that in six of the 64 small houselots we recovered no obsidian, whereas one had over 10 times the mean. Thus, the relative equality between categories of houselots of different size masks inequality among houselots of the same size. This inequality of access might be explained by the fact that some households consumed more obsidian because they required it for specialized productive activities. Data from the Aak residential group (S2E2-F/Op. 9c) confirm this. As discussed above, the members of that group specialized in processing cordage and/or fibers (Hutson et al. 2007).

DISCUSSION

Now that we have presented evidence for the existence of a marketplace at Chunchucmil, the next step is to ask about the nature of the marketplace and what that says about a market economy at Chunchucmil. In this discussion we focus on questions that address the scale, periodicity, organization, and scope of Chunchucmil's marketplace. Not all of these questions have clear answers. We continue to address some topics, such as the degree of government involvement in Chunchucmil's marketplace, in chapter 13.

How many marketplaces were there at Chunchucmil? Though Chunchucmil does have open spaces throughout the site that could have been used as marketplaces, the results of the distributional approach show that obsidian and pottery styles were distributed evenly across the site. This suggests there was a single marketplace (Area D) that everyone at the site had access to. The alternative is that there were many marketplaces spread throughout the site. If this were the case, we might find spatially heterogeneous distributions of marketed items, such that certain kinds of pottery available at one particular market might be found at households near that market but not another market. This is precisely the case at Caracol (Chase and Chase 2004; 2014:245). Fittingly, Chase and Chase argue that there were multiple marketplaces at Caracol (see also Chase et al. 2015). This pattern is not found at Chunchucmil. Different pottery types in the type variety system (e.g., Hunabchen Red, Kanachen Black) are distributed evenly across the site (Hutson 2016).

What was the scale and periodicity of Chunchucmil's marketplace? The discovery of stone footings for what Dahlin believed were market stalls in Chunchucmil's marketplace leads to the conclusion that Area D, like Tikal's East Plaza or the Calakmul's Chiik Nahb Acropolis, was functionally committed to marketing, which could have taken place on a daily base. Area D covered 1.5 ha, which places it at the large end of the size continuum of potential Maya marketplaces. The potentially daily periodicity of Chunchucmil's marketplace and its large size accord well with the large number of people that lived at Chunchucmil (see chapter 5) and the broader argument of this book: commerce was an important part of Chunchucmil's livelihood.

How heavily regulated was Chunchucmil's marketplace? Carol Smith (1976) described markets that were minimally regulated ("competitive" markets), markets in which authorities regulated the middle men but not the producers ("administered" markets), and markets in which authorities controlled production ("monopolistic" markets). This last form of marketplace pertains to colonial situations not relevant to Chunchucmil (see also Braswell 2010; Braswell and Glascock 2002). Smith also presented spatial expectations that correlate with market types. Administered markets are usually bounded spatially such that trade does not cross between polities and people have little choice of what marketplace they can attend (this is the "solar central place system"). Competitive markets feature "interlocking" marketplaces such that goods can be traded across political boundaries and consumers can choose to go to multiple different marketplaces.

Classifying marketing at Chunchucmil according to these two categories is difficult, but we offer some suggestions (see also chapter 13). Competitive interlocking market systems tend to feature many markets and goods that flow freely through them. The northern lowlands in the Postclassic period is generally thought to exemplify this type of system (Freidel and Sabloff 1984; Masson and Freidel 2012, 2013; Sabloff and Rathje 1975) and Braswell has suggested that the Terminal Classic period, where obsidian from the same broad variety of sources was available at both

Uxmal and Chichén Itzá, also pertains to this category. This kind of source analysis does not work well for the northern lowlands in the Early Classic period since the El Chayal source dominates obsidian at all sites. Furthermore, generally low amounts of obsidian across the northern lowlands (not counting Chunchucmil) during this period would suggest anemic long-distance trade. Yet the flourishing port of Xcambo (Sierra Sosa 1999; Sierra Sosa et al. 2014) and the evidence of interaction with Central Mexico at Chunchucmil and other northern lowland sites (Varela Torrecilla and Braswell 2003; Smyth 2006; see chapter 12, this volume) suggest the possibility of a network of interaction as opposed to the clearly bounded interaction spheres typical of solar central place systems. Nevertheless, the distance from Chunchucmil to the next large marketplace would have been much further than the distance between marketplaces in an interlocking market system like that of the Basin of Mexico in the Postclassic period (Blanton 1996). Sheets (2000) has hinted at a competitive interlocking market system at the end of the Early Classic at Cerén, where villagers may have had a choice of which regional centers to attend for marketplace trade. At Copán, exotic green obsidian from the Pachuca source was found only in royal contexts, leading Braswell (2010) to argue that elites closely monitored access to obsidian. This was not the case at Chunchucmil, where 63 of the 2,320 obsidian artifacts visually sourced by Daniel E. Mazeau came from Pachuca. As table 11.6 shows, Pachuca obsidian was found in a variety of architectural group types at Chunchucmil and only 10 percent of it comes from monumental contexts.

As we discuss in the next section, people living over 5 km away from Chunchucmil do not appear to have participated heavily in Chunchucmil's marketplace. This probably does not reflect administrators' desires to restrict trade beyond a certain boundary (cf. Aoyama 2001a, 2001b) and may instead reflect a lower degree of prosperity and purchasing power for the rural population (see chapter 13). We believe that powerful groups organized production and exchange at Chunchucmil (see chapter 13), but these groups may function more like trade corporations as distinguished from market administrators.

