LAQ On-line Supplement for Sheets et al. article: "The Sociopolitical Economy of an Ancient Maya Village: Cerén and its Sacbe"

This text is a response to the most significant issue raised by a reviewer of the manuscript that we submitted for consideration for publication. The reviewer observed that there is insufficient consideration of alternative interpretations of data stated prior to fieldwork beginning. We are in agreement, and here provide the alternative hypotheses that we presented in the funded NSF research proposal, in the context of four principal Research Objectives.

Research Objective # 1: Agricultural Variation, Authority, and Political Economy

Boundaries are distinct in the southern agricultural zone (Figure 1) south of Cerén. Crisp and straight boundaries separate individual manioc plots, and the plots from the flat constructed platforms on east and west sides (Maloof 2009). The formalized field boundaries are all azimuth-aligned to about 30^{o} east of magnetic north, or its perpendicular. The large adobe block found in Operation P may mark an intersection where four fields meet.

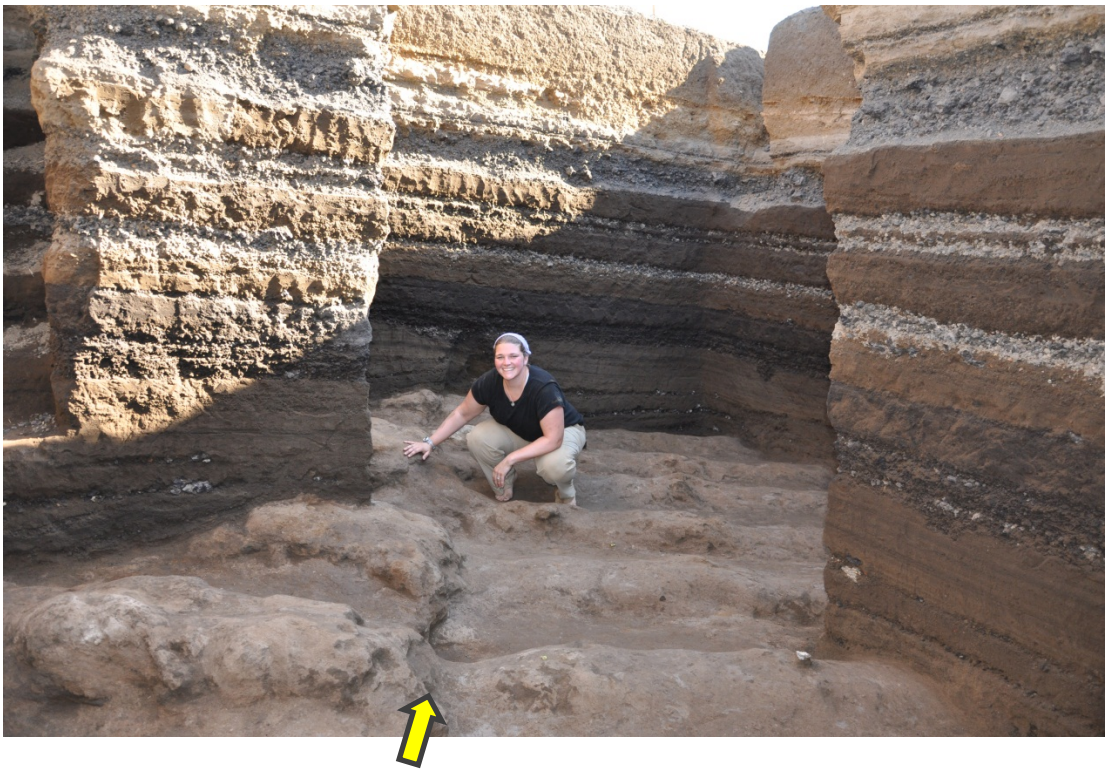

Figure 1. Example of a Field Boundary: Manioc beds on left, Maize Field on Right. Manic had been harvested, maize was mature and drying in field. We removed the maize plants, in the form of dental plaster casts, to the Ceren *bodega* in the Museo Nacional.

