



Mapping ancient chinampa landscapes in the Basin of Mexico: a remote sensing and GIS approach

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ABSTRACT

This paper uses remote sensing data to document a raised field, chinampa system adjacent to the Postclassic kingdom of Xaltocan in the northern Basin of Mexico. Various forms of landscape information; historic records and maps as well as remote sensing; are considered to understand the chinampa system. The remote sensing data examined include 1950s aerial photographs, Landsat 7 data, and Quickbird VHR, multi-spectral imagery. This article evaluates the utility of each of these forms of data to identify buried chinampa features and integrates them in a GIS to produce a map of Xaltocan's chinampa landscape. Canals of various sizes and hydrological positions comprised the chinampas and integrated the system together. Occupying at least 1500–2000 ha, Xaltocan's chinampa system represents the largest pre-Aztec, chinampa system in the Basin of Mexico.

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1. Introduction

Almost 40 years ago, [Pedro Armillas \(1971\)](#) published one of the first reports on chinampa agriculture in the Basin of Mexico that resulted from archaeological research. Theoretically, he attempted to introduce an explicit landscape perspective into Mesoamerican archaeology. Armillas envisioned an approach that was not simply settlement or environmental archaeology but one wedded to the materiality of the landscape itself—a palimpsest on which the imprints of human action “are continually being erased and rewritten, and quite often smudged” ([Armillas, 1971:665](#)).

Armillas used remote sensing data, aerial photos, to initiate his research on Aztec chinampas in the southern Basin of Mexico: “Methodologically, the archaeological investigation of a cultural landscape begins with the interpretation of aerial photographs” ([Armillas, 1971:665](#)). This approach influenced the methodologies of central Mexican surveys of the 1960s and 1970s (e.g., [Sanders et al., 1979](#)). Since then, archaeologists commonly use remote sensing data in investigations on early hydraulic systems in central Mexico (e.g., [Frederick et al., 2005](#); [Morehart, 2009](#); [Nichols, 1988](#); [Nichols et al., 1991](#)).

Following Armillas, this paper uses remote sensing data to document a chinampa system adjacent to the Postclassic kingdom of Xaltocan in the northern Basin of Mexico. Xaltocan was a political center in the Basin of Mexico before the Aztec empire ([Fig. 1](#)). Like Tenochtitlan, the later Aztec capital, Xaltocan was an island kingdom. [Brumfiel \(2005\)](#) documented its initial settlement during the 10th century AD, a time archaeologists refer to as the Early Postclassic period. By the 14th century (Middle Postclassic period), Xaltocan was an influential city-state. Like many other political communities during the Middle Postclassic, Xaltocan was embroiled in conflict. By the end of the 14th century, an alliance of kingdoms conquered Xaltocan. The population fled. The town was re-settled after the Aztec empire incorporated the northern basin 40 years later.

Unlike the relict chinampas Armillas observed, Xaltocan's chinampas are completely buried by a layer of eolian soil, with virtually no visible topographic relief with the exception of some locations where the largest canals created minor depressions ([Frederick et al., 2005](#); [Morehart, 2009](#)). In such situations, remote sensing data are valuable tools for discovering past agricultural systems ([Lasaponara and Masini, 2011](#)). This article evaluates the usefulness of various forms of landscape imagery and integrates them into a GIS to produce a map of Xaltocan's chinampa system. First, I discuss and define chinampa agriculture as a localized manifestation of the broader technology of raised field agriculture.