How large an area did Chunchucmil's marketplace service? A small body of data allows us to assess the geographical scope of Chunchucmil's central marketplace. Despite even distribution of obsidian within Chunchucmil, the frequency of obsidian drops in its hinterland. At a distance of 2.5–5 km from the site center, households had a third of the obsidian of those within 2.5 km. Households beyond 5 km from the site center had one-twentieth of the obsidian of those within 2.5 km of the site center (Hutson et al. 2008). A decrease in access to blades in the hinterlands has also been documented near Yaxhá (Rice 1986), Copán (Aoyama 2001b), and Tikal (Moholy-Nagy's 1989; personal communication, March 2008). In the Middle Postclassic in the lower Río Blanco region of Veracruz, Mexico, Garraty

TABLE 11.6. Excavation contexts at Chunchucmil where green obsidian was recovered.

Operation	*Nickname*	*Group label*	*Group type*	*Pachuca blades*(n)	*Total blades*(n)	*Pachuca blades (%)*
136		S1W1-H	1	1	30	3.3
9a	Pich	N1E1-C	2	5	125	4.0
124		S1W2-H	6	1	14	7.1
126		S1W1-F	6	1	19	5.3
7k		S1E1-D	6	1	2	50.0
9b	Xnokol	S2E2-K	6	4	18	22.2
10	Muuch	S2E2-C	8	2	40	5.0
12		S2E2-E	8	1	3	33.3
13	Lool	N2E2-N	8	1	64	1.6
18		N1E2-F	8	1	10	10.0
39		S2E1-I	8	1	21	4.8
41		S2E1-E	8	1	6	16.7
9c/3g	Aak	S2E2-F	8	8	670	1.2
32		N1W2-E	9	1	9	11.1
36		S2E1-L	9	2	4	50.0
9d/3h	Kaab	S2E1-G	9	22	389	5.7
119		N5W2-P	10	1	5	20.0
9F/31	Chiwol	S2E3-L	12	6	46	13.0
146		N5W3	12	1	8	12.5
15		S1E1-H	15	1	158	0.6

(2009:168–169) found a dropoff in access to obsidian 6 km away from the market center of El Sauce, quite similar to the 5-km radius for Chunchucmil. The radius of the area serviced by markets in the Basin of Mexico in the Postclassic was 4–8 km (Blanton 1996). Chunchucmil is a very different case than the Basin of Mexico, however, because there were no other large markets 10–15 km from Chunchucmil. In sum, Chunchucmil's central market served the city itself better than the hinterlands. At the same time, data presented in the following chapter suggest that Chunchucmil's marketplace linked the city with regions well beyond its hinterland.

How much did the people of Chunchucmil depend on the market? Did most households get just a few things from marketplaces (a *peripheral* market context) or a large portion of their possessions (a *fully integrated* market context) (Bohannan and Dalton 1962)? In comparison with Caracol (Chase and Chase 2004:141) and Tikal

(Moholy Nagy 1997), fewer of Chunchucmil's households specialized in productive activities that left durable remains (see above; Hutson et al. 2010). Systematic research on refuse patterning at Chunchucmil shows that the absence of durable debris from craft production is not a function of site-formation processes (Hutson et al. 2007). At the same time, many specialized activities may have taken place at Chunchucmil without leaving durable archaeological traces (see chapter 10). Given the phosphate data from Area D and comparisons with modern markets (Dahlin et al. 2007), food was likely to have been an important commodity at Chunchucmil's marketplace. Chunchucmil's predicament of having a large population in an area of marginal agricultural productivity (chapter 9) adds support to the claim of a brisk trade in food. Chapter 13 discusses where some of that food may have come from. To the extent that trade in food was necessary for subsistence, the marketplace was critical to many (most?) of Chunchucmil's households. In contrast to those who might claim that a marketplace like Chunchucmil's exchanged only food (Chase and Chase 2014:240; Speal 2014:92), this chapter has shown that non-food items (e.g., obsidian and pottery) were also traded at Chunchucmil's central marketplace. In sum, we do not have a clear answer to the question of how much of a household's goods came from the Chunchucmil marketplace, although most households probably acquired several things through markets. Probably no Maya sites contained a fully integrated market context since such a context, where households get most of their goods from a market, might not predate capitalism (Hirth 2010:230)

CONCLUSION

In this chapter, we have established the presence of a marketplace at Chunchucmil from three different approaches—contextual, configurational, and distributional—using multiple lines of evidence for each approach. Due to the way in which the results from each approach complement each other, Chunchucmil stands as an extremely strong candidate for a Maya marketplace. Tikal and Caracol are perhaps the only other sites where arguments for the existence of marketplaces use all three approaches. Tikal has contextual and configurational data in support of a market (Becker 2015; Jones 2015). Furthermore, Masson and Freidel (2012) make the case that the distribution of polychrome pottery and long-distance goods such as obsidian and shell at Tikal meet the expectations of a distributional approach: households of widely different wealth levels possessed equitable quantities of these items.

To say that there were Classic-period marketplaces in the Maya area might have been revolutionary 25 years ago, when there was fundamental resistance to this idea (see chapter 1; Shaw 2012:120). Now that most people agree that Maya economies were more complex than once thought, the question of whether or not a site had a marketplace is not as pressing as the more nuanced questions about the role of marketplaces in local economies. Therefore, we have paid attention to important questions regarding the scale, periodicity, organization, geographical scope, and importance of marketplace. At the same time, the mere existence of a major marketplace at Chunchucmil is still remarkable because it dates not to the Late Classic, as do Tikal's and Caracol's marketplaces, but to the end of the Early Classic period (see Tokovinine and Beliaev 2013:172 and Masson and Freidel 2012:463 for suggestions of markets as early as the Preclassic period). The following chapter helps make sense of this anomaly by providing details on the regional and interregional context of Early Classic commerce at Chunchucmil.