Boundaries are equally distinct and aligned within the Cerén village (Sheets 2002, 2006), but the features that are separated are of course quite different from the southern agricultural zone. Within the village the demarcations are aligned and abrupt between high-performance milpa and garden, milpa and walkway, milpa and patio, and among buildings and a plaza.

The intermediate agricultural zone (Sheets and Dixon 2011) is quite different from the highly organized village zone and the southern zone. It is less formal, with a striking variability in cultivation strategies, somewhat irregular fallowed areas, and less distinct boundaries. The alignments of ridges and boundaries were less strict than in the village and in the manioc fields.

The ridges and mounds inside fields were much more variable than in the two other zones (Lamb and Heindel 2011).

The pattern discovered so far is quite formalized kitchen gardens and milpas adjacent to the household buildings, perhaps as a visual expression of identity and success/pride as agriculturalists. Farther from the houselots, in the intermediate zone excavated in 2011, informality reigns and farmers apparently were more culturally free to fallow or use whatever milpa technique they wished. The significant increase in formality at greater distance, in the southern area, presents explanatory alternatives. The variation could result from varying edaphic conditions that favor different cultigens, or necessitate different microtopography such as ridging of different sizes or orientations (perpendicular or parallel to slope). Or the variation could result from political economy, as tenure changed from individual households owning their immediate plots and extending into the more informal intermediate zone. It is possible that the more formal southern zone was under a higher authority outside the village, a possibility that we did not consider in the report (Sheets and Dixon 2011).

Hypothesis 1-A: Variations in edaphic conditions correlate with variations in cultigens and cultivation strategies, and thus contribute to decision-making. Maize and manioc have distinctly different edaphic requirements (Cock 1982). Manioc is very drought-tolerant and grows well in less fertile and more acidic soils than does maize. Manioc growth is suppressed by dense soils more than is maize growth. Maize is highly nitrogen-demanding, and manioc is not. Manioc is mildly phosphorous and potassium-demanding (Rehm and Espig 1991). High soil moisture, approaching saturation, suppresses manioc more than maize. Agronomists from the *Centro Nacional de Tecnología Agropecuaria* (CENTA) will identify and measure pH, texture, grain sizes, nitrogen, phosphorus, potassium, zinc, manganese, iron, copper, percent organics, calcium, magnesium, potassium, sodium, interchangeable acids, base saturation, and chemical relationships. The chemical-physical-edaphic factors will be compared to patterns and variations

in surface microtopography (ridges perpendicular and parallel to slope, size of ridges, mounding, lack of ridges and mounds, soil density, and slope) to explore if they correlate and thus might be involved in agricultural decisions. Fallow areas, each with the cultigen that was last cultivated there, will be compared to explore if a deficiency resulted from its cultivation, thus perhaps leading to a decision not to cultivate that crop again at that location. A nitrogen deficiency in a fallow field that had maize, or P and K-deficiencies in the case of abandoned manioc, would support that interpretation. Support for the hypothesis indicates authority at the level of the individual farmer, based on generations of experience. Others living or working at a distance would not have the intimate edaphic knowledge to make these decisions. Alternatively, a lack of correlation is a lack of support for the hypothesis.

Hypothesis 1-B: The more formal, structured cultivation of manioc in the southern zone is under higher administration external to the Cerén village. Testing Hypothesis B involves following the sacbe south of where it was discovered (Dixon 2011) and south of the formal manioc fields excavated in 2009 (Figure 1). If elites were in charge of the manioc fields, that authority presumably would be south of the manioc fields. Our discovering the sacbe to be more formal, large, and heavily traveled to the south would support this hypothesis. Fortunately, relative amounts of foot traffic are well preserved at Cerén, and the harvest had just occurred, so the direction most manioc went will be discovered. This hypothesis is supported if sacbe use increased at and south of the manioc fields. An estimated 10 testpits will be required to follow the sacbe southward.