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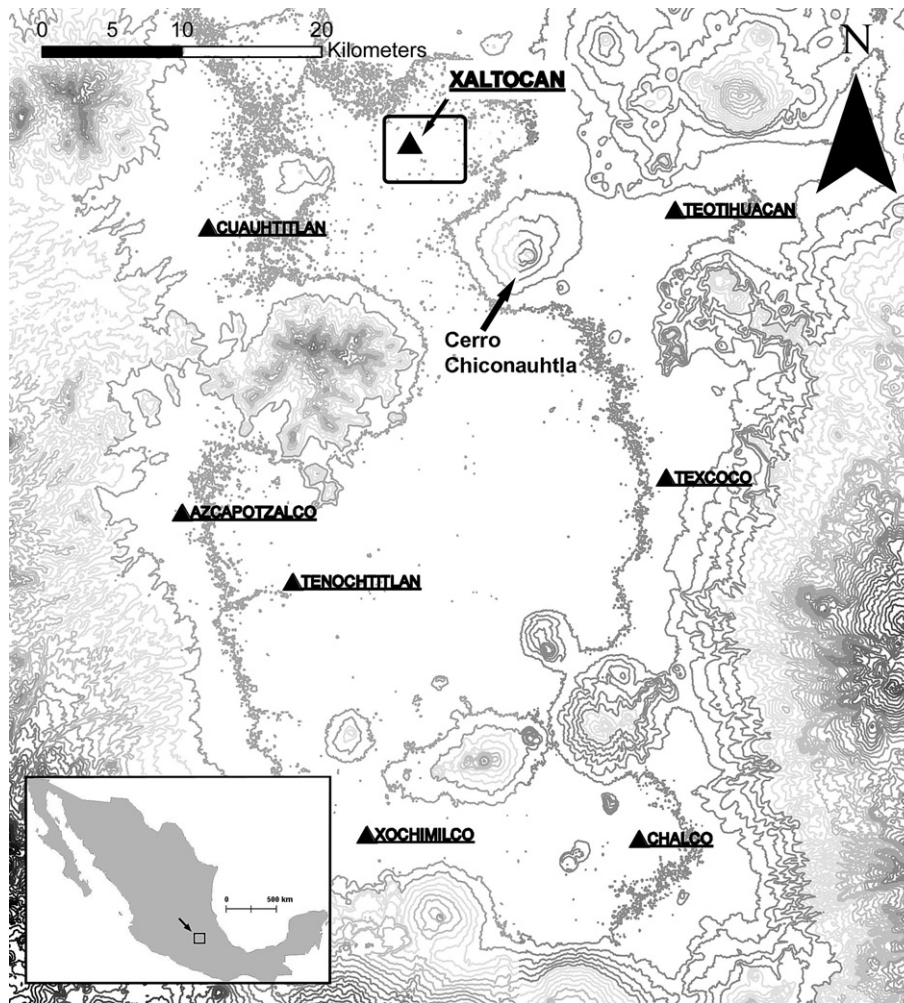


Fig. 1. A regional map showing (1) the Basin of Mexico and (2) its location in Mexico as well as (3) Xaltocan and selected sites. The polygon displays the specific study area (displayed in detail in Fig. 8).

Second, I provide an overview of available historical data on chinampas and other hydraulic systems around Xaltocan. Much of this historical information elucidates the anthropogenic landscape of Xaltocan and provides a crucial starting point for subsequent remote sensing (and field) investigations. Next, I examine the utility of 1950s aerial photographs, Landsat data, and Quickbird VHR imagery. These data were used to create a map of the chinampa landscape, which provides an opportunity to consider the farming system's size and structure. I conclude with a consideration of some of the broader social, political, and economic dimensions of this work as well as the strengths and weaknesses of the remote sensing data used.

2. Background

2.1. Chinampa agriculture

Chinampas are one of the most widely discussed yet least archaeologically studied forms of prehispanic agriculture. The number of archaeological projects that have examined chinampas has grown (Avila López, 1991, 2006; Parsons et al., 1982, 1985; Frederick et al., 2005; Morehart, 2009). However, most information continues to come from indirect means: historic texts, quasi-mythic narratives, ethnographic descriptions, and ecological research (e.g., Coe, 1964; Crossley, 1999; Gomez Pompa and Jiménez Osornio, 1989;

Palerm, 1973; Rojas Rabiela, 1991; Sanders, 1957; Santamaría, 1912; West and Armillas, 1950).

The term chinampa derives from the Nahuatl word *chinamitl*, meaning an area enclosed by a hedge or canes (Molina, 1944:21). Despite the specificity of this definition, the term is used by both scholars and agriculturalists to designate agricultural land in a wetland environment in which plots are elevated above water levels and surrounded by canals. Chinampa fields are typically narrow, around 4 m wide, but may extend in length up to 400–900 m (Santamaría, 1912:13). Often willows or cypress trees are planted along the edges to protect the banks from erosion.

As a form of raised field agriculture chinampas share similarities with comparable systems in highland and lowland regions of the New World. Raised field have been documented elsewhere in highland Mexico as well as in the lowlands of the Mexican Gulf Coast, northern Belize, and Guatemala (e.g., Denevan, 1970, 1982; Doolittle, 1990; Farrington, 1985; Fisher, 2005; Pohl, 1990; Pohl et al., 1996; Puleston, 1978; Puleston and Siemens, 1972; Scarborough, 2003; Siemens, 1983; Turner and Harrison, 1983; Whitmore and Turner, 2001; Wilken, 1987). In South America, raised fields characterize landscapes in the Andean highlands and the Amazonian lowlands (e.g., Bandy, 2005; Darch, 1983; Denevan, 2001; Erickson, 1993, 1994, 2006; Janusek and Kolata, 2004; Kolata, 1991; Stanish, 1994, 2006; Walker, 2011; Zimmerer, 1991). Although the physical characteristics of raised fields vary intra- and

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