Research Objective # 2: Who makes decisions on sacbe construction and maintenance?

The sacbe (Figure 2) averages 2 m in width, and has formal drains on each side (Dixon 2011). It was constructed of highly compacted white volcanic ash from the Ilopango eruption. It could

have been constructed and maintained by communal work groups organized from the village, or by individual landowners with properties adjacent to it, or by a higher authority presumably to the south. Each alternative is testable. Investigating the political aspects of the sacbe focuses on the locus of authority involved in its construction and maintenance. The economic aspects involve transporting food produced in the outlying agricultural zones into the village, and transporting surplus production from the village to an elite center for exchange to obtain obsidian tools, jade axes, and polychrome ceramics (Sheets 2000). The sacbe likely had ritual functions as well (Shaw 2008).

Hypothesis 2-A: The sacbe was built and maintained communally by the Cerén village. Support for this hypothesis would be consistency in construction from the beginning of the sacbe in the village, through the intermediate agricultural zone, and farther south. Construction data will be obtained from excavations exposing its surface, sides, and ditches, and trenches to expose internal construction details. During the rainy season considerable maintenance efforts were necessary, especially along the edges of the sacbe and the canals. Consistency in maintenance would support this hypothesis, as would be a broadening and increase in formality as it enters the village. Variations in construction and maintenance would not correlate with the boundaries of agricultural properties adjacent to the sacbe.

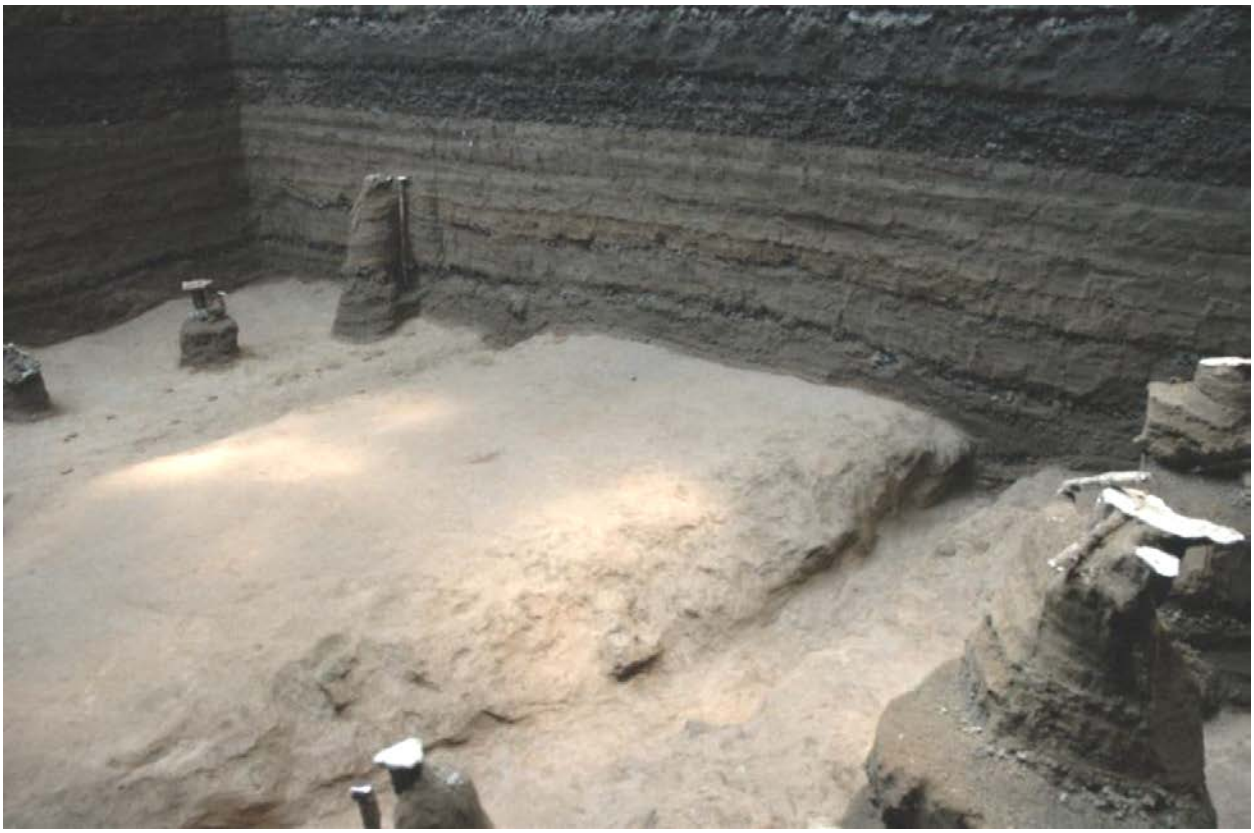

Figure 2.Sacbe in Op. W, with drainage ditches and maize fields on both sides. (C. Dixon)

Hypothesis 2-B: The sacbe was built and maintained in sections by adjoining farmers.

If individual landowners (or users) were responsible for construction and maintenance, significant variation along the sacbe would be expected. Preliminary indications that this hypothesis is not unreasonable were encountered in Operations S, U, and W (Dixon 2011), as the width of the causeway varied from 140 to 214 cm, and maintenance of sacbe edges and the canals varied somewhat. The important test of this hypothesis is predicated on finding the boundaries of the agricultural fields on both sides of the sacbe, tracing those boundaries to the precise locus where they intersect the sacbe, and then determining if construction and maintenance differences are detected at those loci. Milpa boundaries are well preserved at Cerén, but have yet to be found abutting the sacbe. Extensive excavations should have no difficulty in finding them.

Hypothesis 2-C: Sacbe construction and maintenance was by higher authority.

It is possible that the sacbe connected Cerén to an elite center to the south, perhaps San Andres (Dixon 2011). That presents the possibility that construction and maintenance were organized at a hierarchical level above the village. Evidence to support the hypothesis would be finding no correlation between agricultural property boundaries and sacbe sections and sacbe consistency in construction and maintenance. Additional evidence to support this hypothesis could be increasing size and formality of the sacbe south of the manioc fields, and greater foot traffic carrying most of the harvest south toward a more powerful settlement. The width of the sacbe does increase from the northern to the southern testpit, but the present sample is too small and covers too short a distance to test this hypothesis.

Research Objective # 3: Water Control along the Sacbe

The sacbe section discovered in 2011 runs along the top of the local drainage divide, with the east-side ditch easily draining runoff into the river. The west-side ditch has easy access to the depression that drains water westward, south of the village. However, as the sacbe ran farther south, into the manioc growing area and beyond, it faced a considerable problem. The slope is consistently eastward toward the river, and the catchment area for water is sufficient to send large amounts of runoff into it. This research does not involve hypothesis testing, but simply investigation into what techniques were used to confront the problem. Stone linings of sacbe and drainage canals are possible, as are bridges, or stepping-stone walkways. Or it is possible, but we feel unlikely, that the sacbe ends where water control measures were insufficient.

Research Objective #4: Where does the Sacbe end in the Cerén Village?

Shaw (2008:106–124) documents multiple functions of sacbeob on the Yucatan peninsula, including economic, religious, social, practical, hydraulic, military, symbolic, and astronomical. The assumption that a function of the Ceréns acbe was economic seems reasonable. The locus and nature of its termination within the village may shed light on another function. If it continues straight northward from Operation W, it could end at the town plaza, indicating more economic and social, and likely political, functions. If its gentle curve continues, it could terminate in the religious complex of Structures 10 and 12. Structure 10 was built for village ceremonies, and a ceremony celebrating the harvest was actually in progress when Loma Caldera volcanic vent blasted into eruption, 600 m north of the village (Brown and Gerstle 2002).

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